Costing and Pricing Methodologies in the Digital Economy

A paper prepared within the context of ITU Regional Economic Dialogue on Information and Communications Technologies in Europe and CIS (RED-19) held in Odessa, Ukraine on 30-31 October 2019.

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ABSTRACT

Information and Communication Technologies (ICTs) are the backbone of the digital economy and a key enabler of the SDGs, specifically SDG9 – Industry, Innovation and Infrastructure. There is increasing awareness that regulation has a significant role to play in encouraging infrastructure investment and ensuring it is sufficiently widespread so as to make the benefits of the digital economy available to all citizens. Price regulation is particularly important as it sets the parameters for commercial investment decisions.

Traditional regulation has involved setting cost-based prices at the wholesale level and leaving market forces to determine retail prices based on these inputs. Wholesale prices, especially for call termination services, have normally been established through the construction of bottom-up long-run incremental cost models developed by the regulator for this specific purpose. The ITU has supported this work and hosting regional training programmes on cost modelling and price regulation in the framework of the Telecommunication Development Bureau (BDT) activities.

However, in the digital economy broadband networks are increasingly based on fibre optic cables, 4G and 5G mobile and IP transmission, optimized for data rather than voice traffic. This means that regulators have to establish new costing and pricing approaches for the broadband era. In this brave new world cost models continue to be needed, but their application should be focused on specific economic bottlenecks – essential infrastructure that cannot economically be replicated. Just as importantly regulators have to make the transition from *ex-ante* to *ex-post* market intervention, so that investment and innovation can thrive.

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INTRODUCTION

ITU Regional Economic Dialogue on Information and Communications Technologies in Europe and CIS (RED-19) was held in Odessa, Ukraine on 30-31 October 2019. The focus of the event was on the development of economic and regulatory tools for a dynamic ICT market place. Reports were received on ITU-T and ITU-D Study Groups, and a variety of industry expert presentations informed dialogue on four principal topics:

- Policy, regulatory and economic approaches for the digital ecosystem – towards Sustainable Development Goals (SDGs)
- Incentives to foster investment and business opportunities for digital services
- Advances of regulatory costing and pricing strategies in the Digital Economy
- Development and sharing of infrastructure – economic and regulatory impact.

This paper focuses primarily on regulatory costing and pricing, while also highlighting key parts of the wider dialogue.

THE DIGITAL REVOLUTION

It is scarcely believable how much the telecommunications sector has changed over the past 40 years. Figure 1 provides a high-level picture of the two main waves of development that have taken place.

In addition, greetings on behalf of the Head of the committee on digital transformation of the Verkhovna Rada of Ukraine **Mykhailo Kryachko**, and on behalf of the Deputy Minister of Digital Transformation of Ukraine **Oleksandr Bornyakov** were read out for the participants.

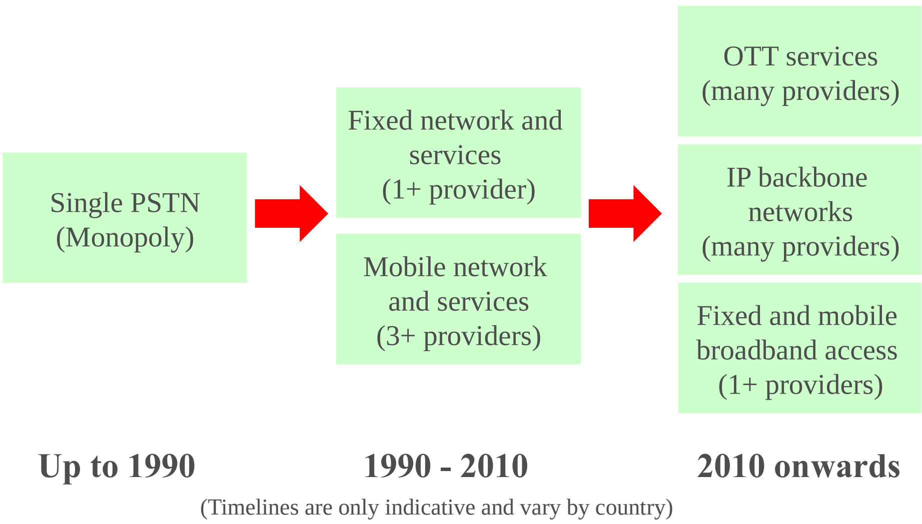

FIGURE 1: CHANGING BUSINESS MODELS FOR TELECOM SERVICE DELIVERY

Liberalisation, which started in the 1980s and spread widely in the 1990s, ushered in a period of choice and change. Incumbent operators were privatised and new licences were issued, most significantly to operators of embryonic mobile telephone services. Initially these services were seen as high-value, high-price, specialist services, but as technology improved and prices fell mobile services became the new norm, especially among younger generations and especially for voice and text communications. Affordable mobile services also spread the economic and social benefits of telecommunications to new communities and across countries where previously only a privileged few had access to fixed telephone lines.

