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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposalsl for

a Directive of the European Parliament and of the Council establishing the European Electronic Communications Code (Recast) and
a Regulation of the European Parliament and of the Council establishing the Body of European Regulators for Electronic Communications

{COM(2016) 590}
{COM(2016) 591}
{SWD(2016) 304}

ANNEXES

2.1 ANNEX 1 - Procedural Information

2.1.1 Identification;

This Staff Working Paper was prepared by Directorate B 'Electronic Communications Networks and Services' of Directorate General 'Communications Networks, Content and Technology'. The RWP reference of this initiative is 2016/CNECT/XX.

This Staff Working Paper is accompanied by the Fitness Check SWD for the current regulatory framework conducted in the context of the REFIT programme assessed not only in terms of achievement of the original goals, but also in view of potential simplification and reduction of the regulatory burden.

2.1.2 Organisation and chronology:

Several other services of the Commission with a policy interest in the review of the telecom framework have been associated in the development of this analysis. The Telecoms Framework Inter-Service Steering Group met for the first time on the 7 May 2015.

A second Telecoms Framework Inter-Service Steering Group meeting took place on 9 July 2015

A third Telecoms Framework Inter-Service Steering Group took place on 26 January 2016 .

A fourth Telecoms Framework Inter-Service Steering Group Impact Assessment Steering Group took place on 14 April 2016 to discuss a draft evaluation report and the problem definition of the IA. Comments were received by 21 April 2016.

A fifth Telecoms Framework Inter-Service Steering Group took place on 30 May 2016 to discuss the draft Impact Assessment

In the ISSG, chaired by SG, DG CONNECT, was flanked by DG DIGIT, DG COMP, DG JUST, DG GROW, DG ECFIN, DG FISMA, DG TAXUD, DG TRADE, DG RTD, DG JRC, DG SANTE, DG EMPL, DG EAC, DG NEAR, DG ENV, LS, DG REGIO, DG HOME, DG ENER, DG AGRI, DG MOVE, EUROSTAT, EPSC.

DG Connect also benefited from the support received by the JRC Information Society Unit for the assessment of the model elaborated for the IA support study *SMART 2015/0005* presented in section **Error! Reference source not found.** and Annex 5..In particular, the analysis carried out by JRC concluded that "*the consultants constructed a CGE model with a rich sectorial and geographical setup (8 sectors and 4 representative countries). Also, the policy considered in the analysis is entered into the CGE model through immediate costs are introduced in the form of (private and public) investments and public expenditures. In addition the sector TFP is adjusted following the estimated impacts from KPIs. This seems a fine way to capture the economic impacts from the policy considered*".

2.1.3 Regulatory Scrutiny Board

This staff working document will be discussed at the regulatory scrutiny board meeting of 7 July 2016.

2.1.4 Evidence

The options considered in this impact assessment were designed by taking into account the following main inputs:

(i) the contributions to the Telecom Framework Review public consultation, a summary of which is attached in Annex 2 to this report.
(ii) the BEREC opinion on the review of the regulatory framework released on 10 December 2015
(iii) [335],

The three review studies (delivered together with this Impact Assessment report) are:

(iv) "*Support for the preparation of the impact assessment accompanying the review of the regulatory framework for e-communications" (SMART 2015/0005)*
(v) *Regulatory, in particular access, regimes for network investment models in Europe"* (SMART 2015/0002)
(vi) *Substantive issues for review in the areas of market entry, management of scarce resources and general consumer issues"* (SMART 2015/0003).

The Impact assessment was carried out on the basis of interim study results of the three review studies quoted above. Finalisation is planned at this stage by the end of July 2016 for SMART /002, by end of August for SMART 003 and by the end of September for SMART/005.

Other recent DG Connect studies in the field of Electronic communication:

(vii) "Review of the scope of universal service" (SMART 2014/11),
(viii) "Study on future trends and business models in communications services and their regulatory impact" (SMART 2013/0019),
(ix) "Identification and quantification of key socio-economic data for the strategic planning of 5G introduction in Europe" (SMART 2014/0008)
(x) "Economic and Social Impact of repurposing the 700MHz band for wireless broadband services in the European Union" (SMART 2015/0010),
(xi) 'Costing the New Potential Connectivity Needs' (SMART 2015/0068)
(xii) "Impact of Traffic Offloading and Technological Trends on the Demand for Wireless Broadband Spectrum" (SMART 2012/0015)28,
(xiii) "Spectrum Policy. Analysis of Technology Trends, Future Needs and Demand for Spectrum in line with Article 9 of the RSPP" (SMART 2012/0005)27,
(xiv) Survey and data gathering to support the Impact Assessment of a possible new legislative proposal concerning Directive 2010/13/EU (AVMSD) and in particular the provisions on media freedom, public interest and access for disabled people,

The other relevant sources quoted in the document are indicated in the bibliography and range from academic papers to industry figures and estimates.

2.1.5 External expertise

The European Commission sought external expertise on the technical field as well as on the socio-economic impacts of the options presented above. The Commission contracted WIK-Consult, Ecorys

[335] See; http://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/5577-berec-opinion-on-the-review-of-the-eu-electronic-communications-regulatory-framework

and VVA Europe to support the preparation of this impact assessment accompanying the review of the regulatory framework for e-communications. In the framework of the study an expert panel of top-level, globally recognised and reputable specialists (scholars, experts in the field). was organized to provide feedback on the preliminary conclusions reached by the consultants concerning the impact of planned changes to the e-communications framework.

A **high level expert panel** was held on 30 May 2016 conducted in the framework of study SMART 2015/0005. Participants were Prof. Joan Calzada, Prof. Frédéric Jenny, Prof. Brigitte Preissl, Prof. Luc Soete, Prof. Reza Tadayoni, Prof. William Webb, Prof. Brett Frischmann, Prof. Eli Noam. Experts profiles and a report of the discussion are presented in Annex 13.

In addition to the review and other studies quoted above also the following EC studies in the field of Electronic communication were considered

- *"Identification of the market of radio equipment operating in license-exempt frequency bands to assess medium and long-term spectrum usage densities" (SMART 2014/0012),*
- *"Eurobarometer household survey on eCommunications" - SMART 2014/0014,*
- *"Investigation into access and interoperability standards for the promotion of the internal market for electronic communications networks and services" (SMART 2014/0023) a study on the 'standardisation' of wholesale access products*
- *"Mapping of Broadband and Infrastructure Study" (SMART 2012/0022),*
- *"Mapping broadband infrastructures and services (phase II)" (SMART 2014/0016),*
- *"Impact of Traffic Offloading and Technological Trends on the Demand for Wireless Broadband Spectrum" (SMART 2012/0015)28,*
- *"Spectrum Policy. Analysis of Technology Trends, Future Needs and Demand for Spectrum in line with Article 9 of the RSPP" (SMART 2012/0005)27,*
- *"Study in support of the preparation of an impact assessment to accompany an EU initiative on reducing the costs of high-speed broadband passive infrastructure deployment" (SMART 2012/0013).*
- *"Steps towards a truly Internal Market for e-communications in the run-up to 2020" (SMART 2010/0016),336*
- *"Study on the socio-economic impact of bandwidth" (SMART 2010/0033),*
- *"Broadband coverage in Europe in 2013" Updated on an annual basis (SMART 2013/0054),*
- *"Broadband retail broadband access prices in 2013" Updated on an annual basis (SMART 2010/0038),*
- *"Challenges and Opportunities of Broadcast-Broadband Convergence and its Impact on Spectrum and Network Use" (SMART 2013/0014),*
- *"Use of commercial mobile networks and equipment for mission-critical high-speed broadband communications in specific sectors " (SMART 2013/0016),*
- *"Study in support of the preparation of an impact assessment to accompany an EU initiative on reducing the costs of high-speed broadband passive infrastructure deployment" (SMART 2012/0013).*

2.2 ANNEX 2 - Stakeholders and Public Consultation

2.2.1 The stakeholders engagement strategy

A continuous and active stakeholder engagement strategy was devised and followed for the evaluation and review of the regulatory framework for electronic communications networks and services. From the outset key ideas for evaluation and reform of the regulatory framework were outlined in a public roadmap[337] that followed the Political Guidelines[338] of the new Commission and the subsequent DSM

[336] https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/final_report_internal_market_ecom.pdf, http://europa.eu/rapid/press-release_IP-12-193_en.htm?locale=en

[337] http://ec.europa.eu/smart-regulation/roadmaps/docs/2015_cnect_007_evaluation__elec_communication_networks_en.pdf

Communication[339]. The published roadmap explained what the Commission was considering, describing the scope of and outlining the main change drivers underpinning this initiative and announced further details of stakeholder consultation strategy. This fed into the subsequent consultation activities, ensued an inclusive process with all interested parties having an opportunity to contribute.

A dedicated 12 weeks open **public consultation** was launched on 11 September 2015 that gathered inputs for the evaluation process in order to assess the current rules and to seek views on possible adaptations to the framework in light of market and technological developments and thus contributing towards the DSM. The consultation document was both broad and detailed, eliciting extensive inputs from consumers, providers of electronic communications networks and services, national and EU operator associations, civil society organisations, broadcasters, technology providers, Internet and online service providers, undertakings relying on connectivity and wider digital economy players, national authorities at all levels, national regulators and other interested stakeholders. Inputs provided include stakeholders affected by the policy, those who have to implement it and those with a stated interest in the policy. The consultation gathered a total of 244 online replies from stakeholders in all Member States as well as from outside the Union.

On 11 November 2015, halfway through a public consultation process, **public hearing** was organised in Brussels as well as broadcasted online[340]. This offered an opportunity for in-depth discussions on issues outlined in the public consultation document, allowing for reasonable time to formulate and gather effective feedback from all relevant stakeholder groups, allowing the collection of all relevant evidence (comprising data/information) and views.

During the consultation process broad public events were combined with more targeted consultation. This in particular relate to a serious of consultation events held with sector regulatory community that is entrusted with key supervisory and implementing tasks stemming from the regulatory framework. Following a series of such events and at the request of the Commission, BEREC provided an input to the evaluation and the review process and published its opinion in December 2015[341]. In addition, the RSPG had provided its opinion on DSM and the Framework Review[342].

In parallel to the public consultation, and as part of such targeted consultation efforts, on 7 October 2015 the Commission convened a **dedicated meeting of e-Communications Administrations High Level Group**, comprising representatives of the relevant ministries. At this meeting national authorities shared their views and discussed challenges, focusing on the need to develop the fixed and wireless connectivity networks of the future and to drive take-up and innovative services across Europe.

As part of the evaluation process the Commission has also contracted a number of studies. Implementation of these studies encompassed public workshops that allowed stakeholders to comment and provide feedback to the ongoing evaluation work.

Several such public workshops took place that allowed cross checking of findings and verifying inputs and assumptions.

On 6 April 2016 was held in the Commission's premises a public workshop to validate the interim findings a study Smart 002/20015 conducted by WIK, IDATE and Deloitte on "regulatory, in particular access, regimes for network investments models in Europe" in the context of the

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[338] http://ec.europa.eu/priorities/publications/president-junckers-political-guidelines_en
[339] http://europa.eu/rapid/press-release_IP-15-4919_en.htm
[340] https://webcast.ec.europa.eu/public-hearing
[341] http://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/5577-berec-opinion-on-the-review-of-the-eu-electronic-communications-regulatory-framework
[342] http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG16-001-DSM_opinion.pdf

preparation of the regulatory framework for electronic communications networks and services. The workshop was attended by 60 external participants – not counting the team of consultants, from the main European industry associations of the sector, from the telecom industry, e.g. operators, service providers, vendors, business users, OTTs, banks and local governments, as well as representatives from BEREC and national regulatory authorities.

On 2 May 2016, a public workshop was held at Commission premises to validate the interim findings of a study conducted by WIK, CRIDS and Cullen on "Substantive issues for review in the areas of market entry, management of scarce resources and general end-user issues" (SMART 2015/003) in the context of preparing the review of the EU regulatory framework for electronic communications. The workshop was attended by around 100 external participants representing EU and national sectorial industry associations, electronic communications network operators and service providers, cable network operators, broadcasters, consumer interest associations, vendors, business users, as well as members of RSPG, Member States and National Regulatory Authorities.

In addition, the Commission responded positively to numerous requests to participate and update on the review progress at conferences, seminars and workshops, keeping open exchange with all stakeholders.

The consultation strategy followed by the Commission allowed the widest possible dissemination of information and allowing stakeholders for a reasonable time to formulate and gather effective feedback on all key elements of both the evaluation and the review process. This among other included problem identification, subsidiarity and the need for EU action, outlining possible policy response and anticipating impacts of such response. The consultation strategy followed ensured that both general principles and the five minimum standards were respected and met. The results of these consultation activities are summarised in the published synopsis report[343] which is annexed to this report.

2.2.2 The outcome of the public consultation

The synoptic report summarising the main outcome of the public consolation carried out for the review of the telecoms framework has been published in April 2016.

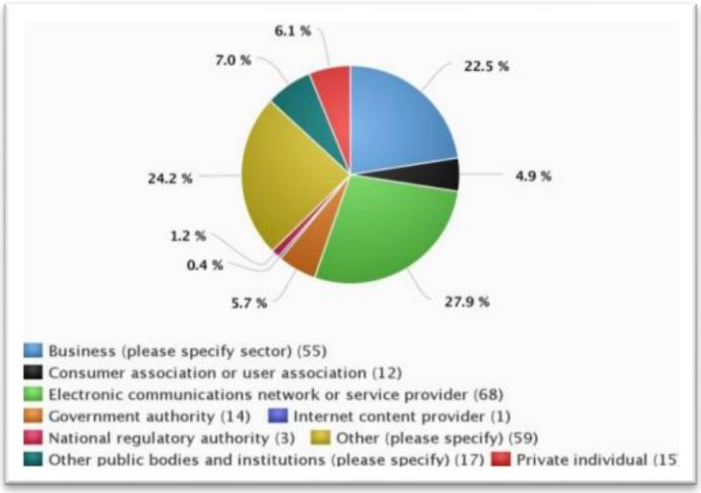
2.2.2.1 Introduction

The consultation on the regulatory framework for electronic communications networks and services was launched to gather input for the evaluation process in order to assess the current rules and to seek views on possible adaptations to the framework in light of market and technological developments, with the objective of contributing to the Digital Single Market Strategy.

The consultation targeted consumers, providers of electronic communications networks and services, national and EU operator associations, civil society organisations, broadcasters, technology providers, Internet and online service providers, undertakings relying on connectivity and wider digital economy players, national authorities at all levels, national regulators and other interested stakeholders. The consultation gathered a total of 244 online replies from stakeholders in all Member States as well as from outside the Union. The consultation elicited both consolidated contributions from umbrella organisations and individual contributions from various stakeholders.

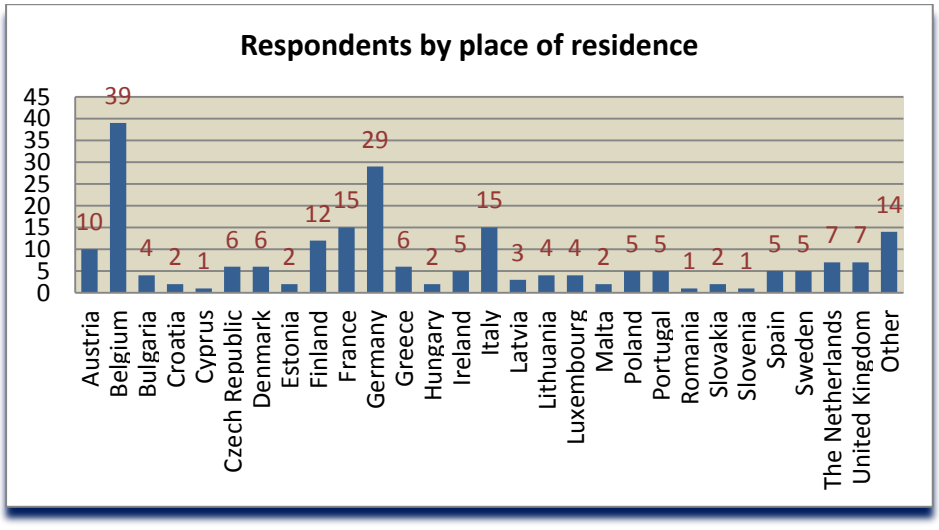
[343] https://ec.europa.eu/digital-single-market/en/news/full-synopsis-report-public-consultation-evaluation-and-review-regulatory-framework-electronic

The participation of different stakeholder categories was overall balanced with stakeholders from the wider digital economy actively responding as well as consumer groups, public authorities and electronic communications networks and services providers. This includes stakeholders affected by the policy, those who have to implement it and those with a stated interest in the policy. Online contributions by public authorities (national administrations and sector regulators) were relatively fewer than the inputs of electronic communications network or service providers or wider digital economy market actors. Among stakeholders representing electronic communications networks and services providers, different clusters of economic actors with diverse economic power gave input – traditional/incumbent operators, alternative operators.



This report uses the above categorisation of stakeholders in presenting converging or differing views on issues addressed in the consultation. The contributions of the stakeholders who gave their consent to publication are available online. This report also takes account of BEREC's[344] input to the evaluation and the review process provided at the request of the Commission, the RSPG[345] opinion on DSM and the Framework Review and some 20 other contributions received outside the online consultation as well as feedback received via the dedicated public hearing dedicated to this review . The BEREC opinion was published in December 2015, and can be found on this website.

This analysis does not represent the official position of the Commission and its services and thus does not bind the Commission.



The input gathered corresponds to the objective of the consultation in both assessing the performance of the regulatory framework to date and also providing insights about possible adjustments in order to respond to market and technological advancements and prospective challenges.

[344] Body of European Regulators for Electronic Communications
[345] Radio Spectrum Policy Group

2.2.2.2 Analysis of responses

The analysis in subsequent sections of this report is based on inputs received by different stakeholder categories.

2.2.2.2.1 Objectives and overall performance

In terms of the *effectiveness*, it is acknowledged by most stakeholders (**consumer organisations, Member States, operators, regulators, other)** that while the framework has been successful in bringing more competition in the market and promoting the interests of EU citizens, it was less successful in promoting the internal market.

On the objective of achieving the internal market, most respondents indicated a moderate contribution. Alternative operators generally perceive the framework as having set the right environment for the internal market to develop. Conversely, several incumbents are rather negative on this point and also some small players point out that the provisions of the framework are not apt to foster cross-border deployments. Many respondents have stated that this objective has not been achieved owing to the lack of a consistent approach by NRAs (national regulatory authorities), with some of them being seen as more willing and ready to enforce framework provisions than others. Hence this objective can be considered as only partially achieved.

The framework's contribution to the objective of protecting the interest of European citizens is rated more positively. Most stakeholder groups (alternative operators, incumbents, others) consider that the framework has contributed moderately to citizens' rights and interest. **Alternative operators and small fibre operators** tend to attribute a more significant impact on EU citizens' interests, while **several incumbents** are rather negative on this point, considering that the interest of the European citizens has been promoted only to a certain extent, owing to the hurdles to investment in NGA allegedly caused by access regulation. **Some large operators** and entities wonder if the interest of citizens has been harmed by the focus on lower tariffs rather than on network quality. Finally, the sparse contributions by **private individuals** have a much more negative character, with 8 out 12 pointing to little or no impact at all.

In terms of *efficiency* and whether the costs involved were reasonable, there was a somewhat negative perception. Larger operators (**incumbents and those with mobile arms**) consider that the administrative and regulatory costs borne have exceeded the results achieved. **Alternative operators** believe, on the contrary, that the benefits have exceeded the costs, underlining that competition, economical offers and several clear consumer benefits would not exist without the framework and that access regulation is necessary and proportionate. **Some alternative operators** underline the value of having a stable, predictable regulatory regime, whilst also highlighting some unnecessary costs: the costs of market analysis for termination markets where the outcome of the analysis in any event is stable, the cost of questionnaires, the overlap of tasks of public authorities, the lack of harmonisation in consumer regulation including data protection and data retention, of universal service obligations.

In terms of *relevance* of the framework and whether EU action is still necessary, the general perception is that framework is still necessary and there is a consensus amongst **incumbents and alternatives, large and small, consumer organisations**. **Alternative operators, consumer associations, wholesale operators** underline that competition cannot be maintained without ex ante regulation and that full duplication of network infrastructures is not realistic. Most **incumbents** argue for a simplified access regulation (limited to fixed infrastructures, with only one access product, based on commercial negotiations and dispute resolution rather than on ex ante cost orientation). Some **operators** and **equipment manufacturers** argue for a progressive transition to ex-post competition law. Many respondents groups support the relevance of the framework for network and service security.

In terms of *EU added value* and whether similar progress could have been achieved at national or regional levels, **most operators** highlighted the importance of competition for increasing choice and transparency, lowering prices and bolstering consumer rights. **Incumbents** acknowledged the role of the framework in liberalising monopolies. Many respondents highlighted a risk of fragmentation due to national implementing measures and of incoherence with other regulation and competition law. **Equipment vendors** in particular acknowledged the role of the framework in promoting competition. While the desire to deregulate in one form or another is present in almost all categories of contributors, albeit not equally, none of the contributions concludes that full repeal of the framework is warranted. Consumer protection rules and universal service were the subject of widely contradictory opinions from different stakeholder groups, with disabled user group noting that without the framework, many measures to facilitate a disabled person's access might not have happened. In terms of process, there were calls from some operators for a full harmonisation to address fragmentation.

Connectivity is the overall converging theme in many contributions across different stakeholder groups, with many suggesting that it should be a more prominent focal point in the revised framework. Including investment as one of the objectives, however, divides the respondents. In particular, **consumer organisations**, **alternative operators** and **regulators** fear that this could be seen as undermining the current competition objective. **Incumbents** and many **mobile operators** stress the increased need for connectivity and investment but diverge in the proposed solutions. Connectivity to the benefit of end-users as an overarching objective to which competition, internal market and investments provide the means, could be considered as a central theme supported by most stakeholder groups.

1.1. Network access regulation

Extensive inputs were received from all of the major fixed and converged fixed/mobile electronic communications providers active in the EU, whether they are former monopolies, small or large access seekers relying on their networks, or independent fixed infrastructure owners including cable and independent fibre networks.

Good connectivity is perceived as a necessary condition to achieve the Digital Single Market, with many respondents pointing to the need for policy measures and possible adjustments to current policy and regulatory tools to support the deployment of infrastructure in line with future needs.

2.2.2.2.2 Evaluation of the network access regulation

Amongst stakeholders from the industry, the positions expressed on network access and interconnection regulation, including the current SMP-based approach, can be divided in two blocks, with on the one hand operators whose business model predominantly relies on access (and who strongly support the current ex-ante regulatory approach) as well as broadcasters, and on the other hand the incumbents (who call for a reform of the regulatory regime in place). Cable operators are supportive of the role that the SMP regime has had to promote competition, but warn that overly aggressive regulation could hinder infrastructure deployment.

The main argument from alternative operators and their national and European trade associations is that regulated access and interconnection have driven competition, innovation and investment and that with the ongoing shift to NGA networks the needs for SMP-based regulated access to broadband networks will remain acute. In addition, they submit that the current regulatory approach provides NRAs with the right level of flexibility. Telecom users are also strongly in favour of the current access regulation, with the exception of one business users association which considers that the emphasis should be put on service competition rather than on the underlying infrastructure, and that the sharing of infrastructure should be emphasised.

On the other hand, incumbents consider that the access regime in general is a deterrent to investment in NGA networks, does not provide enough predictability, and is a burden for operators and regulatory authorities with high administrative costs. They claim in particular that promoting infrastructure investments by enabling competition downstream (first by the imposition of wholesale remedies and then by encouraging access seekers to gradually build their own infrastructure closer and closer to end customers), the so called "ladder of investment" approach, has failed, in particular when applied to NGAs, and that a lighter regime should be put in place with a focus only on situations where monopolistic conditions persist. The need to incentivize investment is raised by many incumbent operators. While many mobile operators also follow this line of thought, some of the mobile operators support the regulatory approach in place.

Regulators consider that the current approach drives investment. On the other hand, some responding Member States call in general for a pro-investment regulatory regime, estimating that the current ex-ante SMP-regulation is outdated and should be adapted, with some suggesting that it should enable NRAs to apply a more flexible approach for imposing symmetrical obligations of access to high-capacity networks.

With respect to the interconnection of voice, mobile operators and certain incumbents call for a phasing out of the ex-ante regime in place, arguing that the IP-based delivery of voice services is modifying market circumstances. MVNOs have an opposing view on the matter, on the ground that terminating networks will always remain a bottleneck. OTTs consider that interconnection rules are needed to avoid discrimination.

Many of the **access seekers** consider that the current rules were effective in addressing single dominance. This view is also shared by **consumer organisations** and part of the **regulatory community**. Those operators in principle agree with the existing scope of access remedies, while raising issues with its implementation in detail. On the other hand **incumbent operators** consider that the full set of access remedies is often imposed mechanically, without cost/benefits assessment and without regard to modulation according to actual problems identified. Intrusive access remedies, imposed at all levels of the "ladder of investment" hamper investments in modern networks. Moreover, the broad provisions concerning access regulation contained in the current framework allows NRAs to engage in product micro-management, business case design and steering market outcomes. This is said to cause significant delays in delivering new technologies and network upgrades.

2.2.2.2.3 Review of the network access regulation

The majority of **Member States/public authorities** that have responded highlight the positive effect that the implementation of the Framework has had on the market and the role of competition in promoting investments. However, there is an acceptance that updating the framework will be necessary, for reasons varying from promoting investment in next-generation infrastructures, responding to technological and market changes and diminishing administrative costs. Some Member States argue for flexibility in the application of incentives to meet future challenges at a national or sub-national level. **Access seekers** and some other operators also call for greater guidance to be given to NRAs to analyse sub-geographic markets to increase consistency. There are also calls from certain Member States, which perceive limits in dealing with oligopolistic market structures, for a greater role for symmetrical rules. **Regulators** broadly underline the achievements of the current system but argue that some flexibility may be needed, for instance by considering more prominently symmetrical obligations or by simplifying the regulatory approach to the termination rates markets.

Among **operators,** the responses of the two largest groups of stakeholders (incumbents on one side and access seekers on the other) correspond to the general lines of the two groups: the first advocating a de-regulatory push in the name of changed market dynamics and the risks involved in future investment plans, the second defending the link between competition and investments and calling for

a protection of access rights to legacy networks as well as to upgraded networks, where they fear that a deregulatory approach would lead to the loss of the welfare gains achieved so far by the regulatory framework. Those seeking further deregulation resist ideas that they fear may result in an increase of the regulatory burden, particularly in relation to regulatory measures that may lead to the continued regulation of markets even in the absence of proven market power. On the other hand, those that rely on regulation resist proposals that imply establishing a link between investment incentives and a lighter regulatory approach, as they fear that upgraded networks will become increasingly inaccessible and that broadband markets will become increasingly concentrated or even re-monopolised. In each case, however, the general approach is typically also accompanied by a recognition that regulated networks and their related markets have changed, leaving scope for adaptations.

In relation to the simplification of access products and focussing on key access points, **network owners** responded in favour of a drastic simplification to a single access product (if at all necessary), whereas **access seekers** insist on the importance of different access products to compete at the retail level. On the other hand, **access seekers** reject the idea that retail market considerations should be the focus of wholesale regulation, an idea that is strongly supported by **network owners**, who consider that continued wholesale regulation is not justified if retail markets are competitive.

In relation to different treatment of legacy copper networks (whether pure copper access networks or upgraded FttC networks with copper sub-loops) to incentivise upgrades, operators invoked the principle of technological neutrality and leaving the market to decide how to best meet demand. However, a number of contributors consider that copper-based solutions will not represent a credible alternative in the long term. **Investors** in FTTH solutions and some **access seekers** call for a recognition that the risk involved in rolling out fibre to the premises is higher than upgrading copper, so that regulatory incentives, if any, should not include FttC solutions. **Regulators** also propose the idea that any risks specific to a particular new investment network project should be considered if wholesale tariffs are subject to regulation, in order to allow the operator a reasonable rate of return on adequate capital employed.

Network owners request discretion to decide whether and how to continue to use copper assets (full copper loop or sub-loop), whereas **access seekers** request guarantees that physical access to copper networks will continue to be guaranteed. While a majority of respondents, including **regulators**, would not agree to mandating the switch-off of copper networks where fibre is present, they still see a role for regulators to manage the transition where switching off copper makes economic sense, with **copper networks owners** advocating minimal intervention, and others rather invoking public intervention to preserve competition (e.g. transitional migration regime).

With regard to co-investment models, many stakeholders can see the advantages of co-investment for increasing the reach of NGA networks, for example, in less densely populated areas. Their views however differ on the related regulatory regime. While **incumbents** favour co-investments on commercially negotiated terms, **access seekers** call for strict conditionality to ensure fairness and openness of the co-investment.

The responses overwhelmingly affirm the important role that civil engineering plays in the roll-out of NGA. Some **Member States** and a number of **infrastructure owners** don't see the need to further intervene to ensure access to civil engineering falling within the scope of the Cost Reduction Directive (2014/61/EU). However, **alternative operators** highlight the importance of detailed SMP obligations, beyond the general obligations in that directive. Furthermore, **incumbent operators** call for symmetrical access to in-house wiring.

There is broad alignment between **regulators, Member States** and many others that longer review periods (compared to the current mandatory three years) would be beneficial, particularly in stable markets such as termination rates.

Regarding measures aimed at facilitating the roll-out of high-speed networks in the most challenging areas, responses were cautious with regards to any first mover advantages (to operators that are willing to roll out next generation networks in challenge areas). **Access seekers** and **consumer associations** warned about the risk of re-monopolisation, whereas **network owners** challenged the proposition that a risk of strategic overbuild can be defined and distinguished from competition. Some **Member States** highlighted the need for local responses to sub-national competitive and investment challenges, indicating openness to consider approaches to incentivise first movers on a geographical basis, subject to suitable safeguards being built in. In supporting first mover incentives, **vendors** and wider digital economy players suggest a concession model, with some operators noting that in such a case regulators should be able to define a period in which the network operator is allowed to use its network exclusively. Most stakeholders agreed that any first mover advantage should be subject to safeguards against re-monopolisation. Wholesale-only models (which may counterbalance fears of re-monopolisation) found the support of **equipment vendors and smaller/fibre-only network operators**, but **operators in general and public authorities** disagree on whether such models would have a positive effect on investment.

On oligopolistic markets, on the basis of BEREC's recently adopted report, all respondent **regulators** and **some Member States** are calling for the widening/strengthening of regulatory powers to deal with new duopolies or oligopolies (where such market structures lead to sub-optimal market outcomes) albeit still with a high threshold for intervention. Some propose symmetrical regulation as a possible solution. Some alternative operators also raised concerns about the adequacy of approach under the current SMP test and guidelines to tackle joint dominance or "tight oligopoly" market structures. However, many operators warn of the risk of over-regulation if ex ante regulation tools are broadened, without a clear economic underpinning, to tackle oligopolistic conditions beyond the current joint dominance test, as set out in Annex II of the Access Directive and the SMP Guidelines, or beyond the current threshold for applying symmetrical rules.

2.2.2.2.4 Spectrum management and wireless connectivity

The importance of wireless connectivity and wireless broadband, and its link and complementarity to a very high capacity fixed connectivity is acknowledged in consultation responses. Industry is supportive of a more co-ordinated approach and looks for additional certainty in investment and possibilities to develop throughout the EU new wireless and mobile communications including 5G. Member States generally underline the achievements in the field of technical harmonisation, and the need for additional coordination to be bottom-up and voluntary; some of them call for a better balance between harmonisation and flexibility. There is widespread recognition of the importance of more flexible access and use of spectrum in the future from both operators and public authorities, although disagreeing about how to realise this.

2.2.2.2.5 Evaluation of the current rules on spectrum management

While a majority of respondents consider the current regime to have significantly contributed to promoting competition, almost half say it has only moderately achieved the aims of providing market operators with sufficient transparency and regulatory predictability, promoting citizens' interests and ensuring effective and efficient spectrum use. A third of respondents considered that the current regime had only a minor impact on keeping the administrative burden appropriate and on promoting the Internal Market.

A majority of respondents that spans public authorities, regulatory and trade bodies both in and outside the electronic communications sectors, MNOs, converged and satellite operators, user associations and vendors, consider the current regime to have contributed to harmonised conditions for the availability and efficient use of spectrum. Member States and regulators have in particular, been consistent supporters of this position. More reserved views are found among broadcasters and

other respondents, notably from the transport sector. The regime has been significantly more effective for new bands than for bands still requiring freeing.

There is a general perception among several respondents (converged operators, operator associations, vendors) that technical harmonisation has worked well and that the involved actors (RSPG, RSC/CEPT and the Commission) have delivered. Even those parties seeing little or no benefit from the existing regime (M(V)NOs, cable, converged operators, non-ECS associations) acknowledge the achievements in technical harmonisation, but stress persistent regulatory fragmentation. Points of criticism concern the ineffectiveness in addressing interference issues (transport) and ensuring usage efficiency.

As for the selection processes for limiting the number of rights of use, industry respondents, including operators and vendors, criticize a lack of consistency as well as sometimes unnecessary restrictions of usage rights. Some respondents recognise coherence of application in the sense of certain rules being widely used, while results still differ (converged operators, ECS associations). A majority of respondents (spanning ECS and non-ECS associations, M(V)NOs, converged operators and vendors) considered that the lack of coordination of selection methods and assignment conditions has impaired the development of electronic communications services. The authorisation methods most often mentioned as efficient for wireless broadband were auctions and general authorisations.

