

Review of the Application of the Concept of Network Externalities in the Telecommunications / ICT Industry

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Abstract

The subject of Externalities is not new; it began around the 1950s but it seems to be gaining popularity in the economic and legal literature since mid 1980,s. The concept is generally recognized in theory but capturing it in practical terms seems to be elusive.

When a transaction between a buyer and a seller directly affects a third party, the effect is called an externality. Negative externalities cause the socially optimal quantity in a market to be less than the equilibrium quantity. Positive externalities cause the socially optimal quantity in a market to be greater than the equilibrium quantity. Those affected by externalities can sometimes solve the problem privately. It is urged that if people can bargain without a cost, then they can always reach an agreement in which resources are allocated efficiently. When private parties cannot adequately deal with externalities, then the Government is expected to step in . The government can either regulate behavior or internalize the externality by using Pigovian taxes.

The term Network externality means that there are benefits if many people join and use a network. It is generally appreciated that the greater the size of the network, the greater the benefit to all users and the greater the overall value of the network. Although the network externality concept and its effects on telecommunications/ICT networks and pricing are widely accepted, the development and implementation of frameworks and models to capture the network externalities effects have been limited. This paper examines the current application of the concept of the network externalities in the Telecommunications/ICT industry.

Introduction

The word "externalities" in economics refer to costs or benefits that fall outside the activity that is under consideration. Economists believe that if all costs and benefits can be charged to the activity that creates them, the market will produce an optimal allocation of resources. The externalities are also grouped as negative and positive.

In economics and business, a network externality (also called network effect or demand-side economies of scale) is the effect that one user of a good or service has on the value of that product to other people. When network effect is present, the value of a product or service is dependent on the number of others using it.

The classic example is the telephone. The more people own telephones, the more valuable the telephone is to each owner. This creates a positive externality because a user may purchase a telephone without intending to create value for other users, but does so in any case. Online social networks work in the same way, with sites like Twitter and Facebook being more useful the more users join. Over time, positive network effects can create a bandwagon effect as the network becomes more valuable as more people join, in a positive feedback loop.

The expression "network effect" is applied most commonly to positive network externalities as in the case of the telephone. Negative network externalities can also occur, where more users make a product less valuable, but are more commonly referred to as "congestion" (as in traffic congestion or network congestion).

Network externality means that there are benefits if many people join and use the network. The phrase "network externalities" was coined by Jeff Rohlfs (1974), once at the Bell labs. It is generally appreciated that the greater the size of the network, the greater the benefit to all users and the greater the overall value of the network. Although the network externality concept and its effects on telecommunications/ICT networks and pricing are widely accepted, the development and implementation of models to capture those effects have been limited.

Since 2003 a number of countries has accepted the concept in principle and some have introduced a network externality surcharge (NES) when determining termination charges within the context of cost based pricing regimes.

The International Telecommunication Union (ITU) has embarked on a number of studies on the subject matter especially between 2005 -2008 with a view to determine whether it would be appropriate for a premium, referred to as a network externality premium, to be a non-cost, additional element, on the

accounting rate for incoming international traffic by operators of developed-world networks to the operators of developing-world networks. These studies culminated into the development and approval of the recommendation (standard) ITU-T D.156 on Network externalities in 2008 under the World Telecommunication Standardization Assembly (WTSA) Resolution 1 procedure, but to date there is little if any evidence towards its implementation.

Therefore there is a need to for further studies towards capturing the concept of Network Externalities and its applications.

Literature Review

Harvey Leibenstein (1950) [1] analyzed the “bandwagon effect,” by which he meant “the extent to which the demand for a commodity is *increased* due to the fact that others are also consuming the same commodity. It represents the desire of people to purchase a commodity in order to get into ‘the swim of things’; in order to conform with the people they wish to be associated with; in order to be fashionable or stylish; or, in order to appear to be ‘one of the boys.’” Leibenstein was not at all specific about the types of goods he had in mind other than to suggest that they were fashion goods.

The bandwagon effect remained largely unexplored for another 20 years or so. At that point, economists interested in the development of telephone networks, which clearly are subject to bandwagon effects, began to explore the issue in some detail using modern game-theoretic techniques. Rohlfs (1974) [2] observed that “The utility that a subscriber derives from a communications service increases as others join the system. This is a classic case of external economies in consumption and has fundamental importance for the economic analysis of the communications industry. Rohlfs then applied this insight in analyzing the origins and development of communications networks.