If mobile technology provided the first wave of the digital revolution, the Internet Protocol (IP) has created a second wave. This highly efficient packet-based transmission technology that underpins the Internet, has become the go-to technology for all applications, voice, video and data, whether fixed and mobile, are now routinely carried over IP networks. The change of scale and complexity has been staggering:

- There has been significant and sustained growth in telecommunications traffic as the variety of services and applications carried has mushroomed.
- Traffic patterns have changed as new applications have taken off. Video streaming is by far the most bandwidth-intensive application, accounting for more than half of traffic volumes; this along with file sharing means that the majority of traffic is no longer person-to-person, and the peak hour loading of the network has increased significantly, representing as much as 50% of total traffic. These trends, however, are asymmetrical:

they affect downloads rather than uploads, and person-to-person communications continues to dominate upstream communication.

- Unit costs have tumbled both as a result of volume growth and technological development e.g. rapid reductions in the costs of routers and dense wave-division multiplex (DWDM) equipment. The cost of mobile data has been falling particularly rapidly as spectrum efficiency improvements have lowered costs per Megabyte (MB).

TRADITIONAL APPROACHES TO COST AND PRICE REGULATION

The earliest forms of price regulation were applied to the state-owned monopolies that historically supplied all telephone services. As public utilities, these companies had to report to Government, with prices set as part of the annual budget cycle. Prices were based on political and social objectives, and in many cases individual price changes had to be approved by Parliament. Telecoms was seen as a "cash cow", so prices would be set at cost plus whatever the Government required as its revenue share. Furthermore, there was a mostly static view of costs without assessing the potential for efficiency improvements.

Monopoly-based regulation still exists in some countries, but it generally holds back investment, innovation and efficiency, results in higher end user prices and constrains the digital economy.

As competition emerged, so regulation changed. The general idea was to allow the competitive market to set prices wherever possible so that consumers would benefit at least in the long-term. However, unless and until competition was fully effective, some regulatory intervention would be required, but even in these cases the goal should be to find a "simulated" market price – try to mimic the prices that a competitive market would produce.

Over time a best practice *modus operandi* for price regulation has emerged for NRAs around the world with the following components:

- Avoid price controls if you can – don't regulate if the market is competitive;
- Regulation based on Significant Market Power – the role of regulation is to correct for ineffective competition, and that arise when there is asymmetry in market power between competitors;
- Concentrate on wholesale price controls as far as possible – prices in downstream retail markets can then be left to competitive forces, enabled by open access to bottleneck services and facilities;
- Remember that not all prices need detailed costing – e.g. retail-minus pricing or benchmarking may be appropriate in many cases
- Allow operators to cover their efficiently-incurred costs plus a reasonable return on capital employed (profit) – this makes for sustainable prices and ensures that investments are not stifled.

These characteristics of effective price regulation need to be applied separately to fixed and mobile networks. This is partly because fixed and mobile are generally seen as separate markets (i.e. the services that are provided over these networks are not fully substitutable), but just as importantly they have very different cost structures and cost drivers.

Much of this regulatory best practice has yet to be established in the CIS. According to the 2017 EaPeReg Regulatory Report "only 3 NRAs identify relevant markets where they subsequently identify the significant market power (SMP) and impose appropriate remedies. Georgia and Moldova follow the Recommendation of the EC in regulating the 7 relevant markets and both countries also added several autonomously identified relevant markets. In Ukraine, the NRA defines its own relevant markets broadly considering the EaPeReg Recommendation." [1]

Approaches to cost modelling

The telecommunications industry is characterised by high levels of fixed common and joint costs, which would not be recovered if pricing were based solely on marginal costs. Equally, telecommunications networks display significant economies of scale. These factors mean that the marginal cost is often well below the average cost of supply, while the stand-alone cost is often well above the average cost. The middle ground, and the generally accepted standard for interconnection charges, is forward-looking long-run incremental cost (LRIC)[2]. Each of the elements of LRIC is described below.