While respondents comprising broadcasters, mobile operators, associations of mobile and alternative operators, regulators and vendors consider that inclusion of spectrum provisions in several instruments should not per se impede their effective interpretation and/or implementation, several respondents including incumbent operators and some Member States nevertheless consider a single instrument to be potentially more effective, stressing the benefits of applying the same set of rules to all spectrum users, which is also supported by most vendors and operators/associations, subject to the rules being consistently applied.

2.2.2.2.6 Review of spectrum management rules

Regarding objectives and principles, **most economic actors and some Member States** seek more consistency in spectrum management to increase legal certainty and spectrum value, and to secure greater transparency and predictability for investment, in particular on licence durations, pricing and availability of spectrum. There is also large support from public authorities to remove barriers to access harmonised spectrum across the EU, in order to foster economies of scale for wireless innovations and to promote competition and investment, as well as to avoid cross-border service impairments. **Operators** also stress problems - in particular, late access to spectrum, high reserve prices, inefficient spectrum packaging, spectrum left idle and lack of long-term vision.

The majority of respondents consider that spectrum assignment procedures have a significant impact on structuring the mobile markets and their competitive landscape, e.g. number of operators, price, network investment, and consumer prices. Some (generally **large operators**) criticise the use of assignment measures as indirect means to ex ante regulate the market (through caps, reservations) without the associated objective criteria. Others (**vendors, some regulators**) also consider that additional factors such as regulatory conditions (e.g. access obligations for MVNOs) and historical national market development have a similar structuring impact.

Most responding **Member States, broadcasters and alternative operators associations** insisted on national specificities and are generally satisfied with the current framework. While public authorities could envisage limited coordination through common deadlines for making a band available or the common definition of certain general principles, many economic actors seek greater harmonisation of award methods and procedures (need and timing of spectrum release and selections, general principles and objectives, transparency, ex-ante competition assessment, refarming conditions, timing of advanced information to market participants, measures to promote use efficiency, spectrum

packaging) so as to enhance legal certainty, support investments, promote competition, provide more clarity to manufacturers and support economies of scale. **Member States** expressed much resistance regarding coordination of spectrum valuation and payment modalities, while many **operators** oppose fee disparities and excesses, and in general support greater coordination of assignment processes. Most **vendors** supported harmonisation for predictability and a robust end-to-end value chain, but warn that timetables alignment should not delay early movers.

Assignment conditions generally are considered as heavily impacting investment and business decisions, competition and the single market. Most **operators** agree on the need for more consistent binding assignment conditions to increase investment predictability, and in particular to support and ensure objective, transparent and non-discriminatory treatment of operators, transparency and alignment of timing and conditions of licence renewals, longer licence duration, flexibility to trade, lease or share, technology and service neutrality limits, refarming conditions, technical performance, use-it-or-lose-it clauses and interference mitigation before assignment decisions are taken. On the contrary, there is strong opposition to harmonise or even use wholesale access conditions from **operators** and to a certain extent to harmonisation of coverage obligations from **Member States**. For **broadcasters**, decisions on criteria and conditions should remain at national level to consider local specificities or media pluralism and cultural diversity. Some also insist on the need for compensation in case of refarming.

Member States reject full harmonisation but are open to a more common approach to spectrum management, some could accept a peer review of national assignment plans as well as a certain level of harmonisation or approximation of conditions and selection processes. A number of Member States expressed their desire to remain flexible to support early take-up of new technologies and to adequately balance harmonisation and flexibility in order to be able to adapt to market demand.

Most public and commercial respondents are calling for flexible or shared access to spectrum to meet future demand, in particular for 5G, preferably on a voluntary basis; **vendors** and **operators** insist on exclusive or licensed shared access for quality purposes. **Broadcasters** raise interference issues and thus urge for careful selection of compatible sharing usages; in addition, some point to their incapacity to at the same time compete for spectrum and meet cultural targets if flexibility is purely market-based.

On refarming, a large majority including operators, vendors and their associations as well as responding Member States and regulators seek further facilitation, notably on a voluntary basis except in cases of inefficient use. The large majority of operators, vendors and their associations consider that longer licence duration would be helpful in this regard. Most operators see a need to protect and give priority to existing users to safeguard investments or avoid interference, while a minority believes that appropriate spectrum pricing, trading and auctions can address this issue. When facilitating refarming, some seek a careful balance between flexibility and preservation of harmonisation.

With regard to facilitating deployment of denser networks, many respondents pointed to obstacles - lengthy permit process, high administrative fees for back-haul provision, inappropriate fee structure, lack of harmonisation of management of electromagnetic fields' emission - to the roll-out of small area access points needed for mobile services, while some **Member States** disagree. Many market actors and public authorities consider that a general authorisation regime would foster innovation and competition both for services and end-devices and should include access rights to public and private property to build a network. **Vendors** seek a common definition of small-area wireless access points and the harmonisation of technical characteristics about their design, deployment and operation.

While opinions are divided as to whether end-users should be entitled to share access to their Wi-Fi connections with others as a key prerequisite for the sustainable deployment of denser small cell networks in licence-exempt bands, many public authorities and private respondents supported the

deployment of commercial/municipal Wi-Fi networks in public premises, while seeking appropriate regulatory safeguards for a.o. liability or exposure to EMF. Some operators reject such idea as network roll-out could be facilitated via various forms of public-private partnerships, many stressed that any such public support should be technologically neutral.

With regard to public protection and disaster relief (PPDR)**,** a majority of respondents reject the inclusion in licence conditions of obligations of service quality and resilience of network infrastructure to enable a dual use of commercial mobile networks for PPDR, as MNOs' individual business models do not combine easily with stringent PPDR requirements, and therefore should be on a voluntary commercial basis only and based on net neutrality rules. Some operators believe that providing PPDR services via commercial networks would be economically more efficient than funding a separate network for PPDR services.

2.2.2.3 Sector-specific regulation for communications services

2.2.2.3.1 Evaluation of the current sector specific regulation for electronic communications services

With regard to the effectiveness of the current regulatory framework in ensuring a high level of consumer protection, the clear majority of respondents (**Member States, telecom operators** and their **associations, broadcasters, vendors and OTT providers**) believe that the current framework contributed to effectively achieving the goal of ensuring a high level of consumer protection in the electronic communications sector across the EU. **Member States** noted that in general the framework had positive effects on the protection of consumer rights regarding traditional electronic communication services (ECS). In particular, provisions related to contracts and those facilitating change of provider (switching) have diminished unfair lock-in practices and ensure a high level of consumer protection. **Users and ECS/ECN associations**, as well as the majority of **operators** consider that the existing rules have delivered good outcomes and high levels of consumer satisfaction.

Many respondents, however, consider that the current regulatory framework has failed to deliver consumer protection with respect to emerging services, which are based on new technological developments and currently fall outside the remit of the sector-specific rules. Most responding **Member States** support specific requirements to be applied to all communications services irrespective of the provider ("traditional" telecom operators or "new" OTTs) in order to avoid risks of (a) insufficient customer protection, (b) a lack of clarity, and (c) confusion among consumers who might mistakenly believe that their communication is protected by sector-specific rules.

Some **telecom operators** think that the current provisions have become outdated with little substantial value for consumers, except for basic provisions on emergency services, number portability and interconnection and argue that competition in the sector would allow for the removal of regulation.

Regarding provisions constituting a particular administrative or operational burden, a majority of respondents (**mainly operators and their associations**) believe that there are administratively or operationally burdensome provisions. The biggest concerns are expressed regarding different and overlapping legal frameworks, e.g. Consumer Rights Directive (CRD); Universal Service Directive; Unfair Commercial Practices Directive. Some respondents argue that this leads to over-regulation, too detailed provisions, and inconsistency of rules. Some **alternative operators** consider the application of end-user protection rules to business customers as burdensome. According to other **incumbents and their subsidiaries** almost the entire Universal Service Directive is burdensome.

With regard to provisions to be repealed, the majority of respondents (mainly **telecom operators** and **their associations**, a **few broadcasters, vendors and OTTs and a Member State**) have identified certain sector-specific end-user rights' provisions, which they consider are no longer relevant. These include provisions such as contract rules which are covered by various other directives, in particular the CRD. Regarding the maximum contract duration, some **telecom operators** suggest either an

application of these rules also to OTT communications, or their abolition. One **telecom operator** suggests the repeal of Art. 34 USD as out-of-court dispute settlements are also addressed in the Directive on Consumer Alternative Dispute Resolution (ADR) and the Regulation on Consumer Online Dispute Resolution (ODR). Some **operators** suggest the repeal of the provisions on printed directories and public payphones. Some **Member States**, **mobile operator association, EU and national consumer associations and a trade union** have not identified any provision to be repealed.

With respect to provisions protecting disabled end-users, the USD contains specific requirements under the universal service obligation (USO) and regarding the equivalence in access and choice. The majority of the respondents (**telecom associations, telecom operators, users' associations, an association of users with disability, other NGOs, regulators and Member States**) found that the current regulatory framework has been effective in achieving these goals. Several **operators and NGOs** stated that the relevant Art. 23a is too weak ("Member States shall encourage"), it leaves too much discretion ("where appropriate") and does not contain financing provisions. They consider that it has therefore been only moderately effective in achieving the goals of providing equivalent access. As a consequence, an inconsistent diversity of approaches has developed across the EU.

Incumbent and larger operators raised the financing issue. Initiatives designed to improve accessibility of services to disabled people should be borne by the public authorities. If any contribution is required from the sector, it should be requested to all players, including OTTs, in proportion to their incomes and the number of users ("responsibility-sharing based on a proportionality principle").

With regard to the efficient implementation of number portability (NP) provisions, a large majority of respondents consider that the current NP provisions allow significantly or moderately for their efficient implementation. However, **operators** criticised the diversity of approaches, and of technical means put in place, in various Member States. In some Member States, there is no common database of ported numbers and in a few of them direct routing of ported calls is still not available. Some **operators and their associations** argued in favour of a receiving provider-led porting process. Some respondents stated that the current NP obligations are not well suited to new services such as M2M or IoT.

With regard to the relevance of 112 provisions to ensure an effective access to emergency services, a large majority of respondents agreed with the significant relevance of the scope and requirements of the current regulation of access to emergency services. **National authorities** are also in line with this trend. The **telecom industry** highlights the importance of reliable access to emergency services that, in view of the technical standards and legal arrangements in place today, can be provided today only through ECS.ECN/ECS argue that access to 112 obligations should be imposed on OTTs as well, if technically feasible. A large number of stakeholders consider that all the voice services perceived by the users as substitutive to the current PSTN voice service and which also give access to E.164 numbers should be subject to the same obligations regarding the access to emergency services. In the same vein **regulators** support an obligation on all communication services (including OTTs) that give access to numbers in the numbering plan.

As regards the effectiveness of network and service security rules in achieving their objectives, over half of all respondents (including several **Member States,** most **telecom operators** and some **vendors**) consider that the rules have been effective. A minority (one **Member State, a** few **telecom operators** and some **associations of operators**) found them ineffective. More than a third of the respondents (many incumbent and alternative telecom operators and associations, several ENISA-member national authorities) underlined the need to involve the complete Internet value chain (including OTT services, software and hardware).

2.2.2.3.2 Review of the sector specific rules for communications services

With regard to the scope of the future rules and the need for sector-specific regulation of communication services, the majority of respondents including **BEREC, Member States, several associations of broadcasters, of cable operators and of alternative operators, consumer associations, cable players and OTTs** note that there is still a need for sector-specific regulation of communications services as ECS have become an essential service in every person's life, crucial to ensuring a well-functioning society and economy. Therefore sector-specific rules are still considered necessary for sustainable competition, innovation, a healthy low concentration of providers' market power and also to guarantee that consumers can reap the benefits of such competition. Several areas were listed, where sector–specific regulation is still needed: retail Internet access services, numbering, end-user protection, universal service obligations, roaming and downstream availability and accessibility of a wide variety of audio-visual services etc. Nevertheless, several of those respondents prefer horizontal to sector-specific regulation wherever possible. A few of them, however, oppose the inclusion of OTTs within the scope of such rules, because there remain fundamental differences between the telecoms market and the market for Internet applications and content, and applying the same detailed sector-specific obligations would be a disproportionate burden for a highly dynamic industry sector.

Regarding the revision of the current ECS definition**, BEREC, several Member States, most operator associations, most incumbents, some cable players, all user associations and some broadcasters** consider that the current definition of ECS should be reviewed owing to the increasing uncertainty on the scope of the definition of ECS related to "conveyance of signals", the inconsistent regulatory obligations for similar services and the convergence of communications services. Several respondents emphasised that a future-proof definition needs to be end-user-centric, the key factor being substitutability from a customer perspective. Those opposing revision of the definition, (some **Member States, OTTs, software and equipment vendors, cable operators, some broadcasters and a few individuals)**, argue that the concept of ECS has proven itself and changes may create regulatory, legal and investment uncertainty. According to some stakeholders, instead of including OTT services in the definition of ECS, the current regulatory requirements on traditional electronic communications providers should be loosened. In **OTTs'** view, if the definition is reviewed, the difference between Information Society Services and telecoms networks should be maintained.

The majority of respondents (some **Member States, operator associations, most incumbents and vendors)** are of the opinion that for consumers OTT services are a functional substitute for traditional ECS. The minority of respondents (some **Member States, a few operators, OTTs and consumer and user associations**) submit that OTT services are functionally different from ECS. The majority of respondents (**Member States, regulators, most incumbents, alternative operators, associations, trade unions, vendors**) are of the opinion that all functionally substitutable communications services should fall under a new common definition, but have significantly varying positions on the types of obligations that should apply to services falling within such a definition.

The minority of the respondents (**several Member States, NRAs, some associations, broadcasters, OTTs, a few cable and fixed players**) suggest maintaining the "conveyance of signals" criterion in the definition of ECS. For broadcasters that criterion helps in distinguishing telecommunications from audio-visual services. However, the majority of respondents (**several associations, most MNOs, most incumbents and few software and equipment vendors**) do not consider "conveyance of signals" as a necessary criterion. Rather, the lack of clarity in the ECS definition, when assessing whether services “consist wholly or mainly in the conveyance of signals”, opens the door to different interpretations and inconsistencies. According to **BEREC**, it "is worthwhile to examine whether it is still an appropriate distinguishing factor."

With regard to the elements of the ECS definition related to transmission services in networks used for broadcasting, **all broadcasters and their associations, alternative operators and their**

associations, many fixed and converged fixed/mobile operators, an equipment vendor and private individuals advocate that these should continue to be considered as ECS. For **broadcasters**, excluding transmission services from the definition would mean that they are omitted entirely from the telecom framework, undermining important legal protections for broadcasting (e.g. transmission obligations). For some respondents "transmission services in networks used for broadcasting" should not be considered as ECS. They argue that in the light of the convergence of the legacy broadcasting transmission services and internet media services (including broadcasting), the transmission of the service is platform-based and no longer network-based and any reference to services provided on a network has to be eliminated.

With regard to a possible differentiation between managed and best-effort services in the ECS definition, the majority of respondents (**incumbents** and **alternative** operators and their **associations, vendors and broadcasters**) prefer no differentiation between *managed and best-effort* services in the ECS definition as such a differentiation would facilitate circumvention of the rules by opting for 'best effort provision' free of obligations. As to the question whether sector-specific regulation should be limited to Internet Access Service, there is almost no support for such reduction, with only a few exceptions.

Regarding the application of sector-specific provisions (end-user and other) to the IAS, **telecom operators, industry associations and vendors** agree that as a general rule only horizontal competition and consumer law should apply to internet access service and that, if any sector-specific provisions are needed, these should apply to all other digital services. Almost all **national authorities**, user **associations, OTTs, some broadcasters and IT service providers** see a need for further end-user rights in relation to IAS in addition to those included in the proposal for the Telecoms Single Market Regulation, although in many cases these stakeholders do not provide detailed arguments to explain this position.

On the issue of definition of communication services, a significant number of respondents (**incumbents and alternative operators**) emphasise that in an "all IP" environment network interconnection is to be distinguished from the interoperability of services as users would be tied to a single connectivity provider but not to a single communications service provider any more.

Some respondents do not believe that there is a need to apply the existing, as well as any further end-user rights, to communication services (some **Member States, a large number of mobile, fixed, and cable operators, and OTTs)**. The main argument put forward by them is that horizontal regulation (consumer and data protection), together with competition-law tools, should suffice. Those who were in favour of having end-user rights applicable to communication services are mostly **Member States and consumer protection bodies,** while **alternative operators** suggested that full harmonisation is needed for contractual information, transparency measures, contract duration, switching, and bundles.

Several associations, most broadcasters, a few incumbents and converged fixed/mobile players consider that there are new sector-specific end-user protection issues that need to be addressed. Among the areas listed are: bundling of contracts and their impact on switching; communications contracts with subsidised equipment; continuity of service (telephone or internet) when switching; control of consumption; contract termination in case of the tacit extension of contracts; rights of the end-users when relocating; improved rules for end-users with disabilities, findability of public-interest content.

Finally, **regulators and others** indicated that some new end-user protection concerns can be anticipated in relation to services which are substitutable to traditional ECS, including access to emergency services, network resilience, cyber security and interoperability between different digital services, , transparency, protection of data confidentiality and privacy.

Trade unions, consumer organisations, vendors and directory services expressed support for specific rules with regard to voice services for end-users. These contributions highlighted the

importance of availability (call to emergency services, functionality during power outages and disasters) and the importance of voice quality as a distinctive characteristic. Some **mobile operators** considered voice-specific requirements still relevant, noting the need to ensure interconnection and access to emergency services, while others noted the importance of requirements such as data retention/lawful intercept. In general most **incumbent operators** would prefer horizontal regulation, while maintaining the possibility of a few specific requirements (such as emergency services) and consumer information was noted as safeguard measure. Directory service providers noted a risk that without a specific requirement (Art. 25 USD), operators might not provide them with subscriber information on a fair, objective, cost-oriented and non-discriminatory basis.

Half of the respondents (some **Member States, broadcasters, a few telecom operators and consumer protection bodies**) are of the view that providers of communication services as newly to be defined should potentially be subject to an SMP-based regulatory regime, if they can limit competition, based on a market analysis and consistent with the non-discrimination principle. Those disagreeing (some **Member States, associations of incumbents, alternative and mobile operators, vendors and OTTs**) highlighted the existing high level of competition, market dynamics and diversification of providers, and stated that competition law and horizontal consumer protection offer sufficient protection in this regard.

There is a majority support ranging from **national authorities to mobile operators and incumbents**, to extend the scope of the access obligations to emergency services to best-effort services. At the same time, it is recognized by all stakeholders that minimum quality of service should be ensured for emergency communications and best-effort communication cannot provide the end-to-end quality that managed services can. Some **operators** support imposition of a general obligation to give access to emergency services, adapted to the quality of service requirements that each type of services (managed vs. best-effort) can provide.

Regarding numbering resources and assigning numbers directly to M2M users, **most MNOs, including smaller ones**, highlight that this solution raises many implementation and security issues and risks of fraud, could exhaust national numbers, would endanger interoperability and end-to-end connectivity. There is a clear consensus that to cope with the numbering needs of M2M in the future, a clear framework for extra-territorial use of numbers is necessary to ensure sufficient numbering resources. A majority of respondents see a demand for over-the-air provisioning of SIM cards for M2M communications, and to a lesser extent for end-users' own devices later on. However, the idea of regulatory promotion of over-the-air provisioning is not supported, with the argument that it should be up to the markets to decide on specific technological options.

While there is a majority view that transmission obligations imposed on electronic network operators (must carry rules) and rules related to electronic programme guides should be adapted to new market and technological realities, there is sharp disagreement as to how such adaptation should be conceived. Extension of the current rules is supported by some **Member States** and most **broadcasters**, whereas most **telecom operators** are in favour of reducing the scope of the rules. **Public service broadcasters** consider that the future scope of rules should extend to interactive and non-linear services, should also cover hybrid TV signalling and should apply on a technologically neutral basis to all distributors of audio-visual content, not only to ECNs. Telecom **operators** call for a level playing field between broadcasters and online platforms and call for improving access to content rights. Some **cable and telecom operators** call for complete removal of must carry obligations or at least to limit them to the main/most essential general interest channels. **Commercial broadcasters**, **one telecom operator** and a citizen consider that the current provisions are adequate.

Media regulators and some **telecom** and **cable operators** consider that the presentation and the order on navigation interfaces is crucial for user choices of audio-visual content and that ensuring non-discrimination of general interest content is sufficient. **Public service broadcasters** consider that Member States should be competent to ensure 'findability' of general interest content on user

interfaces of significant networks and audio-visual platforms and that regulated EPGs should be included in new TV sets. A **pay-tv provider** considers that prominence of content could also be improved by better referencing/tagging of national and European offers. Several **telecom operators** point to the need for broadcasters to be obliged to make real-time signalling available, in order for EPGs to work satisfactorily.

2.2.2.4 The universal service regime

2.2.2.4.1 Evaluation of the current rules on universal service

The majority of **Member States and regulators** agree that universal service has been effective and efficient in safeguarding end users from the risk of social exclusion, while **most of the operators** see little or no impact and efficiency at all. Proponents of universal service argue that the availability of certain basic services increased and that services became affordable and accessible to all. Opponents claim that (1) the universal service regime has become outdated; (2) the high level of competition for fixed and mobile services ensures the affordability of tariffs and not the regulatory obligation; (3) the calculation of net costs have been fraught with controversy, challenges, and appeals; and (4) the overall administrative burden and regulatory uncertainty have been very high, for a regime which has not produced major benefits.

As for coherency with other rules, the majority of **Member States** agree that universal service has been coherent with other provisions of the framework and state aid, while most of the **operators** see little or no coherence at all.

The vast majority of **operators** consider that this review should be the opportunity to redefine or completely reconsider the universal service regime (including its financing), with many claiming that it has become obsolete. **Member States** mostly claim the need to maintain a universal service scheme, with flexibility at Member State level on funding and on broadband. **Regulators** support maintaining the status quo.

2.2.2.4.2 Review of the universal service rules

With regard to the scope of universal service most respondents consider that the current scope is outdated because it was shaped in a context of market liberalisation and since then market conditions have drastically evolved, with more competition and choice available to consumers.

There is a general acceptance among the respondents to exclude public payphones and comprehensive directories and directory enquiry services from the scope. Due to availability of mobile telephony and internet, there is no usage of or demand for public pay phones. **Regulators** acknowledge a decreasing demand/usage for public pay phones but argue that Member States should retain flexibility to include pay phones within the scope. As for directories, the availability of the same information through the internet is a further competitive alternative. However, some directory and local search providers underline that access to data risks being refused in the future, absent a universal service obligation guaranteeing access to directory enquiry services.

Concerning the provision of telephony services at a fixed location, **operators** mostly agree that this inclusion in the universal service scope is no longer necessary, because various types of players are providing voice services (mobile, VoIP) on a competitive basis while **regulators and Member States** mostly claim the opposite.

With regard to the inclusion of **broadband within the scope of universal service**, while most **operators and their associations** have no doubts about the positive impact of broadband on social and economic life, they claim that USO is not the right instrument to foster broadband deployment. In any case, if broadband were to be included in the US regime, it would have to be revised substantially.

Respondents supporting both in and out options (mostly **Member States and regulators)** submit that Member States should retain the flexibility to make the choice at national level.

Most **operators and their associations, several Member States and regulators** consider that broadband under universal service bears high risks of market distortions and cost inefficiencies. In particular, industry funding is considered too distortive. The risk of lowering incentives to invest, crowding-out effects, delays in network expansion and unpredictable large financial transfers between competitors (if industry funding is used) are considerable. Instead, an investment-friendly regulatory framework, lowering of deployment costs, demand stimulation, and well-designed public subsidy schemes targeted at cases of clear market failure (evaluated by an impact assessment) should be used for fostering broadband instead of USO. Many also highlight the need to promote competition and commercial investment via regulatory tools. The use of such other public policy measures should be based on timeliness (so as not to come in too early to disrupt or crowd out private investments), proportionality, non-discrimination and technological neutrality.

As to how broadband should be defined if included: those favouring the speed aspect (**consumer groups, several Member States, media players, operators**) consider it a simpler and more neutral parameter. **Media players** argue for sufficient speeds to deliver media content. Those favouring the criterion of the use of certain types of services (**ECS/N associations**) generally feel that it is more flexible, able to evolve with time, more technologically neutral and has a more direct link to social inclusion. Some players are wary of setting the speeds based on the average speeds used by the majority of the population, so that the speeds are not set at a high level. With regard to the list of essential services, most of the respondents agree that the list of services should be based on what is necessary for social (digital) inclusion, but they have varying views on what set services this would entail.

With regard to financing universal service, most **operators and associations** agree that the most appropriate and equitable way of financing the universal service, in particular in light of the possibility to include broadband within the universal service, would be through public funds. Broadband for all should be supported through general taxation since it is a general public interest goal that benefits society as a whole. The scope of universal service should be defined narrowly, representing only **a safety net** in a market-driven sector. Many **operators** state that industry funding, especially when limited to operators, is disproportionate. The use of public funds would have the advantage of limiting the risk of setting too high targets for the universal service and is the only way of ensuring that Member States properly weigh the needs against costs because of the need of reducing public expenditure and maximising public economic welfare. The high uncertainty of the right to compensation in the present universal service system and the difficult enforcement that led to numerous disputes/litigations are a considerable weakness to be eliminated.

Several actors considered a combination of public funding and industry funding acceptable with the **majority of respondents** however specifying that providers of on-line content, applications and services should contribute, given they are the biggest beneficiaries of access. **Broadcasters** warned against the redirection of resources from audio-visual content, innovative online services and digital skills activities to the financing of infrastructure, since availability of such content is an important determinant for the development of broadband networks.

According to **regulators**, the current funding mechanisms for USO remain relevant and that flexibility should be retained, allowing Member States to choose the appropriate mechanism.

Most market actors and regulators agree that universal service is not the right instrument to foster very high-capacity connectivity for public places. Market forces deliver these services and other public funding policies should be used because the service is of public interest. Only a small minority of respondents (**satellite operators**) agree that universal service should play a future role in to help realise public interest objectives, but this should be financed by public funds.

Most market actors, **Member States and consumer organisations** submit that obligations related to disabled end-users should be incorporated in horizontal law. Respondents stress that any obligations should apply equally to all market players. Through the broader implementation of the provisions of Article 23a of the Universal Service Directive, a wider choice of services and tariffs for disabled users could be achieved. According to **regulators**, specific provisions for disabled end users are already included in the national regulatory frameworks of many Member States. Measures in the Directives should continue to be flexible enough to adapt to the situation of each country.

2.2.2.5 Institutional set-up and governance

2.2.2.5.1 Evaluation of the current institutional set up and governance structure

The perception as regards NRAs' independence is generally positive, in particular those safeguards applicable to independent NRAs. This perception is supported by different kinds of stakeholders, in particular public and private, including **operators** (**mostly incumbents as well as some alternative operators and trade associations**).

Just over half of the respondents consider that there is generally a sufficient degree of coherence in the application of the regulatory framework by the various institutional players (NRAs, BEREC, the European Commission). This idea was supported by **public authorities, especially regulators** and approximately **half of the operators**. Some operators propose to reduce the overlapping competences at EU and national level and to reduce and prioritise the objectives of the framework.

BEREC's role is positively perceived in relation to the Art.7 procedure, roaming, net neutrality, M2M communications and advice to EU Institutions. While more than half of respondents (including national regulators) considered that BEREC has achieved its main objective, a group of **incumbent operators**, on the contrary, considered that BEREC has not achieved its main objective, arguing that flexibility is overall favoured compared to harmonisation/consistency of application and that BEREC has a tendency to support over-regulation. Some **operators** stated that BEREC should be constituted as a supervisory authority independent from national interests or that it should be a proper EU regulatory authority with decision-making powers.

Some respondents submit that BEREC’s current institutional set-up results in it opting for greater flexibility at national level or the lowest common denominator instead of focusing on a more consistent or harmonised approach for the single market, and therefore, BEREC's Positions and Guidelines are sometimes just descriptive documents and not a collective commitment or a development of best practice guidelines. Suggested proposals for addressing this include: allowing BEREC to make binding decisions, appointing board members for four years, establishing a Director appointed by the Board, more adequate funding, reassessment of the location of the BEREC Office, more consistent launch of consultations, longer consultation periods and introducing a two-stage consultation process on key policy matters. There were also calls for a stronger advisory role to the Commission, more pro-activeness, and improved transparency and stakeholders' involvement.

As regards consistency of market regulation, just over half of the respondents answered that the Art.7/7a process had been effective in achieving greater regulatory consistency, while a third were of the opinion that this process had little or no effect on consistency. In the first category of positive responses, there were many **alternative operators, FTTH-operators** and some **incumbents and MVNOs**. Also those **regulators and Member States** who responded were largely positive. With regards to areas which could be improved, many respondents who were generally positive suggested that the entire process could be streamlined, made less burdensome for all stakeholders and that the Commission's role vis-à-vis remedies (under Art.7a) should be strengthened, either by a veto power, or by a so-called double-lock veto (i.e. regulators would be required to withdraw the draft regulatory measures if BEREC agrees with the Commission's serious doubts).

Those who disagree, are mainly **incumbents** as well as some **individual respondents**. The main arguments brought forward for this view differ widely. On one hand, it is criticised that the current process does not lead to enough consistency. On the other hand, some respondents complained that the current system attempts a 'one-size-fits-all' approach not taking sufficient account of the need for different solutions in different Member States, i.e. not giving regulators enough discretion. **Regulators** challenged the need to ensure further regulatory consistency and the link between the lack of consistency and the current institutional set-up. **Regulators** state that access markets are intrinsically local and the nature of competition is not homogeneous either for supply or demand reasons.

As regards the current spectrum governance, the technical side of harmonisation is seen by most respondents to be working well with its aim of harmonising the least restrictive conditions. There is criticism of the present system's capability to bring the actual services into being in a coordinated and timely manner.

There is significant support for the role of RSPG in assisting and advising the Commission on radio spectrum policy issues, with some respondents promoting it for a status similar to BEREC. The interplay between national experts and the European format is seen to work well. In particular, vendors would like the RSPG deliberations to be more open to industry participation.

2.2.2.5.2 Review of the institutional set-up and governance structure

Institutional set-up for market regulation

Almost half of the respondents agree that the current institutional set-up at EU level should be revised in order better to ensure legal certainty and accountability. Respondents call for i) a clearer division of powers between the different institutions (to avoid overlapping), ii) making sure that institutions are accountable for their decisions (both politically and legally), iii) a high level of transparency in decision-making (improved stakeholders' involvement). The arguments brought forward for change, however, differed considerably. On the one hand, a group of mainly **incumbent** operators proposed more discretion for NRAs with a reduced role of the Commission (or BEREC), highlighting the need for taking account of national circumstances. On the other hand, a number of voices have called either for an increased role of the Commission to ensure consistency (through a veto for remedies, for example), or even the establishment of a pan-EU regulator. **The regulatory community** was of the view that there are benefits associated with all NRAs having a common toolkit and flexibility to determine which tools to use, in particular in view of the increasing complexity of the sector.

Amongst those who favoured a revision of the current institutional set-up, proposals differed from BEREC adopting a limited advisory or benchmarking role (giving opinions and giving assistance to NRAs where needed, providing timely technical guidance, etc.) to turning it into an EU regulatory authority with proper decision-making power. Some respondents called for strengthening BEREC's role within the Art.7 procedure and also for improving coordination rather than implementing institutional changes. Some i**ncumbents** and **alternative operators** submit that BEREC in its current form has shown a limited ability to act strategically and in the interest of EU competitiveness and, in particular, for the development of the single market. Further it was alleged that it does not contribute to the objectives of the framework in a satisfactory manner. Most respondents (**all types of operators and public bodies**) considered that the current EU consultation process can be streamlined. However, in the detail as to how this could be done the respondents vary considerably. Whilst some respondents call for more NRA discretion (and a less prominent role for the Commission), others ask for full harmonisation measures, at a minimum regarding the termination markets. In addition, a shift from *ex-ante* to *ex-post* control is proposed, rendering an Art.7 procedure less relevant. Among those who disagree (largely **alternative operators**), most argue that the current process is well-balanced and has proved effective.

Some **incumbents** advocate for dividing competence between EU and national levels, making BEREC redundant, arguing that stronger compliance or a more binding nature of BEREC guidance would not be appropriate. On the contrary, some **alternative** operators supported a stronger role of BEREC within the Art.7 procedure and the strengthening of its influence on the scope of remedies in case of a veto of the Commission. The sentiment as regards whether BEREC should be given more executive tasks or binding powers is generally negative (including the **majority of operators as well as public authorities**). Some respondents are concerned by the lack of accountability of BEREC because it has a '*de facto'* significant influence on national regulatory decisions and decisions by the Commission.

The majority of the respondents disagreed with the establishment of an EU Agency with regulatory decision-making powers for all the different areas (market regulation, EU spectrum management, end-user protection and other). Some respondents, mainly **operators,** recommended that an EU agency should be responsible for services of the EU single market or for issues such as consumer protection, content, service platforms, whilst NRAs should continue dealing with local issues (e.g. network access). As regards spectrum and numbering there was a call for more harmonisation, but there were divergent positions as to whether these issues should be dealt with by an EU agency.

The regulatory community expressed its view against further harmonisation and indicated that differences in regulatory approaches can be beneficial where they allow experimentation and innovation (leading to the discovery of new best practices). Respondents were divided as to whether a common EU approach would add value in addressing the differences in the regulatory approach chosen by NRAs for individual markets in similar circumstances. **The regulatory community** also notes that, in the wider digital ecosystem, it is particularly important to adopt a "light touch" regulatory approach so as not to undermine investment and innovation. In principle, there could be more room for co-regulation and self-regulation mechanisms. According to **regulators**, while this kind of innovative and "softer" approach to regulation can be effective, where it is pursued it will be important that its details are defined "bottom-up", through the direct involvement of the affected stakeholders.