Except for applications to communications, the analysis of “network effects” lay largely dormant until the 1980s. At that point, economic historians such as David (1985) [3] as well as economic theorists such as Farrell and Saloner (1985) [4] and Katz and Shapiro (1985) [5] began to explore these issues in the context of the economics of standardization. This stimulated considerable interest in the topic, with the result that literally hundreds of papers devoted to network industries have been published. Moreover, this is a subject to which major contributions have been made by economic theorists, applied economists, economic historians, applied mathematicians, and engineers. Indeed, there is now exists a sort of “invisible college” in which people from a wide variety of disciplines study the subject and attend the same conferences where standards issues are discussed.

For economists, the theory of network effects, or network externalities, or standardization, has wide applicability. Indeed, it has fundamental importance for competition policy, regulation, business strategy, intellectual property, and technical change in a wide range of industries; developments in these industries cannot be fully understood without an understanding of network effects.[\[6\]](#)

In law and economics, the Coase theorem (1959) [\[7\]](#), attributed to Nobel Prize laureate Ronald Coase (1991) describes the economic efficiency of an economic allocation or outcome in the presence of externalities. The theorem states that if trade in an externality is possible and there are no transaction costs, bargaining will lead to an efficient outcome regardless of the initial allocation of property rights. In practice, obstacles to bargaining or poorly defined property rights can prevent Coasian bargaining.

Coase developed his theorem when considering the regulation of radio frequencies. Competing radio stations could use the same frequencies and would therefore interfere with each others' broadcasts. The problem faced by regulators was how to eliminate interference and allocate frequencies to radio stations efficiently. What Coase proposed in 1959 was that as long as property rights in these frequencies were well defined, it ultimately did not matter if adjacent radio stations interfered with each other by broadcasting in the same frequency band. Furthermore, it did not matter to whom the property rights were granted. His reasoning was that the station able to reap the higher economic gain from broadcasting would have an incentive to pay the other station not to interfere. In the absence of transaction costs, both stations would strike a mutually advantageous deal. It would not matter which station had the initial right to broadcast; eventually, the right to broadcast would end up with the party that was able to put it to the most highly valued use. Of course, the parties themselves would care who was granted the rights initially because this allocation would impact their wealth, but the end result of who broadcasts would not change because the parties would trade to the outcome that was overall most efficient. This counterintuitive insight that the initial imposition of legal entitlement is irrelevant because the parties will usually reach the same result.

Introduction of a **Pigovian tax**; a tax levied on a market activity that generates negative externalities. The tax is intended to correct the market outcome. In the presence of negative externalities, the social cost of a market activity is not covered by the private cost of the activity. In such a case, the market outcome is not efficient and may lead to over-consumption of the product. A Pigovian tax equal to the negative externality is thought to correct the market outcome back to efficiency.

In the presence of positive externalities, i.e., public benefits from a market activity, those who receive the benefit do not pay for it and the market tends to under-supply the product. Similar logic suggests the creation of Pigovian subsidies to make the users pay for the extra benefit and spur more production. Pigovian taxes are named after economist Arthur Pigou (1920) [8] who also developed the concept of economic externalities.

Sources of Network Externalities

Network externalities exist when the value of a product to any user is greater the larger is the number of other users of the same product. There are basically two ways in which such externalities can occur. *Direct* network externalities exist when an increase in the size of a network increases the number of others with whom one can “communicate” directly. *Indirect* network externalities exist when an increase in the size of a network expands the range of complementary products available to the members of the network.

Telecommunications/ICT industry exhibit network externalities. Some examples are:

- The Public Switched Telephone Network, where the network externalities are direct in that the value that any user places on subscribing depends on the number of others with whom he can communicate.
- ATM networks, where the network externalities are indirect in that the larger the network the greater is the number of machines at which an ATM card can be used, and hence the greater is the value of the network to any user.
- Networks of users of computers that use the same operating system, e.g., the Mac network, where there are direct benefits associated with more efficient file transfers and indirect benefits associated with access to a wider range of applications software as the size of the network grows.
- Networks of users of compatible videocassette recorders, which exhibit what are probably small direct benefits from the ability to exchange cassettes and much larger indirect benefits from being able to purchase or rent a wider variety of pre-recorded cassettes that employ the same format.

