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Economic replicability tests for next-generation access networks^{*}

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18 September 2013

COMMENTS ARE WELCOME

Abstract

This paper discusses the relevant cost standard for the economic replicability test for Next-Generation Access (NGA) networks, described in the Recommendation on Costing and Non-discrimination adopted by the European Commission. We demonstrate that a cost standard that implies fully fixed and variable cost recovery for the access seeker would be incompatible with the economics of NGA networks and that such a test would deter NGA investment. We show that to reconcile investment and competition, the wholesale price must be a two-part tariff and the economic replicability test should only be based on variable wholesale prices. We underline that during a transition phase, until competitors have secured access to NGA infrastructure, a temporary second test called the “competition migration test” should be added to ensure incumbent NGA retail prices do not foreclose copper-based efficient entrants. The tests we propose surpass the limits of the “ladder of investment” theory by including the “business migration effect” developed by Bourreau et al. (2012).

Keywords: Margin squeeze; Regulation; Next-generation access networks

JEL codes: L51, L96

1. Introduction

On 12 July 2012, Neelie Kroes, Vice-President of the European Commission (EC) charged with the Digital Agenda, announced a far-reaching set of measures to enhance the broadband investment environment in order to meet the objectives of the Digital Agenda for Europe (DAE) by 2020.

Neelie Kroes considered that regulatory policy for next-generation access networks (NGAN) must be based on the following key elements: stable copper prices and flexible NGA wholesale access prices combined with high non-discrimination obligations, including “a properly-specified *ex ante* margin squeeze test.”

Details of the test are provided in the “Commission Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment” adopted by the European Commission on 11 September 2013. In this Recommendation, the *ex ante* margin squeeze test was renamed “economic replicability test” to avoid any confusion with the margin squeeze test used *ex post* by competition authorities.

^{*} The views expressed in this paper are purely the authors’ and may not under any circumstances be regarded as those of Orange.

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The Recommendation, suggests that the test should be done with a discounted cash flow (DCF) on an average customer lifetime and account for long-run incremental costs plus (LRIC+) as a cost standard. At the same time, according to the EC, the costing methodology should guarantee an “appropriate balance between ensuring efficient entry and sufficient incentives to invest.” According to the document, this would imply allowing operators investing in NGA networks a certain degree of pricing flexibility. This flexibility would enable significant market power (SMP) operators and access seekers to “share some of the investment risk by differentiating wholesale access prices according to the access seeker’s level of commitment.” Volume discounts and/or long-term access pricing agreements are considered by the EC as important tools for fostering NGA investment. In practice, this results in the introduction of nonlinear wholesale prices, including a variable wholesale price that is proportional to the volume of access and other components that will be considered in this paper as a fixed part of the wholesale price. This price structure reflects the underlying cost structure of the operator that invests, since a large part of its infrastructure cost is fixed, independent of demand that is otherwise uncertain. In this case, the economics literature shows that optimal wholesale prices should include a fixed component in order to effectively allocate the risk that fixed costs may not be covered if demand is low.

This paper addresses the question of how to implement the economic replicability test for NGA networks. The test is required in the Recommendation to regulate wholesale prices while acknowledging that wholesale prices have a two-part structure. The test must be structured to fulfil the EC’s dual objective of encouraging NGA investment and maintaining the competitive structure inherited from copper unbundling, while obeying the principle of fair investment risk distribution between access provider and access seekers. Although the paper directly refers to the EC Recommendation on Costing Methodology and Non-discrimination, the economic arguments would also be suitable for a margin squeeze test under competition law.

This paper first explains that the fixed part of the wholesale price, representing the fixed part of the NGA investment cost, must not be included in the economic replicability test. Indeed, its inclusion would be incompatible with FTTH economics. To prove this point, we demonstrate that the economic replicability test could be expressed as the difference in a company’s profitability between its total NGA investment and its wholesale NGA activity. It is common knowledge that the profitability of NGA investment is uncertain in the long term and certainly negative in the timeframe of a customer lifetime, otherwise investments would flourish and there would be no concern for achieving the NGA coverage political objectives in the Digital Agenda. Therefore, a positive NGA economic replicability test (i.e. the absence of supposed foreclosure strategy) including the fixed part of wholesale price and at a customer’s lifetime horizon would be obtained only if the profitability of the wholesale activity is negative. Therefore such a test would guarantee the business profitability of the access seeker and eventually weaken upstream business activity thereby making upstream investments economically irrational for investors. This formulation of the test is thus inconsistent with the EC’s assigned objective to share investment risk between SMP operators and access seekers.

Furthermore, using a simplified but representative numerical example, we demonstrate that if fixed wholesale prices are included in the test, then a negative result, implying a supposed foreclosure strategy, will be obtained even if it is abundantly clear there is no form of discrimination whatsoever.

The NGA economic replicability test must thus be based on variable costs and exclude the fixed part of wholesale prices. In other words, performing a test with discounted cash flow on an average customer lifetime, as recommended by the EC in the Recommendation, supposes the infrastructure costs are disregarded. Indeed, the payback period for NGA infrastructure is much longer than a customer lifetime. In the test we propose, only the variable price is accordingly limited by the economic replicability test. It guarantees there is no discrimination on the basis of variable costs for all operators with access to NGA infrastructure.

Nevertheless, this formulation of the economic replicability test does not explain how to determine the fixed infrastructure prices and, more specifically, it does not guarantee that an operator as efficient as the investor can pay the fixed costs and enter the NGA market.

Therefore, in a transition phase, until competitors have secured access to NGA infrastructure, a temporary second test called the “competition migration test” should be added to ensure incumbent NGA retail prices and wholesale fixed prices do not foreclose copper-based efficient entrants.

The second test is meant to preserve the competitive structure inherited from unbundling regulation of the copper local loop, assuming that this competitive structure is satisfactory and, in particular, does not entail the incumbent having any significant power in the retail broadband market. The second test prevents the incumbent investor simultaneously setting high fixed wholesale prices for NGA access and low retail prices for its NGA products to take retail copper customers from its competitors during a transition phase. This additional test *de facto* introduces a constraint on the determination of the fixed infrastructure prices. With this second test, the only way to incite customers to migrate at a sufficient scale is to encourage the migration of alternative operators. Therefore, the investor must determine the infrastructure prices to a level that allows its competitors to enter the market. The infrastructure prices are determined by the market but constrained by the second test, which gives bargaining power to the alternative operators. This second test puts the access provider and an efficient access seeker on a level field for negotiating an appropriate fixed price to secure access to NGA network.