Consumer associations called for caution and considered that co-regulation and self-regulation should only be used on very specific issues and under strict conditions, such as: strong independent governance of the self-regulatory scheme, oversight and enforcement across the sector, and the presence of effective sanctions in cases of non-compliance.

As regards BEREC and the BEREC Office, almost half of the respondents had identified provisions in the framework which in their opinion should be revised. Proposals put forward include longer or extendable mandates for the BEREC Chair, relocation of the BEREC Office and definition of the role of BEREC in drafting Recommendations. Some **national regulators** considered that the governance structure is satisfactory but suggested a number of proposals for the mandate (consultation by the Commission on legislative initiatives, new responsibilities as regards connectivity objectives, more involvement in the area of spectrum through the exchange of best practices in the design of auctions and beauty contests and monitoring of coverage and QoS), deliverables (binding acts in limited circumstances, reinforced data collection) and functioning (simplification of the role of the Management Committee, establishment of an office in Brussels).

Consumer and civil society organisations referred to the need for better collaboration of BEREC with consumer organisations, civil society organisations and individual operators in addition to operators' associations as well as with other bodies/agencies such as ERGA and ENISA. The **regulatory community** has also identified the need to strengthen the cooperation with other networks of regulators established in adjacent economic sectors.

NRA status and competences

There is overall support for strengthening NRAs' independence, in particular by ensuring i) complete separation between ownership of providers and regulatory tasks, ii) political independence in particular in cases of restructuring, iii) control of adequate human and financial resources and iv) no political appointment of Board members. **Alternative operators** stated that NRAs' independence may also be affected when sector-specific NRAs are merged with other authorities. Respondents favoured that the powers of NRAs are extended to areas such as State Aid, consumer protection and coordination of spectrum policies. **The regulatory community** stressed the need of aligning the minimum competences (including end-user protection) of NRAs to those of BEREC.

A clear majority of respondents considered that NRAs should have a role in mapping areas of investment deficit or infrastructure presence because they are vested with the necessary powers to access relevant information and have the necessary expertise, as well as independence. Those opposed to such a role contested as a matter of principle any public interference with investment. There is strong support to a revision of the framework to better accommodate the role of NRAs regarding state aid, notably i) identification of target areas, ii) setting access price and access obligations, iii) ensuring better coherence between state aid and ex-ante regulation and iv) resolution of disputes. A few respondents propose that the role of NRAs regarding mapping of infrastructures or setting target areas must be limited to provide technical assistance to the relevant competent authorities or to being consulted.

Most **operators** indicated the need to revise several aspects of the general authorisation conditions, strictly interlinked with some general substantive choices on the scope and extent of regulation on ECNS (level playing field), in order not to hinder the cross-border provision of electronic communications services and networks. Several operators suggested a specific lighter regime for some categories of services (best efforts OTT, business services, small cross-border providers) in order to reduce cross-border obstacles. Other suggestions included the harmonisation of Mobile Network Codes conditions, reducing the scope of national discretion in setting the conditions attached to rights of use, and a common notification template.

The principle according to which established and non-established operators should be subject to the same rules in the country of provision was stressed by several respondents. The extension of notification requirements to OTTs as well as the harmonisation of a notification template and administrative simplification (online submission, single language version, one-stop-shop, harmonisation of categories of services) were suggested, in particular by business users and **cross-border providers**.

On numbering, most respondents do not consider it necessary to allocate more executive powers to BEREC, in particular since numbering is a national competence and existing harmonisation at CEPT/ITU/COCOM level seems to be working. On the contrary, some **operators** did not exclude the power to grant pan-EU numbers for specific services (M2M).

Institutional set-up for spectrum management

With regard to spectrum governance, in order to serve the future wireless connectivity needs of the EU, a common EU approach to governing spectrum access was welcomed by respondents in order to enable technologies to be used seamlessly, but respect for spectrum as a national asset is required. Delays in availability of spectrum and fragmentation between conditions of use in different Member Stated were noted. Some respondents promoted a stronger role of the Commission. Some respondents disagreed and stressed the national character of spectrum policy.

As regards spectrum management, **the regulatory community** encompassing both BEREC and RSPG was of the view that the EU already benefits from substantial coordination and harmonisation processes, and no further EU-level coordination procedures are necessary. However, RSPG showed openness to a peer-review mechanism as regards spectrum assignment.

As regards the need for binding guidance on certain aspects of assignment procedures and conditions, there was a split between **regulators** and (mainly) **broadcasters** that preferred a national approach and telecoms operators that supported a certain level of binding guidance. Most respondents supported the Commission issuing Recommendations (Art.19 FD) on assignment conditions and/or procedural aspects, often qualifying it with basing any Recommendation on an RSPG/RSC process. The majority of respondents supported the idea of establishing a mechanism similar to that set by Article 4 of the Radio Spectrum Decision for certain key assignment parameters, at times pointing out the need to choose between this process and the one under Art.19 FD.

There is little demand for mandatory **pan-EU or regional assignments**. Most respondents questioned the need for EU-wide licences. A preponderance of answers viewed assignment as a national matter. Any wider geographical scope should involve the Member States with some respondents viewing it as a Council matter.

2.3 ANNEX 3 - Discarded options

The following annex presents the options discarded that were not assessed in terms of impacts and provides a rationale of the reason why they were not retained. The topics included below are further investigated in the IA support study, SMART 2015/0005.

2.3.1 Access regulation

- **Full deregulation of telecoms networks;** Full deregulation of telecoms networks similar to the system that applied following market liberalisation in New Zealand and now applies in the US. This option was considered in light of the fact that when it was first introduced, it was envisaged that the framework would enable a gradual roll-back of regulation with eventual reliance on competition law. However, a full deregulation was discarded due to the disruption it would bring to the industry (although option 4 describes a sunset-clause scenario).
- **Regulation of non-collusive oligopolies on the basis of a unilateral effects test similar to the one used under the European Merger control regulation.** This approach has been considered by some NRAs and new entrants in the market as an alternative to the finding of joint SMP, or 'joint dominance', as a basis for imposing regulatory remedies to redress market failures on oligopolistic markets. It should be kept in mind that oligopolistic market structures in network industries are likely, and in certain cases efficient, market outcomes. They are also the result of the market liberalisation over the past twenty years. It is thus far not clear on what economic grounds such an additional concept could be identified, and the merger-specific concept of unilateral effects is not adequate. BEREC has raised this issue, but has recognised that the underlying economic assessment approach is not yet clear. As criteria for such a new intervention threshold are difficult to establish and therefore the risk of overregulation and further regulatory fragmentation increases, it does not seem appropriate to increase the regulatory burden by deviating from the current significant market power test.

  Any competition concerns that may arise could be alleviated by facilitating alternative infrastructure roll-out through symmetric access for strictly non-replicable assets and by providing long enough transitional periods when regulation is removed. Furthermore, the **future revision of the current guidelines on market analysis and the assessment of significant market power (SMP guidelines**) is intended to bring more clarity on the criteria for the finding of joint dominance, based on the experience with the Article 7 case practice and relevant jurisprudence, which would assist NRAs to identify joint dominance. For this purpose, the present SMP Guidelines need to be reviewed in line with the developments of EU law, with the aim of further clarifying the tools for the correct application of this concept in the electronic communications sector.

  The experience in applying the principle of collective dominance by NRAs is limited. Since 2002, less than ten cases proposing a joint SMP finding have been notified to the Commission (out of more than 1,800 notifications in total), primarily in mobile origination markets (Market 15 of the 2003 Recommendation on Relevant Markets). The reasons for this could be manifold and will be explored when SMP guidelines will be reviewed.

- **Mandatory structural separation of former monopolies; this option would entail a mandatory breakdown of the incumbent telecom operator.** Under this option a structurally separate operator supplies dark fibre on a wholesale –only basis and cannot compete on services. The ownership of the two operators would then be distinct. The model would follow the

experiences being developed in New Zealand[346], Australia or Singapore. The current regulatory framework already contains a procedure for exceptional measures, potentially beyond voluntary separation. Thus, on the basis of the Access Directive, structural separation is a remedy which is already available to NRAs. The concrete legal basis, would be Art. 8(3) for forms of separation going beyond the functional separation foreseen in Art. 13a. Although this measure has been advocated by a number of competitive and fibre operators in the public consultation, a mandatory structural separation would impinge on the existing ownership rights and it was decided not to pursue this option as a central part of the EU-level policy prescriptions. The proportionality of such a measure would be put into question by the fact that voluntary separation is already promoted by the measures described in chapter 4.

- **Mandatory copper switch off.** This option was discussed because **c**ompetitive pressure from legacy copper networks can be considered as one of the barriers to NGA deployment. Some MS have trialled copper switch-off and operators have already announced the de-commissioning of local exchanges and copper network switch-off in order transfer their customers base to their NGA platform only. To date, however, no copper switch-off was mandated in any MS. Network owners strongly opposed it in the public consultation the mandatory nature of such a move which would cause disruption in network management. A mandatory copper switch-off was judged as not feasible for proportionality and legal reasons, but a clearer and more predicable mechanism can be provided to the incumbents who decide to switch off copper network, as envisaged under option 3 for access.

- **Explicitly reducing legacy copper access charges** with the aim of incentivising incumbents to deploy FTTH/B and switch-off the copper network. This strategy to accelerate the deployment of fibre by regulated incumbents was proposed by alternative operators during the course of the development of the 2013 Recommendation on cost methodologies and non-discrimination and not retained.[347] This option was rejected on the basis that it could make copper-based access relatively more attractive compared with fibre-based access (to both access-seekers and consumers), and therefore impede investment in and the migration to higher speed offers, which would ultimately provide better quality, social and economic benefits.

- **Remove the special competences for the Commission to recommend and ultimately mandate ECNS standards and to rely fully on the mechanisms established for general ICT standardisation.** The instruments provided by ECNS legislation have been used very carefully by the Commission since the last amendment of the Framework Directive in 2009. There have been no changes to the list of voluntary standards and there have been no standards mandated. The Commission has only issued a mandate to ETSI in the area of emergency call location. It had therefore to be considered to remove the special competences of the Commission related to ECNS standards. However a November 2011 study conducted for the EC [348] identified substantial benefits from greater standardisation of solutions within the EU. While this could in principle be achieved under the mechanisms established for general ICT standardisation[349], the possibility to encourage and ultimately mandate the use of ECNS standards could help fostering the process. The ongoing work in the area of emergency call location might also benefit from the possibility – once the work is finished and a standard has been established - to encourage its use. Furthermore, the second impact assessment interim report by WIK/Ecorys[350], explains that voluntary standardisation may not be sufficient in the area of wholesale products used for business access products, in particular when provided cross-border. It would therefore appear not to be

[346] In Australia and New Zealand structural separation has been imposed in combination with massive public investment.

[347] A discussion of this point can be found in section 6.1.2.2. of the IA accompanying that recommendation http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/swd_2013_0329_en.pdf

[348] Ecorys/TNO/TU Delft (2011) 'Steps towards a truly internal market for electronic communications' https://ec.europa.eu/digital-agenda/en/news/steps-towards-truly-internal-market

[349] Regulation 1025/2012 EC on European Standardisation, see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:316:0012:0033:EN:PDF

[350] Annexed to this document, p35, the importance of standardisation in this area is also highlighted on p40 and p97.

appropriate to remove the special Commission competences in the area of ECNS standards. Moreover, technical adaptations to the current provisions can be used to ensure that BEREC expertise can be relied upon when the Commission issues mandates to European standardisation organisations (ESOs) and to clarify the details of the procedure which would apply before the Commission makes the use of a specific ECNS standard mandatory.

2.3.2 Spectrum

Several options have been envisaged or have been suggested by a few respondents to the public consultation but will not be further considered at this stage .

- **Full harmonisation**, in the directive on all aspects of spectrum assignment, and especially of the method to determine and/or collect spectrum fees; fee determination and collection has always been considered as a national regalian competence. Therefore in regard to these elements coordination should be limited to the main criteria used by MS when determining and collecting fees and avoid revenue maximisation being used as the primary objective and criterion. Implementing measures would be more suitable to enhance coordination in the definition of these and other key spectrum assignments elements.
- **Creation of a single EU spectrum license** which would be granted by an EU body be it the Commission or an agency. Besides the fact that this would only be justified in case of truly pan-European services relying on spectrum (which to date have not emerged except for satellites), it would be very difficult to create from a legal point of view and the principle has proven to be politically unacceptable; even the implementation of a coordinated solution which required similar national licenses to be granted to commonly selected applicants by the MS themselves has been very difficult to put in place (see MSS case).
- **Grant delegated powers to the Commission** to further define harmonised conditions for assignment of spectrum: as these are national competence, MS would possibly be less keen to accept such a procedure and would possibly prefer the use of implementing decisions through comitology. Moreover delegated acts are not always suitable from a substance point of view.

2.3.3 Universal Service

Connectivity to a network at all locations: This option is to enhance the focus of universal service on individual end- users and to provide connectivity to a network in all locations (by contrast to the current provision at a fixed location, which may be restricted to user's primary location or residence). This option is discarded because the expected deployment cost to deliver connectivity at all locations were much higher than the cost to deliver connectivity at the end-user's primary location or residence. The universal service cost needs to be kept at what is necessary to achieve a minimum safety net, with other tools being prioritised to enlarge both fixed and mobile coverage.

- **Terminate the universal service regime:** Taking into account the current social, economic and technological developments, this option suggests terminating universal service completely. This option could be accompanied by the introduction of horizontal accessibility obligations on all providers to ensure equivalence of access and choice for disabled users. This option is discarded because universal service is still considered a valid concept by most stakeholders (i.e. MS, NRAs, consumer organisations and most of industry players) and there are identifiable affordability needs for the most vulnerable sections of the population even under competitive market conditions, which can be met at limited cost.
- **Provision of very high-capacity broadband networks in public areas and places of specific public interest as an addition to Options 3 and 4:** As an additional measure to Options 3-4, it has been suggested providing very high-capacity broadband networks in public areas and places of specific public interest such as schools, universities, libraries, education centres, digital community centres, research centres, health care centres and town halls. Such provision under USO would apply when private and other public investments do not deliver, and would be financed from public

funds due to its general social benefits. This option is discarded because there are other EU and national policies supporting NGA deployment in such specific places (for instance, ERDF, GÉANT) and because USO cannot be considered a suitable instrument to foster high capacity connectivity by comparison to private investment, PPP or other public policy instruments (e.g. public procurement for public-service needs).

- **Changing the national financing regime in addition to other financing options under options 3-4:** In addition to other approaches, this option suggests establishing a system administered at EU level which would permit contributions to be distributed across MS. This would allow to bridge digital divide between less developed and more developed broadband areas. The providers established in one MS only may be targeted more effectively. This option is discarded because it requires significant changes to the institutional setup (i.e. delegating powers to the existing entity or creation of a new entity for administration of the financial scheme at the EU level) that might be difficult to achieve. Also, the suggested processing of the financing requests will result in a heavy administrative burden.
- **Changing the financing regime in addition to other financing options under Options 3-4 by setting national user levies:** In addition to other approaches, this option suggests setting national user levies via direct surcharge on user invoice. This could also be another option for a social solidarity scheme within the context and rationale of universal service where broadband were to be included in universal service. While this approach should be relatively simple to manage, any approach that targets subscribers directly elevates the retail price and risks both undercharging and overcharging and impeding broader digital take-up.

2.3.4 Services and end-user protection options

2.3.4.1 *Services*

- **No sector-specific regulation for services in the future:** This option would consist in abolishing provisions related to services from the Regulatory Framework. As a consequence of this measure, there would not exist any sector-specific consumer protection that is not desirable given the highly technical nature of telecommunications services. General consumer protection rules would not suffice to protect consumers sufficiently in all respects.

2.3.4.2 *Numbering*

- **Adapting the EU framework on numbering to address the competition issue on the M2M market, and creating (E.164 and E.212) European numbering ranges to promote a single market for M2M:** This option would complement the option 3 under numbering. A European numbering solution could provide the additional numbering resources necessary for M2M in Europe, with M2M-adapted and common requirements, and a country-agnostic use within Europe adapted to cross-border operating M2M applications. However past experience with ETNS and the results of the public consultation did not reveal a preference for a European numbering range. Therefore this option is not pursued at this stage. However, building on the current provisions of the framework with regard to further harmonisation of specific numbers or numbering ranges a mechanism is foreseen which allows for introducing a common EU-level numbering space in the future in case extra-territorial use of national numbering resources is not sufficient to meet the increasing demand.

2.3.4.3 Must carry and findability

- **Extending the scope of must carry obligations to OTT services.** This option would extend the scope of operators on which must carry obligations could be imposed to OTT providers. In case broadcasters, and more generally any content provider would provide their content via OTT services, net neutrality provisions (in particular Art 3(1) and 3(3) of Regulation (EU) 2015/2120) ensure that broadcasters as end users of Internet access services can distribute

their content to their viewers without discrimination. It is therefore not necessary to extend the potential scope of must carry rules to OTT services.

- **Extending the scope of EPG obligations and introduce regulatory safeguards to improve findability.** This option would extend the scope of existing EPG access and presentational obligations by modifying the definition of an EPG, which could include services and facilities providing access to on-demand content and recommendation engines. It would be envisaged to define at EU level the scope of possible measures under national law. Online viewing will continue to grow and larger PSBs will have little difficulty in finding a prominent place in app stores as well as on equipment installed at consumer premises or hand-held equipment. Regional and local PSB will have more difficulty in this respect. Cooperation with larger PSBs to carry niche content in their apps (possibly imposed by national governments) is a possible solution. In addition, niche content providers can develop alternative routes to gain exposure via social media strategies. Extending EPG obligations would not impose a great additional burden on OTT platforms as many of the essential platforms (like app stores and streaming platforms like YouTube and Daily Motion) include content of public interest in their current navigation facilities anyway. MS have already the possibility under national legislation to introduce prominence obligations on online service providers.[351] So far, MS have not made use of this possibility and the public consultation on the ECNS review has not revealed any concrete concepts how such obligations could be conceived.

The considerations outlined above (platforms already provide navigation facilities + lack of action at national level) put into question whether such obligations would be necessary and could achieve their intended purpose. It would therefore appear to be premature to define at EU level the scope of possible measures under national law and the option has therefore been discarded at an early stage of the analysis.

2.3.5 Institutional governance

- Commission powers to regulate markets directly

This option would mean the transfer of powers from national level (NRAs) to EU level (Commission). This option was discarded at an early stage as, even though it would likely serve to increase consistency, it does not meet political feasibility, the subsidiarity requirements and the need to build some flexibility into the system to efficiently ensure that national circumstances can be adequately addressed and taken into account.

- Not having an EU agency at all: substituting the BEREC Office by secretarial support functions to the Board of regulators to be provided by the Commission

This option, which is currently used for other EU bodies --- COCOM, RSPG or ERPG – could help in avoiding the application of the detailed set of rules that applies to all EU agencies (financial, staff/implementing rules, procurement, reporting, etc.) to a small organisation such as the BEREC Office. However, it was discarded as these difficulties could also be overcome by the option of establishing an EU agency carrying out certain regulatory tasks (not only a support function) with the additional benefit of ensuring more autonomy.

Moreover, the political feasibility of this option is not guaranteed as the European Parliament in its DSM report has called the Commission to ensure that a more efficient institutional framework is in place by strengthening the role, capacity and decisions of BEREC in order to achieve consistent application of the regulatory framework. In particular, the need to improve the financial and human resources and further enhance the governance structure of BEREC was highlighted.

[351] See Commission Staff working document AVMSD impact assessment, p.52

- Merging BEREC with the European Network and Information Security Agency (ENISA)

In 2007 the Commission proposed the establishment of a new agency building on the telecoms advisory group ERG and taking over the functions carried out at the time by ENISA. The option of following a similar approach with the current proposal, in particular in view of the discussions of the Inter-Institutional Working Group on decentralised agencies' resources[352], was considered. There are, however, several reasons which would not make it a feasible option at this stage, in particular the fact the two bodies have become in the meantime well established organisations with increasingly growing mandates (see e.g. Regulation (EU) 2015/2120 and current proposal for BEREC tasks and the tasks assigned to ENISA, which has time definite mandate, in the Directive 2016/1148/EU on security of network and information systems) which are not overlapping. Moreover, the nature of the tasks that BEREC and ENISA would carry out are rather different in terms of the intensity of human and financial resources needed and the type of relationship needed with stakeholders (ENISA counts with a Permanent Stakeholders Group). Therefore, only minimum synergies (in the area of administrative and budgetary matters, not specifically related to ENISA) could be expected to be derived from a merger scenario.

Although the two agencies fall under the remit of DG CONECT and could be considered by some that the tasks of BEREC and ENISA are related, contents-wise the two domains of cyber-security and telecoms are different. Telecoms is an important infrastructure but ENISA deals with any network infrastructure (not only the public ones that fall within BEREC remit) and any hardware and software (that are outside BEREC remit). In particular, ENISA advises on cybersecurity in energy networks, aviation networks, financial networks, health networks, etc.

Additionally, there are significant disadvantages to that option, as the representatives at Management Board level are different: telecoms NRAs for BEREC and predominantly representatives from ministries (telecoms, defence ministry, prime minister's office) or national agencies/offices focused on cyber security or information security for ENISA[353]. Also the consideration of the need to align the BEREC/BEREC Office structure with the 2012 Common Approach makes it difficult at this stage to consider, in addition to the significant governance changes needed, a possible merger with other existing agencies.

The possible disconnection of the proposal for a BEREC Regulation from the proposal for a European Communications Code would not ensure the achievement of the goals foreseen in the telecoms review. The institutional proposals derived from the analysis carried out in the relevant substance areas and it is pretty much interlinked (the current BEREC structure is not suitable for the new tasks in the enlarged mandate – not sufficient resources, no voting rights for Commission, limited role for the Administrative Manager, etc.). It is a package which not only concerns BEREC but other institutional elements (NRAs, other competent authorities, RSPG, COCOM, Commission powers, etc.), thus it could not be addressed in isolation or be delayed.

2.4 ANNEX 4 - Who is affected by the preferred options and specific impacts on stakeholders

This annex describes the practical implications of the preferred options identified in the Impact Assessment for the Review of the Framework for electronic communications for representative groups likely to be directly or indirectly affected by the legislation including electronic communication network and service providers, Over-the-Top players, SMEs and consumers, Ministries, National Regulatory Authorities and Spectrum Management Authorities.

For each stakeholder group, we discuss the relevant impacts of the preferred options, the key obligations that will need to be fulfilled and when these might need to be fulfilled in order to comply

[352] Analytical fiche n°3: Efficiency gains and synergies.

[353] Only for two Member States a representative of telecoms NRA is the representative at ENISA Management Board.

with obligations under the revised framework. Wherever possible, we also indicate potential costs that may be incurred in meeting those obligations.

The opportunities and challenges presented by the proposed revisions to the electronic communications framework are described in the following table.

It is envisaged that consumers and SMEs will be the greatest beneficiaries of reforms to the electronic communications framework. These stakeholders will benefit from greater availability and choice in very high speed fixed and mobile connectivity, as well as an increased focus on the affordability of broadband and measures enabling them to defray the costs for newly installed fibre connections. Consumes and SMEs will also benefit from an extension in privacy and security protections for OTT services and improved switching for broadband bundles. Multi-national businesses should also benefit from more consistent standards for high quality connectivity cross-border.

Although they will need to meet tighter privacy and security standards, new (including European) players in the OTT and IoT space should also benefit from improved broadband connectivity as well as provisions, such as maximum harmonisation of consumer protection rules and cross-border number utilisation which should foster the scaling up of service provision across the EU.

The package includes several measures which should benefit electronic communication network providers which intend to invest in high speed networks. Such investors should benefit from increased attention to duct access and symmetric access to non-replicable assets such as in-building wiring – which are core elements facilitating the deployment of high speed networks. They should also benefit from the potential to defray connection costs over a longer period. Finally, the revisions to the Directive will explicitly recognise the important role that wholesale only models and co-investment play in supporting sustainable competition in the market. Such models will be subject to lighter touch regulatory controls. Incumbent operators which have been subject to tight regulatory controls on wholesale access, may also receive regulatory relief in areas where there is effective competition or where they make genuine co-investment offers.

Electronic communication network providers of all kinds should benefit from the increased certainty and reduced administrative costs associated with longer periods between market reviews (of 5 rather than 3 years except where there are material differences in the market situation). However, in countries which do not yet pursue such strategies, there may be additional effort required to submit mapping data to the NRA (to enable the geographic targeting of regulation) – and for operators with SMP to make duct access operational and adapt product specifications for business access to meet standardised requirements (following a suitable period).

The proposed revisions to the framework entail measures to increase reliance on general authorisations for spectrum, speed up spectrum assignment and foster consistency in assignment and core licence conditions. These provisions are broadly beneficial to electronic communication network providers and should reduce costs, improve spectrum availability and facilitate multi-national operations and service provision.

Operators offering broadband Internet access will need to meet more stringent requirements relating to transparency and quality of service. However, they will benefit from a streamlining of the rules applying to other electronic communication services. All operators should also benefit from a planned removal of redundant universal service obligations and switch away from sectorial levies which should reduce the regulatory burden on designated universal service providers and more widely reduce administrative cost.

Member States should benefit from the greater broadband diffusion, consumer trust and associated economic benefits associated with the preferred policy options. It is also possible, but not assured, that streamlining of regulatory approaches (such as the consolidation of mapping responsibilities) could

save costs at a national level. However, where not already the case, Ministries will need to ensure adequate resourcing and empowerment of NRAs, and the introduction of a minimum remit for independent National Regulatory Authorities may require a transfer of certain responsibilities in a few member states.

NRAs will benefit from the changes in a number of ways. Their independence and empowerment will be reinforced, and certain NRAs would benefit from an expanded remit concerning consumer protection and/or market-shaping aspects of spectrum. Burdens from market analyses should be reduced by extending the period between reviews. NRAs will also play a more formal and decisive role in an enhanced BEREC. However, NRAs will also need to conduct more geographically targeted reviews, and will need to ensure they have adequate expertise to take on a more extensive remit in relation to infrastructure, investment and quality of service mapping, as well as ensuring that regulation is adapted to support infrastructure competition (if not already the case).

Table 1 - Summary stakeholder impacts

	Opportunities	Challenges
Incumbent fixed and mobile telecommunication operators	☑ More geographically targeted access regulation ☑ Lighter regulation in presence of co-investment or wholesale only business models ☑ Savings from less frequent market reviews ☑ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up ☑ Faster access to spectrum, greater regulatory certainty concerning spectrum assignments and more consistent usage conditions ☑ Lower spectrum access cost and regulatory burdens in bands subject to general authorisation ☑ Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings ☑ Elimination of redundant USO obligations and abolition of sectoral funding leading to reduced administrative cost and financial burden	☒ Requirement to supply infrastructure/investment mapping data for market reviews and operationalise duct access (where not already applied) ☒ Greater (commercial) pressure to invest in infrastructure due to additional infrastructure competition ☒ Need to standardise business wholesale products (given due notice) ☒ Further obligations concerning Internet access (to aid transparency QoS and switching)
Alternative fixed and mobile telecommunication operators	☑ Operational duct access, co-investment and wholesale only incentives support more sustainable competition ☑ Standardised business wholesale products foster cross-border entry and competition ☑ Savings from less frequent market reviews ☑ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up ☑ Faster access to spectrum, greater regulatory certainty concerning spectrum assignment and more consistent usage conditions ☑ Lower spectrum access cost and regulatory burdens in bands subject to general authorisation ☑ Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings ☑ Abolition of sectoral USO funding leading to reduced financial burden	☒ Less regulation of short-term fixed access rental ☒ Greater pressure to invest or co-invest in own NGA infrastructure ☒ Requirement to supply infrastructure/investment mapping data (where not already the case) ☒ Further obligations concerning Internet access (to aid transparency QoS and switching)
Alternative (cable and fibre) infrastructure	☑ Greater focus on infrastructure competition and regulatory targeting supports commercial flexibility	☒ Requirement to supply infrastructure/investment mapping data (where not already the case)

investors	☑ Operational duct access may support network expansion ☑ Measures to extend contract duration for connections in challenge areas, as well as regulatory support for wholesale only models, are likely to benefit municipal and regional fibre investors ☑ Savings from less frequent market reviews ☑ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up ☑ Fewer consumer protection obligations regarding electronic communication services resulting in administrative savings ☑ Abolition of sectorial USO funding leading to reduced financial burden	☒ Greater use of symmetric obligations for non-replicable assets (where not already the case) ☒ Further obligations concerning Internet access (to aid transparency QoS and switching)
OTT and IoT providers	☑ Greater availability and quality of fixed and mobile bandwidth supports OTT and IoT service delivery and innovation ☑ Reduced barriers to entry and expansion for OTT and IoT firms due to maximum consumer protection harmonisation, and provisions to foster cross-border use of numbers ☑ Increased efficiency in engagement with bodies handling e-comms regulation due to converged set-up	☒ Switching and portability procedures currently existing for EC(N)S need to implemented by OTTs that interconnect with E.164 ☒ Privacy and security obligations need to be implemented by all OTTs ☒ OTT that interconnect with E.164 potentially subject to levies for administration of regulatory authority
SMEs	☑ Greater availability of and choice in very high bandwidth connectivity with continued choice and value in basic broadband ☑ Improved affordability for fibre connections through defraying connection charge ☑ Potential to connect business sites cross-border boosted through standardised wholesale offers ☑ Reduced barriers to entry and expansion for smaller OTT and IoT firms due to maximum consumer protection harmonisation, and provisions to foster cross-border use of numbers ☑ Lower cost of access to spectrum (through greater use of general authorisations and best practice in assignment conditions) leading to greater access for smaller electronic communication companies ☑ Greater predictability and trust amongst SMEs as users of ECS and OTT, improved transparency concerning IAS	☒ Smaller electronic communication providers may be less well placed to invest or co-invest in infrastructure ☒ Potential new obligations and NRA contributions for small OTT in relation to E.164 interconnection, privacy and security

	☑ Reduced USO contributions for small suppliers (where previously captured) ☑ Increased ease of engagement, reduced administrative burdens due to converged governance	
Consumers	☑ Greater access to and choice in high quality broadband connectivity ☑ Improved affordability for fibre connections through defraying connection charge ☑ Greater availability and innovation in services relying on 5G and future generation wireless technologies ☑ Accelerated fast mobile broadband ☑ Greater predictability and trust amongst users of ECS and OTT due to extended privacy and security measures ☑ Increased ease of switching in relation to bundled offers ☑ Greater end-to-end connectivity and access to emergency services when using OTT interconnecting with E164 ☑ Improved transparency concerning IAS ☑ Potentially improved access to affordable broadband	☒ Potentially less detailed obligations on some ECS, but practical implications limited since consumer protection would be covered by horizontal rules or addressed through competitive markets
Member States	☑ Streamlining of regulatory approaches and governance at national and EU level should drive synergies and may enable cost savings ☑ The proposed changes should support the diffusion of fixed and mobile connectivity, thereby supporting economic development and social welfare	☒ Ministries will need to ensure adequate resourcing and empowerment of NRAs (where not already the case), and governance changes may require a transfer of certain responsibilities in some member states
NRAs	☑ NRAs will see a reinforcement of independence and empowerment as well as a harmonisation of their remit to provide a more converged regulatory approach (for example in relation to consumer protection and broadband mapping (including for state aid and broadband cost reduction) ☑ NRAs will play a more formal and decisive role in EU policy-making through the enhanced BEREC ☑ NRAs will benefit from a longer period between market reviews reducing administrative costs and enabling longer-term decision making	☒ NRAs not already pursuing such strategies will need to ensure competence in mapping, ensure the effective operationalization of measures to ensure infrastructure competition in broadband, support the deployment of broadband in challenge areas and provide standardised solutions for business access

2.4.1 Implications for telecommunications network operators and service providers

2.4.1.1 Access Provisions

Under the preferred option for access (Option 3 NGA+), telecommunication network operators and service providers will be affected by adaptations to the market analysis process. This may affect telecommunications operators differently depending on whether they are incumbent operators, which are subject to SMP obligations, alternative operators which may rely to a degree on regulated wholesale access, or other competitive operators making use of their own network infrastructure.

2.4.1.1.1 Access provisions and operators subject to SMP obligations

Economic impacts

Incumbent operators which are today typically subject to SMP regulatory obligations are expected to benefit from better motivated, more targeted and, in some instances, less onerous regulatory obligations resulting from a requirement for NRAs to place greater focus on retail market failure prior to intervention and from more granular geographic market analyses which may result in deregulation in some areas. Incumbents may also benefit from greater flexibility (for example in price setting) and reduced costs resulting from potential reduction on regulatory access obligations in cases where they propose adequate co-investment or commercial offers, or where they pursue voluntary structural separation.

The preferred option is also expected to increase commercial incentives on incumbent operators to invest in upgrading networks in order both to protect their market share and to compensate for the loss of wholesale revenues in a more competitive environment, as well as to benefit from the proposed lighter regulatory treatment for new upgraded networks. As a result, it is expected that following transposition and implementation of the legal provisions, CAPEX intensity amongst incumbent operators in countries which have not already undertaken significant network upgrades to VHC connectivity may increase.