Application of Network Externalities Concept by Some Countries

It is notable that the introduction of a network externality surcharge (NES) is a factor that has been included when determining termination charges, and is usually considered within the context of cost based pricing regimes. However the

degree to which the effect of this component is felt would be a function of whether or not, and to what extent, it can be demonstrated that the introduction of such a subsidy would encourage more people to join the network.

In 2003, a Network externality was implemented in the United Kingdom (UK) for mobile cellular networks, based on the Rohlfs model. The UK approach to network externalities was also used in a Cost study of mobile termination charges in Israel, in which the value of the Network externality was found to be negligible.

The introduction of a NES was also proposed in Australia in 2004. However, the regulator was of the view that although the concept in relation to telecommunications markets was intuitively valid, based on the highly mature state that existed in the mobile telecommunications market in Australia, the relative importance of network externalities would be low.

In Tanzania the Long Run Incremental Cost (LRIC) methodology was used in 2004 and 2007 by the regulator, the Tanzania Communications Regulatory Authority, as the appropriate basis for determining interconnection rates. The network externality concept was considered but was not captured and factored in the determined interconnection rates because it was considered as a complex subject, very subjective and with both positive and negative impacts on the industry.

The Authority ruled that network externality should be for now excluded from the interconnection rate determination but may be considered in the future when standards are set by the ITU and or the regulator.

The ITU work on Network Externalities

A rapporteur group was set up in 2003 by the ITU-T Study group 3 with the objective to consider the issue of network externalities and international accounting rates. Questionnaire was circulated in July 2006. A workshop was held in September 2007. Draft recommendation was proposed by Cameron and Cote D'Ivoire. The revised recommendation determined under TAP was considered and approved at the WTSA 2008 Johannesburg, South Africa.

It is my considered view that the network externalities concept is well summarized and explained in the recommendation D.156 and its recap and review may further foster understating of the issues around the Network externalities concept in the Telecommunications/ICT industry and beyond.

The Recommendation ITU-T D.156 on Network externalities

Summary

A network externality relates to the additional effects of a user joining a network which the user does not take into account. A user joins a network to obtain a benefit from making and receiving calls and derives a benefit from being part of the communications network. This benefit derives from being able to communicate with other users and increases with the number of users connected to the network: the bigger the network, the more beneficial it is to both existing and potential users. Hence, a user's decision to join a network benefits both them and other users. This Recommendation provides recommendations related to the payment of network externality premiums.

Recognizing

Resolution 3 (Melbourne, 1988) of the World Administrative Telegraph and Telephone Conference and Resolution 22 (Rev. Antalya, 2006) of the Plenipotentiary Conference on the apportionment of revenues in providing international telecommunication services,

Considering

1. that in accordance with the International Telecommunication Regulations, accounting arrangements shall be established by mutual agreement;
2. the principles established in Recommendations ITU-T D.93 and D.140 in regard to cost oriented tariffs and the application of accounting rates on a non-discriminatory basis;
3. that telecommunication network externalities are benefits, inter alia, provided to users of networks in developed and developing countries by users of networks with a strong potential for extension;
4. that users of networks in developed countries would benefit from the addition of users in developing countries because of increased calling opportunities to users in developed countries;
5. the development potential for telecommunication networks in developing countries;
6. that a network externality relates to the additional effects of a user joining a network which the user does not take into account; a user joins a network to

obtain a benefit from making and receiving calls and derives a benefit from being part of the communications network; this benefit derives from being able to communicate with other users and increases with the number of users connected to the network: the bigger the network, the more beneficial it is to both existing and potential users; hence a user's decision to join a network benefits both them and other users;

7. that network externality premiums have been applied in specific circumstances in one country for termination of mobile calls,