- **Forward-looking costs:** If LRIC is to provide efficient price signals to the market, then the result must reflect the forward-looking costs of building and operating a modern network. Forward-looking costs reflect the costs that a network operator would incur were it to build a new network today, using Modern Equivalent Assets (MEA). These costs would be based on looking forward to anticipated levels of demand for network capacities and planning horizons for equipment installation necessary to run an efficient network.
- **Long-Run costs:** Costing needs to consider the time period in which the service provider can realise capital investments (or divestiture of capital) in order to increase (or decrease) its productive capacities. In the long run, all capital inputs, and therefore all costs, vary due to a change in the volume or in the structure of production, in response to changes in demand. All investments are therefore considered as variable costs in this long-run view as all will require replacement at some time.
- **Incremental costs:** The incremental cost is the increase in total costs following the introduction of an additional product or service increment. The service volume increment can take several forms. For instance, a volume change of a product or group of products could be defined as the increment. Alternatively, a single unit of output (either in the access or core network) could be the increment (which would also be equivalent to the marginal cost). LRIC is therefore defined as the cost of adding a product or service to a portfolio of existing products or services or, conversely, the cost avoided if production of a product or service is taken away from the list of existing products or services.
- **The size of the increment:** LRIC refers to the is the incremental or additional cost a firm incurs in the long run in order to provide a particular service, assuming all of its other production activities remain unchanged. LRIC estimates focus on the incremental costs of specific services (such as PSTN, mobile call termination, SMS). This form of LRIC was required because regulators have always focused on regulating services, particularly in markets where there is ineffective competition.

[1] EaPeReg Regulatory Report, 2017, p33 (http://eapereg.org/index.php/documents/public-reports)
[2] However, within CIS countries, only Moldova uses LRIC for regulatory costing.

There are several ways of building a LRIC cost model, as shown in Figure 2.

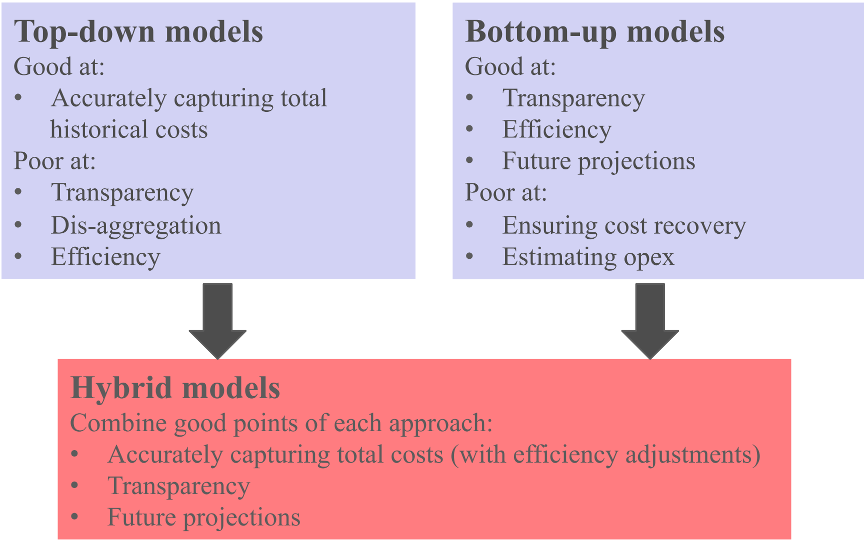

FIGURE 2: THREE DIFFERENT COST-MODELLING METHODOLOGIES

The most common approach adopted by NRAs is a bottom-up model. Bottom-up models work from the basis of theoretically efficient network design and equipment purchase. They calculate the costs of an efficient network capable of offering the same scale and scope of services being offered by the service provider using the latest available technology. In principle, the bottom-up model starts with understanding the network element requirements for switching, transmission and access network resources that an efficient service provider would install today to meet the forward-looking demand of the service provider. Thus the model is of a hypothetical network designed to meet the required demand and coverage and, by implication, the costs (if any) of migrating from today's operations to the efficient service provider standard would not be expected to be included in the LRIC calculation.

Regulators often have difficulty adopting the alternative top-down approach. This is because the data that forms the basis of a top-down model is derived from the operator's accounts. This has the advantage of accurately reflecting the real-world experience of the operator, but it is based on historic data and tends to embed any inefficiencies of the operator. It is possible to make adjustment for these factors (e.g. to convert to current cost accounting) but the results are never transparent because of the complexity of the source data and the confidentiality of the operator's data.