The two tests proposed are meant to overcome the limits of the “ladder of investment” (LoI) approach when the issue no longer concerns whether an operator can climb a ladder vertically, but rather how it can move horizontally from the “copper” ladder to the “NGA” ladder. The solution we propose goes beyond the LoI approach and incorporates the “business migration effect” developed by Bourreau et al. (2012). The economic replicability test regulates the variable part of the wholesale price and thus guarantees fair competition between all competitors with access to the NGA infrastructure. The second test—creating a condition on the interdependence between old and new infrastructure prices inspired by the business migration effect developed by Bourreau et al. (2012)—ensures in a transition phase that efficient operators can pay the fixed price to secure access to the NGA network and thus facilitate the business migration.

The remainder of the paper is organized as follows. Section 2 defines the notion of “economic replicability test” and details the EC formulation in the draft Recommendation on Cost Orientation

and Non-discrimination. Section 3 presents the two tests. In section 4, we discuss how our proposal of a dual-test system can be integrated into existing regulatory theory and practice.

2. Economic replicability test: definition and EC formulation of the test for NGA networks

In the Recommendation on Cost Orientation and Non-discrimination published on September 11, 2013, the European Commission advocates allowing for a certain degree of pricing flexibility for NGA services. This results in the non-imposition or lifting of regulated wholesale access prices on the NGA network. This flexibility is considered by the EC as without prejudice to the extent that the upstream and downstream prices are constrained by an *ex ante* economic replicability test.

- General definition of *ex ante* economic replicability and margin squeeze test

The term “economic replicability test” has been used by the EC to avoid any confusion with the margin squeeze test used *ex post* by competition authorities. However, the term “*ex ante* margin squeeze test” is frequently used in the literature and the practice of National Regulatory Authorities (NRAs) on broadband access products that use the copper pair.

Regulatory policy and competition policy address the common objective of ensuring efficient market competition to protect consumers. However, the two policies address different sides of the issue. Competition policy is designed to protect competition in a market where competition is established, and would act *ex post* if a dominant company is alleged to have abused its position to harm competitors and consumers. Competition authorities base their margin squeeze test on case law. In the telecommunications industry, three notable cases (Deutsche Telekom in 2003, Telefónica in 2007 and TeliaSonera in 2011) substantially contributed to the definition of margin squeeze. Regulatory policy aims to promote competition and prevent *ex ante* abuses in specific markets characterized by a monopoly or a company with significant market power.

There is a margin squeeze when a vertically-integrated company that provides essential input to downstream competitors charges retail and input prices that do not leave a sufficient economic margin for efficient competitors to make positive profits. Therefore, there is no margin squeeze if the customer retail price for the incumbent’s downstream branch covers its upstream and downstream costs (Gaudin and Saavedra (2013)):

$$p \geq a + c$$

where p is the retail price, a is the wholesale access charge per access and c is the downstream cost per customer. This condition guarantees that an efficient competitor could not be excluded from the market. The equation above shows that the test is clearly specified only when wholesale prices are proportional to the volume of access.

European Union competition law, clearly expressed by the European Court of Justice (ECJ) in its TeliaSonera and Deutsche Telecom judgments, recognizes margin squeeze as a separate, stand-alone form of abusive behaviour prohibited by Article 102 of the Treaty on the Functioning of the European Union. This view is in contrast to the US Supreme Court's view. In the Linkline case, the US Supreme Court rejected the very notion that a margin squeeze itself could constitute a separate form of Sherman Act §2 violation. Instead, it limited the claim to cases where vertically-integrated companies apply predatory pricing in the downstream market. In the European view, the occurrence of a margin squeeze is, however, subject to several conditions explicitly mentioned in the Court's TeliaSonera decision. It is not clear whether these conditions will be met if we apply the test to the NGA context. Yet, this is not the purpose of our study. In the rest of the paper, we focus our analysis on the conditions of application of the *ex ante* economic replicability test for NGA networks.

- Economic replicability test for NGA network in the European Commission Recommendation on Cost Orientation and Non-discrimination

The deployment of NGAs is one of the core objectives of the Digital Agenda for Europe. The economic replicability test should thereby preserve the competitive structure inherited from unbundling regulation of the copper local loop but also promote efficient investment and innovation in new infrastructures. The EC has to ensure that the *ex ante* economic replicability test for NGAs allows for an appropriate balance between these two objectives.

The Recommendation specifies the different parameters of the test, i.e. the relevant downstream costs, the relevant cost standard, the relevant regulated wholesale inputs, the relevant retail products and the relevant time period for running the test.

The relevant downstream costs are “estimated on the basis of the costs of the SMP operator's own downstream businesses (EEO test). NRAs should use the SMP operator's audited downstream costs, provided they are sufficiently disaggregated.”

According to the Recommendation, the relevant cost standard is the long-run incremental costs plus (LRIC+) including sunk costs.

NRAs should identify the most relevant regulated input used or expected to be used by access seekers.

NRAs should also define the most relevant retail products including broadband services, i.e. “flagship products” offered by the SMP operator on the basis of their market observations. Those observations should include an assessment of retail market shares in volume and value.

Finally, NRAs should measure the profitability of the flagship products on the basis of a dynamic multi-period analysis, such as the discounted cash flow (DCF) approach on an average customer lifetime.

- The EC Recommendation encourages nonlinear wholesale price structures

The Recommendation itself opens the way to using nonlinear wholesale prices. Pricing flexibility must allow SMP operators and access seekers to share the investment risks by differentiating wholesale access prices according to the access seeker's level of commitment. In this context, volume discounts and/or long-term access pricing agreements are considered by the EC as important tools for fostering NGA investment. In practice, this results in the introduction of nonlinear wholesale prices.

The use of nonlinear access prices is also in line with the principles adopted in articles 8 and 12 of the framework directive.

In the NGAN context, a nonlinear access charge would be composed of:

- A wholesale variable access price that is directly proportional to the number of customers;
- Other elements of the wholesale price that are not proportional to the volume of access and which will hereafter be considered as part of the fixed wholesale price invariable to the volume of access.