Recalling

1. the importance of telecommunications/ICT for the social and economic development of all countries;
2. the increasingly marked imbalance that is currently to be seen between the situation of developed countries and that of developing countries in regard to economic growth and technological progress;
3. that, pursuant to Resolution 23 (Nice, 1989) of the Plenipotentiary Conference and as a follow-up to the recommendation made in "The Missing Link", ITU carried out a study of the costs of providing and operating international telecommunication services between developing and industrialized countries and concluded that the cost of providing such services was significantly higher in developing countries than in developed countries – a situation that continues to prevail;

1. *The following countries have expressed a reservation and stated that they will not apply this Recommendation:* Austria, Canada, Czech Republic, Finland, France, Germany, Greece, Italy, Japan, Liechtenstein, Lithuania, Netherlands, Norway, Poland, Portugal, Russian Federation, Serbia, Spain, Switzerland, Turkey, UK, USA.

In addition, the following countries have expressed a reservation with respect to this Recommendation: Argentina, Australia, Mexico, Paraguay, Thailand, Uruguay.

2. Rec. ITU-T D.156 (10/2008)

The recommendation contained in "The Missing Link" to the effect that Member States should consider adjusting their procedures for charging for international traffic in relations between developing and industrialized countries such as to set aside a small portion of call revenues for purposes of development.

Acknowledging

1. that network externalities should be expressed by a premium referred to as an externality premium which is a non-cost element in addition to the cost elements included in Recommendations ITU-T D.93 and D.140;
2. that the amount of the premium referred to as a network externality premium should be determined having regard to the following elements, amongst others:
 - a) assessment of the price elasticity of demand and sensitivity of the traffic flow to the network with a strong potential for extension;
 - b) the correlation between the increase in incoming international traffic and the increase in the subscriber base in the developing countries;
3. that the funds made available by the network externality premium should be determined by elements including:
 - a) economic assessment of the additional customers in the country in question (including assessment of income levels and rates of mobile and fixed telecommunication penetration);
 - b) geographical targeting, reduced monthly charges for certain customers, subsidies for telephone terminals, and tariff schedules tailored to the needs of marginal consumers;
 - c) the cost of the investments for the network extension,

Recommends

1. that the developing countries examine whether it would be appropriate for a premium, referred to as a network externality premium, to be a non-cost, additional element, on the accounting rate for incoming international traffic from the operators of developed networks to the operators of developing-country networks;
2. that this premium be negotiated on a commercial bilateral basis by the concerned operators on the basis of the elements referred to in acknowledging 2 and 3 above, taking into account all relevant factors including, but not limited to: traffic level, potential business, immigrants to the developed countries, and languages spoken in the two countries;

3. that this premium be paid on the tariff for incoming international traffic from developed countries to developing countries, in other words, that it be a non-cost, additional element on the termination rate/accounting rate;
4. that the funds made available by the network externality premium, be used exclusively for extending networks in developing countries, and for awareness campaigns, including, but not limited to media and advertising costs, taking into account acknowledging 3 above; such costs for awareness campaigns should have a positive effect on the number of customers;
5. that the use of the funds made available by the network externality premium be monitored by the concerned parties, as mutually agreed, with appropriate oversight by an independent accounting firm, providing that this firm is not the regular auditor for either of the two parties; moreover, this fund may be established in a third country for the purposes of neutrality;
6. that further studies be carried out regarding formulas, models and guidelines for determining the actual value of any premium, how it should be collected, shared, distributed, and used, and its impact on the concerned operators.

Appendix I to the recommendation D.156

Items for study

The appendix does not form an integral part of the D.156 Recommendation but lists the following items that should be studied:

1. The implications of the incorporation of a network externality premium with relation to Recommendations ITU-T, such as D.93 and D.140, relative to the application of cost oriented tariff principles, establishing whether the said premium constitutes a cost element that should be added to the cost elements included in the said Recommendations ITU-T.
2. The establishment of guidelines to guarantee the actual deposit of the said externality premium and its application to expansion networks.
3. Clarifying who should receive the funds.
4. Control and collection procedures.
5. The implementation of follow-up to allow the observation of the effects caused by the application of the Recommendation.