An alternative hybrid approach captures the benefits of the bottom-up design but then calibrates the model against the actual network and accounts of the operator. The hybrid model can then be used to project costs into the future and/or to consider costs under alternative scenarios. In particular, the model can be used to simulate the costs of a notionally efficient operator.

Just as hybrid models help to narrow the reasonable range of cost-based prices compared with exclusive use of either bottom-up or top-down models, so benchmarks can be used to check the results of cost models and inform regulated pricing decisions. The ITU has produced a practical guide for this process[3].

[3] http://www.itu.int/en/ITU-D/Regulatory-Market/Documents/Publications/Benchmarking_guide_Final.pdf

THE NEW PARADIGM OF IP NETWORKS

IP network models are radically changing the service supply chain, affecting costs and prices, and requiring a rethink of traditional regulatory practices. Figure 3 shows a typical IP network infrastructure. The key characteristics compared with a traditional circuit-switched network are:

- Ring rather than star topology
- Routers rather than switches
- Fewer nodes
- Nodes further from the customer premises
- Shared transmission paths
- Different transmission technology (e.g. DWDM rather than SDH)
- Costs driven by capacity rather minutes of traffic.

All these changes have to be reflected in cost model design: IP network models are substantially different from PSTN models. The tendency in IP networks is to have high fixed and low variable costs, thus making usage-based charges somewhat theoretical. This results from the fact that service-logic has been separated from routing functionality and is hosted at the core of the network with the result that all calls tend to use all levels of the IP transmission hierarchy. There has also been much greater standardisation of components within IP networks (e.g. routers and ports) with the result that it is often cheaper to purchase significantly more capacity than is required. The practice of deploying routers in redundant pairs and further enhances the tendency to build in lots of spare capacity. It is therefore hard to reconcile assumptions on theoretical efficiency within a bottom-up cost model with actual deployment practice.

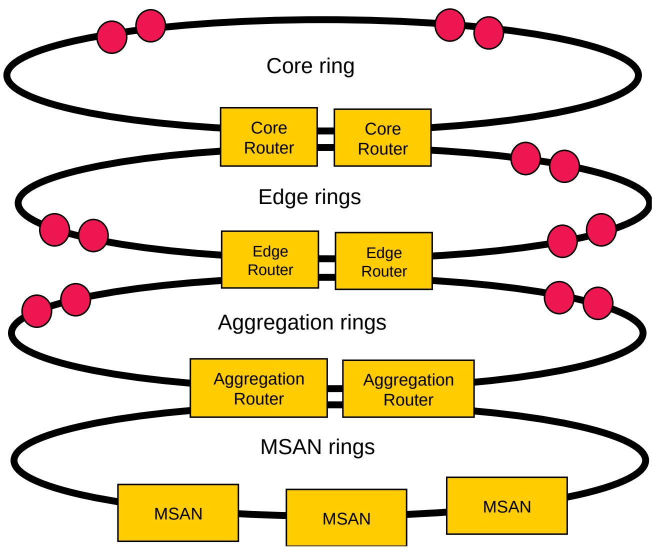

FIGURE 3:TYPICAL STRUCTURE OF AN IP NETWORK

However, the transition to IP networks affects much more than the design of regulatory cost models. It affects the fundamental requirement for cost-based regulation, especially for interconnection services. The IP world is dominated by data traffic: voice is a diminishing and insignificant part of the overall network capacity so cost-based voice termination is of marginal significance. In this brave new world, cost models for the core IP network may not be needed at all, as competition thrives, there is potentially less SMP and less need for ex-ante regulation.

In contrast, broadband access, whether provided over fixed or mobile, is critical to service providers that are increasingly bundling their retail services: e.g. quad-play (fixed, mobile, internet and TV). This means that cost-based regulation may still be important, and regulatory cost models necessary, but they likely to be focused on high-capacity fixed and mobile access.

NEW REGULATORY APPROACHES

As the need for regulated cost-based interconnection is reducing, so the need for regulated cost-based access is increasing. Application providers require open access to digital infrastructure, as it is only through that infrastructure that they can reach their customers. In many cases, especially for bandwidth-intensive applications such as video, they require access to high-capacity infrastructure. This requires investment on the part of the access provider (e.g. fibre rollout for fixed networks or 4G/5G mobile technology) that will need to be recovered either directly from the customer or via the application service provider.