In the NGA Recommendation, the European Commission advocates mutualisation and co-investment, which are also forms of nonlinear access price and contain two parts: one fixed and the other variable. There is necessarily a separation between fixed costs for infrastructure deployment, which can be shared, and wholesale variable access prices (i.e. costs incurred by each new client: acquisition costs, customer relationship management costs, etc.).

The two-part wholesale price structures encouraged by the Recommendation on NGAs are in line with lessons from the economics literature.

Relying on the economic literature, two-part tariffs are a good instrument for solving the dynamic consistency issue by conciliating access obligations and investment incentives.

Most of the literature on competition policy considers linear access tariffs in relation with the past practices of regulatory authorities. Until recently, regulatory authorities had been dealing with existing infrastructures without seeking to promote investment, therefore linear pricing was sufficient. Furthermore, in the access and interconnection pricing literature, nonlinear access prices are hardly discussed, unlike nonlinear downstream prices (Vogelsang (2003)). However, Brito et al. (2010) suggest that as new technological developments provide an opportunity to invest in new infrastructures, "it comes as natural that, in light of these changes, regulators should use new regulatory instruments." In this context, the addition of a fixed fee appears to the authors as the obvious solution.

Brito et al. (2010) study this specific issue in a duopoly model where a vertically-integrated incumbent and a downstream entrant compete. The regulator sets the access tariff to the incumbent's network. They point out that the trade-off may generate a "dynamic consistency problem." Before the network is deployed, it is socially optimal to set high access charge to encourage investment. After the network is deployed, it is socially optimal to lower the access tariff to promote competition in the retail market. The authors show that this dynamic consistency

problem affects NGA investment negatively. “The incumbent anticipates that it will be expropriated from the incremental profit of its investment and reduces investment.”

They demonstrate that two-part tariffs can solve this dynamic consistency issue because the regulator obtains an additional instrument—the fixed fee—to encourage the incumbent to invest.

If the investment cost is low, the regulator can set the marginal price for the access tariff at marginal cost and used the fixed fee as an incentive for the incumbent to invest.

If the investment cost amounts to an intermediate value, the fixed fee is no longer enough to induce investment. The regulator has to raise the marginal price of the access tariff above marginal cost. In these circumstances, a regulatory moratorium could emerge as socially optimal.

If the investment cost is high, investment is not socially desirable.

Lestage and Flatcher (2011) also find in their model on investment games that a two-part tariff results in better welfare than a linear access price. They found that the flat fee reduces the optimal variable fee and that the variable part should be cost-oriented only when service-based competition is feasible. The variable fee is above marginal cost when facility-based competition is possible. Raising the access price reduces welfare under service-based competition and makes duplication more socially desirable, which in turn improves welfare.

A two-part access charge is a promising instrument: the variable part could be set relatively low to encourage access and competition and the fixed part could be set at a level that still incentivizes investment.

- How an economic replicability test should be applied with two-part wholesale prices?

From a regulatory point of view, separating the fixed part from the variable part makes the test operational. Indeed, the fixed fee is particularly difficult for a regulator to regulate because it presupposes a rule to spread the fixed costs among operators. It is possible to spread fixed costs based on market shares. However, in a growing market, it is likely that this distribution becomes rapidly invalid. It would seem difficult and hardly operational to constantly adapt regulations to market characteristics. As we will demonstrate later, it may be relevant to disregard the fixed prices from the test.

The two-part structure makes it possible to accurately consider the singularity of an NGAN investor’s cost structure characterized by a significant part of fixed costs.

However, the compatibility between the objectives of the European Commission and the parameters of the test are not self-evident. An LRIC+ test as required by the Recommendation could be formally interpreted as consideration for both the fixed and the variable parts of the wholesale price. But since the fixed part of wholesale prices reflects high NGA investment costs of a long and uncertain payback period, it would be inappropriate to include the fixed wholesale price in the test using a DCF method on a customer lifetime.

Indeed, economically, the NGA infrastructure payback period is much longer than a customer lifetime. If we consider a customer lifetime, there is no other solution than to disregard the fixed wholesale price, otherwise the test is systematically negative. If we consider an infrastructure’s lifetime, results would be unpredictable.

It is difficult to find a formal way to regulate both fixed and variable fees based on a single condition. Moreover, the impact of fixed fees is market shares that are dependent and very difficult to regulate.

In the next section, we will demonstrate that these reasons imply leaving the wholesale fixed price out of the test; only the variable price is constrained in the economic replicability test we propose in this paper. It guarantees there is no discrimination on the basis of variable costs for all operators with access to NGA infrastructure.

The issue of the level of the wholesale fixed price and the migration of competitors from copper infrastructure to NGA infrastructure will be addressed separately and introduce a second complementary “competition migration test.”

3. Two tests that resolve the dilemma of maintaining competition while encouraging NGAN investment

In this section, we first demonstrate that an economic replicability test that includes fully fixed and variable cost recovery for the access seeker would be inappropriate in an NGA context because all NGA investment risk would be concentrated on the access provider and none on the access seeker, thereby discouraging investment. We then describe the characteristics of the economic replicability test that should be applied. This test includes only variable costs and excludes the fixed part of the wholesale price from the cost standard to guarantee fair and vibrant competition between access providers and access seekers, once access seekers have managed to secure access to the NGA infrastructure. Lastly, we describe a second “competition migration test” designed to put access providers and seekers on a level field for negotiating wholesale fixed prices and ensure a competitive market structure is maintained during the migration from copper to NGA infrastructure.

a. A cost standard that includes fully fixed and variable cost recovery in the economic replicability test for NGA networks would be inappropriate and discourage investment

To date, the profitability of NGAN investment is uncertain, otherwise investments would flourish and there would be no concern for achieving the political objectives of NGA coverage and take-off defined in the European Commission’s Digital Agenda. The NGA market in most European countries starts a transition phase. For the moment, the demand for NGA networks is still weak and gradual. It is following an S-curve where the initial investment is massive and deployment time is long.

The weakness of the demand is inherent to the small number of services only possible over very fast broadband. This undoubtedly has an impact on consumer willingness to pay for NGA services. Rosston et al. (2010) point out that the difference in American consumer willingness to pay for fast or very fast broadband is low (about \$3.00).