Administrative impacts

Changes to the market review process are likely to result in certain administrative requirements, as well as change in the nature of access obligations resulting from a shift in focus towards infrastructure based competition (in countries where this is not already the case). Specifically, in the early stage, immediately following the adoption of a revised framework and during an estimated period thereafter of around 3-5 years, incumbents in countries which are not already subject to such obligations may have the additional requirements to submit infrastructure coverage data and plans concerning infrastructure deployment to support mapping by the NRA.

It should be noted that such obligations are only incremental to the data collection exercises that already exist or are planned in many member states, as described in the study (SMART 2012/0022) on the mapping of broadband and infrastructures,[354] and (when combined with planned guidance in this area) should ideally serve to streamline and bring some coherence between data collection for market analysis purposes and the transparency obligations that exist in what may currently be viewed as separate exercises. For example, the Cost Reduction Directive already includes obligations to provide information concerning civil works to be performed in the next 6 months (Article 6 Directive 2014/61/EU) – relevant for investment mapping, while reporting obligations are already undertaken to undertake investment mapping in the context of State Aid schemes for broadband.

[354] See Table 5-1 https://ec.europa.eu/digital-single-market/en/news/mapping-broadband-and-infrastructure-study-smart-20120022

Measures to operationalise duct access and symmetric obligations aimed at sharing non-replicable assets

The greater focus on infrastructure competition in the framework is likely to result (for those Member States not already pursuing such strategies) in a shift towards passive access and greater attention to symmetric obligations concerning non-replicable assets. This may require incumbents to provide information on availability of duct access, and potentially automated systems to support ordering, provisioning and repair, in cases where duct access is feasible and would be proportionate, but is not already fully operational. For incumbents in countries where such obligations are not yet fully effective the operationalization of duct access could result in one-off costs as well as ongoing costs associated with maintaining an online database for duct access availability and meeting access requests (if not already incurred)..[355]

Moreover, administrative costs from the operationalization of duct and symmetric access may be offset if these obligations result in infrastructure competition, which enables the relaxation or removal of downstream asymmetric (SMP) access obligations.

Standardised wholesale offers for business

Incumbents may also be affected by requirements to move towards standardised wholesale offers for business access, in areas where such access is required.[356] The study SMART 2014/0023[357] assessed the impact of such a requirement, and concluded that while (some not readily quantifiable) costs may be incurred in adapting product offers, systems and processes, these could be mitigated by a phased introduction of the obligation, permitting these changes to be introduced during a refresh of systems. NRAs could determine the timing of such a required change subject to national circumstances, but for the benefits to be realised introduction should be subject to a deadline, which could be determined in Implementing Guidelines associated with the revised Framework.

Extension of market review period

Another planned change to the market review process is a reduction in the frequency of market reviews, which would be required every 5 years rather than every 3, with the potential for an interim review if needed in light of changed market circumstances. This change should in principle reduce the administrative burden involved in supplying market and operational data to the NRA and preparing information for cost modelling purposes. However, these cost savings are unlikely to be significant in the context of sector revenues, and it is possible that this change could negatively impact incumbent operators if it results in obligations being in place for longer than under the current cycle (although the reverse is also possible, in cases where regulatory obligations are withheld, for example on newly installed infrastructure in the presence of reasonable co-investment offers).

2.4.1.1.2 Access provisions and Alternative operators

It is anticipated that the increased focus on measures to boost infrastructure competition and foster investment is likely to impact the business models of alternative operators, supporting a

[355] However, it should be noted that duct access and symmetric obligations are already operational in several member states including Portugal, Spain and France, while there are ongoing initiatives to operationalise duct access in countries such as the UK, which should be complete before the framework review comes into effect. See for instance Feb 2016 Ofcom Digital Communications Review Statement http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/dcr-feb-16/

[356] For example, where there is no prospect of effective infrastructure-based competition

[357] Investigation into access and interoperability standards for the promotion of the internal market for electronic communications https://ec.europa.eu/digital-single-market/en/news/investigation-access-and-interoperability-standards-promotion-internal-market-electronic

move to more self-sustaining models based on investment, co-investment and/or longer term remedies or commercial solutions.

As this model is likely to involving upfront commitments, this may entail greater initial capital expenditures for these alternative operators, which would be offset in subsequent years by lower operational expenditures as business models shift from rental towards investment, co-investment or risk sharing arrangements. Engagement in infrastructure build or long-term agreements is likely to provide greater predictability for alternative operators than the current short-term arrangements, although it will also entail greater upfront risks.

In turn, as and when alternative operators invest in their own VHC infrastructure they may be subject to obligations to provide data concerning existing and planned fibre deployment as part of the expanded mapping process. They may also be subject to symmetric obligations for the sharing of in-building wiring or wiring up the first distribution point, in countries which do not already pursue such approaches, although it should be noted that such obligations are already operational under the existing framework in some countries[358]..

Precise cost impacts on alternative operators willing to invest in own infrastructure resulting from changes to the framework are difficult to estimate. However, the expectation is that the greater focus on infrastructure-based competition in NGA and VHC may result in different (more capex-intensive) business models for entrants, rather than increased costs overall.

As regards the standardisation of wholesale offers for business end users, changes to incumbent systems may also imply a need for adjustments to access-seekers' ordering and repair processes and systems, which could be made after a suitable period determined by the NRA as discussed above. On the other hand, standardised offers should lower barriers to expansion for operators which do not have nation-wide coverage in specific countries.

Finally, alternative operators which currently make use of wholesale access would, like incumbent operators, also benefit from reduced administrative costs associated with longer market review periods, although these administrative savings are not expected to be very significant as compared to other categories of costs and savings considered in this chapter.

2.4.1.1.3 Access provisions and other competitive operators

Cable operators and regional fibre investors are unlikely to be significantly impacted by the proposed changes to the market analysis process. Nonetheless, these operators are expected to benefit from an enhanced focus in the framework on infrastructure competition and more geographically targeted regulation. Specifically, they may be able to exploit operational duct access and symmetric measures to expand their existing footprint, and they may also benefit indirectly from the possible relaxation of SMP obligations in certain areas where infrastructure competition emerges, if this results in greater potential for pricing flexibility and tailoring of products and bundles to specific customer groups for the market as a whole.

Regional fibre investors including municipal investors may also benefit from specific provisions within the NGA+ option which aim to identify underserved areas that may offer deployment opportunities for this operator group, as well as benefiting from measures which are designed to hold operators to account as regards their investment declarations as made in the context of the geographical surveys conducted by the NRAs..

[358] Symmetric obligations on in-building wiring and terminating segments on all operators are possible under the current Framework and are already operational and in place in countries such as Spain, France and Portugal. Furthermore, under the cost reduction directive, any owner or user of in-building physical infrastructure should meet reasonable requests for access in view of deploying high-speed electronic communications networks.

On the other hand, VHC networks built by these operators may become subject to symmetric obligations as regards sharing of in-building wiring or the non-replicable terminating segment, which will entail additional cost. However, it should be noted that in several countries, these rules are already in place, and it is envisaged under proposed revisions to the framework that operators could be exempted from such obligations if they operate wholesale only business models.

Like other operators they would benefit from reduced administrative costs resulting from extended market review periods, but may need to supply additional information in order to facilitate infrastructure mapping by the NRA, in those countries which have not already pursued such procedures.

2.4.1.2 Spectrum provisions

The preferred spectrum option emphasises the need to prepare Europe for the future deployment of 5G and to speed up access to spectrum resources. The preferred spectrum option (Option 3: binding criteria) introduces (amongst other provisions) common criteria for most relevant elements of spectrum assignments such as for example timing of awards, license duration and coverage, a greater focus on general authorisations versus individual licenses and provisions to facilitate the deployment of small cells and Wi-Fi. These provisions affect network and services providers in terms of speed and access to spectrum resources across the Single Market and the cost of such access. Under the preferred option these common criteria would be binding on Member States.

2.4.1.2.1 Common assignment criteria and licence conditions

Mobile Network Operators (MNOs) are some of the main users of spectrum and they will therefore be affected by common assignment criteria and obligations attached to rights of use (e.g. license duration, spectrum caps, timing of assignment, methods for determining coverage obligations, etc.). The nature of the impact will depend on the specific decisions taken at EU level which are not specified in the option and are subject to negotiation.

However, it is already clear that under the preferred option, compared with the baseline, all mobile network operators will be subject to more consistent conditions to access and use spectrum resources across the Single Market. This will likely generate greater regulatory certainty and foster the development of a level playing field across the EU. For instance, if the regulatory framework specifies that e.g. spectrum auctions should reflect a due balance of overall spectrum objectives, this should bring greater consistency in the conditions that will govern spectrum assignment across the Union.

2.4.1.2.2 Greater focus on general authorisations over individual licenses

A greater focus on general authorisations is likely to significantly reduce access costs to spectrum resources thus making spectrum available to smaller companies which cannot afford purchasing exclusive access under individual licenses e.g. in an auction.

Operators who are already present in multiple countries would benefit because they could have access to the same frequencies all over Europe, with similar conditions. Such a system would rapidly speed time to market, as there would be no decisions needed (either at national or EU level) on which operator obtains which spectrum. Furthermore, consistency of usage conditions could be improved (e.g. if a harmonised EU band plan was agreed to) and costs would be reduced compared with traditional assignments.

2.4.1.3 Universal service provisions

The preferred option with regard to universal service is Option 3 (incremental adaptation to trends with the focus on broadband affordability). This option foresees exclusion of payphones and accessory services from the universal service scope at the EU level. The universal service scope shall cover PATS and affordable broadband at least at a fixed location meaning that Member States may introduce affordability measures also by mobile (connection at least at a fixed location) at the national level. At the EU level, broadband can be defined by referring to certain services to be accessible via the connection (web-browsing, eGovernment, VoIP etc.). This option would ensure only the *affordability* of broadband (i.e. affordable retail pricing measures), that shall be ensured at least at a fixed location, thus allowing Member States the possibility to include affordability measures by mobile, while its availability shall be further promoted by other policy tools (incentives to private investment, state aid, etc.). Availability of broadband can be ensured only at a fixed location. Minimum harmonisation would be applied at EU level, such that Member States could enhance the basic services baskets. Member States may also decide, in exceptional circumstances, to support availability of broadband additionally to its affordability. The preferred financing option is through general budget as a more equitable, fair and least distortive way of funding of the provision of universal service.

ECS providers are likely to benefit from the revision of universal service according to Option 3 as it will likely reduce the uncertainty and administrative and financial burden on them. For instance, they will not be obliged to provide pay phones that are considered redundant and largely function at loss. Financing through public funds is easier to implement so that it will lessen administrative costs and will contribute to a fairer distribution of costs and benefits of the universal service provision among all market participants with less distortion to competition.

2.4.1.4 Provisions relating to electronic communications services

The preferred option regarding services (option 4) reduces, for services other than the IAS, the burden relative to a number of USD obligations for ECS providers regarding contractual rights, transparency, quality of services (QoS) monitoring, and out-of-court dispute resolutions. Additional costs might be attached to the role that access network providers might have in the standards that enable the routing of emergency calls from OTTs to numbers in the PSTN network. Option 4 also introduces a number of new obligations for ECN providers applying to IAS regarding transparency, QoS, and switching to other providers (including facilitated switching process). The preferred option regarding numbering saves telecom operators from inefficiencies in relation to extra-territorial use of numbers. The option on must carry/EPG does not impact on telecommunications network and service providers.

2.4.1.4.1 Reductions in obligations regarding ECS

In relation to overlapping consumer protection provisions, telecom operators will be relieved from unnecessary administrative and compliance costs regarding contractual rights, transparency, quality of services (QoS) monitoring, and out-of-court dispute resolutions. It is however not possible to estimate the overall costs for telecom operators of complying to potentially redundant rules.

In a survey among telecom operators organised in the context of this impact assessment, telecom operators indicate having to incur higher compliance costs resulting from existence of the rules that overlap with horizontal rules and/or rules having become redundant due to market forces. The overlapping information requirements create additional burdens for businesses that have to check all sets of requirements for any small or national differences and engage with two different sets of regulators in relation to enforcement. Activities that drive administrative burden and are related to complying with sector specific obligations regarding contractual terms and transparency are (amongst others):

- Activities related to regulatory/legal discussions with authorities on the terms of obligations;
- Activities related to assuring proper implementation of elaborate guidelines for marketing and sales (including specific provisions in contracts, in scripts for sales, in supporting IT, etc.);
- Other activities involved with assuring internal compliance with regulation;
- The need to inform customers about the corresponding regulatory provisions have the effect of making sales activities more lengthy and complex;
- Similarly, discussions with suppliers and partners (device suppliers, resellers) are made complex and imbalanced by the constraints on contracts terms;
- Activities involved with in potential litigations;
- Public Affairs involved in potential public controversies relating to the compliance with the rule.

In addition, specific resources may be dedicated to answering questions and to regularly updating online information in order to comply with transparency obligations. Telecom operators found it difficult to provide robust calculations of all compliance costs.

2.4.1.4.2 Introduction of new obligations regarding IAS

The reduction in enforcement and compliance costs regarding ECS will partially be undone by the additional obligations applying to IAS regarding transparency (related to consumption monitoring and comparison tools), QoS (reporting and, when criteria are not met, fines/compensation/termination of contracts), and switching (facilitated switching process).

2.4.1.4.3 Changes with regards to extra-territorial use of numbers.

Compared to the base scenario a number of management complexities and implementation costs may be prevented, such as: "*Network testing, functional testing, billing verification, table updates (in switches, STPs, HLRs, billing systems, etc.) [which] would need to be performed by the operator and each of its roaming partners."*[359] More streamlined extraterritorial usage would allow operators to gain efficiency by benefiting from economies of scale granted by the Single Market. Thus operators can provide cross border services without the need to change numbers., and can enter new markets without requesting a block of numbers in that country. At the same time, current bilateral arrangements for extraterritorial use (resulting in an equally burdensome costs for operators and roaming partners) may be replaced by a more harmonised governance structure that is much less burdensome on operators. This may require a possible extension of the activities (and costs) of BEREC as well as costs related to coordination with CEPT. However, these costs are likely much lower than the costs of the currently required multiple bilateral agreements between NRAs and telecom providers.

2.4.1.5 Governance provisions

The preferred option for Governance (option 3) involves the alignment of the remit of Regulatory Authorities at national level, as well as the extension of BEREC's remit to encompass responsibility for market-shaping aspects of spectrum assignment and to take certain normative powers in relation to developing implementing guidelines (which would be adopted by the Commission) as well as playing a deciding role in enabling a Commission 'decision' in relation to case by case assessment of remedies (under an expanded article 7a process). BEREC would also perform the peer review of national spectrum assignment procedures.

This consolidation of responsibilities for market-shaping measures in fixed and mobile networks as well as service regulation is likely to have a positive impact especially for those electronic

[359] http://www.attglobalpolicy.com/wp-content/uploads/2014/06/ATT-Comments_BEREC-M2M-Project-Team-_19-June-2014.pdf

communication network and service providers, which are converged and/or operate or aspire to operate cross-border. Converged regulatory responsibilities should lead to more coherent decisions, while greater consistency at EU level may enable cross-border suppliers to achieve cost savings from reduced regulatory variation.

Notwithstanding these potential benefits to electronic communication operators however, increased consistency which reduces barriers to access or service provision between member states, may pose competition challenges for operators which currently have a strong position in national markets.[360]

2.4.1.6 Overview table

The following table summarises the changes obligations per subject area and associated practical implications and costs.

[360] For example, in the context of interviews for SMART 2015/0002 and SMART 2014/0023, multi-national business end-users claimed that incumbent operators aimed to protect national markets. Additional cross-border competition from OTT players might also pose a challenge to the service revenues of traditional electronic communication providers.

Table 2 - Practical implications of preferred options for telecommunication network and service providers

	Changed obligations	**Practical implications**	**Costs**
Access	- Longer market review periods - Requirement to demonstrate retail failure - Infrastructure mapping - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for non-imposition of access obligations on new high capacity networks deployed on the basis of an open co-investment offer - Standardised wholesale remedies for business end users	- Reduced admin burden for market reviews due to longer periods, focus on commercial rather than regulatory solutions, but increased burden in some countries for mapping, duct access, greater focus on symmetric rules for non-replicable assets - Requirement to standardise specifications (and potentially certain systems) for wholesale products designed for business	- Potential savings from less frequent market reviews ~€28m - Other costs e.g. mapping difficult to quantify and vary depending on whether rules are already in place - Standardised wholesale products may involve set-up costs if/where they require changes to systems and processes, but these costs could be mitigated by phased introduction. Operational costs for multi-national providers should be reduced
Spectrum	- Harmonised assignment criteria and licence conditions (e.g. license duration) in all markets - Greater use of general authorisations rather than individual licenses	- More consistency across the Single market - Greater regulatory certainty - Definition of coverage that is better suited to a wireless environment (e.g. not based on households but based on share of time the service is available) - Faster access to spectrum - More efficient use of spectrum	- Lower cost of access to spectrum leading to greater access for smaller companies - Reduction in administrative costs associated with assignment procedures
Services and numbering	1. Less obligations regarding ECS: • Transparency • Contractual rights • QoS • Dispute resolution 2. More obligations regarding IAS	A number of activities/resources can be downsized as a result of 1), such as: Regulatory affairs, Legal advice, Customer Care, IT-Resources, Product development, Product lifecycle management, Terms and conditions	1) and 2) lead to a net relief of administrative burden. No information on the monetary implications of 3).

	• Transparency • QoS • Switching 3. Different arrangements for extra-territorial use of numbers	management, Billing. A number of activities resources will be re-introduced as a consequence of 2) Compared to the base scenario inefficient bilateral agreements on extra-territorial use of numbers are replaced by a more efficient system. A number of management complexities and implementation costs relate to roaming may be prevented.	
USO	Affordability measures for broadband at least at a fixed location Abolition of sectorial funding, instead financing through public funding	Reduced administrative burden due to clearer and easier to implement funding mechanism Reduced financial burden due to exclusion of redundant services at the EU level and introduction of public funding	Reduced administrative costs Potential cost savings due to exclusion of pay phones and accessory services for EU-28 – (pay phones alone – 1 bn euro annually) Cost of affordable broadband at a fixed location – from 147 mln euro to 436 mln euro per annum for EU-28
Governance	- Merged institutional structure covering access, services and aspects of spectrum at national and EU level - BEREC to take prime responsibility for the drafting of implementing guidelines	- Greater policy alignment - Increased institutional alignment on fixed and mobile regulation and consumer protection	- Coherence in regulatory responsibilities should benefit converged players while greater EU consistency should reduce administrative costs, especially for cross-border providers, but may increase cross-border entry and service competition, challenging the service revenues of traditional players

2.4.2 OTT providers and non-telco

2.4.2.1 Access and spectrum

Changes to access and spectrum rules do not entail any changes to obligations for OTT providers. However, as for other sectors of the economy, but likely to an even greater degree, OTT providers will benefit indirectly if the preferred options lead to greater deployment of fixed and wireless network and technology and greater take-up among consumers across the Single Market.

Similarly, greater coordination of spectrum assignments under the preferred option does not directly affect users in industries that might develop 5G applications and services. However, if this option leads to successful and fast deployment of 5G in Europe it will constitute a significant growth opportunity in some sectors (e.g. automotive, transport, health, utilities, and others) and for consumers who benefit from the resulting innovations by way of greater safety, energy efficiency, and environmental sustainability, etc.). In addition, a greater focus on general authorisations could put spectrum resources within the reach of operators who are not at present able to purchase exclusive access.

In terms of other current spectrum users such as broadcasters, the preferred option does not have any direct impact since it focuses on assignment criteria and usage conditions for the provision of electronic communication services other than broadcasting rather than on allocations of spectrum bands. Of course, future deployment of 5G will affect all current spectrum users - both in terms of spectrum demand and supply, as well as in terms of optimal allocation of spectrum to different uses. These considerations go beyond the assignment criteria and usage conditions in the preferred option.

2.4.2.2 Universal service

The adoption of Option 3 for universal service will reduce the number of unconnected households and improve access to a number of enhanced communications services. Due to these developments, OTT providers are likely to benefit from the inclusion of affordable broadband in the universal service scope as they can make better use of the increased connectivity and reach a larger pool of users.

2.4.2.3 Electronic communication services

The preferred option regarding services (option 4) introduces additional administrative burden for OTT providers that use numbering resources as they will be subject to additional sector regulation. All communications services providers (regardless of the technology used, this includes OTTs) will experience an increased administrative burden in relation to complying with rules on security and privacy. The preferred option regarding numbering does not impose additional administrative burden on OTTs/IoT. OTTs may, however, have easier access to numbering ranges. The option on must carry/EPG does not impact on OTTs.

The ERG 2007 guidelines indicate that NRAs may subject OTT voice services that interconnect with the number regime to certain obligations. However, these guidelines are not binding and SMART 2013/0019 concludes that many NRAs do not follow these guidelines in practice. Under option 4, the obligations become binding and will have to be enforced by NRA’s for all OTT services that make use of the numbering regime (i.e. including OTT messaging services). As such, compared to the baseline, the administrative burden may increase for OTT providers that use numbering resources as they will now be subject to the same regulation. Most of the obligations and costs (except those related to accessing emergency services) would be associated only with paying customers, as direct

revenues[361] largely relate to customers paying for interconnecting with the numbering plan. There is no quantitative information available on the size of the impact.

OTT services that make use of numbers (like Skype, Viber, or Google Voice) will be subject to the same obligations with regards to interoperability, end-to-end connectivity, and number portability. Since interconnection with the numbering regime is already part of the respective service, the obligation to provide interoperability and end-to-end connectivity will have little to no impact on current business models of the respective OTTs. With regards to portability (and associated activities to facilitate the switching process) it is not clear to what extent OTTs are currently de facto subjected to obligations. Following the ERG 2007 guidelines they could be, but in practice they are often not[362]. Under option 4, it becomes explicitly clear that OTTs will have to be subjected to portability obligations and this may have an impact on compliance costs, but we don't have information on the size of this effect.

In addition, Article 12 and 13 of the Authorisation Directive would also apply to respective OTTs, which implies that NRAs may levy administrative charges. While following the ERG 2007 guidelines, NRAs could already impose such levies on OTTs that interconnect with the numbering regime, in practice this is not the case. The financial burden differs per Member State, but the size is relatively small. For example, in Italy the charges under Article 12 may add up to a maximum of 0.2% of turnover[363]. For a mobile operator with an annual ARPU of 250 to 400 EUR, this boils down to an average annual burden of €0.65 per paying customer.

Finally, OTTs would also be obliged to provide access to PSAPs, as far as this is technically feasible. In some Member States (such as the Denmark, Finland and UK) such functionality is already enabled[364] in other Member States this is currently not the case. There is no information available on the size of the costs.

All OTTs (regardless of the technology used) will experience an increased administrative burden in relation to complying with rules on security and privacy and this may imply that some of the current OTT business models may need to evolve. It cannot be expected from past experience that the costs would be unreasonable compared to the benefits.

2.4.2.4 Governance

The preferred Governance option (option 3) envisages that the responsibilities of all NRAs would be aligned with that of BEREC, and would therefore cover inter alia issues relating to sector specific consumer protection. Alignment of governance mechanisms as well as maximum harmonisation and greater co-ordination at EU level is likely to benefit OTT players which frequently operate in a multi-national or even global environment.

2.4.2.5 Overview table

The following table provides an overview of the practical implications of the preferred options on OTT players and other non-telco users of electronic communication networks.

[361] not accounting for the indirect revenues as a result of e.g. integration in the wider MS Office suite in the case of Skype In / Out
[362] SMART 2013/0019 and additional interviews with NRAs in relation to this study.
[363] As indicated in the answers to the consultation by an Italian telecom operator

Table 3 - Summary of impacts on OTT

	Changed obligations	**Practical implications**	**Costs**
Access	Na	Na	na
Spectrum	Na	Na	na
USO	Na	Na	na
Services and numbering	**For E.164 OTTs** - Interoperability - Interconnections - Portability - Access to emergency services **For all OTTs** - Privacy & security -	Interoperability and interconnection are currently already in place. switching and portability procedures currently existing for EC(N)S need to implemented by OTTs that interconnect with E.164 Privacy and security obligations need to be implemented by all OTTs	Extended obligations may entail some additional costs. No detailed estimate possible
NRA financing	OTT potentially captured within levies for financing NRAs, where relevant	Additional administrative obligations and costs	Costs for NRA financing likely to vary by member state, but experience suggests limited. No detailed estimate possible
Governance	Alignment of responsibility for sectoral service regulation	May affect relevant bodies for engagement in certain MS	Streamlining of consumer protection responsibilities and increased EU-level guidance should allow reduced engagement cost

2.4.3 SMEs

2.4.3.1 Access and SMEs

Micro enterprises and smaller enterprises outside central business districts (including small businesses in rural areas) are likely to be important beneficiaries of strategies which boost the widespread deployment of fibre, as these organisations may today be under-served compared with larger corporations which may already have fibre connectivity installed to their premises. For example, the UK NRA Ofcom found in the context of research conducted in 2015**365** that a significant minority of SMEs had had less favourable experiences with broadband, including a lack of widespread superfast broadband availability, a concentrated retail market structure, and dissatisfaction in relation to quality of service.

In addition to potentially benefiting from the installation of higher speed broadband, small businesses should benefit from a choice in high speed offers either as a result of infrastructure competition or otherwise through co-investment or regulated access (in the absence of co-investment offers). Competition in standard broadband services via regulated access will also remain. Small businesses which have or aspire to multi-national operations should also benefit from measures to ensure consistent product and service specifications, which should increase competition in the provision of cross-border services in addition to supporting seamless service characteristics.**366**

The preferred option for access envisages that payments for newly installed very high capacity connections in rural areas (which might not otherwise be economic) could be defrayed over a longer period than 24 months, [367] while maintaining the current rules for contract duration for service contracts. This could support affordability of VHC connections for SMEs that may not be able to pay high costs up front. It is not envisaged that the potential for longer term payments for the installation, would impact customers' rights as regards switching service providers.

Finally, the provisions on mapping of quality of infrastructure, will have a positive effect on SMEs, as they entail the publication of this data. Businesses will therefore be able to gauge in advance the status of connectivity (by means of line-specific tests and not by headline speed) in a given area. This will be useful for instance when setting up a new business or relocate an existing one.

There are few electronic communication network providers that could be characterised as SMEs with fewer than 250 employees, as the capital and resources required to install and operate networks mean that most providers are larger in scale. However, smaller players may exist, for example in the installation of regional networks or the provision of targeted electronic communication services, and certain providers with scale across the EU such as suppliers of business communications, may nonetheless operate at small scale in individual national markets. These providers would in principle be subject to the same rules as other electronic communication providers with attendant advantages and costs as described in section **Error! Reference source not found.** except that, as today, NRAs are required to ensure that obligations are '*proportionate* and justified' in light of the objectives.[368] More specifically, smaller regional fibre investors are likely to benefit from an increased focus on infrastructure competition, while business providers (which may have small scale in individual countries) will benefit from standardised wholesale offers. Smaller alternative operators serving the mass market which rely primarily on regulated access will be able to continue to offer competitive broadband services at standard speeds (on the basis of regulated wholesale access in cases where SMP persists). However, they may be less well placed to invest or co-invest in their own VHC network infrastructure than larger scale players.

[365] http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/sme/bb-for-smes.pdf
[366] The impacts of consistent wholesale offers are described in more detail in SMART 2014/0024
[367] The currently allowed period under Article 30(5) Universal service and User Rights Directive
[368] Article 8 Access Directive

Smaller OTT players are not directly affected by network access obligations, but would benefit from the additional capacity that may result from the focus on supporting infrastructure deployment.

2.4.3.2 Spectrum and SMEs

Under the preferred spectrum option, a greater focus on general authorisations over individual licenses has the potential to open up spectrum resources to smaller companies which are not at present able to purchase exclusive access. In addition, many of the end-user businesses which will benefit from accelerated access to spectrum and introduction of 5G will be smaller companies. By opening access to spectrum resources and accelerating 4G and 5G coverage across the Digital Single Market, the preferred spectrum option will facilitate innovation and entrepreneurship which benefits primarily (though not only) start-ups and smaller companies. For instance, there might be companies aiming to bring innovative new applications to market that rely on 5G availability and reliability in sectors such as utilities, automotive and transportation or e-health.

2.4.3.3 Universal service and SMEs

There are likely to be few implications of the universal service option on SMEs as the proposals aim specifically to target broadband affordability for remote or vulnerable consumers. However, affordable broadband home connections may also support the development of self-employment and micro-organisations.

2.4.3.4 Services and SMEs

The preferred option as regards services creates more equality in regulatory treatment as obligations on security and privacy would now apply to all types of communication services (telecom and OTT), regardless of how they are provided. There may be some costs to smaller OTT providers which would need to meet extended obligations (which are difficult to quantify). However, the changes would also provide greater regulatory certainty for all players, as well as increased trust for SMEs as end-users of OTT services, potentially thereby supporting increased take-up of OTT services including European OTT start-ups.

A further important benefit which is especially relevant to OTT start-ups is the proposal to apply full harmonisation for sectorial consumer protection rules. This should reduce barriers for scaling up in Europe (by reducing regulatory heterogeneity) to the benefit of start-ups entering as new players shaping the IoT value chain. As users of communication services, SMEs are not covered by horizontal consumer protection rules, yet they still enjoy a certain degree of protection through competitive markets. Furthermore, SMEs in new digital value chains (e.g. IoT) enjoy more trust and predictability as regards the scope of the Regulatory Framework, contributing to confidence in future planning and investment. SMEs in all sectors will be more inclined to embrace IoT applications and services as these can now be purchased at lower prices and higher quality (including better guarantees for being always and everywhere online). This will give more room for innovations by SMEs within the IoT value chain as well as in other sectors.

2.4.3.5 Governance and SMEs

Changes to Governance will not impact SMEs directly, but may benefit cross-border operations for smaller businesses supplying and using electronic communications services by ensuring consistent application of the rules and by requiring interaction with fewer interlocutors.

2.4.3.6 Overview table

The following table summarises the changes obligations per subject area and associated practical implications and costs.

Table 4 - Practical implications of preferred options for SMEs

	Changed obligations	Practical implications	Costs
Access	- Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for longer contract duration for connectivity - Obligations for the publication of broadband QoS data - Standardised wholesale remedies for business end users	- Greater access to and choice in high quality broadband connectivity - Improved affordability for fibre connections through defraying connection charge - Better availability and competition in cross-border business connectivity (also benefiting providers) - Greater transparency on line quality - Smaller electronic communication providers may be less well placed to invest or co-invest in infrastructure	- na
Spectrum	- Faster access to spectrum - Greater use of general authorisations rather than individual licenses	- Lower cost and improved potential for smaller firms to access spectrum - Facilitate innovation and entrepreneurship amongst services relying on 5G and future generation wireless technologies	- na
Services and numbering	- Clarity with regards to the scope of the Regulatory Framework - More equivalence in approach to ECS and OTT providers offering ostensibly equivalent services - Maximum harmonisation: - Less obligations regarding ECS: • Transparency • Contractual rights • QoS • Dispute resolution - More obligations regarding IAS	- For SMEs as customers - Greater predictability and trust amongst SMEs as users of ECS and OTT - Improved transparency, affordability and quality concerning IAS - Less barriers to embrace new digital applications and services (notably IoT). - The reduction in sector specific obligations (regarding ECS)	- Extended OTT obligations and potential contribution to NRA financing may imply some cost increases for SME suppliers – level difficult to estimate - Max harmonisation for consumer protection should reduce compliance costs

	• Transparency • QoS • Switching - Potential contribution to NRA admin costs - Clearer and Improved arrangements for extra-territorial use of numbers	may impact negatively on SMEs since equivalent horizontal obligations only apply to consumers. However, SMEs will enjoy protection through competitive markets. For SMEs as suppliers - Increased consistency and reduced barriers to cross-border provision - Potential contribution to NRA (but may be subject to threshold) - Potential new obligations (in relation to E.164 interconnection, as well as privacy and security)	
USO	Sectorial contributions excluded for broadband USO	Reduced contributions for SMEs as suppliers	- Potentially reduced costs for SME suppliers in member states which applied sectorial financing
Governance	- Alignment of responsibility for consumer protection and market-shaping spectrum regulation	Increased coherence in fixed, mobile and service regulation, greater consistency	- Greater consistency may reduce administrative cost for multi-national companies

2.4.4 Consumers

2.4.4.1 Access and consumers

Consumers in countries and areas currently lacking infrastructure competition (including rural areas) are likely to be the main beneficiaries of measures to support the deployment of VHC networks. This may lead to the availability of broadband services with significantly higher quality than is available today. In addition, consumers will benefit from a continuation of the degree of competition in existing broadband services (as access obligations offering quality levels equivalent to those prior to new infrastructure deployment will remain). This is unlikely to alter the current pricing dynamics for broadband currently experienced in Europe.

From experience in countries such as France and Portugal, it is also expected that consumers will benefit from competition in high speed offers and affordable prices resulting from infrastructure competition or co-investment in very high capacity infrastructure. In cases where infrastructure competition or co-investment does not materialise as expected, such choice can and should also be preserved through regulated wholesale access. Experience from countries which have pursued a similar approach to that advocated in the preferred option, including France, Spain and Portugal, suggests that pricing for VHC broadband is likely to be reasonable.[369]

Affordable prices for VHC broadband are likely to be supported not only by competition in the provision of high bandwidth services, but also as a result of continued support for competition in copper-based networks , which is likely to result in 'anchor' prices for standard speeds, which constrain the levels offered for higher speeds. Econometric analysis in the context of SMART 2015/0002 also tend to confirm that access regulation for standard broadband (through local loop unbundling) can have an influence on prices for NGA and VHC broadband, which in turn support take-up.[370]

The preferred option for access envisages to enable the cost of the (network) connection to be defrayed over a longer period than the current contract duration (24 month) while maintaining the current rules for contract duration for service contracts.[371] This could support affordability of VHC connections for customers that may not be able to pay high costs up front. It is not envisaged that the potential for longer term payments for the installation, would impact consumers' rights as regards switching service providers.