Regulators therefore have the following cost modelling requirements:

- Mobile network cost model
  - With an efficient mix of mobile technologies
  - Cost increments for coverage and capacity
  - Capacity to be based on Mbps.
- Fixed access cost model
  - Different technologies (e.g. copper and fibre; buried and overhead cable)
  - Different local geographies (e.g. urban and rural; rocky or sandy terrain)
  - Costs for different access products (e.g. full loop, shared loop, sub-loop unbundling).

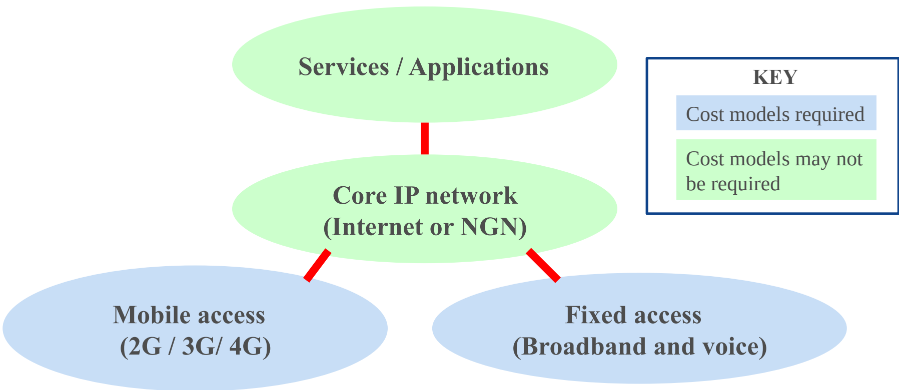

FIGURE 4: REGULATORY COST MODELLING REQUIREMENTS IN THE DIGITAL ECONOMY

These models will be used by the NRA ex-ante (to set regulated access prices for network operators with SMP) but they will also be available for ex-post usage in resolving any disputes between the network operator and the applications service providers.

It is worth noting that, although mobile cost models to date have included a mixture of 2G/3G/4G technologies, over the next few years, 2G will be phased out entirely and 5G will need to be taken into account. The inclusion of 5G within regulatory cost models will be particularly challenging because it will be implemented in a variety of ways:

- Integration of 5G into existing cell sites (where spare capacity exists) either re-using existing spectrum, using spare spectrum in bands already allocated, or deploying newly acquired spectrum dedicated to 5G.
- Adding new cell sites. Meeting demand for 5G will likely involve a process of "densification" in which smaller cell sites are established much closer together and using much higher frequencies (e.g. 3500MHz or, eventually, mm-wave bands).
- Enhancing backhaul networks both to reach closer to the customer and/or to carry greater traffic-carrying capacity. Ultimately much of this backhaul, especially for the new 5G micro-sites, may be provided over radio links using mm-wave spectrum but for the planning horizon of the current assignment fibre deployment is more likely.

European Union case study

The changing requirements for regulatory cost modelling are well illustrated in the legislative changes recently completed within the European Union (EU). This legislation is, of course, only binding on EU Member States (e.g. Latvia, Lithuania, Romania) but it provides a helpful benchmark for all countries represented at the ITU Regional Economic Dialogue (RED-19).

A new European Electronic Communications Code (EECC)[4] was launched in December 2018, which overhauls the EU legislative framework that was established in 2003. The EECC establishes a new harmonised framework for the regulation of electronic communications networks and services in the EU and a template for the wider Europe and CIS region.

The overall aim of the EECC is to (EECC) is facilitate the Digital Single Market Strategy for Europe. It focuses on measures that will:

- Provide incentives for investment in high-speed broadband networks
- Bring a more consistent internal market approach to radio-spectrum policy
- Support the internal market by tackling regulatory fragmentation
- Ensure effective protection of consumers, a level playing field for all market players and consistent application of the rules.

The EECC preference is for market-driven deployment of very-high capacity networks (VHCNs). NRAs shall exercise their responsibility in a way that promotes efficiency, sustainable competition, the deployment of very high capacity networks, efficient investment and innovation, and gives the maximum benefit to end-users. They shall also allow a fair return for the investor in particular where there are risks associated with investment projects specific to new access networks which support products for which demand is uncertain.