However, a short-term pricing policy aimed at achieving immediate economic equilibrium would be counterproductive because it would lead to prohibitive prices. There is thus a conflict between retail prices that allow retail earnings to cover full costs and retail prices that consumers are willing to pay.

This analysis of NGAN investment profitability is highly relevant for the specification of the test since it affects the economic replicability test results. If the cost standard of the test includes all fixed and variable costs as in the analysis of NGAN investment profitability, and if the latter is uncertain in the long term and negative in the short term, then a positive test result (i.e. proof that a potential sufficient margin lets competitors enter the market, a guarantee of positive business for access seekers) can be obtained only if the access provider's wholesale business is uncertain in the long term and negative in the short term. With such a test, access seekers would be much better off than access providers and no one would have an interest in investing.

This can be formalised by the following simple reasoning.

Indeed, the profitability of the NGA Business Case (NGA BC) of an access provider can be expressed as follows:

$$\begin{aligned}
 NGA\ BC &= \\
 & m \times (\text{retail revenues} - \text{downstream costs} - \text{upstream costs}) \\
 & \quad + \\
 & (1 - m) \times (\text{wholesale revenue} - \text{upstream costs})
 \end{aligned}$$

Where m is the market share of the access provider in the retail market and *upstream costs* are the costs of the wholesale activity, including investment in NGA infrastructure. This mathematical equation can be modified as follows;

$$\begin{aligned}
 NGA\ BC &= \\
 m \times & \left(\frac{\text{retail revenues} - \text{downstream costs}}{-\text{wholesale revenue} + \text{wholesale revenue} - \text{upstream costs}} \right) \\
 & \quad + \\
 & (1 - m) \times (\text{wholesale revenue} - \text{upstream costs})
 \end{aligned}$$

i.e.

$$\begin{aligned}
 NGA\ BC &= \\
 m \times & (\text{retail revenue} - \text{downstream costs} - \text{wholesale revenue}) \\
 & \quad + \\
 & [m + (1 - m)] \times (\text{wholesale revenue} - \text{upstream costs})
 \end{aligned}$$

i.e.

$$NGA\ BC = m \times (\text{economic replcability test}) + (\text{wholesale revenue} - \text{upstream costs})$$

i.e.

$$m \times (\text{economic replcability test}) = NGA\ BC - (\text{wholesale revenue} - \text{upstream costs})$$

Whether an economic replicability test is positive or negative, therefore, directly depends on the sign of the difference in profitability between NGA investment and NGA wholesale business. The profitability of the NGA wholesale business activity has to be below the NGA Business Case for the economic replicability test to be positive. More specifically, if the NGA business case is negative, then the NGA wholesale business case will be even more negative if the economic replicability test is positive.

It is common knowledge that the profitability of NGA investment is uncertain in the long term and certainly negative in the timeframe of a customer lifetime, otherwise the deployment of NGA networks would not be an issue. Therefore, a positive NGA economic replicability test (i.e. the absence of supposed foreclosure strategy) that includes the fixed part of wholesale prices as customer lifetime ends would be obtained only if the profitability of the wholesale activity is negative. Therefore, such a test would guarantee the business profitability of the access seeker and result in weakening the upstream business, thereby making upstream investments economically irrational for investors. This formulation of the test is thus inconsistent with the EC's assigned objective of sharing investment risks between SMP operators and access seekers.

The same point can be shown using a simplified but representative numerical example¹ (see Appendix) based on Fibre to the Home (FTTH) investment. In that example, we demonstrate that if fixed wholesale prices are included in the test, then a negative result (implying a supposed foreclosure strategy) is obtained, even if it is abundantly clear there is no form of discrimination whatsoever. The example simulates an LRIC+ test using a DCF method, including all the access seeker's fixed and variable costs in the cost standard.

We consider two *ex ante* scenarios:

- Positive: the migration from a copper network to an NGAN is achieved in five years (the penetration rate p is equal to 20% in time 1, 40% in time 2, 60% in time 3, 80% in time 4, 100% in time 5);
- Negative: the migration is achieved in 20 years.

We used two alternative calculation hypotheses where we conducted the test by alternately applying a customer lifetime of, for instance, five years and an infrastructure lifetime of 20 years. As mentioned above, the DCF method on a customer lifetime is recommended by the European Commission in the Recommendation published in September 2013.

If we use a DCF method on a customer lifetime, we find that the profitability of FTTH investment is always negative, regardless of the length of migration. Profitability is even negative when we consider the access seeker benefits from cost-oriented and non-discriminatory access from the FTTH investor (price equal to cost in level and structure) and secures a 50% market share.

¹ Figures in the numerical example reflect the industry's orders of magnitude. However, they were chosen for purely illustrative reasons and should not be considered representative of any one company.

If we then run the estimation using a DCF method on an infrastructure lifetime (20 years), results are uncertain because it depends on the length of the migration from copper to fibre network. The FTTH investment profitability is positive if we consider the optimistic scenario that the migration is achieved in five years and negative if the migration takes 20 years. Thus, assuming that the profitability of fibre investment is negative, the profitability of the wholesale business has to be negative to obtain a positive result in the economic replicability test.

A LRIC+ economic replicability test that includes all the access seeker's fixed and variable costs would squeeze upstream investment. The access price would be adjusted to secure the access seeker's downstream business. This policy, which guarantees the access seeker's profitability, would weaken the upstream business and make extensive upstream investments economically irrational for fibre investors.

Moreover, in a case where it is abundantly clear there is no form of discrimination, an LRIC+ economic replicability test (including all fixed and variable costs) thus shows that the operator behaves in a discriminatory manner. A test like this with erroneous and unfair findings is a highly powerful deterrent for investors.

b. An economic replicability test based on variable wholesale prices

As mentioned before, the two-part wholesale price, in an NGAN context, would be composed of:

- A wholesale variable access price that directly depends on the number of customers;
- A wholesale fixed cost invariable with the level of access.