Finally, the provisions on mapping of quality of infrastructure, will have a positive effect on consumers, as they foresee the publication of these data. Consumers and businesses will therefore be enabled to know in advance the status of connectivity (by means of line-specific tests and not by headline speed) in a given area. This will be useful for instance when setting up a new business or relocate an existing one or when moving to a new house with additional effects in terms of house prices, repopulation, relocation of economic activity which in turn will drive more demand for connectivity.

2.4.4.2 Spectrum and consumers

While the spectrum options do not directly impact on end-consumers /citizens, greater and faster 4G and 5G coverage will enable consumers across the Single Market to benefit from advanced wireless data services and innovative applications resulting in particular from the deployment of 5G . These applications are likely to cover sectors as diverse as e-health , automotive / transportation and utilities , all of which potentially affect a large share of EU citizens. In addition, common methods for determining coverage obligations and improved connectivity across the DSM will contribute to

[369] See SMART 2015/0002

[370] See SMART 2015/0002 – also discussed in interim presentation slides http://www.wik.org/fileadmin/Konferenzbeitraege/2016/Public_Workshop_April/Public_Workshop_slide_presentation.pdf

[371] Article 30(5) Universal service and User Rights Directive

reducing social inequalities (e.g. by fostering digital inclusion). Finally, the introduction of 5G services is likely to create a significant number of jobs (estimated at 2.39m across the EU)

2.4.4.3 Universal service and consumers

The preferred option for universal service is likely to have positive implications for end-users (and particularly consumers) by reducing the number of unconnected households (currently 20% to 30% of households), especially in rural and remote areas, where cost is the main reason for not subscribing. This would allow for an improved access to essential e-services (eGovernment, VoIP, ebanking etc) and would enhance citizens' social participation and their exercise of fundamental rights, for instance right to information, right to conduct business and right to education. For vulnerable groups of consumers (those on low incomes, elderly, those that are less mobile or less able to leave home due to carer responsibilities), affordable broadband is likely to reduce social isolation, improve sense of community and promote social inclusion.

2.4.4.4 Services and consumers

Suggested measures focussing on potential bundling related lock-in problems and other measures supporting transparency and switching will support end-users' protection and freedom of choice which will have a positive impact in terms of affordability and/or quality for the end-user. People with a preference for privacy, confidentiality and/or security are more likely to be included in participating in popular and innovative communication networks. The options for consumers to reach PSAPs (when technically possible) will increase, however, while only a few OTTs seek to interconnect with the numbering regime, the impact is limited.

Although the number of rules dealing with sector specific consumer protection would reduce, this would not be at the expense of consumer protection. Rules are abolished only if respective consumer issues are sufficiently protected by horizontal rules and/or if they are sufficiently protected by competitive constraints imposed on market players.

2.4.4.5 Governance and consumers

Changes to governance will not impact consumers directly, although consumers will indirectly benefit from greater connectivity, cross-border entry and competition that may result from more effective co-ordination at EU level.

2.4.4.6 Overview table

Table 5 - Practical implications of preferred options for consumers

	Changed obligations	**Practical implications**	**Costs**
Access	- Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Potential for longer contract duration for connectivity - Obligations to publish QoS mapping data	- Greater access to and choice in high quality broadband connectivity - Improved affordability for fibre connections through defraying connection charge - Greater transparency over quality of service	- na
Spectrum	- Faster access to spectrum - Greater use of general authorisations rather than individual licenses	- Greater availability and innovation in services relying on 5G and future generation wireless technologies - Accelerated fast mobile broadband	- na
Services and numbering	- Equivalence in approach to ECS and OTT providers offering ostensibly equivalent services - Measures to reduce bundling-related lock-in - Interoperability, emergency service access and portability requirements for OTT interconnecting with E164 - Less obligations regarding ECS, but More obligations regarding IAS • Transparency • QoS • Switching	- Greater predictability and trust amongst users of ECS and OTT due to extended privacy and security measures - Increased ease of switching in relation to bundled offers - Greater end-to-end connectivity and access to emergency services when using OTT interconnecting with E164 - Improved transparency concerning IAS - Potentially less detailed obligations on some ECS, but practical implications limited since consumer protection would be covered by horizontal rules or addressed through competitive markets. - a positive impact in terms of affordability and/or quality for the end-user	na

USO	- Focus on broadband affordability at least at a fixed location	-Potentially improved access to affordable broadband	na
Governance	- Alignment of responsibility for sectoral service regulation	- Increased ease of engagement, reduced administrative burdens	- na

2.4.5 Member States' authorities

2.4.5.1 MS and Governance

The proposed changes to the EU framework for electronic communications would require transposition into national legislation, and will entail certain changes to the institutional set-up in countries which do not already implement the revised structures and procedures as well as changes at EU level. Specifically, at national level, NRAs remit would be subject to minimum harmonisation (to cover inter alia market-shaping spectrum assignment issues and sector specific regulation in areas such as consumer protection). Likewise, at EU level the preferred option would give BEREC an expanded remit for market-shaping aspects of spectrum assignment and services alongside access, as well as increased responsibilities including responsibility for developing implementing guidelines and an enhanced role in the article 7a process on remedies as well as a peer review role on market-shaping aspects of spectrum assignments. These changes may have the following implications for member states' responsibilities and budget.

Taking into account factors which may reduce costs as well as those which increase them, the preferred option is projected to result in costs which are similar to the status quo (see discussion in the detailed chapter on Governance in SMART 2015/0005). However, in a scenario where the projected efficiencies are only partially achieved, the preferred option could entail additional costs of around €5.5m across the EU, with costs varying for different countries. The implications of the adapted governance structure on member states' responsibilities and budget are described in more detail below.

2.4.5.1.1 National level

An important change at national level will be the allocation of responsibilities in the field of consumer protection and spectrum awards design under the framework to those NRAs[372] which do not currently have such responsibilities. This affects a subset of member states.[373] If it entails a transfer of responsibilities for existing tasks, cost implications may not be significant.

The preferred option also entails a requirement to ensure appropriate resourcing for NRAs both to conduct their duties at a national level, and contribute to the expanded remit of BEREC.

Additional expenses are expected to vary between member states, depending on the current resourcing available to the NRAs, but across the EU overall additional expenses for the resourcing of NRAs are expected to be minimal.

Based on an additional 20FTE from NRAs across the EU contributing to BEREC (in addition to the current estimated 49FTE),[374] and a 50% increase in contributions from national authorities[375] to EU spectrum co-ordination (concerning the design of auctions and market-shaping measures), the increased cost to NRAs for BEREC contribution is estimated at €2m in the EU 28 under the preferred option.

Certain NRAs may also need greater resourcing in order to adequately perform duties such as market analyses under the revised framework including the proposed requirement for infrastructure mapping.

[372] Independent National Regulatory Authorities within the meaning of article 3 Framework Directive

[373] According to data from Cullen, NRAs in Denmark, Estonia, Latvia, Malta, Poland and Spain do not currently have responsibility for consumer protection, while NRAs in Netherlands, Spain, Cyprus and to some extent Slovakia and Portugal do not have primary responsibility concerning regulatory aspects of spectrum management

[374] Based on BEREC interview

[375] Today contributions are made to the RSPG by various bodies at national level, but would under the revised framework proposals be made by NRAs as regards spectrum auction design and market-shaping measures

However, as elaborated in the detailed analysis of impacts resulting from changes to the access regime conducted under SMART 2015/0005, the additional mapping obligations are only incremental to the advanced mapping initiatives that already exist in many Member States. Such mapping processes may already have been developed for market analysis purposes, for the implementation of transparency measures required under the Cost Reduction Directive (such as advance notification of civil works) and to meet reporting obligations for identification of white areas through investment mapping before notification of State Aid schemes. Indeed, it would be recommended for those national administrations which have not already done so, to streamline these 'mapping' processes under the remit of NRAs, which should ensure that the assessments are coherent, and may ultimately reduce complexity and cost.

Other policy approaches such as extended market review periods and standardised wholesale specifications for certain products with EU-level relevance, could also be expected to reduce costs for NRAs on average.

Moreover, the introduction of greater co-ordination concerning certain aspects of spectrum assignment, may result in reduced resourcing requirements for the management of spectrum resulting in a reduced overall national burden associated with regulation of the electronic communication sector at national level.

If costs for the application of non-spectrum aspects of regulation are broadly stable (taking into account positive and negative factors), but spectrum-related resourcing could be reduced by an average of 1FTE per member state due to greater co-ordination, the average estimated reduction in national costs for application of the electronic communication framework as a whole would be around €2.6m per annum across 28 Member States, but not necessarily equally distributed, since resourcing levels vary widely.

2.4.5.1.2 EU level

As regards EU co-ordination, the reinforcement of BEREC's responsibilities and its structure to conform with the 2012 Common Approach will entail increased annual costs of an estimated €7m compared with the status quo. This increased cost could be met from the EU budget[376]. The preferred option bundle may also entail increased resourcing requirements for the Commission (especially relating to the proposed spectrum assignments peer review) with an estimated budgetary implication of around €0.6m.

At EU level, Ministries would continue to play a role in comitology bodies such as COCOM.

2.4.5.2 MS and Services

In general, sector specific rules would be followed by the NRA and the attribution of horizontal rules would be at national discretion. Some Member States might opt to give all consumer questions relevant for a sector to the sector specific regulator. Options with regards to numbering and with regards to must carry/EPG do not require actions from ministries, besides transposing new rules (regarding the assignment of MNCs to non-MVNOs, and regarding extra-territorial use of national numbers) into national law.

2.4.5.3 MS and Universal service

Adoption of Option 3 for universal service will have slight implications for ministries of some Member States where ministries share the relevant competences with NRAs (for instance, in Austria,

[376] Some EU agencies are partly financed by fees but no specific tasks carried out by BEREC which could be subject to a fee paid by the beneficiaries of those tasks have been identified.

Estonia, Finland, France, Italy and Greece). In such countries, there will be new requirements with regard to the definition of the scope of universal service and universal service obligations at the national level, because Option 3 foresees only PATS and affordable broadband for the scope. Yet, depending on the national distribution of competences, ministries may retain the task of defining broadband at the national level (for example, by reference to specific communications services) as well as to assess affordability. Nevertheless, flexibility of Member States will be preserved due to a minimum harmonization at the EU level, i.e. the accessible communications services basket can be enhanced at the national level and broadband affordability can be expanded to at least at a fixed location. In addition, if a need is demonstrated at national level, Member States would have the possibility to include the availability component in the universal service obligation and to maintain services, which are currently part of USO at the respective national level (i.e. payphones and accessory services). There is a further limitation of discretion of Member States as regards the choice between different financing options, if public funding (as opposed to optional funding from the industry) is mandated at the EU level.

2.4.5.4 Overview table

An overview of the impacts for member states is shown in the following table.

Table 6 - Practical implications for Member States

	Obligations	Steps to be taken	Costs
Access	- Extension of market review periods, more detailed reviews (including mapping), harmonised wholesale specifications - BEREC to develop Implementing guidelines on adapted market analysis process and standardised wholesale products	- Ensure adequate resourcing of NRAs to conduct market analyses and contribute to BEREC	Increased costs of ~€2m (+20FTE across EU28) to support NRAs in contributing to BEREC, some increased costs also to ensure effective NRA resourcing where not currently the case, but may be balanced by potential for reduced costs from extended market reviews
Spectrum	- EC to adopt implementing Decisions subject to RSPG input and comitology - BEREC to play role in peer review of spectrum assignment	- Ensure adequate resourcing of NRAs to contribute to BEREC/ RSPG -	Some additional costs to support spectrum co-ordination (see governance), but overall potential saving of approx. €2.6m across EU28 for ECS spectrum management if co-ordination reduces resourcing requirement (by 1FTE) at national level
Services and numbering	- In general, sector specific rules would be followed by the NRA and the attribution of horizontal rules would be at national discretion. Some MS might opt to give all consumer questions relevant for a sector to the sector specific regulator	- Ensure adequate resourcing of NRAs	- Limited impact as the responsibilities of NRAs in enforcing current sector specific obligations can be downsized as a result of the preferred option.
USO	- Defining the scope of functional internet access - Implementing affordable universal service	NRAs already have significant responsibilities on technical implementation of universal service, only a (slight) adjustment of them will be necessary	The overall cost of specifically attributing certain US implementation responsibilities to NRA is likely to be neutral Removal of sectorial funding possibility
Governance	- Harmonised minimum remit for NRAs to include consumer protection and market shaping aspects of spectrum - Expanded remit for BEREC to encompass consumer protection, spectrum and alignment of structure with Common Approach - Peer review process for spectrum (involving BEREC, EC)	- Transfer responsibilities for consumer protection and market shaping aspects of spectrum to NRAs (where not already lying with independent NRA) - Potential increased contribution to BEREC and EC costs -	Cost of transferring responsibilities between national authorities may be limited Estimated increased costs of reinforced EU co-ordination ~€4.4m for enhanced BEREC, and ~€0.6m for Commission (although potential national savings from spectrum co-ordination described above)

2.4.6 National regulatory authorities (NRAs) and spectrum regulatory authorities (SRAs)

Under the preferred option bundle, NRAs will have full responsibility for implementation of regulatory rules under the EU framework for electronic communications including those associated with consumer protection and market-shaping aspects of spectrum assignment. This will entail an expanded remit and associated resources for those NRAs which do not already have these responsibilities. [377] NRAs will also need to make additional contributions to the output of an enlarged BEREC. This may have the following practical implications.

2.4.6.1 NRAs and Access regulation

As regards implementation of the framework at a national level, the market analysis process will be adapted to include infrastructure mapping, greater consideration of duct access and clarifications in relation to the application of symmetric obligations, as well as co-investment and other commercial arrangements, prior to mandating obligations for access on the basis of SMP. NRAs can already adapt market analysis processes on a voluntary basis to reflect this approach, but will be obliged to follow this approach in the reviews subsequent to the adoption of the revised EU framework for electronic communications. These additional considerations – and especially mapping and the potential greater focus on duct access and symmetric remedies may imply additional effort and resource for those NRAs which have not already undertaken such analysis, especially in the first review process following the application of the revised framework. However, many NRAs or regional authorities already conduct mapping assessments thereby reducing the additional burden entailed by such an obligation (see SMART 2015/0002 and section 2 (access) of the detailed Impact Assessment, while the required effort in relation to duct access and symmetric remedies should be reduced in subsequent reviews.

The preferred option also provides a role for NRAs in identifying 'challenge' areas, holding operators accountable for the provision of misleading information concerning their deployment plans. This may result in greater engagement by NRAs with the process of broadband state aid allocation, which also involves the identification of areas in which NGA deployment is unlikely.

However, in addition to measures which may increase resourcing requirements for certain NRAs, there are measures which are likely to reduce the effort needed. Market reviews will be required only every 5 years as opposed to 3 years as currently,[378] and the introduction of standardised wholesale remedies for example in relation to business access, will avoid duplicate processes for the specification of new wholesale remedies, and simplify the imposition of remedies (in cases where such remedies would be appropriate).

NRAs will need to be effectively resourced not only to fulfil their national functions under the electronic communications framework, but to contribute to an expanded BEREC, which will have responsibility for the development of implementing guidelines as regards issues such as infrastructure mapping and the development of standardised wholesale offers to support business communications. NRAs would also contribute via BEREC to an updated article 7a process whereby a Commission veto on remedies would be possible in circumstances where BEREC agrees.

Some of the changed requirements are likely to result in increased budgetary and resourcing requirements for a subset of NRAs. These include obligations to ensure adequate resourcing, responsibility for market shaping aspects of spectrum and consumer protection (where not already the

[377] According to data from Cullen, NRAs in Denmark, Estonia, Latvia, Malta, Poland and Spain do not currently have responsibility for consumer protection, while NRAs in Netherlands, Spain, Cyprus and to some extent Slovakia and Portugal do not have primary responsibility concerning regulatory aspects of spectrum management

[378] The 2014 Recommendation on Relevant Markets susceptible to ex ante regulation also involves two fewer markets than the previous 2007 Recommendation, which should also entail reduced effort as the markets removed from the list are progressively deregulated

case), and the requirement to conduct robust mapping exercises in relation to market analyses (where not already the case). Additional contribution to BEREC would also need to be resourced.

However, many NRAs already have sufficient resourcing, scope and undertake detailed mapping, and as discussed there are other aspects of the preferred package that may result in cost savings. Cost implications for changes to NRA duties under the preferred option (excluding spectrum) may therefore be considered neutral on average, although with variations amongst member states.

2.4.6.2 NRAs and Spectrum

In terms of the preferred spectrum option, NRAs would also need to have sufficient resources to deal with the spectrum assignment selection processes and the related peer review and to engage with BEREC accordingly. However, increased co-ordination of certain aspects of spectrum assignments at EU level, may allow for cost savings in spectrum management to be made at national level. For example, an estimated €2.6m could be saved across the EU, if greater spectrum co-ordination permitted a reduction in spectrum management staffing of 1 FTE per member state.

2.4.6.3 NRAs and Electronic Communication Services

Under the preferred option, NRAs indicate that the impact on enforcement costs for consumer protection is not a major issue. Abolishing the rules that overlap with horizontal rules would not bring any savings in terms of the enforcement costs; either because they are currently already enforced by competent authorities or because MS may decide to give responsibility for enforcing horizontal rules to the NRA. Moreover, while NRAs may reduce a number of activities related to transparency and QoS monitoring in relation to ECS, a number of these activities need to be re-introduced to enforce similar type of obligations imposed on IAS.

The obligations imposed on OTTs that provide communications services with regards to security and privacy may require additional activities to guide OTTs in implementing obligations (which may include legal enforcement activities). While OTT business models are EU-wide it may require coordination of activities at BEREC. The preferred option as regards numbering makes current procedures with regard to extra-territorial use of numbers much more efficient. This may require an increase of activities as it may lead to more applications for extra-territorial use of numbers. Moreover, the ability of non-M(V)NOs to apply for MNCs may also require more resources for NRAs. With regards to must carry and EPG, there is no impact on NRAs.

2.4.6.4 NRAs and Universal service

NRAs will be responsible for monitoring the national market evolution of functional internet access and voice communications. NRAs will also continue to keep the tasks related to assessing the possible unfair burden from the universal service provision and the calculation of the net costs.

An overview of the implications for NRAs is shown in the following table.

Table 7 - Practical implications for NRAs/SRAs

	Obligations	**Steps to be taken**	**Costs**
Access	- Longer market review periods, requirement to demonstrate retail failure - Infrastructure mapping - Greater infrastructure competition focus involving duct access, symmetric rules, incentives for co-investment, long-term commitment - Standardised wholesale remedies for business	- Implement revised market analysis process in market reviews following application of the framework to be conducted on 5 yearly basis. - Conduct infrastructure mapping exercises (where not already implemented) - Investigate and where appropriate apply measures to make duct access and symmetric access to non-replicable assets effective - Include additional assessment e.g. of co-investment, commercial offers, prior to imposition of any additional SMP remedies - Implement standardised wholesale solutions (after adoption and following suitable period)	Difficult to precisely estimate and likely to vary between NRAs as some may already comply with the spirit of the preferred option, while others require further resourcing in order to do so. Given balance between positive and negative cost impacts, overall impact may be neutral
Spectrum	- Negotiate assignment criteria and usage obligations which would form part of EC implementing decisions - Adopt system promoting general authorisations over individual licenses	- Take on new responsibilities and provide necessary resources - Engage with spectrum advisory board	- Greater EU co-ordination in spectrum assignment processes and licence conditions requires additional engagement with RSPG but may allow cost savings estimated at ~€2.6m based on reduction of 1FTE per SMA on average - Transfer of certain spectrum competences to NRAs in countries where not already the case considered cost neutral

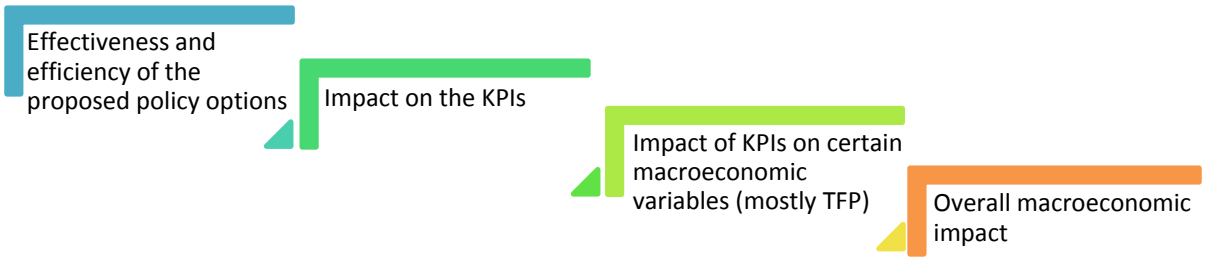
Services and numbering	1. Enforcement of obligations on IAS and ECS 2. Assist OTTs in implementing security and privacy obligations 3. Enforcement of new OTT obligations 4. Operationalise new (more efficient procedures) regarding roaming and extra-territorial use 5. Clear possibility to assign numbers to non-M(V)NOs	1. Adapt activities in enforcement of some IAS and ECS obligations 2. Interact with OTTs, coordinate with BEREC, legal challenges. 3. Integrate enforcement of OTT obligations into current operations 4. Intensify cooperation between NRA's as the relevance of cross border aspects may increase 5. Increase resources as number of applications may increase	• Net impact of 1 and 2 is likely zero • Impact of 2 is mostly during a brief transition period following implementation of option 3. It requires coordination with other NRAs and may involve legal challenges. • Impact of 4 is negligible • 4 and 5 may require some additional resources because increased efficiency may lead to an increase of the number of applications (where the current nr of applications is close to zero)
USO	- Monitoring market evolution - Net-cost calculation	NRAs already have significant responsibilities on technical implementation of universal service, only a (slight) adjustment of them will be necessary	The overall cost of specifically attributing certain US implementation responsibilities to NRA is likely to be neutral
Governance	- BEREC to develop Implementing guidelines on adapted market analysis process and standardised wholesale products - EC to adopt implementing Decisions subject to RSPG input and comitology - Double-lock veto on draft SMP remedies under Article 7 - BEREC to play role in peer review of spectrum assignment	- Contribute to expanded BEREC and RSPG responsibilities	~€2m per year (for an additional 20FTE) contributing to BEREC (over current estimate of 39FTE) and some additional contribution to RSPG

2.5 ANNEX 5 - Analytical models used in preparing the impact assessment.

2.5.1 Modelling the gains from intervention

The impact of the preferred policy options is estimated quantitatively using a mix of econometric and computable general equilibrium (CGE) techniques. The algorithm for performing the impact evaluation is presented very generally in the figure below. As a first step, the evaluated impact in terms of effectiveness and efficiency of the proposed policy measures is translated into quantitative (where possible) key performance indicators (KPIs).

To provide a link between the KPIs and the macroeconomic framework, econometric estimates of the effect of the indicators on certain macroeconomic variables are performed. These are complemented by other estimates, based on relevant economic literature. Finally, the evaluated impacts are fed into the CGE modelling framework as an input shock and the effects are multiplied and spread across the entire economy through the model system of equations. The impact is evaluated quantitatively by means of comparison of a baseline (largely extrapolation-based) and relevant alternative scenarios for the preferred policy options in each of the considered policy areas.



The choice of a CGE modelling framework for the estimation of the macroeconomic gains from intervening is justified by the suitability and widespread use of this type of models for evaluation of the impact of policy interventions. As the behaviour of various economic agents, such as consumers and different businesses, is explicitly modelled, this framework provides also estimations on the impact of the evaluated changes on different types of stakeholders, as well as the economy as a whole (through aggregate measures such as GDP or welfare). As the model is recursively-dynamic in its nature, it allows us to estimate also the transition paths for the macroeconomic variables, where, for the purposes of the current impact assessment, we have considered the cumulative impacts up to 2025.

2.5.2 Assumptions and limitations of the modelling approach

The modelling approach relies on the assumptions that the selected KPIs reflect sufficiently enough the expected developments in each policy area and that the estimated econometric relationship with the total factor productivity (TFP) will not change as a result of the implemented policies. The implementation of a CGE framework is also based on the following assumptions:

- No change in the input-output structure of the economies modelled. As already discussed, in the context of the current evaluation this implies that the estimated impacts are very conservative, where there is potential for higher benefits in case of disruptive technologies and innovations.
- Constant share of public investment with respect to the gross value added in the absence of policies

- Constant share of sectorial public investment with respect to the total capital expenditures of the government in the absence of policies
- Assumptions about important model parameters, which are presented in detail below in the current macroeconomic modelling annex. They are calibrated in order to ensure a plausible trajectory of the macroeconomic variables in the baseline.
- Also, in order to present estimates of the magnitude of the estimated impacts in nominal terms, we have also adopted the assumptions that in the baseline scenario annual GDP growth in the EU will be 2%, while employment will increase by 0.3% per annum and finally, that annual growth in gross fixed capital accumulation will be around 5%.

More generally, it is important to note that there are limitations on what can be estimated on the basis of the model. Specifically, we note that the implementation of the preferred policy options might have a significant boost on innovation and ultimately lead to disruptive growth. By their definition, however, such structural economic changes cannot be estimated ex ante. Therefore, the estimates presented below should be treated as a lower bound on might be practically achievable in case the implemented policies facilitate the development and application of disruptive technologies with an important implications on a wide variety of businesses and, eventually, on the economy as a whole.

The achievement of a structurally different economic growth however will be strongly dependent on the ability of the business to absorb efficiently and effectively new technologies and benefit to the highest extent from the competitive advantages such technologies might provide. More generally, the impact of the proposed policies will be also contingent on the application of relevant innovation policies.

Finally, as a recommendation for an ex post impact assessment, a dynamic study of the behaviour of the various businesses at firm level before and after the introduction of the proposed policy changes in the e-communication regulatory framework and the respective legislative and institutional setups might provide useful insights. Also, if feasible, a large scale study with richer regional specifications might have high value added, as territorial variations might prove significant.

2.5.3 Impact of the proposed policy options on the KPIs

2.5.3.1 Access

The economic literature recognizes the positive effect of improved broadband access and uptake for achieving higher productivity and economic growth. Policy options in this domain relate to measures fostering the adaptation of the existing infrastructure to be 'fibre-ready' and provide stimulus for the development of the single market.

While the implementation of the policy options will be associated with significant CAPEX costs and transition periods, they should also lead to higher-speed broadband access and improved business and consumer climate.

2.5.3.2 Spectrum

As pointed out in the relevant section, spectrum has important implications on the deployment on mobile and fixed wireless networks, as well as on mobile competition, thus on the quality and prices of the services provided. Policy options, related to spectrum consist mainly of different degree of harmonization (more or less binding rules) of the regulatory framework on spectrum management, ranging from maintenance of the current status quo to full harmonization.

The enhanced harmonization of the spectrum regulations should lead eventually to higher speed due to realized economies of scale and investments and improved transparency and certainty for the end consumers.

It will, however, also lead to higher regulatory costs and various implementation-related expenditures. It will require a certain transition period and, in case of higher harmonization, will reduce the flexibility of the national authorities to conduct policies.

2.5.3.3 Services

Electronic communication services regulations need to be streamlined to level the playing field for all market participants, while ensuring the safe and continuous provision of the services. Various policy options are being considered, related mainly to identification of redundant regulations and/ or extension of some of the existing rules to all market participants and specification of the role of the National Regulatory Authorities and of BEREC.

The implementation of the envisaged measures might cause some additional administrative costs but should in the end promote competition in the sector and, at the same time improve the business climate through optimized regulation. In the end consumers are expected to benefit from higher quality and more securely provided e-communication services.

The problem with the must carry and EPG is also related to the provision of e-com services. However, the regulation of the access of public service broadcasters to online platforms falls out of the E-communication regulation and will not be considered in the current impact assessment.

2.5.3.4 Numbering

The problem with the numbering is closely related to the observed trend of expansion of the M2M applications and possible negative implications of solutions implemented only at national level. The policy options considered are related to the establishment of a common basis for extra-territorial use of national numbers throughout the entire EU and the use of M2M across borders.

Implementation costs for some of the policy options considered might be significant, but they should eventually lead to a boom in the development of M2M applications and, thus of innovations and economic growth.

2.5.3.5 Universal Services

Universal services have important social impacts and therefore it is essential to ensure that their scope and coverage is aligned with the societal and technological developments. The policy options considered in this respect comprise of exclusion of certain services from the US scope, which have become redundant (payphones, directories and directory enquiry services), inclusion of broadband affordability and, possibly, availability and, thirdly, adjustments in the pool of US contributors.

Optimizations in the scope of the universal services and contributors will enhance efficiency and effectiveness in the provision of these services, leading possible to lower financial burden for the contributors and better alignment of the US with the current technological, societal and economic developments in the EU.

2.5.4 Impact of the KPIs on some macroeconomic variables

The literature review of the impact of the various policy areas considered under this study, shows a multitude of studies assessing the effect from broadband access and uptake and some evidences on the impact of 4G on economic growth, productivity and employment. Estimations of the macroeconomic impact of high-speed broadband are however still limited in number and scope.

As can be inferred from the introductory section to this annex, the approach followed consists of estimation of the impact mainly on total factor productivity (TFP) and predominantly the effect from it to the other macroeconomic variables through the CGE model. To this end, we have constructed a two-

factor productivity function, where economic growth is explained by the contribution of capital (public and private) and labour (skilled and unskilled). Contrary to the typical estimation of the TFP as a residual in the production function, we have adopted the approach, used in GSMA and Deloitte (2012)[379], where Stochastic Frontier Analysis (SFA) is used to proxy total factor productivity as a measure of efficiency. The main advantage of this approach to TFP estimation is that it allows for decomposition of the TFP into two analytically useful components: 1. technical progress over time and 2. different efficiency levels, measured as deviations of the respective economies from the (maximum achievable) production frontier.[380] The results of the SFA estimation are given below.

As a first step, TFP was estimated by regressing GDP in volumes against the two typical production factors – capital (CAP) and labour ($EMPL$), respectively measured as cumulative investments, assuming a 10% depreciation rate, and employment. The remaining variables take into account the economic crisis after 2008 (dummy variable $dCRISIS$), evolution of the GDP in time ($Time$), i.e. technical progress, a constant (Intercept) and country fixed effects. The parameter $Gamma \in [0,1]$ estimates the proportion of total residual variance, which is attributed to inefficiencies. Meanwhile $sigmaSq$ measures the sum of the variances in the error components (inefficiency and statistical noise).[381]

Variable	Estimate	Significance	Variable	Estimate	Significance
(Intercept)	3.37	***	**FI**	0.07	*
log(CAP)	0.09	*	**FR**	-0.10	
log(EM)	0.97	***	**HR**	-0.83	***
dCRISIS	-0.03	***	**HU**	-0.89	***
sigmaSq	0.00	**	**IE**	0.27	***
Gamma	0.80	***	**IT**	-0.24	**
Time	0.13	***	**LT**	-0.78	***
BE	0.09	***	**LU**	1.04	***
BG	-1.62	***	**LV**	-0.87	***
CY	-0.24	.	**PL**	-0.98	***
CZ	-0.72	***	**PT**	-0.63	***
DE	-0.26	*	**RO**	-1.35	***
DK	0.22	***	**SE**	0.13	***
EE	-0.72	***	**SI**	-0.46	***
EL	-0.39	***	**SK**	-0.68	***
ES	-0.35	***	**UK**	-0.22	*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The results indicate much bigger elasticity of output to labour (0.97) as compared to capital (0.09) and show returns to scale, which are close to constant (the sum of the coefficients in front of capital and labour inputs is 1.06). If estimated only on the subset of Eurostat data for 2000-2007, the elasticities of output to capital and labour are much more balanced, standing respectively at 0.45 and 0.46. The estimation results show a positive time trend in national income with an elasticity of 13% and the downturn from 2008 is estimated to provide a negative contribution to GDP of around 3%.

[379] GSMA and Deloitte, 2012, "What Is the Impact of Mobile Telephony on Economic Growth?", Report prepared for the GSM Association, available at: http://www.gsma.com/publicpolicy/wp-content/uploads/2012/11/gsma-deloitte-impact-mobile-telephony-economic-growth.pdf .

[380] The method and data used are described more in length below in the chapter devoted to the Elaboration of the methodology.

[381] Technically, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $= {}^{\sigma_u^2}/_{\sigma^2}$, where are the variances in the assumed distributions of the inefficiency (u) and statistical noise (v) components in the error term.

The mean efficiency for the dataset, including 28 EU MS in the period between 2000 and 2015 stands at 0.88, where fixed effects are calculated negative mostly for the converging economies (highest for Bulgaria and Romania) and positive for the highest income countries in the EU – Luxembourg and Denmark, but also for Ireland.

Once efficiencies are estimated, they are used as proxy for the total factor productivity and are regressed against:

- Heritage index of economic freedom $heritage_{rt}$, which is mostly used as a proxy of the regulation effectiveness and efficiency and, more generally of the business and consumer climate.
- 4G mobile broadband coverage (as % of all households) mbb_ltecov_{rt}
- Average broadband connection speed $speed_{rt}$

Finally, as no data for Croatia was available for the speed of connection, it was excluded from the estimation panel.