6. The definition of parameters enabling to qualify: "developed country" and "developing country".
7. Seeking mechanisms to prevent operators in developing countries from funding their original license obligations with what they receive from applying the externality premium, nor investment projects already contemplated in Universal Service programs provided by regulations in the said countries.
8. Seeking mechanisms to prevent the subscribing of discriminatory agreements between telecommunications main companies in developed countries and their subsidiaries in developing countries, and abuses in the calculation of the premium in bilateral agreements.
9. The elaboration of studies at a regional level referred to traffic sensitivity from and to developing countries, with the incorporation of a network externality premium and the assessment of potential subscribers and investments in developing countries.

Development of Annex 1 to Recommendation D156 on Network Externalities

During the study period 2009 – 2012 the ITU-T Study Group Three made a number of efforts to clarify issues and develop a practical implementation of the recommendation D.156 that are contained in an Annex to the recommendation as follows:-

Amendments of the Recommendation ITU-T D.156 on the Network externalities

1.Amendment 1

New Annex A – Practical implementation of Recommendation ITU-T D.156

(This annex forms an integral part of the Recommendation)

1.Does the externality premium constitute a cost element that should be added to the other cost elements included in Recommendations ITU-T D.93 and ITU-T D.140?

The externality premium is not a cost element but is rather the financial expression and the evaluation of an economic benefit (network externality)

enjoyed by an economic agent, in this case the subscribers to a telecommunication network. The premium is additional to the service cost and must be seen as an element involved in service pricing in the same way that the profit margin is added to the service cost to obtain the price.

2. *To which networks does the network externality premium apply?*

The externality premium is the financial expression and the evaluation of an economic benefit enjoyed by an economic agent as a consequence of the benefits created by the expansion of a network that presents a strong potential for expansion in terms of subscribers. The premium would only apply to networks which have a potential for expansion in terms of subscribers.

3. *How will it be guaranteed that the externality premium will be paid and then used for network development?*

Payment of the externality premium and its use for network expansion in terms of subscribers will be guaranteed by the parties to the relationship and may be overseen by national regulators as appropriate:

- 1) Payment of the premium is recorded by the regulators following its payment and receipt by the two operators in the relationship.
- 2) At the beginning of each year, the operator receiving the premium must draw up a plan for expanding its network in terms of subscribers using those funds. The plan must be sure to specify the investment needed for the proposed expansion and the corresponding financial assessments. A copy of the plan is submitted to the regulator and to the other party.
- 3) Execution of the plan is verified by the regulator, which reports the results of its verification to the national operators and to the foreign operators paying the premium. The latter operators have the right to send a verification mission to the regulator. Charging of the premium must be effected at the beginning of each period. National regulators may take actions as appropriate should the expansion fail to take place. For example, the regulator could submit an expansion programme by way of the operator's regulatory obligation, and that operator would at the same time be barred from receipt of the externality premium for a period of three years. In the interests of transparency, regulatory bodies may publish a verification report on the same.

1 South Africa stated that network externalities, in principle, are not only applicable for the expansion of networks in terms of subscriber numbers, but also for the retention of marginal subscribers.

2 Rec. ITU-T D.156 (2008)/Amd.1 (05/2010)

The levels of externality premiums and the amounts involved in expansion activities financed from the premium, together with any other statistical data called for by ITU.

4. Who receives externality premiums?

The externality premium is received by a developing country operator whose network shows potential for expansion in terms of subscriber numbers. Such a network is a source of value for mature – and in many cases saturated – networks. The level of the premium is proportional to the volume of traffic originating in a developed country and terminated on the developing country operator's network.

It is important to note that payment of the premium will take place only where there is a genuine network externality.

5. What is the procedure for collecting the externality premium and controlling the use to which it is put?

The collection procedure will be the same as is used for the accounting rate. The means of control will be the audits carried out by regulatory bodies, which may also take the following steps:

- 1) Submission, at the beginning of the financial period, of a network expansion in terms of subscribers to be financed from externality premiums.
- 2) Verification by the regulator of adherence to the financial estimate for the expansion and of consistency between the use of the funds and the premium received or to be received.
- 3) Evaluation of the expansion work done, or to be done, under financing from the externality premium.
- 4) In the event of non-consistency, the regulator may impose an obligation to expand or a reduction in the amount to be paid by the paying party in subsequent exchanges.