The two-part structure makes it possible to accurately account for the singularity of an NGAN investor's cost structure characterized by a significant share of fixed costs. The economic replicability test could be operational only if the fixed wholesale costs are excluded from the test for two reasons:

- A difficulty in regulating fixed wholesale prices because the regulator is supposed to find a rule to spread the fixed costs among operators. It is possible to spread fixed costs based on market shares. However, in a growing market, it is likely that this distribution becomes rapidly invalid. It seems difficult and hardly operational to constantly adapt regulations to market characteristics. In addition to these logistical impediments and, more fundamentally, adjusting fixed fees to market share would change fixed fees into variable fees and defeat the entire purpose of two-part prices;
- The impossibility of running an LRIC+ test (including variable and fixed costs) using a DCF on a customer lifetime for the reasons described in the previous subsection.

In this respect, we propose excluding the investment infrastructure fixed costs from the economic replicability test insofar as these fixed costs are translated into a fixed wholesale price.

Hence, the economic replicability test becomes:

$$p_{rf} \geq a_{vf} + c_f$$

The NGA retail prices, p_{rf} , would be compared with the sum of wholesale variable NGA prices a_{vf} and to the downstream cost c_f .

This formulation of the economic replicability test makes it possible to regulate the variable part of wholesale prices and guarantee fair competition between all competitors that access the NGA infrastructure. The test results would not be subject to the uncertainty of the NGA Business Case.

However, this economic replicability test does not explain how to determine the fixed part of wholesale prices and, more specifically, it does not guarantee a competitor as efficient as the investor can pay the fixed costs and migrate from a copper infrastructure to an NGA infrastructure and compete on NGA products.

The introduction of a second “competition migration test” provides our answer to these questions. The wholesale fixed price will not be regulated by the NGA economic replicability test but can be efficiently negotiated between access providers and access seekers, if the access provider is also subjected to a second “competition migration test” designed to even out the bargaining balance in these negotiations.

c. A transitory test to secure access for efficient entrants to NGA infrastructure: “the competition migration test”

Our proposal addresses a situation where the initial retail market structure based on the copper market is competitive². The incumbent operator does not have significant market power in the retail copper-based broadband market. Therefore, its retail market share is not sufficient to directly control the migration of the bulk of retail customers from copper to NGA infrastructure. It retains a minority share of the retail market, which is presumably insufficient for amortising its NGA investment, otherwise its competitors could also develop and amortise profitably with their own alternative infrastructure and migrate their own retail customers to this alternative infrastructure. Complete infrastructure competition would be sustainable in this case, which is not the example analysed in this paper. In other words, in the case we are discussing, the NGA investor has no opportunity to make a profit from an NGA investment unless its copper-based competitors’ broadband customers migrate from its copper infrastructure to its NGA infrastructure.

To attract the greatest number of customers, the investor may then be tempted to practice very low retail prices—lower than those offered in the copper broadband market. At the same time, the investor can also set high fixed prices for access to infrastructure to foreclose its competitors from the market insofar as the fixed costs are left out of the test. An economic replicability test only based on variable prices does not discourage this behaviour in investors.

To prevent this, we introduce a second transitory test called the “competition migration test.”

This section details the mechanisms by which this additional test meets these objectives.

- the “competition migration test”

The second test is meant to ensure migration of the broadband market’s competitive structure to the NGA market.

² Complementary provisions would be needed in the event of significant market power on the retail market.

The “competition migration test” ensures that the investor’s NGA retail prices do not foreclose copper-based efficient entrants.

This test stipulates that a access provider’s retail FTTH price should conduct an LRIC+ margin squeeze test on copper:

$$p_{rf} \geq a_c + c_c$$

Where a_c is the wholesale regulated copper access charge and c_c is the leader’s downstream cost.

Consistent with existing regulatory rules reiterated and detailed in the EC Recommendation on Costing Methodology and Non-discrimination, copper access prices are proportional to the volume of access and cover fixed copper infrastructure costs. Therefore, this second transitory test reintroduces fixed infrastructure costs into the price system.

This formulation of the test supposes that access to an NGA network has no greater utility for consumers than a copper network.

In practice, an NGA network offers better quality than copper. This difference in quality between fast and very fast broadband may justify an observable utilitarian shift in the market. This element could be taken into account in a test that integrates the difference in utility between copper and NGA networks. The test thus becomes:

$$p_{rf} \geq a_c + c_c + U_f - U_c$$

Where U_f is utility for a consumer with access to an NGA network, U_c is utility for a consumer with access to a copper network.

Consumer utility does not depend only on the technical quality of the products. Increasing the technical quality supposes also increasing the usage value and safeguarding the overall quality of the consumer experience. Today, an observation of market data in most regions of the world does not indicate any significant difference in value between NGA services and copper services. There is little or no premium observed in the pricing for NGA products around the world, particularly for the following reasons:

- Currently few or no NGA-specific services;
- A perception that copper networks are adapted to customer usage: no perception of network congestion specific to copper access networks and copper and NGA networks share resources in the backhaul and transport networks;
- From the consumer standpoint, the costs of migrating from copper to NGAN (time and complexity of home NGA installation, compatibility issues with the customer’s existing equipment, change in how services are navigated, etc.).

However, if an obvious difference in utility does appear between NGA and copper networks, it would be observable in the market and therefore can be quantitatively included in this transitory “competition migration test.”

Furthermore, since there is still competition between copper and NGA networks, the investor cannot set a high NGA retail price, otherwise too few customers would migrate and it would be unprofitable.

- Negotiation process between the investor and the access seeker to determine the fixed infrastructure price

By design, the “competition migration test” introduces a constraint in determining fixed infrastructure prices. The only way to achieve consumer migration on a sufficient scale is to encourage alternative operators to migrate along with their customers. Therefore, the investor must agree with each of its competitors on a wholesale fixed price that allows them to access the NGA infrastructure and operate in the NGA retail market. The constraint of the transitory “competition migration test” gives the alternative operators bargaining power to negotiate the wholesale access fixed price.

If the investor cannot lower its prices to attract the maximum number of clients to the NGA network, the only way to monetize its investment in new infrastructures is to ensure a level of fixed prices that would allow operators and their clients to migrate to the NGA network.

Indeed, as mentioned above, the two alternative conditions for which the investor would not need its competitors’ clients to migrate *en masse* would be as follows:

- The investor starts with strong dominance in the copper-based broadband retail market, which would allow him to control the migration process of the whole copper customer base to NGA;
- The NGA investment is profitable, even with a limited number of customers. In this case, several operators could build their own profitable networks. The existence of such infrastructure-based competition would make the economic replicability test irrelevant. But this is not the hypothesis retained in the EC Recommendation and therefore in this paper.