Variable	**Estimate**[382]	**Significance**	**Variable**	**Estimate**	**Significance**
log(heritage)	0.225	***	**HU**	-1.176	
log(mbb_ltecov)	0.003	**	**IE**	-1.210	
log(speed)	0.021	***	**IT**	-1.099	
AT	-1.169		**LT**	-1.285	
BE	-1.166		**LU**	-1.187	
BG	-1.207		**LV**	-1.253	
CY	-1.142		**MT**	-1.160	
CZ	-1.216		**NL**	-1.191	
DE	-1.174		**PL**	-1.212	
DK	-1.193		**PT**	-1.153	
EE	-1.234		**RO**	-1.263	
EL	-1.091		**SE**	-1.200	
ES	-1.153		**SI**	-1.163	
FI	-1.179		**SK**	-1.224	
FR	-1.137		**UK**	-1.191	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The estimation results indicate significant impact of economic freedom of the total factor productivity (elasticity of 0.225), including also important governance aspects. Higher broadband speed and expansion of the LTE mobile broadband also turned out to be statistically significant, though their coefficients are much lower - 0.021 and 0.003 respectively.

[382] The country fixed effects are all negative due to the lack of constant in the equation specification.

In addition to the results for the entire economies, sectorial production functions were also estimated. As sectorial breakdowns for Croatia were not available on the Eurostat website, it was excluded from the panel. The table below summarizes the results of the estimates performed for the seven sectorial aggregates that are incorporated in the CGE model for estimation of the macroeconomic impact[383].

Variable (in logs)	TOTAL		AGR		LOWMAN		HIGHMAN		ENERGY	
heritage	0.225	***	0.300		0.058		-0.163	*	0.107	
mbb_ltecov	0.003	**	0.001		0.005	**	0.003	**	-0.006	
speed	0.021	***	-0.078	***	0.032	***	0.035	***	-0.136	***

Variable (in logs)	TRANS		TELECOM		ECOM		SER	
heritage	0.0000002		-0.123		-0.412	*	0.141	.
mbb_ltecov	-0.00000004	**	-0.020		0.012	***	0.003	*
speed	-0.0000009	***	-0.139		0.072	***	0.012	**

Sector abbreviations: AGR – agriculture, LOWMAN - low-tech manufacturing, HIGHMAN - high-tech manufacturing, ENERGY - energy sector, TRANS - transport, TELECOM - telecommunications, ECOM - other electronic communication-related services, SER - Other services.[384]

Based on these estimates, we have assumed the following coefficients for the impacts in the CGE model, taking into account both the statistical significance of the coefficients and the logics behind the estimates. The table below summarizes the elasticities of the total factor productivity to the KPIs, used for the subsequent estimations:

Variable (in logs)	AGR	LOWMAN	HIGHMAN	ENERGY	TRANS	TELECOM	ECOM	SER
heritage	0.225	0.225	0.225	0.225	0.225	0.225	0.225	0.225
mbb_ltecov	0.003	0.005	0.003	-0.00000004	-0.00000004	0.003	0.012	0.003
speed	0.021	0.032	0.035	-0.0000009	-0.0000009	0.072	0.072	0.021

[383] Estimates in grey are not statistically significant.
[384] The definition of the sectors is discussed in length in the section, describing the structure of the CGE model.

As estimated, the impacts of connection speed and 4G mobile broadband coverage on the sectorial total factor productivity is higher in the e-communication services (ECOM and TELECOM) and manufacturing and much less – in transport and energy sectors.

2.5.5 Overall macroeconomic, social and environmental impacts

Having established a link from the policy options, through the KPIs to some macroeconomic variables and parameters allows us to perform an overall macroeconomic impact assessment. To this end, we have constructed a CGE model, which is run for the three modelled economies (Germany, Czech Republic and Bulgaria), selected based on a cluster analysis, taking into account the digital and economic development and the size of the economies.

Each of these three economies is inhabited with a government, eight production sectors and a single representative household, maximizing its utility from consumption, skilled and unskilled labour and savings, given its budget constraint. The economic sectors comprise of agriculture, low-tech manufacturing, high-tech manufacturing, energy, transport, telecommunications, other electronic communication-related services and other services. Each of them maximizes its profit, based on its production technology. The government is formalized through its budget constraint. The link with the foreign sector is made through the invest-savings balance. Armington and constant elasticity of transformation aggregation functions are used to determine the quantity and relative price of the imports and exports.

The model is static in its essence, as all optimizing agents choose their optimal values only for the current period. However, the model features also some transitional dynamics, defined through the capital accumulation equation and an equation for total factor productivity growth.

The quantitative modelling approach can be schematically presented as in Figure 1. The next Figure 2 presents an overview of the impact mechanisms of the preferred policy options. To simulate the impact of the preferred policy options on the economy, shocks to the TFP have been introduced. Their magnitude is estimated based on the expected size and timing of the of the respective KPIs and their identified econometric relationship with TFP. Most of the shocks were introduced in 2020 and had impact already in 2021. Exceptions include accelerated fibre scenario, where impacts begin to be felt in 2019 as market analysis processes are voluntarily adapted in anticipation of the modification of the electronic communications framework and the 5G spectrum scenario, where impacts are not experienced before 2021, on the expectation that 5G technologies will not be ready for service before that date.

Figure 1 - Overview of the quantitative modelling framework

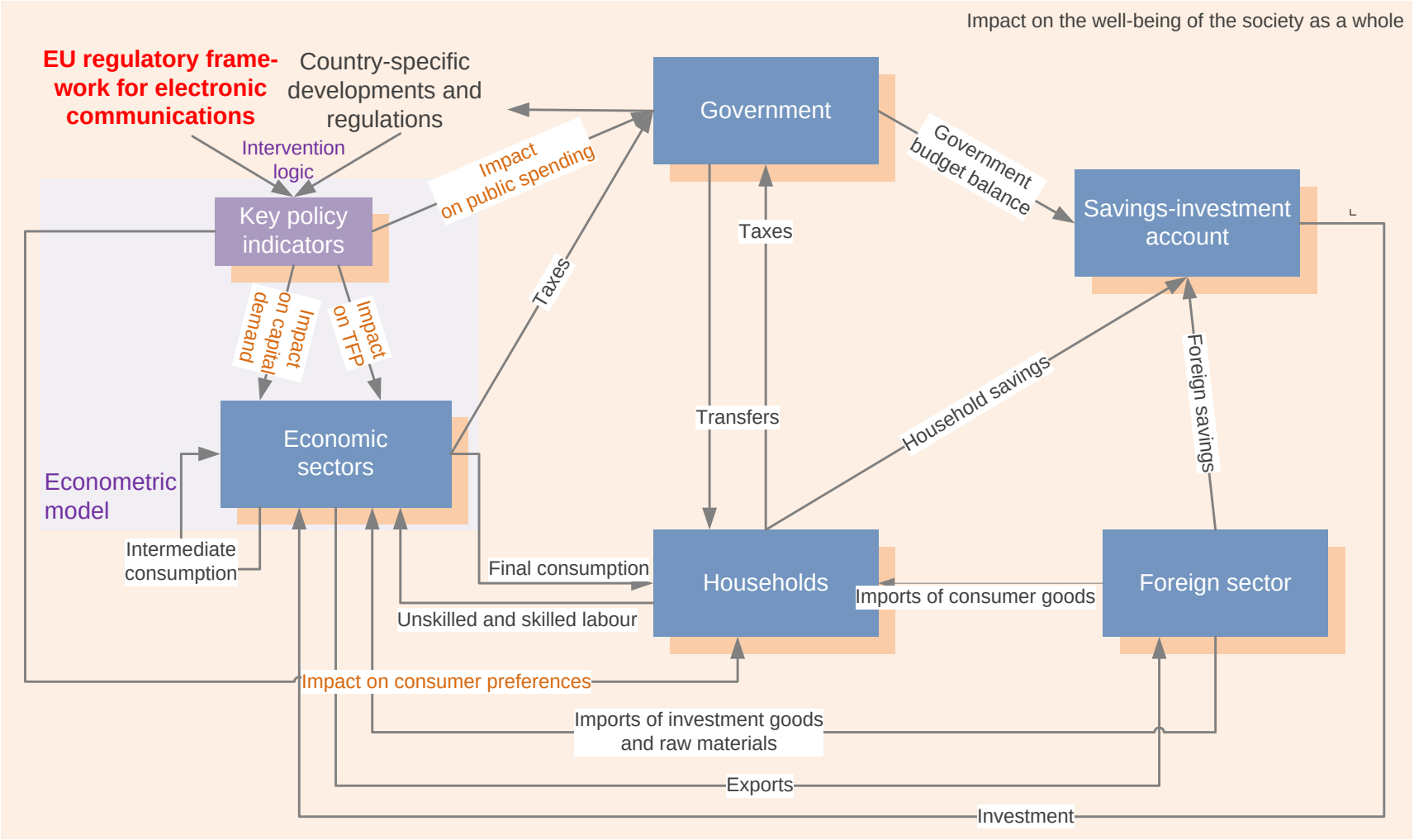
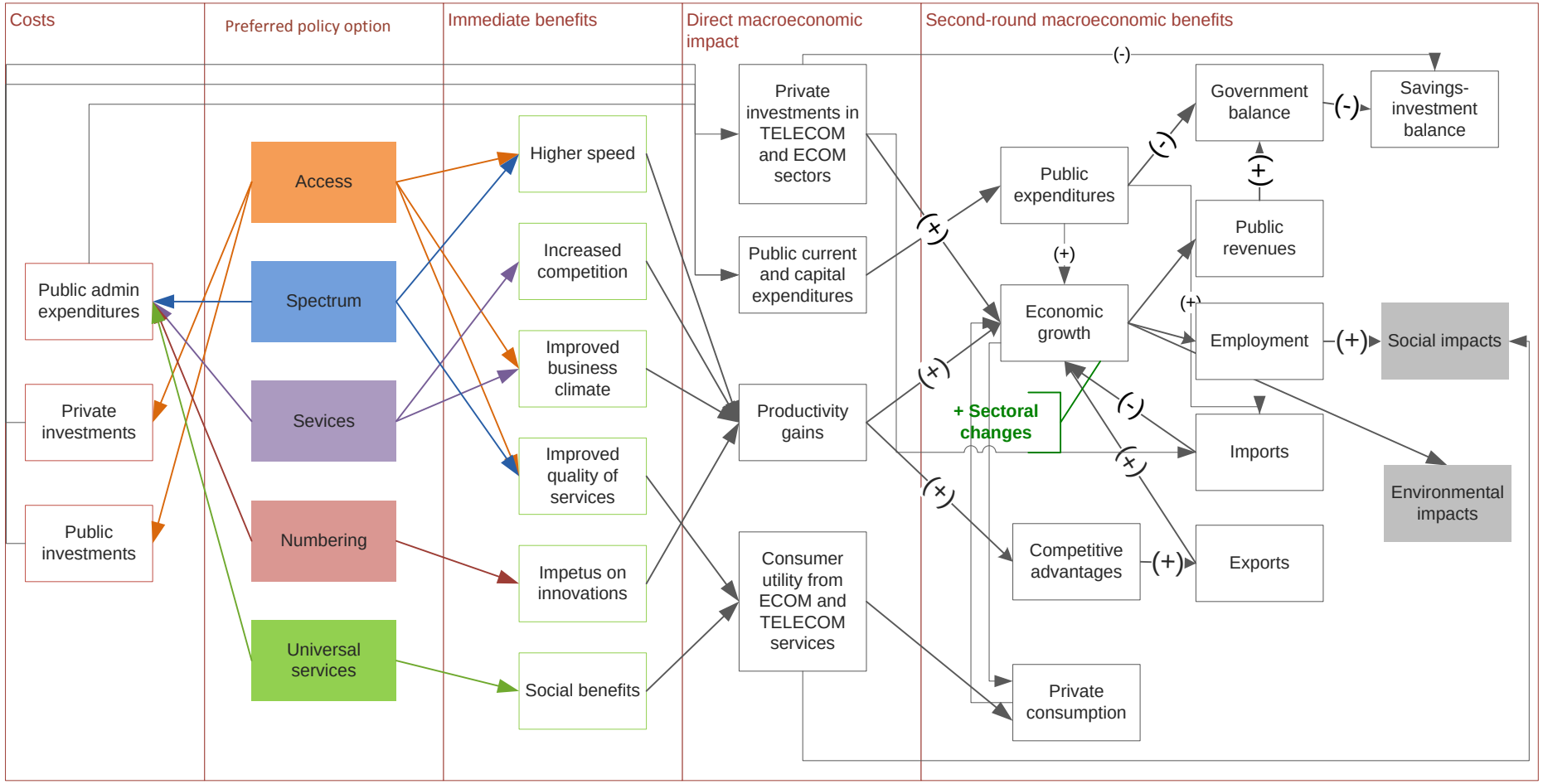


Figure 2 - Overview of the impact mechanisms of the preferred policy options.

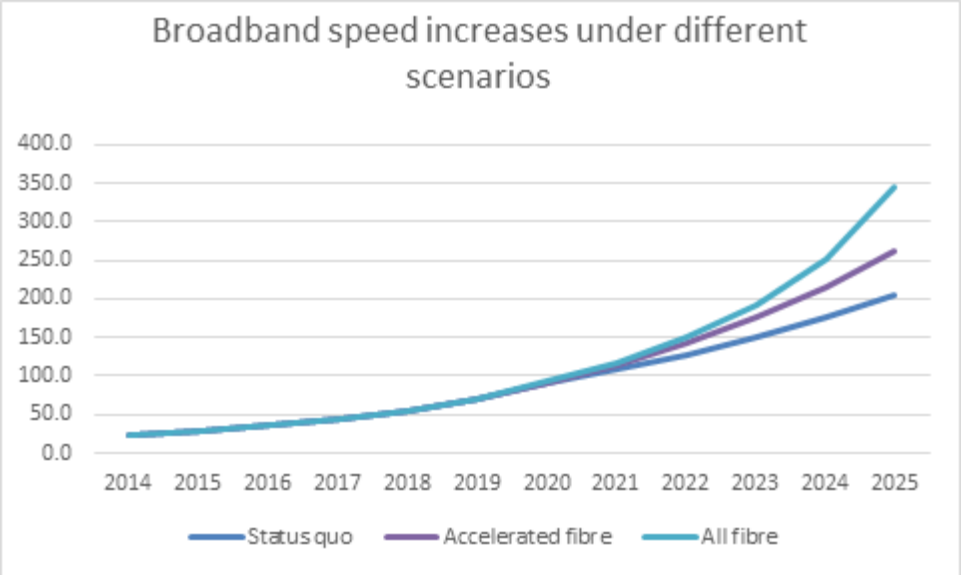


2.5.6 Simulation results, based on the preferred policy scenarios

Access

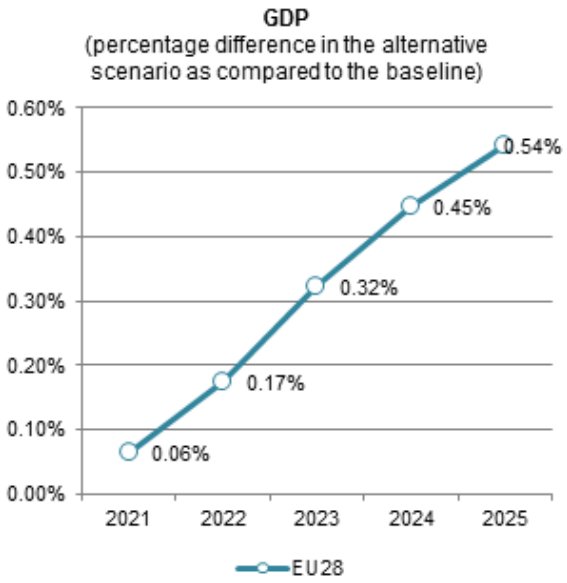
The impacts on broadband download speed from the implementation of the preferred policy options with respect to access are summarized in Figure 3 below:

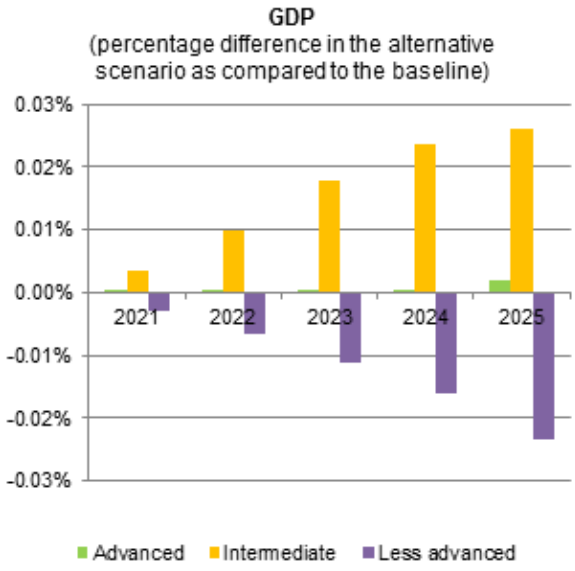
Figure 3 – Broadband speed increases under different scenarios



Under both alternative policy scenarios, connection speed growth is expected to exceed that of the baseline, respectively by an average of 3 percentage points in the accelerated fibre scenario and twice higher in the all fibre scenario. In the accelerated growth scenario deviations in connection speed growth amount to 6 p.p. in 2025. In the all fibre scenario, the gap in growth increases to 22 p.p. by 2025.

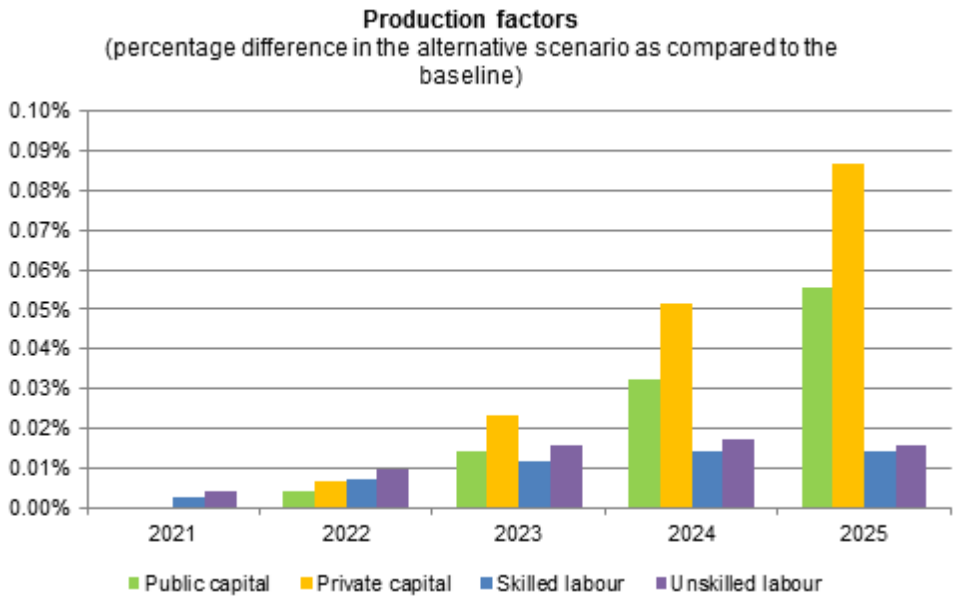
In the **accelerated fibre scenario**, the impact on GDP is expected to be positive by 0.06% already in 2021 and deepen to 0.54% by 2025. The impact will not be evenly spread across all EU economies. Specifically, the middle group of countries will benefit most from the proposed policy changes, while the group of less economically and digitally advanced economies is expected to gain slightly less than the average from the increase in average connection speed.


GDP
(percentage difference in the alternative scenario as compared to the baseline)
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
0.54%
0.45%
0.32%
0.17%
0.06%
2021
2022
2023
2024
2025
EU28


GDP
(percentage difference in the alternative scenario as compared to the baseline)
0.03%
0.02%
0.01%
0.00%
-0.01%
-0.02%
-0.03%
2021
2022
2023
2024
2025
Advanced
Intermediate
Less advanced

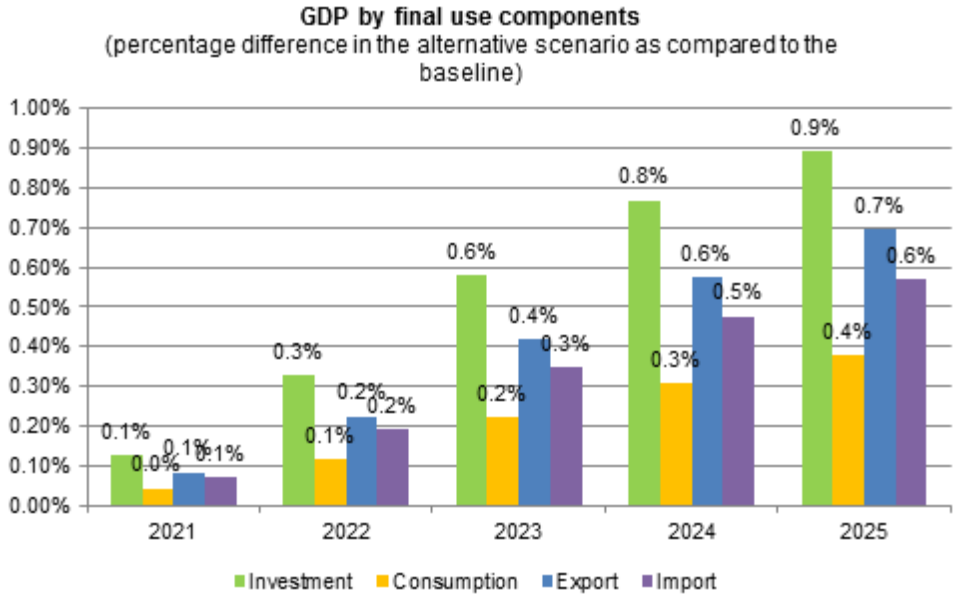
From the supply side, private capital increases are expected to have the highest contribution to economic growth, while the increases in labour will be modest (around 0.01%). Generally, employment is expected to decline somewhat in the TELECOM sector, and, as this sector uses skilled labour more intensively, overall growth in skilled labour is projected to be marginally lower as compared to the unskilled labour. In the less digitally advanced economies the replacement of the labour factor with higher productivity is expected to be more intensive and therefore in these economies the overall employment growth will be marginal as employment is expected to decline slightly also in the manufacturing sectors.

Figure 4 – Production factors



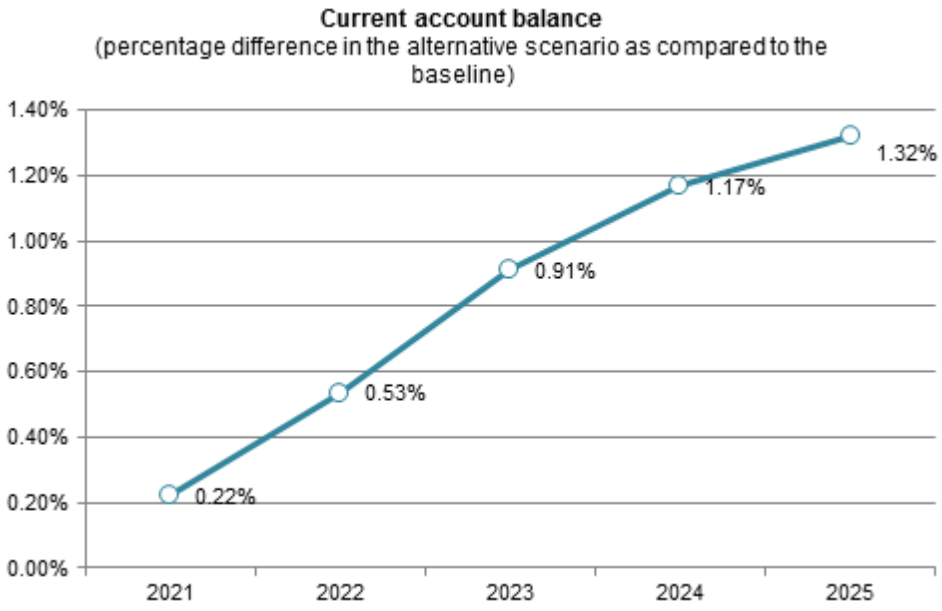
In terms of GDP composition by final use components, expectedly the highest deviation in the alternative scenario as compared to the baseline will be recorded in investments, as they are typically more volatile and respond more quickly to positive economic developments. In 2025 the cumulative deviation of investments against the baseline will amount to 0.9%.

Figure 5 – GDP by final use components



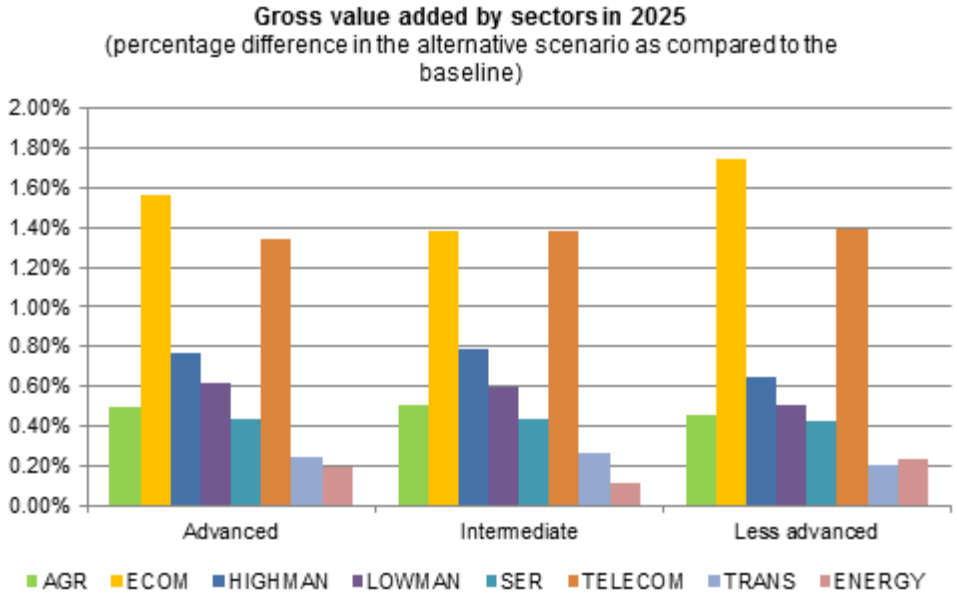
In contrast, consumption growth will be much more moderate - the deviation will amount to 0.4% in 2025. With respect to the external sector, exports will increase faster than imports and thus the current account will improve.

Figure 6 – Current account balance, % GDP



As the largest impact from higher broadband connection speed was estimated in the electronic communication sectors, they also exhibit the highest growth in value added, where other e-com services increases slightly more than telecom due to the very low share of the former in total gross value added. Manufacturing is also expected to benefit largely from higher connection speed, while the impact on transport and energy will be much lower, around 0.2% in 2025, thus contributing to the achievement of greener and more sustainable economic development.

Figure 7 – Gross value added by sectors in 2025



With respect to other important macroeconomic variables, relative prices of the e-communication sectors are expected to decline, thus exercising downward pressure on inflation.

Finally, it should be noted that the realization of the preferred policy options is also associated with some costs. For access policies, it has been estimated that the achievement of the accelerated fibre scenario is associated with a need for investment of EUR 92 bn for EU 28. If we assume that half of it is covered with public resources and financed through foreign borrowing and if it is divided equally in the years between 2018 and 2020, than this public spending is estimated to have an initial positive impact on GDP of around 0.1% from the demand side. However it will also imply worsening of the government budget balance and the external balances of the EU member states. This public spending is not expected to have a significant long-term impact on employment or consumption. In the much more ambitious scenario, where a total of EUR 200 bn is to be invested, the impacts are similar only scaled up around 2 times.

In case all investment costs are covered out of public resources, GDP grows by around 0.22% in 2018-2020, but afterwards budget and consumption restrictions induce small declines of GDP as compared to the baseline scenario. In the initial years of public investment, it also induces private capital formation, where the latter increases by 0.2% and 0.3% respectively in 2019 and 2020 as compared to the baseline.

In the **all fibre scenario**, macroeconomic developments are largely the same, only scaled upwards. The deviation in GDP from the baseline in 2025 will be as high as 0.95%, fuelled by larger investment by 1.5% and 0.7% expansion in consumption as compared to the baseline. Meanwhile, higher exports as compared to imports will determine the improvement in the current account balances. In this scenario, employment in the less advanced economies in the EU is already expected to decline on the account of lower job creation in the e-communication and manufacturing sectors.

Table 8 - Percentage deviations in the all fibre scenario as compared to the baseline in the main macroeconomic variables.

	2021	2022	2023	2024	2025
GDP	0.07%	0.23%	0.45%	0.67%	0.95%
Public capital	0.00%	0.00%	0.02%	0.04%	0.08%
Private capital	0.00%	0.01%	0.03%	0.07%	0.12%
Skilled labour	0.00%	0.01%	0.02%	0.02%	0.02%
Unskilled labour	0.00%	0.01%	0.02%	0.03%	0.02%
Investment	0.15%	0.43%	0.80%	1.15%	1.54%
Consumption	0.05%	0.16%	0.31%	0.46%	0.67%
Export	0.10%	0.30%	0.58%	0.87%	1.23%
Import	0.08%	0.25%	0.48%	0.72%	1.00%
Current account	0.26%	0.71%	1.27%	1.78%	2.39%

Table 9 - Percentage deviations in the all fibre scenario as compared to the baseline in the gross value added in 2025.

Gross value added	Advanced	Intermediate	Less advanced
AGR	0.87%	0.88%	0.80%
ECOM	2.81%	2.46%	3.14%
HIGHMAN	1.36%	1.39%	1.15%
LOWMAN	1.08%	1.04%	0.88%
SER	0.77%	0.77%	0.74%
TELECOM	2.39%	2.47%	2.49%
TRANS	0.43%	0.45%	0.34%
ENERGY	0.32%	0.18%	0.39%

Spectrum

The impacts from the implementation of the preferred policy options with respect to enhanced mobile broadband aspects of 5G[385] are summarized in the table below:

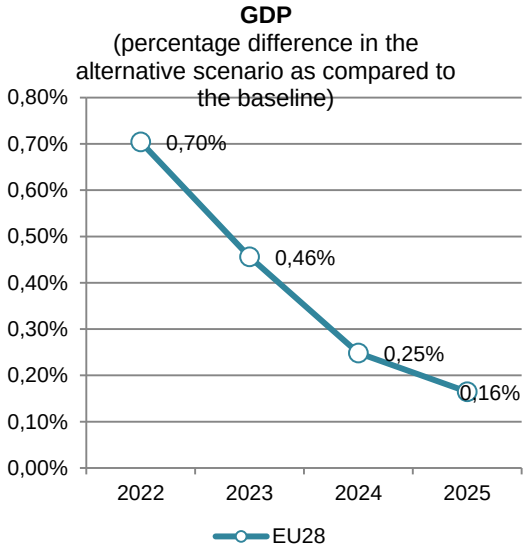
Table 10 – Impact from the preferred policy option

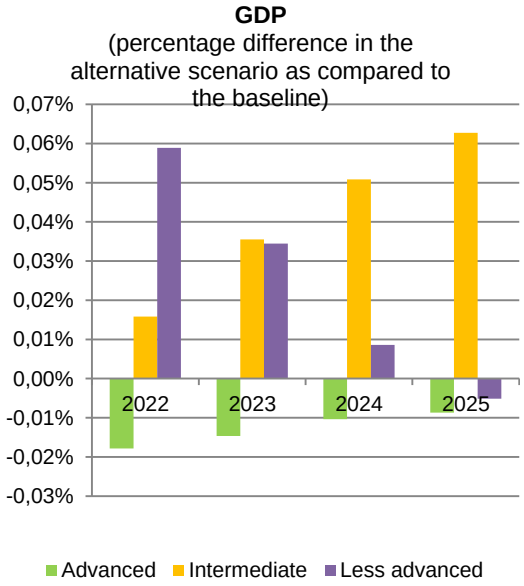
Year	EU eMBB 5G Coverage under baseline	Estimated eMBB 5G coverage under Option 3
2021	8.3	70.0
2022	27.0	93.3
2023	59.1	100.0
2024	79.4	100.0
2025	85.9	100.0
2026	89.0	100.0
2027	92.0	100.0
2028	95.0	100.0

[385] 5G as a network of networks will consist in different scenarios (i) enhanced mobile broadband (eMBB) (ii) massive machine-to-machine communications (very dense networks) and (iii) ultra-reliable and low latency networks. The coverage requirements of two specificities of 5G networks ie density and latency, will not reach 70% of EU population by 2020. However, as the economic gains are modelled on the gains assessed from LTE, a comparison with eMBB is considered to be more relevant. Other aspects of 5G which support IoT may in turn unlock further disruptive growth opportunities as discussed in the overview to the study

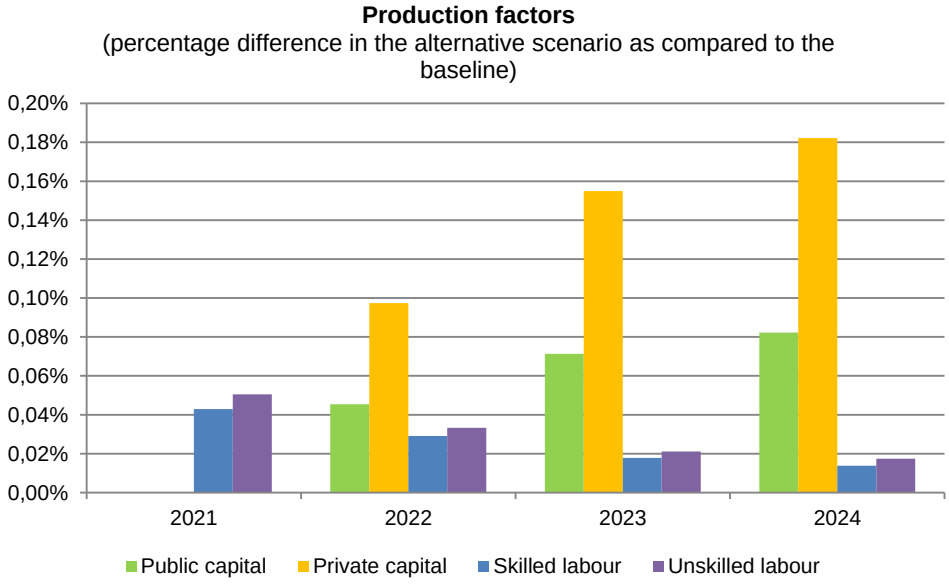
2029	98.0	100.0
2030	100.0	100.0

In the 'no change' policy scenario full eMBB coverage will achieved only in 2030, while under Option 3, a 100% coverage might be expected to be established in only 4 years (from 2020 up to 2023). If we assume that the impact on total factor productivity from eMBB aspects of 5G will be of the same magnitude as that of 4G, then it will have an effect on GDP of 0.16% in 2025. The impact will be highest in 2021, when almost 3/4 of the eMBB coverage will be realized. In terms of variations between EU countries the intermediate and less economically and digitally advanced countries are expected to benefit more from enhanced mobile broadband.