- 5) Failure to abide by the relevant provisions may result in action by the regulator as appropriate, for example suspension of payment of the premium for a period of three years.
- 6) *How to define developed countries and developing countries?*
This definition has already been made by UNDP.
- 7) *What mechanism can be used to prevent the funding of original licence obligations and universal service obligations with funds received from payment of the externality premium?*

This mechanism will form part of the control function to be exercised by the regulatory body in the country of the operator receiving the externality premium. The regulatory obligations associated with licences and universal service are set out in each operator's terms of reference and are subject to ongoing verification by the regulator, which ensures that regulatory obligations in regard to coverage are fully complied with and that externality premiums received by its operators have actually been used for network expansion in terms of subscribers. The regulator may also draw up and publish a verification report, thereby ensuring transparency in implementation of the network externality premium.

3. Rec. ITU-T D.156 (2008)/Amd.1 (05/2010)

8. *What mechanism can be used to prevent the conclusion of discriminatory agreements between the main telecommunication companies in the developed countries and their subsidiaries in the developing countries, as well as abuses in the calculation of the premium in bilateral agreements?*

Just as the regulatory bodies seek to ensure adherence to transparency, non-discrimination and equity in interconnection agreements, which constitute bilateral agreements between operators, they may also seek to ensure that those same principles are upheld when it comes to calculation of the network externality premium and its payment to operators. To this end, the same level of premium is paid, per minute of terminated call, to each recipient operator within a given national territory.

9. *Do the provisions of Recommendation ITU-T D.156 violate provisions of WTO agreements?*

No. The WTO provisions apply only to actions of governments who are members of WTO. The operative part of Recommendation ITU-T D.156 is addressed to operators, not to governments. As a consequence, this

Recommendation cannot violate provisions of the WTO agreements.

Further, individual decisions taken by operators in developed countries in accordance with Recommendation ITU-T D.156 could not be considered to be discriminatory measures in the sense of WTO provisions, because the decisions in question are within the economic freedom of operators and do not fall within the mandate of WTO provisions, which forbid discriminatory actions on the part of the WTO Member States and oblige the said States to ensure that their major suppliers offer interconnection on a non-discriminatory basis. It cannot be said that an operator's decision to pay an externality premium to a given operator in order to finance a likely increase in its revenue would be a discriminatory measure, because clearly the operator who is paying would likely be ready to pay the same premium to any other operator whose network could experience strong growth in terms of subscriber numbers.

Conclusion

A network Externality exists when a product's value to the user increases as the number of users of the product grows. Each new user of the product derives private benefits. But also confers external benefits (Network externalities) on existing users. Network externalities may cause markets to fail. Networks may not reach optimal size, because users fail to take account of external benefits. Markets in which incompatible standards compete may go in the direction of a standard that gains an early advantage, even if that standard is objectively inferior. In the recent years some countries e.g. Jamaica, Ghana, Cote d'Ivoire, Gabon and Senegal have introduced specific tax/surcharge on the incoming international Telecommunication traffic. Could this could be interpreted as the application of the Network Externality Concept ? Thus there is a need for further studies towards capturing the concept of Network Externalities and its applications.

References

[1] H. Leibenstein, "Bandwagon, Snob, and Veblen Effects in the Theory of Consumers' Demand," *The Quarterly Journal of Economics* (May 1950), reprinted in W. Breit and H.M. Hochman, *Readings in Microeconomics*, Second Edition (New York: Holt, Rinehart and Winston, Inc., 1971), pp. 115-116.

[2] J. Rohlfs, "A Theory of Interdependent Demand for a Communications Service," *Bell Journal of Economics and Management Science* (Spring 1974), p. 16.

[3] P.A. David, "Clio and the Economics of QWERTY," *American Economic Review* (May 1985).

[4] J. Farrell and G. Saloner, "Standardization, Compatibility, and Innovation," *Rand Journal of Economics* (Spring 1985).

[5] M. L. Katz and C. Shapiro, "Network Externalities, Competition, and Compatibility," *American Economic Review* (June 1985).

[6] Potential applications of the theory are even more widespread; the analysis of industrial location provides a good example.

[7] Recommendation ITU-T D.156 was approved on 30 October 2008 by ITU-T Study Group 3

(2005-2008) under the WTSA Resolution 1 procedure.