Outside of these two specific cases, investors need their competitors’ retail clients to migrate from copper to NGA to make its activity profitable.

At the same time, as recommended by the European Commission, significant market power (SMP) operators and access seekers have to “share some of the investment risk by differentiating wholesale access prices according to the access seeker’s level of commitment.”

In the absence of strong dominance by the incumbent in the broadband market, there is at least one large access based competitor. The incumbent and this access seeker will be in a position to negotiate the fixed fee access seekers have to pay to access the NGA infrastructure. The two forces we just described will be at opposition:

- A willingness of the access seeker to pay the lowest fixed fee and a necessity for the investor for the access seeker to migrate to the NGA network;
- An objective where the investor and the access seeker share some of the investment risk in proportion to the market share they will anticipate obtaining in the retail market.

It should be noted that both parties have reason to reach an agreement reasonably quickly: the incumbent because the profitability of its investment depends on its competitors’ customers migrating quickly and its largest rival because it would be a commercial risk to leave the incumbent

alone on the NGA market or let the incumbent be the first to reach an agreement with another competitor.

Moreover, once the incumbent has reached an agreement with one competitor on the fixed wholesale fee for accessing the NGA infrastructure, and as long as authorities apply the transitory “competition migration test,” it will feel strong pressure to agree with other competitors on their fixed fee. First, because the competitor that gains access to the NGA infrastructure may undercut his retail price and second, because these other competitors may negotiate access with both the incumbent and its initial competitor.

Once authorities consider that negotiations on fixed wholesale access fees have generated an adequately competitive market structure on the NGA infrastructure, and that each efficient access seeker has secured access to the NGA infrastructure, the second transitory test may be removed.

Obviously, a formal microeconomic model on this qualitative reasoning would provide more rigorous insight into the likely outcome of the proposed process. In further research, it would be interesting to theoretically model the negotiation process described above to determine the level of the fixed equilibrium price.

4. The proposed dual-test system in terms of existing regulatory theory and practice: overcoming the limits of the ladder of investment approach

In this section, we discuss how our proposal of a dual-test system can be integrated into existing regulatory theory and practice. In particular, it is meant to overcome the well-known limits of the “ladder of investment” approach in the context of NGA investments and integrate the “business migration effect” developed by Bourreau et al. (2012)

The “ladder of investment” (LoI) is a regulatory approach proposed by Cave (2006). The idea is to provide entrants with several levels of access to the incumbent network, the “rungs of the ladder,” in such a way that alternative operators may climb up the ladder and progressively develop their own infrastructure. From a theoretical point of view, this approach considers that service-based and facility-based entries are complementary and not two alternative ways of promoting competition.

Since the very beginning, the “ladder of investment” approach has widely influenced the European telecommunications policy areas and broadband regulation. In 2005, in its broadband market competition report, the European Regulators Group (ERG) analysed and explained the impact of regulatory intervention with the “ladder of investment concept.” In the Commission Recommendation of 20 September 2010 on regulated access to Next-generation Access Networks, the European Commission indicates that “The appropriate array of remedies imposed by an NRA should reflect a proportionate application of the ladder of investment principle.”

Some papers have already studied the application of the LoI approach in the NGA context (see Hori and Mizumo (2006), Vareda and Hoerning (2007), Cave (2010)). They recommend using instruments

that are basically the same as were applied to regulate copper broadband (access prices increasing over time and regulatory holidays). The limits of the Lol approach in the NGA context are highlighted by Bacache et al. (2013). They use an empirical model with data from the European Commission to test the “ladder of investment approach” in the NGA context. The “ladder of investment” is composed of three rungs: bitstream access, local loop unbundling and new access facilities. They find no empirical support for the Lol hypothesis in the transition from local loop unbundling to NGA infrastructures. In other words, they find the number of unbundled lines has no impact on investment in new access infrastructures by new entrants.

However, the stream of literature considers a hypothesis where new technology is the next rung of this ladder and should immediately replace old technology: the investment decision is classified as “zero-one.” As Cave (2010) emphasised, the issue is more complex in the NGA context. Regulators have to think vertically (i.e. how competing providers can climb the ladder by building their own fibre network) but also horizontally about movements from one ladder to another (see Figure 1). Operators in European countries are specifically in the middle of the two ladders and operating in both networks. And the “ladder of investment” approach fails to explain this intermediary situation where different generations of technologies coexist.

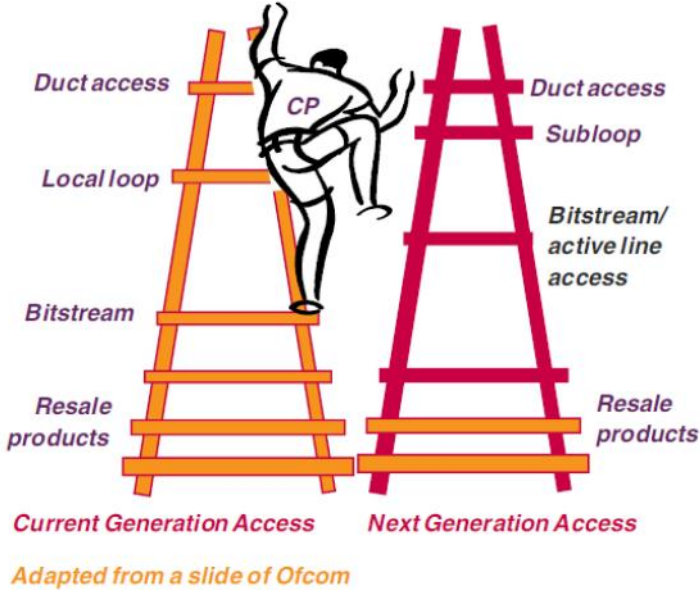


Figure 1. Migration between the ladders (Cave (2010))

The importance of analysing incentives to migrate from “old” to “new” technology has been put forward by Bourreau et al. (2012).