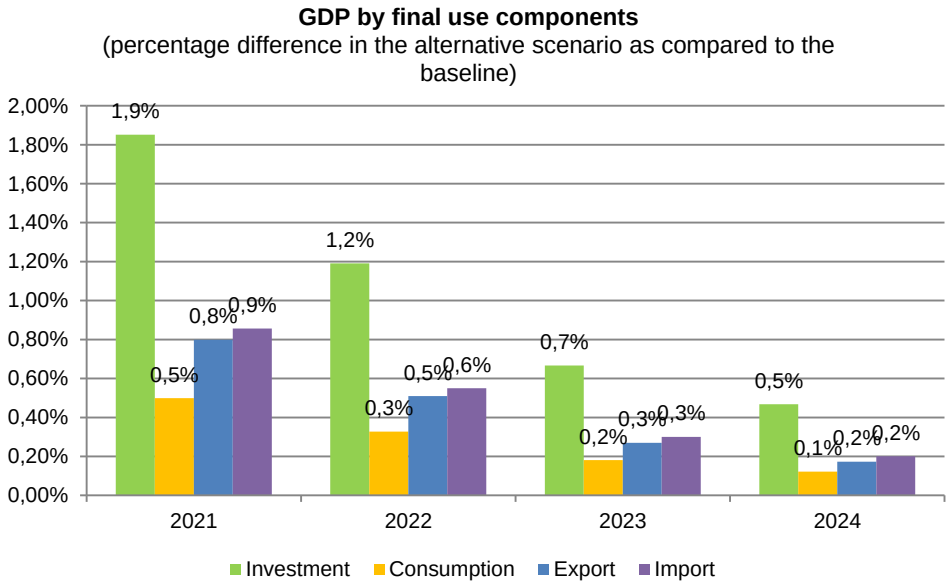


Similar to the simulations, based on access policies, faster coverage will have an important impact on capital and a marginally positive effect on employment.

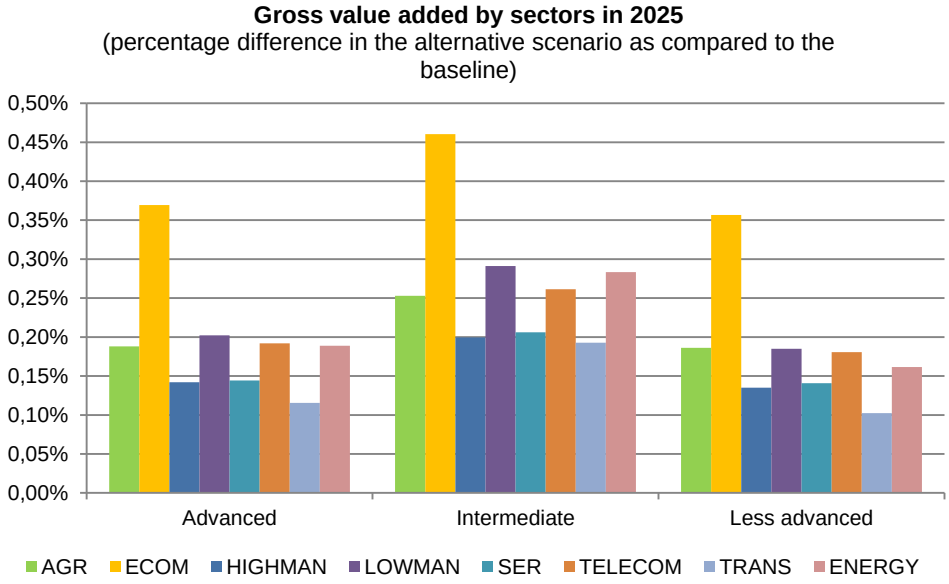


Again, gross fixed capital formation will expand most, by 1.9% in 2021 and 0.5% in 2025, while consumption dynamics will be much smoother. In contrast to the access scenarios, in this

spectrum-related scenario import will grow slightly faster than export, leading to a nearly balanced external sector.



E-communication sectors again will benefit most from higher eMBB coverage, this time followed by low-tech manufacturing and the production of electricity, thermal energy and gas.



Services – efficiency gains

The policy options in this area will have positive impact mainly on regulatory efficiency and effectiveness in the electronic communication sectors. However the magnitude of this impact is not directly quantitatively measurable. In order to overcome this difficulty, we have used the

results of a study by Haidar (2012)[386], which indicates that impact of a more significant regulatory reform on the growth rate of GDP per capita is 0.15% on average. We have assumed that such an impact will be channelled through improved TFP in the e-communication sectors and by means of iterations estimated that an average increase in GDP growth rate of 0.15 percentage points is associated with a 4% annual increase in TFP in the TELECOM and ECOM sectors, starting from 2020.

Under this scenario, GDP is expected to be by 0.74% higher than the baseline in 2025. However, this scenario will be associated with somewhat lower investment (or postponed consumption) at the expense of higher current consumption growth. Due to the fact that services policies will have direct impact on the TFP in the e-communication sectors only, it is associated with higher increases in skilled labour.

Table 11 - Percentage deviations in the services scenario as compared to the baseline in the main macroeconomic variables.

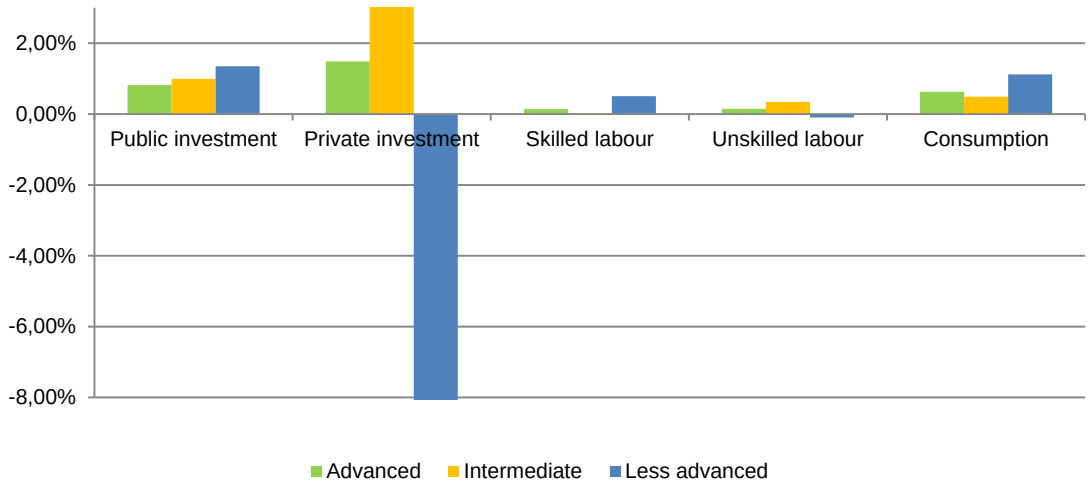
	2021	**2022**	**2023**	**2024**	**2025**
GDP	0.13%	0.27%	0.42%	0.57%	0.74%
Public capital	0.00%	0.01%	0.03%	0.07%	0.11%
Private capital	0.00%	0.01%	0.01%	0.01%	-0.02%
Skilled labour	0.01%	0.04%	0.08%	0.14%	0.20%
Unskilled labour	0.04%	0.07%	0.09%	0.11%	0.13%
Investment	0.20%	0.30%	0.29%	0.12%	-0.30%
Consumption	0.12%	0.25%	0.40%	0.55%	0.70%
Export	0.12%	0.26%	0.43%	0.63%	0.87%
Import	0.08%	0.16%	0.24%	0.29%	0.31%
Current account, % GDP (ppt)	0.02	0.07	0.14	0.25	0.40

The variation in the responses of the EU MS economies is larger in this scenario as well. The groups of less economically and digitally advanced economies, in particular, stands out as this scenario estimates a relatively higher increase in public investment in these economies, crowding out private investment. Also, in this cluster of EU MS the expansion in skilled labour is expected to outweigh significantly that of the unskilled labour.

Table 12 - Percentage deviations in the services scenario as compared to the baseline in investment, labour and consumption by clusters of EU Member States in 2025.

[386] Haidar J. I. (2012) "The impact of business regulatory reforms on economic growth", *Journal of The Japanese and International Economies*, 26 (2012), pp. 285-307.

Investment, labour and consumption by types of EU economies in 2025
(percentage difference in the alternative scenario as compared to the baseline)



2.5.6.1 Cumulative impact

Generally, for all assessed scenarios GDP is expected to increase compared with the baseline, with an anticipated **GDP uplift of 0.16% in 2025 for spectrum policies** compared with the baseline and a **GDP uplift of 0.54% for access policies** based on the more conservative 'accelerated fibre' scenario.

The cumulative impact up to 2025 is expected to be significant due to the expected supply side impacts, which are built up over time. More positive economic developments will have a significant impact on investment, while the effects on consumption with be more moderate, along with the life-cycle hypothesis for consumption smoothing. In the access scenarios the effects are larger for the intermediate and the most economically and digitally advanced economies in the EU, which have the potential to capitalize best the benefits from applying the preferred policy options, and for the least advanced economies in the EU, which start from a lower base. In the spectrum scenario, intermediate economies are expected to perform better against the remaining EU countries, as 5G will most probably induce more investments both in the e-communication sectors and manufacturing.

We also find **some positive employment impacts from access and spectrum policies (around 0.02% higher than the baseline)**, while the efficiency gains potentially driven by reforms fostering **digital services, might result in increases in employment of up to 0.15%** compared to status quo.

Table 13 - Impact of assessed scenarios on GDP, consumption, investment and employment

	GDP		Consumption		Investment		Employment	
	2021	2025	2021	2025	2021	2025	2021	2025
Accelerated fibre								
Advanced	0.06%	0.54%	0.04%	0.38%	0.14%	1.11%	0.00%	0.03%
Intermediate	0.07%	0.57%	0.04%	0.35%	0.12%	0.66%	0.01%	0.02%
Less advanced	0.06%	0.52%	0.04%	0.40%	0.08%	0.22%	0.00%	-0.03%
EU28	**0.06%**	**0.54%**	**0.04%**	**0.38%**	**0.13%**	**0.89%**	**0.00%**	**0.01%**
All fibre								
Advanced	0.08%	0.96%	0.05%	0.66%	0.16%	1.92%	0.00%	0.04%
Intermediate	0.08%	1.00%	0.04%	0.62%	0.14%	1.09%	0.01%	0.03%
Less advanced	0.07%	0.91%	0.05%	0.71%	0.10%	0.34%	0.00%	-0.05%
EU28	**0.07%**	**0.95%**	**0.05%**	**0.67%**	**0.15%**	**1.54%**	**0.00%**	**0.02%**
Services-efficiency gains								
Advanced	0.11%	0.62%	0.10%	0.63%	0.30%	1.38%	0.02%	0.14%
Intermediate	0.11%	0.67%	0.05%	0.49%	0.62%	3.06%	0.01%	0.21%
Less advanced	0.22%	1.25%	0.23%	1.12%	-0.44%	-8.80%	0.06%	0.16%
EU28	**0.13%**	**0.74%**	**0.12%**	**0.70%**	**0.20%**	**-0.30%**	**0.02%**	**0.15%**
Spectrum								
Advanced	0.00%	0.16%	0.00%	0.12%	0.00%	0.48%	0.00%	0.01%
Intermediate	0.00%	0.23%	0.00%	0.14%	0.00%	0.74%	0.00%	0.04%
Less advanced	0.00%	0.16%	0.00%	0.12%	0.00%	0.24%	0.00%	0.01%
EU28	**0.00%**	**0.16%**	**0.00%**	**0.12%**	**0.00%**	**0.47%**	**0.00%**	**0.02%**
Cumulative								
Advanced	0.17%	1.32%	0.14%	1.13%	0.44%	2.91%	0.02%	0.18%
Intermediate	0.17%	1.46%	0.09%	1.00%	0.73%	4.33%	0.02%	0.26%
Less advanced	0.28%	1.93%	0.28%	1.66%	-0.36%	-8.62%	0.06%	0.13%
EU28	**0.19%**	**1.45%**	**0.16%**	**1.22%**	**0.33%**	**0.96%**	**0.03%**	**0.18%**

Source: Ecorys

2.5.7 Earlier literature on modelling e-communications and ICT

Overall, the economic literature acknowledges that e-communications and ICT are an important driver of growth in the long-run, mainly through higher productivity. EC White paper on "Growth, competitiveness, employment: The challenges and ways forward into the 21st century"[387] and US International Trade Commission study on the "Global competitiveness of U.S. Advanced Technology Manufacturing Industries"[388] already in the early 1990s draw attention to the development of the information society as a key driver of growth and competitiveness. Later studies, such as a study by OECD on "Globalization of Services and Jobs"[389] and an UN paper from 2007[390] also indicate that efficient IT has become crucial infrastructure for improvement of the tradability of certain services and for long-term economic development.

Recently, there has been a multitude of studies, which either estimate the trends in the development in e-communication services or the socio-economic benefits from higher connectivity. The first group of studies incorporates either the construction of some measures of digitalization or other indexes for IT readiness or use, like the 2013 "Global Information Technology Report 2013: Growth and Jobs in a Hyperconnected World", edited by Beñat

[387] http://europa.eu/documentation/official-docs/white-papers/pdf/growth_wp_com_93_700_parts_a_b.pdf
[388] https://www.usitc.gov/publications/332/pub2434.pdf
[389] http://www.oecd.org/site/tadicite/50287724.pdf
[390] United Nations, 2007, "Technology, globalization, and international competitiveness: Challenges for developing countries" in Industrial Development for the 21st Century", http://www.un.org/esa/sustdev/publications/industrial_development/full_report.pdf

Bilbao-Osorio, Soumitra Dutta and Bruno Lanvin[391], or some market analysis, such as the Telco 2015 report[392].

The aforementioned 2013 Global Information Technology Report, in addition to the provision of various measures of technological readiness and digitalization, also identifies a significant favourable impact of digitalization of GDP per capita and for curbing unemployment. Sectorial impacts in the same paper show profound and accelerating effects of digitalization, which lead to modification of the business models and lower barriers to entry, enhanced communication and service provision to customers, optimization of the production process and streamlined operations of the companies. The Global IT report from 2013 also provides evidence of the 3G penetration on economic growth, as well as on the social and economic impacts the electronic healthcare records.

Based on the above-mentioned studies, there is a general acknowledgement of the fact that the development of electronic communication services has a significant positive impact on trade, productivity and GDP. More specifically, the economic literature outlines the following impacts of the enhanced use of e-communications:

- **Human capital**. The impact is channelled through two mechanisms: 1. an enhanced use of e-communications would require more skilled labour and 2. the use of e-communications makes information more easily available and favours more flexible and distance learning.
- **Labour mobility, business costs and environment**. The use of video conferences or other means of distance communication enables individuals to work from distance and reduces both operating costs for the respective businesses and the traffic in the transport network.
- **Disintermediation and reduced transaction costs**. The use of e-communications allows for shortening the supply chain in the provision of a large number of goods and services.
- **Social benefits**, like connection of excluded regions (e.g. rural regions) and gaining collective power (e.g. by using social media). However the effect on employment is not always unambiguous: sometimes technological progress might lead to less intensive use of labour or facilitate outsourcing to countries with cheaper labour.
- Introduction of **new products and services**.
- With the use of e-communications **more time becomes available** for leisure or work.
- E-communications **fosters innovation**.

With respect to the methodological approach to the estimation of the social, economic and environmental impact of various policies, affecting the e-communication sector, there is a multitude of modelling alternatives. Recently applied methods include mostly econometric modelling, but also computable general equilibrium (CGE) models and even dynamic stochastic general equilibrium (DSGE) models.[393]

[391] http://www3.weforum.org/docs/WEF_GITR_Report_2013.pdf
[392] Telco 2015: Five Telling Years, Four future Scenarios, IBM, http://public.dhe.ibm.com/common/ssi/ecm/gb/en/gbe03304usen/GBE03304USEN.PDF
[393] DSGEs have become a popular tool for economic modelling, but they are still limited to a highly stylized representation of the economy due to the challenges related to their numerical solution. Taking into account the need to design a multi-sector model for the implementation of the current impact assessment, the development of a large-scale DSGE model will be too ambitious within the scope of this project.

2.5.8 Econometric modelling

Examples of the **econometric modelling** approach are:

- Czernich et al. (2009)[394] specifying a production function, assuming that increased use of broadband services has a positive impact of the total factor productivity in the economy. In their estimations, however, they use instrumental variables to control for the broadband penetration already achieved. Thus, an increase in the broadband penetration rate by 10 p.p is estimated to contribute to annual GDP growth per capita by 0.9-1.5 p.p. It should, however, be taken into account that the results of this study cannot be directly used in our work, as they relate more to increased coverage, rather than to higher speed access. Nonetheless, this study could be useful from a methodological point of view.

- Spiezia (2012)[395] constructs a production function, where three types of ICT investment are incorporated: computer, software and communication. It is then estimated econometrically for 26 industries and 18 OECD countries for the period between 1995 and 2007. ICT investments are found to contribute to economic growth by 0.4-1 % per annum.
- Oliner et al. (2007)[396] and Jorgenson et al. (2008)[397] providing an estimation of the impact of information technologies for the productivity increases in the US by including both IT and intangible capital in a growth accounting framework.
- Regeneris' investigation, performed in 2012 for UK's largest communication services supplier BT also provides econometric evidence on the impact of increased broadband speed on welfare (measured by the gross value added) and employment due to enhanced business performance, new business creation and better home working opportunities.
- Mölleryd's[398] paper builds on a model used for estimation of the social and economic benefits from the development of an open, operator-neutral fibre network in Stockholm. It provides useful estimates of the benefits of high-speed broadband on economic growth and firms productivity. The study also finds evidence that high-speed broadband networks can potentially substitute some transport services, create employment opportunities and even provide more efficient home care services.

2.5.8.1 DSGE modelling

Seeking to account for more general macroeconomic effects from the reforms, related to the digital agenda of the EU, Lorenzani and Varga (2014)[399] augment the EC **dynamic general equilibrium model** QUEST III. The estimated policies include competition and investment-enhancing policies in the radio spectrum, enhancement of the professional e-skills, deepening of the e-Commerce and increased fixed broadband take-up. They find a positive impact of over 1% on long-term economic growth of the reforms that have already been implemented and potential for additional 2.1% in case the Digital Agenda for Europe targets are achieved.

[394] Czernich, N., O. Falck, T. Kretschmer and L.Woessmann (2009), "Broadband Infrastructure and Economic Growth", CESifoWorking Paper, No. 2861, Munich

[395] Spiezia V. (2012) "ICT investments and productivity: Measuring the contribution of ICTs to growth", OECD Journal: Economic Studies, vol. 2012/1.

[396] Oliner, S. D., D.E. Sichel and K.J. Stiroh (2007), "Explaining a Productive Decade", *Brookings Papers on Economic Activity*, 1, 81-151.

[397] Jorgenson, D. W., M.S. Ho and K.J. Stiroh (2008), "A Retrospective Look at the US Productivity Growth Resurgence", *Journal of Economic Perspectives*, 22(1), 3-24.

[398] Mölleryd G., 2015, "Development of High Speed Networks and the Role of Municipal Networks", *OECD Science, Technology and Innovation Policy Papers No. 26*, OECD.

[399] Lorenzani D. and J. Varga (2014) "The Economic Impact of Digital Structural Reforms", EC economic papers 529/September 014.

2.5.8.2 CGE modelling

CGE models are less frequently used to study the economic, social and environmental impact of electronic communications but they present a number of advantages in case multiple countries or multiple sectors need to be incorporated. As a most recent example of this type of modelling, Christensen (2015)[400] presents a multi-country, multi sector dynamic computable general equilibrium model, where ICT and R&D are imbedded in the production function.

Khorshid and El-Sadek (2012)[401] also develop a CGE model with a focus on the ICT sector for Egypt, where they base their estimations on a social accounting matrix, which aim is to capture the impact of the ICT on the other economic sectors, as well as on the labour and capital demand and on the income distribution. As a result, they provide estimates of the impact from four policies – 1. Measures to increase ICT investment, 2. Policies, specifically targeted to achieve growth in the ICT sector, 3. National training, reorientation and capacity building program leading to an enhanced factor productivity and labour efficiency in the economy as a whole based on advanced ICT and 4. Foreign exchange policy to promote ICT exports to the outside world.

Finally, Moon et al. (2000)402 use the ORANI-F model, calibrated to the Korean economy, but rather than estimating the impact of ICT, they only make projections on the structure of the Korean economy by sectors and draw implications about the development of the ICT sector in terms of growth, export share, composition by subsectors, etc. However, this study has the merit of providing a reference classification of the ICT activities.

2.5.9 Elaboration of the methodology

2.5.9.1 Estimation of the production function with stochastic frontier analysis

If we take into account that the production function is defined as the function, which transforms given inputs into the maximum output quantity, then the actual output will be either at the production possibility frontier or below it. Therefore, the output can be estimated as a function of the production function, taking into account also possible inefficiency and stochastic shocks[403]:

$$\ln Y = \ln f(x) - u + \epsilon, \qquad u \geq 0$$

(SFA1)

where Y is the output, $f(x)$ is the production function, where the input x is an argument, $u \geq 0$ are inefficiencies and ϵ is the error term. The latter equation is equivalent to

$$Y = f(x).e^{-u}.e^{\epsilon}$$

(SFA2)

and allows us to define the following measure of output-oriented technical efficiency:

$$TE = \frac{Y}{f(x).e^{\epsilon}} = \frac{f(x).e^{-u}.e^{\epsilon}}{f(x).e^{\epsilon}} = e^{-u}$$

(SFA3)

[400] Christensen M.A. (2015), "A CGE Model with ICT and R&D-driven Endogenous Growth: A Detailed Model Description", *Joint Research Centre technical reports*, Report EUR 27548 EN.

[401] Khorshid M. and A. El-Sadek (2012) "A Multi-sector ICT Economy Interaction Model for Egypt: The Path to Information Society", International Conference on Policy Modeling 2012.

[402] Moon S-W, Y. Kim and D-P. Hong (2000), " The Economic Importance of the Information and Communications Technology (ICT) Industry in Korea: A CGE Approach", presented at the 3rd Annual Conference on Global Economic Analysis.

[403] Meeusen, W. and J. van den Broeck, 1977, "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error", *International Economic Review* 18:435-444. Aigner, D., C. Lovell and P. Schmidt, 1977, "Formulation and Estimation of Stochastic Frontier Production Function Models", *Journal of Econometrics* 6:21-37.

We have estimated the above econometric model by maximum likelihood estimator with time-varying efficiencies, available in package 'frontier' under the R software. The error term follows a normal distribution with zero mean and constant variance and the inefficiencies u are assumed to be independently distributed according to a positive half-normal distribution:

$$\epsilon \sim N(0, \sigma_\epsilon^2)$$

$$u \sim N^+(\mu, \sigma_u^2)$$

These standard assumptions ensure that the distribution of $-u + \epsilon$ is skewed to the left so that the difference between actual and optimal production $\ln(Y) - \ln(f(x))$ stays negative.

Based on a dataset for the 28 EU economies[404], we have estimated a production function, relating GDP to capital and labour:

$$\ln(Y_{rt}) = \alpha_0 + \alpha_1 . \ln(L_{rt}) + \alpha_2 . \ln(K_{rt}) + \alpha_{3,r} . Country_r + \alpha_4 . DCRISIS_t + t + \varepsilon_{rt},$$
(SFA4)

where Y_t stands for GDP in constant 2010 prices of country r in period t ($t \in [2000,2015]$), L_{rt} is employment, $Country$ capture the fixed effects for each of the EU28 MS and $dCRISIS_t$ is added to account for the economic crisis, starting from 2008 onwards. The capital K_{rt} is defined as:

$$K_{rt} = 3 . Y_{r1995} . \sum_{i=0}^{t-1995} (1-v)^i + \sum_{i=0}^{t-1-1995} (1-v)^i I_{ri}, \qquad t \in [1996,2015]$$
(SFA5)

Assuming a depreciation rate $v = 0.1$, the assumption of the capital-to-GDP ratio in the base 1995 year becomes irrelevant from 2005 onwards.

As a second step we then regress the derived efficiency terms against the Heritage Index of Economic Freedom and variables, related to the development of the e-communication services in the EU:

$$\ln(EFF_{rt}) = \beta_1 . \ln(heritage_{rt}) + \beta_2 . \ln(mbb\_ltecov_{rt}) + \beta_3 . \ln(DOWNSPEED_{rt}) + \beta_{4,r} . Country_r + \upsilon_{rt},$$
(SFA6)

In the above formula, $heritage_{rt}$ stands for the Heritage Index[405], intended to measure the developments in terms of rule of law, size of the government, regulatory efficiency and openness of the economy as key contributors to total factor productivity. Among others it can also be used as a proxy to measure of the effectiveness and efficiency of the regulation.

The variable $DOWNSPEED_{rt}$ measures the average download speed. Finally, the impact of the 4G mobile broadband coverage (as % of all households) mbb_ltecov_{rt} also proved to be statistically significant.

In the estimation of the impact of e-communications on the total factor productivity we also tested specifications including other key variables from the Digital Agenda Database[406], such as the Herfindahl-Hirschman Index on broadband competition, investments in the telecom sector, market share of leading operator (in % of active SIM cards) and share of the individuals interacting online with public authorities in the past 12 months. They however proved either

404 Eurostat, National Accounts (ESA2010) statistics.

405 http://www.heritage.org/index/

406 https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators

statistically insignificant, or had the wrong sign. These problems are largely due to the short time series available for most of the considered indicators, covering post-2008 crisis period, when unsteady GDP growth rates and, at the same time, significant improvements in digital agenda indicators were observed. Attempts to add other variables to control for the crisis were largely not very successful either.

2.5.9.2 C.2. Cluster analysis for the selection of representative economies

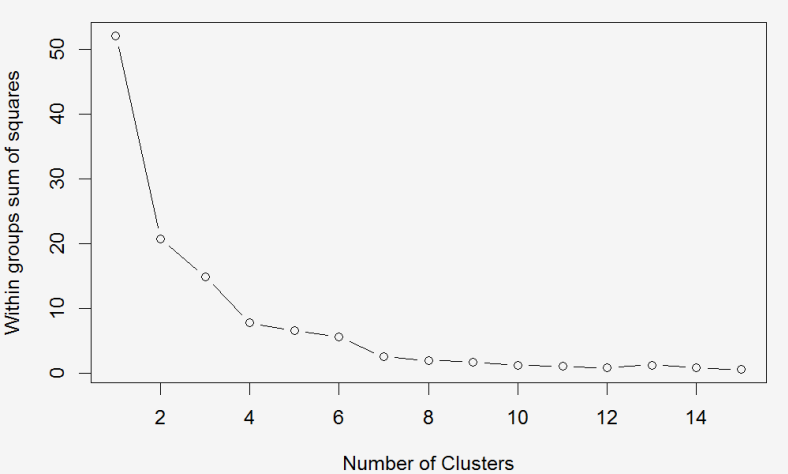
The model features a regional breakdown to allow for assessment of the impact of the proposed policy options not only for the EU as a whole, but also taking into account the differences between the EU MS in terms of digitalization, overall economic development and size of the economy.

As inclusion of all 28 EU MS economies increases exponentially the dimension of the model, we decided to cluster the EU countries according to the dimensions, mentioned in the previous paragraph and select a single representative economy from each of the identified clusters.

The variables, which were used to identify each cluster, are the following:

- The Digital Economy and Society Index (DESI), compiled by the EC
- Gross domestic product

The number of clusters was set to 6, based on the so called elbow method – number of clusters is plotted against the percentage of variance explained (see the figure below).



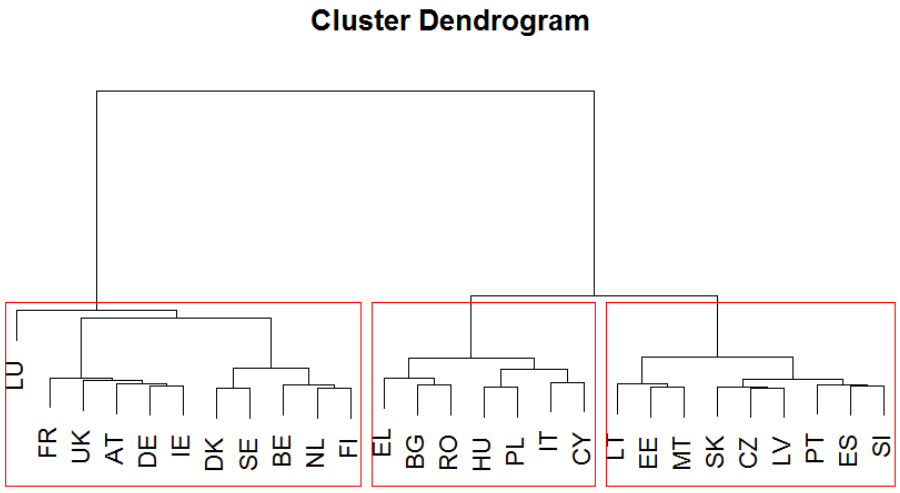
The number of clusters to be used is selected based on two criteria:

1. Keep the number of clusters as small as possible

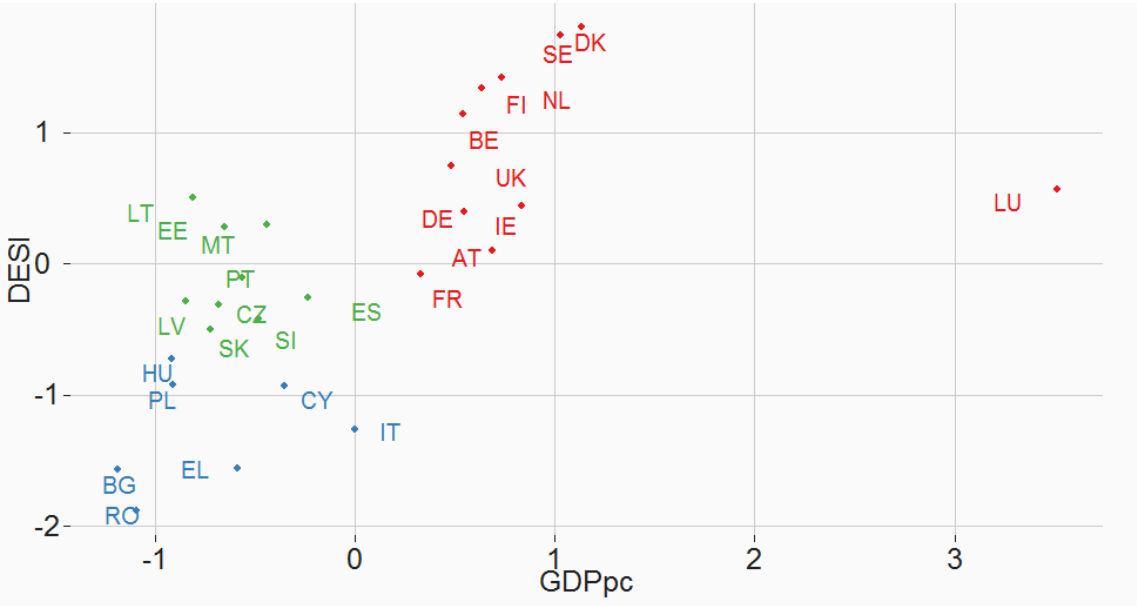
2. Choose the number of clusters so that adding another cluster does not improve the explanation of the differences significantly.

Based on the above figure, we had to select either 4 clusters, but the grouping of the countries into 4 distinctive clusters resulted in a separate group, consisting of Luxembourg alone. So, for efficiency reasons, we resorted to 3 clusters.

The clusters were selected with the Ward method for hierarchical cluster analysis, based on minimization of the within-cluster variances. As a result the following clusters were identified:



To obtain a better idea of the groups of countries, employed in the model, we have depicted each of the countries along the clustering criteria, where colour codes were introduced to distinguish the six clusters.



Generally, one can identify a group of 11 countries (LU, DK, SE, FI, NL, BE, UK, DE, IE, AT, FR), which have very developed economies and rate very high in terms of digital development. The second cluster consists of the largest share of the countries, which joined the EU in 2004. They are slightly worse in terms of digitalization and economic development – LT, EE, MT, PT, CZ, LV, SK, SI. The group of the least developed countries in terms of economy and digitalization consists of Bulgaria, Romania, Greece, Cyprus, Italy, Hungary and Poland.