[4] EU Directive EU2018/1972: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972

The EECC builds on an earlier Recommendation on Costing Methodologies for Broadband Investment[5], in particular confirming the use of a Regulatory Asset Base (RAB) in which reusable legacy civil engineering assets (such as ducts, cabinets and poles) are revalued at current costs but taking account of the elapsed economic life of the assets so that costs already recovered do not form part of the access prices. However, whereas the earlier Recommendation was focused on copper access networks, the EECC extends the application of the RAB to all electronic communications networks, specifically to cable networks as well as copper networks. In so doing it recognises that the future Very High Capacity Networks (VHCNs) require performance parameters which will require the installation of optical fibre elements at least up to the first concentration/distribution point beyond the customer premises. See Figure 5. It is also anticipated that fibre will in some circumstances be deployed to the home (FTTH) or business (FTTB), so that even the final drop wire will be upgraded – but in most cases these wires are not installed within re-usable ducts.

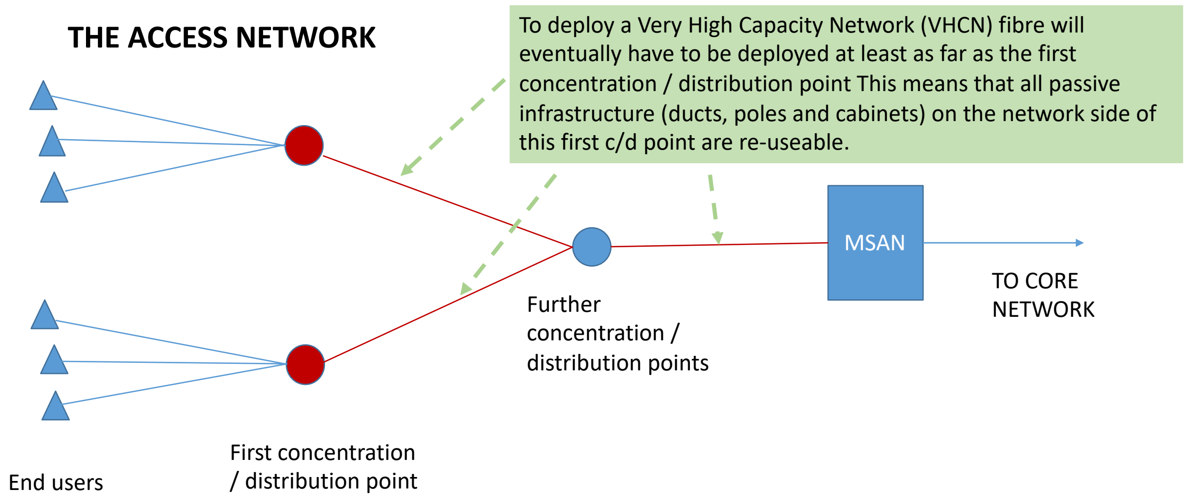

FIGURE 5: THE FIXED ACCESS NETWORK IN VERY HIGH CAPACITY NETWORKS

The EECC also builds on the earlier EU Recommendation on Regulatory Treatment of Mobile Termination Rates[6]. Mobile termination rates are to be set on the basis of a bottom-up cost model using:

- Current costs.
- Pure LRIC
- Economic depreciation
- An efficient operator with market share not less than 20%.

However, the EECC goes further in that it requires a single EU-wide maximum call termination rate ("Eurorate") is to be established by 31 December 2020. To achieve this the EC has constructed a unified cost model to determine the costs of call termination in a harmonized manner. The results of the model have been consulted upon via the NRAs and the EC is now engaged in a wider public consultation to determine:

[5] EC Recommendation C(2013) 5761: http://ec.europa.eu/digital-agenda/en/news/commission-recommendation-consistent-non-discrimination-obligations-and-costing-methodologies

[6] See: https://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2009/c_2009_3359_en.pdf

- In which countries and in what circumstances deviation from the Eurorate might be justified;
- In which countries and in what circumstances a glidepath or other transitional arrangements might be justified;

Whether Eurorates could be applied outside the European Economic Area (EEA) - by establishing requirements on companies that also operate within the EEA.

CONCLUSIONS

The last 15-20 years has seen a boom in regulatory cost modelling. That era may now be coming to an end. In the future there will be greater standardization and harmonisation of cost models. New trans-national models such as those recently developed for the European Union, and/or the results of such cost models, may be translated into other national environments without substantial loss of accuracy. There may be scope for a similar trans-national initiative to include non-EU countries in the Balkans and CIS. In any case, regulators throughout Europe and CIS countries might be best advised to use Eurorates, possibly making adjustments where there are major national differences in input costs.