Using the game-theory framework, Bourreau et al. (2012) analyses the incentives for incumbents and entrants to migrate from “old” technology to “new” technology (the NGA network). They find that NGA-related investment incentives are impacted by access regulation charges in the “old” copper networks via three effects:

- A “replacement effect” that reduces investment incentives of alternative operators when the “old” infrastructure access price is low;

- A “wholesale revenue effect” where the old infrastructure revenue decreases with the access price. The incentive to invest in new infrastructure is related to the profitability of the access services on the old infrastructure;

- The “business migration effect” which stipulates that there is a link between the wholesale and retail prices of the old infrastructure and the retail price of the new infrastructure. According to Bourreau et al. (2012), if the access price of the old infrastructure is low, then retail prices based on that network are low. Hence, to encourage customers to switch from the “old” infrastructure to the “new” infrastructure, operators should also offer low prices for NGA. In this case, the profitability of the new infrastructure is also low as well as the incentive to invest in NGA networks. Consequently, they demonstrate that “regulators cannot treat the two access prices to the two different technologies independently.”

The objective of their paper is to determine the right level of copper prices that spur investment in an NGA network. Bourreau et al. (2012) conclude that if regulators want to encourage the incumbents to invest in NGAN, they cannot set wholesale copper prices at a low level.

The “competition migration test” we propose is in the same vein as Bourreau et al. (2012), but we address a slightly different question. The idea is not to evaluate the impact of the legacy network’s wholesale access price on the incumbent’s NGAN investment, but rather to analyse how copper prices may interfere when implementing NGA regulation. The interdependence between copper and fibre prices is materialized through this specific “competition migration test.” This test overcomes the limits of the “ladder of investment” approach integrating what Bourreau et al. (2012) named the “business migration effect.” The formulation of the second test demonstrates that the interdependence between copper and NGA prices must also be considered when determining NGA retail prices.

For the purpose of this paper, it is realistic to assume that all operators previously offered copper services. They all are at the top of the “copper” ladder and have to decide whether to enter the NGA market. During the technological transition, the operators that develop NGA access keep offering copper services for a smooth migration between both generations of access networks in the presence of high infrastructure costs.

Thus, a competitive provider could be in a transition phase, represented by the “grey zone” in Figure 2 where the investment decision is not 0 or 1 but somewhere between the two.

Through the NGA regulation, one of the objectives of the regulator is to make sure that the entrants migrate from the “copper” ladder to the “NGA” ladder, in other words help operators cross the bridge depicted in the Figure 2.

The set of two tests proposed in this paper, notably with the introduction of an interdependence condition between old and new infrastructure prices are innovative tools to ensure “the business migration” but also the “competitive structure migration.”

The economic replicability test based on variable wholesale prices regulates the variable part of the wholesale price and thus guarantees fair competition between all competitors that access the NGA infrastructure. The second test ensures that efficient operators can pay the fixed price to secure access to the NGAN.

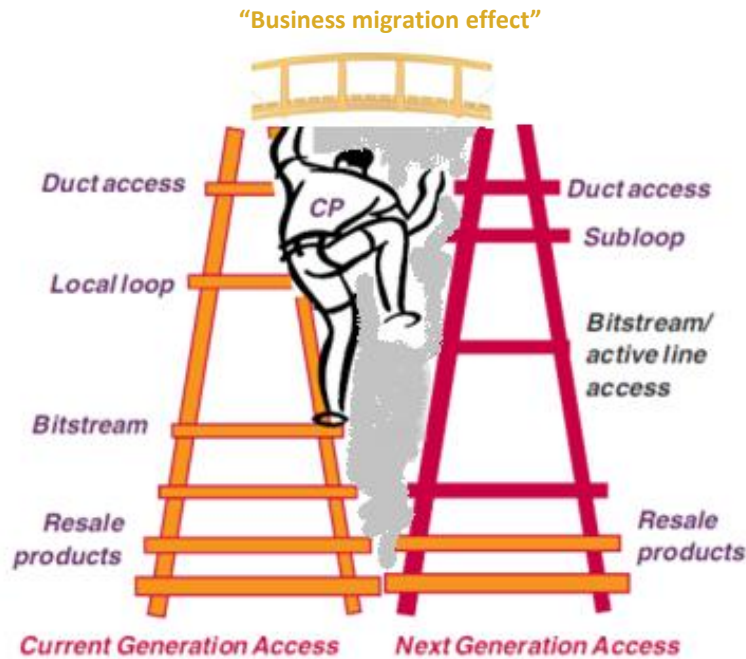


Figure 2. Migration between the ladders accounting for interdependence between old and new infrastructures (adapted from Cave (2010))

5. Conclusion

Specifying the economic replicability test for NGA services is a highly topical issue. It also must be accurate in the interest of not discouraging investment because, as demonstrated in this paper, NGA economics are incompatible with the traditional margin squeeze test used by authorities.

This paper addresses the question of how to implement the economic replicability test for NGA networks. This test is required by the Recommendation to regulate wholesale prices and taking into account that wholesale prices have a two-part structure. The test must be built in a way that fulfils the EC two-part objective to encourage NGA investment and preserve the competitive structure inherited from copper unbundling, while obeying the principle of fair allocation of investment risks between access providers and seekers.

This paper demonstrates that to be operational and realistically align with NGA networks, the NGA economic replicability test must only be based on variable costs and exclude the fixed part of wholesale prices.

Nevertheless, this test is not sufficient because it does not explain how to determine the fixed infrastructure prices and, in particular, it does not guarantee that an operator as efficient as the investor can pay the fixed costs and enter the NGA market.

Therefore, in a transition phase, until competitors have secured their access to NGA infrastructure, a temporary second test called the "competition migration test" must be added to ensure the incumbent's NGA retail prices and fixed wholesale price do not foreclose copper-based efficient

entrants. The second test is meant to preserve the competitive structure inherited from unbundling regulations on the copper local loop by ensuring business migration.

This pair of tests overcomes the limits of “the ladder of investment” theory integrating “the business migration effect” concept developed by Bourreau et al. (2012). The two tests proposed solve the dynamic consistency issue that Europe is facing: encouraging NGA investment while preserving the benefits of competitive markets. This economic analysis would also be relevant for a margin squeeze test under competition law.

The concept of two-part access prices, with a different form of regulation for each part of the tariffs may have broader applications than the one described here. This specification does not claim to be a general theory that is robust in all circumstances, rather only relevant for meeting the double requirement of infrastructure investment and competitive structure safeguards in European fixed telecommunications markets.