Based on the identified clusters of countries, we have selected the following three representative economies modelled in the CGE framework:

- Germany
- Czech Republic
- Bulgaria

They are viewed as 'typical' representatives of their groups, where no special economic or political circumstances have been observed in the past years.

2.5.9.3 C.3. Computable general equilibrium model: outline

We model an economy, which consists of the three representative regions/ countries, selected as a result of the cluster analysis, and rest-of-the-world, where eight types of products are being produced using private and public capital, unskilled and skilled labour.

Each **economic sector** operates under perfect competition, maximizing its profit, subject to its production technology. The sectorial production functions are defined as Constant elasticity of substitution (CES) production functions. They take as production factors private and public capital KPR and KPU, skilled labour H and unskilled labour N.

$$\max_{L_{jrt},H_{jrt},KPR_{jrt},KPU_{jrt}}\left(PVA_{jrt}.VA_{jrt} - PN_{rt}.N_{jrt} - PH_{rt}.H_{jrt} - PKPR_{rt}.KPR_{jrt} - PKPU_{rt}.KPU_{jrt}\right)$$

(CGE1)

s.t.

$$VA_{jrt} = \sigma_{jrt}^{VA}\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right)^{\frac{1}{\nu_{jr}^{VA}}} \quad \text{(CGE2)}$$

$$N_{jrt} \geq 0, \qquad H_{jrt} \geq 0, \qquad KPR_{jrt} \geq 0, \qquad KPU_{jrt} \geq 0$$

where j, r and t represent respectively the j-th economic sector, r-th region and t-th time period. In other words, we have unconstrained maximization problem and a definition of the value added VA_{jrt}:

$$\max_{L_{jrt},H_{jrt},KPR_{jrt},KPU_{jrt}}\left(PVA_{jrt}.\sigma_{jrt}^{VA}\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right)^{\frac{1}{\nu_{jr}^{VA}}} - PN_{rt}.N_{jrt} - PH_{rt}.H_{jrt} - PKPR_{rt}.KPR_{jrt} - PKPU_{rt}.KPU_{jrt}\right)$$

(CGE3)

The **household** derives utility from final consumption C_{irt} and savings S_{rt} and disutility – from the two types of labour N_{jrt} and H_{jrt}. The introduction of labour as a control variable in the household problem (i.e. endogenous labour supply) allows for modelling the link between technological progress and labour supply.

$$\max_{C_{irt},N_{jrt},H_{jrt},S_{rt}}\left(\sum_i \theta_{ir}.\ln C_{irt} - \sum_j \xi_j \frac{{N_{jrt}}^{\rho+1}}{\rho+1} - \sum_j \pi_j \frac{{H_{jrt}}^{\rho+1}}{\rho+1} + \kappa.\ln S_{rt}\right)$$

(CGE4)

s.t.

$$\sum_i P_{irt}.C_{irt} = (1-td_r)\sum_j\left(PN_{jrt}.N_{jrt} + PH_{jrt}.H_{jrt} + PKPR_{jrt}.KPR_{jrt}\right) + ror * A_{rt} + tr_r - S_{rt}$$

(CGE5)

$$C_{irt} \geq 0, \qquad N_{jrt} \geq 0, \qquad H_{jrt} \geq 0,$$

The **government** revenues consist of receipts from direct and indirect taxes, interest on its assets[407] and income from public capital. It spends on government consumption, transfers to the households and capital expenditures. The difference between government revenues and expenditures constitutes the government budget balance:

$$BB_{rt} = R_{rt} - G_{rt} =$$

$$ttd_r.\sum_j\left(PN_{jrt}.N_{jrt} + PH_{jrt}.H_{jrt} + PKPR_{jrt}.KPR_{jrt}\right) + \sum_i \tau_{ir}.\frac{P_{irt}}{(1+\tau_{ir})}.Q_{irt} + \sum_j PKPU_{jrt}.KPU_{jrt} + ror * AG_{rt} - \left(\sum_i cg_{irt}.P_{irt} + tr_{rt} + KE_{rt}\right) \quad \text{(CGE6)}$$

For the **foreign sector**, we have adopted the Armington assumption, which contradicts the conventional Heckscher and Ohlin foreign trade theory, but provides explanation on the following facts:

- many commodities are imported and exported from a single country simultaneously;
- even at the most disaggregated level, most countries produce in all product categories and thus specialization in a single product, for which the country has comparative advantage, is not possible;
- the assumption takes into account the different substitution elasticities between the commodities, produced in the country and the imported ones and therefore allows for estimation of the changes in the relative prices of the imported goods and services.

To apply the Armington assumption, a composite product Q_{irt} is defined, which quantity is determined as a CES function of the quantity produced in the country for the domestic market QD_{irt} and imports QM_{idt}.

$$Q_{irt} = e_i\left(\beta_i.QM_{irt}^{-\sigma_i} + (1-\beta_i).QD_{irt}^{-\sigma_i}\right)^{-1/\sigma_i} \quad \text{(CGE7)}$$

where e_i is a scale parameter, β_i measures the share of imports and σ_i is an exponent, which is equal to $\frac{1}{elasticity\ of\ substitution} - 1$. It is constrained to satisfy $-1 < \sigma_i < \infty$ to ensure that the respective isoquant is convex, i.e. that we have a decreasing technical rate of substitution.

The domestic prices, respectively are determined by calculation of the optimal ratio between imported and domestically produced goods and services:

$$\frac{QM_{irt}}{QD_{irt}} = \left(\frac{PD_{irt}}{pm_{it}}.\frac{\beta_i}{1-\beta_i}\right)^{1/1+\sigma_i} \quad \text{(CGE8)}$$

In a similar manner the substitution between the products, produced for the domestic market and for exports is described through a constant elasticity of transformation function (CET). The CET is almost identical to the above CES function, defined for the combination of domestically produced and imported commodities, with the exception of the elasticities of substitution, which are no longer negative.

[407] Is government assets are positive, then it receives interest, if not – it pays interest on its debt.

$$QP_i = f_i\left(\eta_i . QE_i^{\gamma_i} + (1-\eta_i) . QD_i^{\gamma_i}\right)^{1/\gamma_i}$$ (CGE9)

Here $-1 < \gamma_i < \infty$ to ensure a concave isoquant.

Again, the optimal relationship between exports and products for the domestic market is calculated:

$$\frac{QE_i}{QD_i} = \left(\frac{pe_i}{PD_i} . \frac{1-\eta_i}{\eta_i}\right)^{1/\gamma_i - 1}$$ (CGE10)

To complete the external sector, foreign savings FS_{rt} are estimated as the difference between foreign sector revenues from imports and interest on its assets and incurred expenditures from exports, where p is an index for the respective external trade partners.

$$\sum_i \sum_p PE_{it} . QE_{iprt} + FS_{rt} = \sum_i \sum_p PM_{it} . QM_{iprt} + ror * AF_{rt}$$ (CGE11)

We also specify the usual equalities between total quantity supplied and used, defining the link between the make and use tables in the national accounts:

$$Total\ quantity\ supplied = Q_{irt} =$$

$$Total\ quantity\ used \quad = \sum_j IC_{ijrt} + C_{irt} + cg_{irt} + ID_{irt} + QE_{irt} + QT_{irt}$$ (CGE12)

and savings equals investment:

$$\overline{PK}_{rt} . II_{jrt} = \frac{K_{jrt}}{\sum_j K_{jrt}} (S_{rt} + KE_{rt} + BB_{rt} + FS_{rt} - ror * (A_{rt} + AF_{rt} + AG_{rt}) - \sum_i P_{irt} . Z_{irt} - DUMMY_{rt})$$ (CGE13)

where $DUMMY_{rt}$ is a dummy variable, added to ensure that the system of equations becomes functionally independent (which is not the case otherwise, due to Walras law). To close the model, an additional equation for each region is defined by normalizing the prices to the overall price level in the respective region:

$$plevel_{rt} = \sum_i w_{ir} . P_{irt}$$ (CGE14)

As specified, the model is static in its nature, as all agents optimize only in the current period t and not over the entire time horizon of the simulations. However, the model allows also for transitional analysis by incorporating a capital and asset accumulation equations and constant growth of total factor productivity to capture some of dynamic in changes to the "state of the world":

$$KKPU_{jrt+1} = (1-\delta) . KKPU_{jrt} + IPU_{jrt}$$

$$KKPR_{jrt+1} = (1-\delta) . KKPR_{jrt} + IPR_{jrt}$$

$$\sigma_{jrt+1}^{VA} = (1 + \gamma A_t).\sigma_{jrt}^{VA}$$

$$A_{rt+1} = (1 + \mathrm{ror_r}).+S_{rt}$$

$$AF_{rt+1} = (1 + \mathrm{ror_r}).+FS_{rt}$$

$$AG_{rt+1} = (1 + \mathrm{ror_r}).+BB_{rt}$$

2.5.9.4 C.3.1. Sectorial and skill breakdowns

Sectorial disaggregation

In the selection of the disaggregation by economic sectors, we largely follow Christensen (2015). The classification of the low-tech and high-tech manufacturing sectors is made following the Eurostat classification[408]. In addition to this division of the manufacturing activities, we also specify the telecom, energy, transport and other e-com activities separately due to their importance for the impact assessment. Thus the economic sectors covered include:

1. Agriculture
2. Low-tech manufacturing
3. High-tech manufacturing
4. Energy sector
5. Transport
6. Telecommunications
7. E-communication services
8. Other services.

Skill disaggregation of labour

As specified the sectors use labour with very different qualification. If we assume the ILO classification based on occupations[409] , where the occupations are mapped by skill, using the following transition key:

ISCO-08 major groups	Skill level (from 1 to 4, where 4 is the highest)
1 Managers	3 + 4
2 Professionals	4
3 Technicians and Associate Professionals	3
4 Clerical Support Workers	2
5 Services and Sales Workers	2
6 Skilled Agricultural, Forestry and Fishery Workers	2
7 Craft and Related Trades Workers	2
8 Plant and Machine Operators and Assemblers	2
9 Elementary Occupations	1
0 Armed Forces Occupations	1 + 2 + 4

For the modelling purposes, we have grouped skill levels 1 and 2 into unskilled labour and skill levels 3 and 4 into skilled labour. In this way over 4/5 of the labour employed in agriculture and transport are unskilled. The share of unskilled labour in low-tech manufacturing and services is respectively around 2/3 and 1/2 and for the telecommunications and other e-communication services – between 1/4 and 1/3.

[408] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

[409] International Labour Office, 2012, "International Standard Classification of Occupations ISCO-08", Geneva, available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf

2.5.9.5 C.3.2. Data sources and transformations

The inputs to the model consist of three major types: statistical data, estimates of some of the parameters for the model, based on identified relevant studies and information on the policy options considered, based on the input from the EC and a review of the development of the relevant legislative and institutional framework.

In order to perform simulations with the specified model, it is calibrated with some representative data about the groups of countries identified in the cluster analysis (described in the next section). The latter, together with the envisaged econometric estimations of particular parameters, also require detailed data about the e-communications services sector. Additionally, data on the main socio-economic variables has been collected.

Below, a list of all used sources of information is provided. Data for the econometric estimations was used in logarithms.

Data	Source	Used for
Supply-use tables for all EU MS economies	Eurostat, Supply, Use and Input-Output tables	Construction of the social accounting matrices for the CGE model.
Main revenues and expenditure aggregates for the government	Eurostat, Annual government finance statistics	Construction of the social accounting matrices for the CGE model.
GDP and components by final use, income and production accounts (including by economic sectors), employment population and per capita	Eurostat, National accounts	Econometric estimations of the impact of the KPIs SAM and parameters calibrations for the CGE model Cluster analysis
Employment by occupation and economic activity	Eurostat, Detailed annual LFS statistics on employment	Estimation of the skilled and unskilled labour supply in the CGE model
Exports and imports by trading partners and commodities	Eurostat, EU trade since 1988 by SITC	Construction of the social accounting matrices for the CGE model.
Data on KPIs, related to the e-communications	EC Digital Agenda Key indicators dataset	Econometric estimations of the impact of the KPIs.
Heritage index	Heritage foundation webpage: http://www.heritage.org/index/explore	Econometric estimations of the impact of the KPIs.
Data on DESI index		Cluster analysis for the identification of the regions in the CGE model

2.5.9.6 C.3.3. Calibration

The majority of the parameters are calculated from the social accounting matrices, constructed for the implementation of the computable general equilibrium model, respectively for Germany, Czech Republic and Bulgaria. They are computed backwards, so as to reproduce some of the equations in the model for the base year, taking the variable values as given.

Another big group of parameters are also calibrated based of historical data for the respective economies. Finally, there is also a group of parameters, which are set, based on economic literature review. The model proved robust with respect to most of them with the exception of the elasticities in the Armington and CET aggregation functions ($\boldsymbol{elQ_{jr}}$ and $\boldsymbol{elQP_{jr}}$). They were adjusted to achieve a better reproduction of the baseline trajectories.

Parameter	Setting of the value
$\boldsymbol{elVA_{jr}}$	0.99 (i.e. practically corresponds to Cobb-Douglas function)
$\boldsymbol{elL_{jr}}$	0.99 (i.e. practically corresponds to Cobb-Douglas function)
$\boldsymbol{elK_{jr}}$	0.99 (i.e. practically corresponds to Cobb-Douglas function)
$\boldsymbol{elQ_{jr}}$	0.20, adjusted to reproduce plausible economic development trajectory in the baseline
$\boldsymbol{elQP_{jr}}$	0.20, adjusted to reproduce plausible economic development trajectory in the baseline
$\boldsymbol{\beta_{jrt}^{VA}}$	Calculated values of the share of labour in gross value added (SAM)
$\boldsymbol{\beta_{jrt}^{L}}$	Calculated values of the share of unskilled labour is total labour (SAM)
$\boldsymbol{\beta_{jrt}^{K}}$	Calculated values of the share of public capital in total capital (SAM)
$\boldsymbol{\beta_{jrt}^{Q}}$	Calculated from equation (QMQD) in the base year (SAM)
$\boldsymbol{\beta_{jrt}^{QP}}$	Calculated from equation (QEQD) in the base year (SAM)
$\boldsymbol{\nu_{jrt}^{VA}}$	$\boldsymbol{\left(elVA_{jr}-1\right)/elVA_{jr}}$
$\boldsymbol{\nu_{jrt}^{L}}$	$\boldsymbol{\left(elL_{jr}-1\right)/elL_{jr}}$
$\boldsymbol{\nu_{jrt}^{K}}$	$\boldsymbol{\left(elK_{jr}-1\right)/elK_{jr}}$
$\boldsymbol{\nu_{jrt}^{Q}}$	$\boldsymbol{\left(elQ_{jr}-1\right)/elQ_{jr}}$
$\boldsymbol{\nu_{jrt}^{QP}}$	$\boldsymbol{\left(elQP_{jr}-1\right)/elQP_{jr}}$
$\boldsymbol{\sigma_{jrt}^{L}}$	Calculated from equation (LAGGR) in the base year (SAM)
$\boldsymbol{\sigma_{jrt}^{K}}$	Calculated from equation (KAGGR) in the base year (SAM)
$\boldsymbol{\sigma_{jrt}^{Q}}$	Calculated from equation (QAGGR) in the base year (SAM)
$\boldsymbol{\sigma_{jrt}^{QP}}$	Calculated from equation (QPAGGR) in the base year (SAM)

η_{jrt}^{L}	Calculated from data on employment by occupation and economic activity (from 2008 onwards, NACE Rev. 2) from Eurostat
η_{ijrt}^{IC}	Calculated from equation (ICSH) in the base year (SAM)
η_{jrt}^{VA}	Calculated from equation (VASH) in the base year (SAM)
η_{jirt}^{QP}	Calculated from equation (QPSH) in the base year (SAM)
η_{ii1rt}^{QT}	Calculated from equation (QTEQ) in the base year (SAM)
η_{rt}^{KE}	Calculated from equation (KEEQ) in the base year (SAM)
η_{irt}^{ID}	Calculated from equation (IDEM) in the base year (SAM)
η_{jrt}^{IPU}	Calculated from equation (IPUSH) in the base year (SAM)
η_{rt}^{FS}	Set as the share of current account in GDP in the base year
η_{rt}^{BB}	Set as the share of consolidated government budget balance in GDP in the base year
η_{rt}^{S}	Set as the share of savings in GDP in the base year, adjusted to reproduce plausible economic development trajectory in the baseline
utk_r	Calculated to reproduce a plausible economic development trajectory in the baseline
td_r	Calculated from the SAM as a ratio between revenues from direct taxes and the respective tax base
τ_{ir}	Calculated from the SAM as a ratio between revenues from indirect taxes and the respective tax base
δ_r	0.025
θ_{ir}	Calculated from equation (HCONS) in the base year (SAM)
w_{ir}	Calculated as the share of consumption of product I in total consumption in the base year (SAM)
ξ_{jr}	Calculated from equation (NSUP) in the base year (SAM)
π_{jr}	Calculated from equation (HSUP) in the base year (SAM)
ρ_r	2.3436, based on Mandelman and Zlate (2011)[410]
κ_r	1 (the parameter has a scaling effect and simulations with different values did not show impact on the results)
ι_r	Calculated from equation (IbarEQ) in the base year (SAM)
ror_r	Set at very low levels, in line with the current trend of very low interest rates
$plevel$	Calculated from equation (PNORM) in the base year (SAM)
zv_{ir}	Calculated from the respective use tables in the base year

2.5.10 List of abbreviations and equations in the CGE model

2.5.10.1 List of indices

Abbreviation	Definition
j	sectors
i	products
r	regions
t	time periods

[410] Mandelman F. and A. Zlate (2011), " Immigration, Remittances and Business Cycles", Federal Reserve Bank of Atlanta.

2.5.10.2 List of parameters

Abbreviation	Definition
$elVA_{jr}$	Elasticity of substitution in the CES production function
elL_{jr}	Elasticity of substitution in the labour aggregation function
elK_{jr}	Elasticity of substitution in the capital aggregation function
elQ_{jr}	Elasticity of import substitution (Armington)
$elQP_{jr}$	Elasticity of transformation
β_{jrt}^{VA}	Share of value-added to labour in activity j
β_{jrt}^{L}	Share parameter in the labour aggregation function
β_{jrt}^{K}	Share parameter in the capital aggregation function
β_{jrt}^{Q}	Share parameter in the composite supply Armington function for i
β_{jrt}^{QP}	Transformation function share parameter for i
ν_{jrt}^{VA}	Exponent parameter for the production function
ν_{jrt}^{L}	Exponent in the labour aggregation function
ν_{jrt}^{K}	Exponent in the capital aggregation function
ν_{jrt}^{Q}	Exponent in the composite supply Armington function for i
ν_{jrt}^{QP}	Transformation function exponent for i
σ_{jrt}^{L}	Shift parameter in the labour aggregation function
σ_{jrt}^{K}	Shift parameter in the capital aggregation function
σ_{jrt}^{Q}	Shift parameter in the composite supply Armington function for i
σ_{jrt}^{QP}	Transformation function shift parameter for i
η_{jrt}^{L}	Share of unskilled labour in total labour supply
η_{ijrt}^{IC}	Quantity of i as intermediate input per unit of output of j
η_{jrt}^{VA}	Value added per unit of output of j
η_{jirt}^{QP}	Yield of commodity i per unit of activity j
η_{ii1rt}^{QT}	Quantity of commodity i as trade input per unit of i1 produced and sold domestically
η_{rt}^{KE}	Share of public investments in GDP
η_{irt}^{ID}	Share of investment demand for product i in total investment
η_{jrt}^{IPU}	Share of public investment in sector j
η_{rt}^{FS}	Share of foreign savings to GDP
η_{rt}^{BB}	Share of budget balance to GDP

η_{rt}^{S}	Share of private savings to GDP
utk_r	Capital utilization rate
td_r	Implicit direct tax rate
τ_{ir}	Implicit indirect tax rate
δ_r	Depreciation of capital
θ_{ir}	Share of commodity i in the consumption of household
w_{ir}	Weight of commodity i in the CPI
ξ_{jr}	Weight to disutility from unskilled labour in hhd utility function
π_{jr}	Weight to disutility from skilled labour in hhd utility function
ρ_r	1 over Frisch elasticity of labour
κ_r	Weight of utility to savings in the hhd utility function
ι_r	Shift parameter in the investment aggregation function
ror_r	Rate of return
$plevel_r$	Consumer prices level in the base year
zv_{ir}	Change in stocks in value terms (for the base year calibration)

2.5.10.3 List of variables

Abbreviation	Definition
Endogenous variables	
σ_{jrt}^{VA}	Total factor productivity in the production function for activity *j*
VA_{jrt}	Value added in sector *j*
PVA_{jrt}	Value-added price of activity *j*
N_{jrt}	Quantity of unskilled labour demanded by activity *j*
H_{jrt}	Quantity of skilled labour demanded by activity *j*
L_{jrt}	Total labour employed in activity *j*
KPU_{jrt}	Quantity of public capital demanded by activity *j*
KPR_{jrt}	Quantity of private capital demanded by activity *j*
K_{jrt}	Quantity of capital demanded by activity *j*
PN_{jrt}	Price of non-skilled labour in activity *j*
PH_{jrt}	Price of skilled labour in activity *j*
$PKPU_{jrt}$	Price of public capital in sector *j*
$PKPR_{jrt}$	Price of private capital in sector *j*
IC_{ijrt}	Intermediate consumption of product *i* in activity *j*
QA_{jrt}	Gross output in activity *j*
PA_{jrt}	Price of gross output in activity *j*
QP_{jirt}	Quantity of product *i* produced domestically
QPT_{jirt}	Total quantity of commodity i produced domestically
PPT_{irt}	Price of total quantity of commodity i produced domestically
QD_{irt}	Quantity sold domestically of domestic product *i*
PD_{irt}	Domestic price of domestic output *i*
PDD_{irt}	Domestic price of domestic output *i* including trade and transport margins
QT_{irt}	Quantity of commodity demanded as trade and transport margin
P_{irt}	Composite price of product *i*
Q_{irt}	Composite supply of product *i* at domestic market
QM_{irt}	Imports of product *i*
QE_{irt}	Exports of product *i*
C_{irt}	Consumption of commodity *i* by household
S_{rt}	Household savings
$\bar{I}_{rt}$	Total investment demand
ID_{irt}	Investment demand for product *i*
Z_{irt}	Change in stocks of product i
$\overline{PK}_{rt}$	Composite investment goods price
II_{jrt}	Sectoral investment
IPU_{jrt}	Public investment in activity *j*

Abbreviation	Definition
IPR_{jrt}	Private investment in activity *j*
$KKPU_{jrt}$	Total public capital stock in sector *j*
$KKPR_{jrt}$	Total private capital stock in sector *j*
A_{rt}	Private cumulative assets
AF_{rt}	Foreign cumulative assets
AG_{rt}	Government cumulative assets
KE_{rt}	Government capital expenditures
R_{rt}	Government revenues
G_{rt}	Government expenditures
BB_{rt}	Budget balance
FS_{rt}	Foreign savings
$DUMMY_{rt}$	Walras variable (zero at equilibrium)
Exogenous variables	
tr_{rt}	Transfers from the government to the household
cg_{irt}	Government consumption of *i*
pm_{irt}	Import price of product *i*
pe_{irt}	Export price of product *i*

2.5.10.4 Complete list of model equations

Production function

$$VA_{jrt} = \sigma_{jrt}^{VA}\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right)^{\frac{1}{\nu_{jr}^{VA}}} \quad \text{(PRODF)}$$

First-order conditions for the producer optimization problem

$$L_{jrt} = \sigma_{jrt}^{L}\left(\beta_{jr}^{L}.N_{jrt}^{\nu_{jr}^{L}} + \left(1-\beta_{jr}^{L}\right).H_{jrt}^{\nu_{jr}^{L}}\right)^{\frac{1}{\nu_{jr}^{L}}}$$
(LAGGR)

$$K_{jrt} = \sigma_{jrt}^{K}\left(\beta_{jr}^{K}.KPU_{jrt}^{\nu_{jr}^{K}} + \left(1-\beta_{jr}^{K}\right).KPR_{jrt}^{\nu_{jr}^{K}}\right)^{\frac{1}{\nu_{jr}^{K}}}$$
(KAGGR)

$$PN_{rt}.N_{jrt}^{1-\nu_{jr}^{L}} = \frac{\beta_{jr}^{VA}.\beta_{jr}^{L}.PVA_{jrt}.VA_{jrt}.L_{jrt}^{\nu_{jr}^{VA}}}{\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right).\left(\beta_{jr}^{L}.N_{jrt}^{\nu_{jr}^{L}} + \left(1-\beta_{jr}^{L}\right).H_{jrt}^{\nu_{jr}^{L}}\right)} \quad \text{(NDEM)}$$

$$PH_{rt}.H_{jrt}^{1-\nu_{jr}^{L}} = \frac{\beta_{jr}^{VA}.\left(1-\beta_{jr}^{L}\right).PVA_{jrt}.VA_{jrt}.L_{jrt}^{\nu_{jr}^{VA}}}{\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right).\left(\beta_{jr}^{L}.N_{jrt}^{\nu_{jr}^{L}} + \left(1-\beta_{jr}^{L}\right).H_{jrt}^{\nu_{jr}^{L}}\right)} \quad \text{(HDEM)}$$

$$PKPU_{rt}.KPU_{jrt}^{1-\nu_{jr}^{L}} = \frac{\left(1-\beta_{jr}^{VA}\right).\beta_{jr}^{K}.PVA_{jrt}.VA_{jrt}.K_{jrt}^{\nu_{jr}^{VA}}}{\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right).\left(\beta_{jr}^{K}.KPU_{jrt}^{\nu_{jr}^{K}} + \left(1-\beta_{jr}^{K}\right).KPR_{jrt}^{\nu_{jr}^{K}}\right)}$$
(KPUDEM)

$$PKPR_{rt}.KPR_{jrt}^{1-\nu_{jr}^{L}} = \frac{\left(1-\beta_{jr}^{VA}\right).\left(1-\beta_{jr}^{K}\right).PVA_{jrt}.VA_{jrt}.K_{jrt}^{\nu_{jr}^{VA}}}{\left(\beta_{jr}^{VA}.L_{jrt}^{\nu_{jr}^{VA}} + \left(1-\beta_{jr}^{VA}\right).K_{jrt}^{\nu_{jr}^{VA}}\right).\left(\beta_{jr}^{K}.KPU_{jrt}^{\nu_{jr}^{K}} + \left(1-\beta_{jr}^{K}\right).KPR_{jrt}^{\nu_{jr}^{K}}\right)}$$
(KPRDEM)

Leontief aggregation of intermediate consumption and value added

$$IC_{ijrt} = \eta_{ijr}^{IC}.QA_{jrt}$$
(ICSH)

$$VA_{jrt} = \eta_{jr}^{VA}.QA_{jrt}$$
(VASH)

$$PA_{jrt}.QA_{jrt} = \sum_i \frac{\eta_{ijrt}^{IC}}{\sum_i \eta_{ijrt}^{IC}}.P_{irt}.\sum_i IC_{ijrt} + PVA_{jrt}.VA_{jrt} \quad \text{(QAVAL)}$$

Transformation of activity into output

$$QP_{jirt} = \eta_{jir}^{QP}.QA_{jrt}$$
(QPSH)

$$PA_{jrt} = \sum_i \eta_{jir}^{QP}.PPT_{irt} \quad \text{(PAEQ)}$$

$$QPT_{irt} = \sum_j QP_{jirt}$$
(QPTEQ)

$$PDD_{irt} = PD_{irt} + \sum_{i'} \eta_{i'i}^{QT}.P_{i'rt}$$

$$PPT_{irt}.QPT_{irt} = PD_{irt}.QD_{irt} + PE_{it}.QE_{irt} \quad \text{(QPTVAL)}$$

$$\frac{P_{irt}.Q_{irt}}{(1+\tau_{ir})} = PDD_{irt}.QD_{irt} + PM_{it}.QM_{irt} \quad \text{(QVAL)}$$

$$QT_{irt} = \sum_{i'} \eta_{ii'}^{QT}.QD_{i'rt} \quad \text{(QTEQ)}$$

Armington function for domestic-import aggregation

$$Q_{irt} = \sigma^{Q}{}_{i}\left(\beta^{Q}{}_{i}.\overline{QM}_{irt}^{-\nu^{Q}{}_{i}} + \left(1-\beta^{Q}{}_{i}\right).QD_{irt}^{-\nu^{Q}{}_{i}}\right)^{-1/\nu^{Q}{}_{i}} \quad \text{(QAGGR)}$$

$$\frac{\overline{QM}_{irt}}{QD_{irt}} = \left(\frac{PDD_{irt}}{PM_{it}}.\frac{\beta^{Q}{}_{i}}{1-\beta^{Q}{}_{i}}\right)^{1/(1+\nu^{Q}{}_{i})} \quad \text{(QMQD)}$$

Constant elasticity of transformation function for the domestic-export aggregation

$$QPT_{irt} = \sigma^{QP}{}_{i}\left(\beta^{QP}{}_{i}.\overline{QE}_{irt}^{\nu^{QP}{}_{i}} + \left(1-\beta^{QP}{}_{i}\right).QD_{irt}^{\nu^{QP}{}_{i}}\right)^{1/\nu^{QP}{}_{i}} \quad \text{(QPAGGR)}$$

$$\frac{\overline{QE}_{irt}}{QD_{irt}} = \left(\frac{PE_{it}}{PD_{irt}}.\frac{1-\beta^{QP}{}_{i}}{\beta^{QP}{}_{i}}\right)^{1/(\nu^{QP}{}_{i}-1)}$$
(QEQD)

First-order conditions in the household optimization problem

$$\sum_i P_{irt}.C_{irt} = (1-td_r)\sum_j\left(PN_{jrt}.N_{jrt} + PH_{jrt}.H_{jrt} + PKPR_{jrt}.KPR_{jrt}\right) + ror * A_{rt} + tr_r - S_{rt} \quad \text{(HBUDG)}$$

$$C_{irt}.P_{irt}.\kappa = \theta_{ir}.S_{rt}$$
(HCONS)

$$\xi_j.N_{jrt}{}^{\rho}.S = \kappa.(1-td_r).PN_{jrt}$$
(NSUP)

$$\pi_j.H_{jrt}{}^{\rho}.S = \kappa.(1-td_r).PH_{jrt}$$
(HSUP)

Government equations

$$KE_{rt} = \eta_r^{KE}.\sum_j PVA_{jrt}.VA_{jrt} \quad \text{(KEEQ)}$$

$$R_{rt} = td_r.\sum_j\left(PN_{jrt}.N_{jrt} + PH_{jrt}.H_{jrt} + PKPR_{jrt}.KPR_{jrt}\right) + \sum_i \tau_{ir}.\frac{P_{irt}}{(1+\tau_{ir})}.Q_{irt} + \sum_j PKPU_{jrt}.KPU_{jrt} + ror * AG_{rt}$$ (REQ)

$$G_{rt} = \sum_i cg_{irt}.P_{irt} + tr_r + KE_{rt}$$ (GEQ)

$$BB_{rt} = R_{rt} - G_{rt}$$
(BBEQ)

Capital and investment equations

$$ID_{irt} = \eta_{ir}^{ID}.\bar{I}_{rt}$$ (IDEM)

$$\bar{I}_{rt} = \iota_r.\prod_i ID_{irt}^{\eta_{ir}^{ID}}$$
(IbarEQ)

$$\overline{PK}_{rt} = \sum_i \eta_{ir}^{ID}.P_{irt}$$
(PKEQ)

$$IPU_{jrt} = \eta_r^{IPU} * KE_{rt}$$
(IPUSH)

$$II_{jrt} = IPU_{jrt} + IPR_{jrt}$$ (IPREQ)

$$KPU_{jrt} = utk.KKPU_{jrt}$$
(KPUEQ)

$$KPR_{jrt} = utk.KKPR_{jrt}$$
(KPREQ)

Recursive dynamic equations

$$KKPU_{jrt+1} = (1-\delta).KKPU_{jrt} + IPU_{jrt}$$
(KKPUDYN)

$$KKPR_{jrt+1} = (1-\delta).KKPR_{jrt} + IPR_{jrt}$$
(KKPRDYN)

$$\sigma_{jrt+1}^{VA} = (1+\gamma A_t).\sigma_{jrt}^{VA}$$
(TFPDYN)

$$A_{rt+1} = (1+\mathrm{ror_r}).+S_{rt}$$
(ADYN)

$$AF_{rt+1} = (1+\mathrm{ror_r}).+FS_{rt}$$
(AFDYN)

$$AG_{rt+1} = (1+\mathrm{ror_r}).+BB_{rt}$$
(AGDYN)

Foreign sector balance

$$\sum_i\sum_p PE_{it}.QE_{iprt} + FS_{rt} = \sum_i\sum_p PM_{it}.QM_{iprt} + ror * AF_{rt}$$ (FSEQ)

Savings-investment balance

$$\overline{PK}_{rt}.II_{jrt} = \frac{K_{jrt}}{\sum_j K_{jrt}}(S_{rt} + KE_{rt} + BB_{rt} + FS_{rt} - ror * (A_{rt} + AF_{rt} + AG_{rt}) - \sum_i P_{irt}.Z_{irt} - DUMMY_{rt}) \quad \text{(IIEQ)}$$

Product market clearance

$$Q_{irt} = \sum_j IC_{ijrt} + C_{irt} + cg_{irt} + ID_{irt} + Z_{irt} + QT_{irt} \quad \text{(PRODMKT)}$$

Additional equation due to Walras law of functional dependence

$$plevel_{rt} = \sum_i w_{ir}.P_{irt} \quad \text{(PNORM)}$$