Appendix

We use a numerical example to technically demonstrate that conducting an LRIC+ test using a DCF method on customer lifetime is highly unlikely, independent of the existence of any actual discriminatory practices.

Figures in the numerical example were chosen for purely illustrative reasons and should not be considered representative of any one company.

It describes the effect of an LRIC+ economic replicability (test) in a case of asymmetric access to passive infrastructures (ducts and fibre).

To serve FTTH customers, an operator must first deploy its infrastructure, which generates an investment cost per eligible customer (a customer who has access to fibre infrastructure).

When the eligible customer adopts the service and becomes a commercial customer, the operator also has to deal with a variable cost per commercial customer.

We suppose that p is the ratio of commercial FTTH customers to all eligible FTTH customers, i.e. the penetration rate.

We consider two *ex ante* scenarios:

- Positive: p = up 20% per year after investment, which indicates that the migration is achieved in five years (p = 20% in time 1, 40% in time 2, 60% in time 3, 80% in time 4, 100% in time 5);
- Negative: p = up 5% per year after investment, which implies that the migration is achieved in 20 years.

We consider two alternative calculation hypotheses: we conducted the test by alternating between an infrastructure lifetime of 20 years and a customer lifetime of five years.

The cost of capital is presumed to be 10% (WACC: weighted average cost of capital).

I. Costs estimation

Companies have to deal with both investment costs and operational variable costs to deploy fibre infrastructure for its clients.

1) Investment costs

For all eligible FTTH customers, we suppose that the investment cost of access to the passive mutualised FTTH infrastructure is €600 per eligible customer.

For commercial FTTH customers, the investment cost to build individual fibre drop line is €300 per contracted FTTH customer, i.e. €60 per year per commercial customer.

The initial total asset is thus €660 in time 1 and increases by €60 per year.

Annual asset depreciation (D) is 1/20 of the total asset in time t-1.

Net assets (NA) in time 1 = $600 + 60 + D_{t-1}$

Net assets in time t = $NA_{t-1} + 60 + D_{t-1}$.

The return on investment (ROI) is 10% of net assets:

ROI = 10% * NA

2) Variable downstream costs (DC)

For all commercial customers, a company has to deal with three types of variable downstream costs:

- Costs of a shared network, commercial resources and activities shared with ADSL customers: €10* p per month;
- Costs associated with a specific network, commercial resources and activities: 10*(1- p)* p per month;
- Cost-oriented price for duct usage, i.e. €3* p per month.

Variable downstream costs per month:

$$DC = p \cdot (10 + 10(1-p) + 3)$$

3) Average revenue per user (ARPU)

The average revenue per user (ARPU) for an FTTH commercial customer is estimated at €35, i.e. €35* p per month.

4) Discounted cash flow results

The discounted cash flow results are estimated on an annual basis according to the following equation:

$$DCF = \sum_0^{20} [((35 * p * 12) - (DC + RNA) * p * 12)) * (1 - WACC)^{t+1}]$$

The test results are summarized in Figure 3.

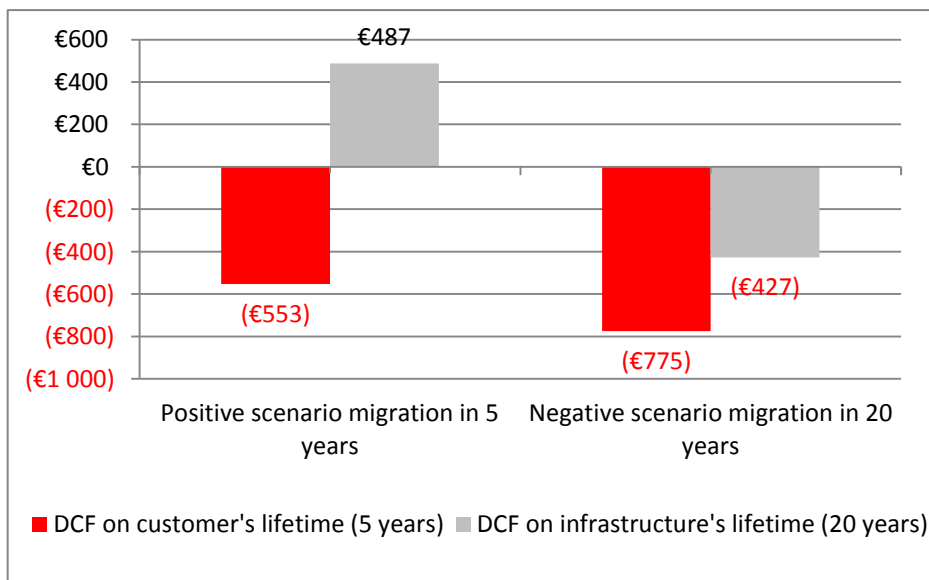


Figure 3. Economic replicability test results

The test is systematically negative (infringement of the economic replicability condition) when we performed it using a DCF method on a customer lifetime (five years). When we then ran the test using a DCF method on the infrastructure lifetime (20 years), the results were uncertain depending

on the length of the migration from copper to fibre network. The test is positive only under the extremely unlikely hypothesis that the migration is achieved in five years and negative if the migration takes 20 years.

The test is even negative when we consider that the access seeker benefits from cost-oriented non-discriminatory access from the FTTH investor (price equals cost in level and structure) and achieves a 50% market share. In this case, the hypotheses are as follows:

- wholesale duct price is €3 per month per FTTH commercial customer;
- wholesale access price for the FTTH infrastructure is 50% of a €600 upfront investment per potential customer;
- the EEO hypothesis supposes that there is an identical downstream unit cost and the unit retail revenue accounts for 50% of the total business.

Results are thus 50% of previous findings:

- Positive scenario, migration in five years:
 - o customer lifetime (five years): $50\% \times (-553) = -€276$;
 - o infrastructure lifetime (20 years): $50\% \times 487 = €243$;
- Negative scenario, migration in 20 years:
 - o customer lifetime (five years): $50\% \times (-775) = -€387$;
 - o infrastructure lifetime (20 years): $50\% \times (-427) = -€213$.

The conclusion of this example is that in this test an FTTH investor may be accused of not complying with the economic replicability test in situations where there is no discrimination.

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