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How much is an incoming message worth? Estimating the call externality[☆]

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ABSTRACT

A feature of electronic communication markets is that a consumer's decision to join or use a communications network can generate two effects on other users of the network: a *network* externality and a *call* externality. The former effect is defined as the benefit that users receive when a new subscriber joins the network (an expanded customer base can now be reached). The existence and magnitude of this effect is important from both theoretical and policy points of view. As a consequence, its empirical importance in various network markets has been documented in the literature. A *call* externality is defined as the benefit that a consumer derives when receiving a message (e.g. call) from another user, and it plays a crucial role both in the equilibrium predictions of theories of network competition and in the results of recent empirical work; however, as opposed to the network externality, no attempt has been made to quantify its empirical importance. In this paper I report results of a study designed to elicit and estimate the call externality. The data were generated using a stated-preference choice experiment designed to match theory and several characteristics of the mobile industry in Ecuador. To enhance the external validity of the results, the choice experiment was administered to over 2,500 individuals using 492 different internet-equipped government-run locations throughout the country. I find that call externalities are quite important in this market, but that their intensity depends heavily on the type of call (on-net v. off-net) as well as on the type of user (pre-paid v. post-paid). The call externality parameter for on-net calls is estimated at 0.67, while the significance of the call externality for off-net calls is significantly smaller (economically and statistically). Further, I find that the existence of call externalities in the market are mostly driven by pre-paid users.

1. Introduction

Electronic communications (phone, e-mail, video conferencing) involve two (or more) parties who exchange messages through the usage of a network (e.g. telephone system, internet). The fact that communication involves multiple users who simultaneously decide to consume this service (e.g. making a phone call) imposes effects (costs or benefits) on more than just one customer of the network. The literature has identified two main effects that turn out to be important theoretically in these markets and has labeled them "network effects" . The first is called *network* externality and the second is referred to as *call* externality.[1]

A good is said to be characterized by a network externality when an increase in the number of users of the good, ceteris paribus, increases the value of the good perceived by other users. The internet and mobile phones are often cited as goods that are characterized by (some degree of) network externality: as more consumers decide to join the network, remaining users of the network increase their chances of reaching (or being reached by) other users thereby increasing their valuation of joining the network. The existence of network externalities has important implications for the equilibrium size of the network, which, in turn, are critical from a policy perspective. In markets where network externalities exist, equilibrium network size can either be nil or

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[1] I use the term "externality" for the two noted effects to be consistent with (most of) the literature. In particular, I make no claim of whether this effect is an appropriate reflection of economists' definition of an externality (for a critique see Liebowitz and Margolis, 1994); rather, I interpret them as two "technological" effects that are specific to network industries.

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large in size, with the latter being Pareto optimal (Economides and Himmelberg, 1995);[2] in this setup, the intensity of the network externality defines the minimum network size (the *critical mass*) needed to move the equilibrium away from a zero-sized network. The importance of network externalities can also be seen in the possibility that, when faced with the adoption of one of several new technological standards, the market might fail to coordinate on a Pareto-superior technology (Farrell and Saloner, 1985; Katz and Shapiro, 1986). From a policy/societal point of view, there is clearly a preferred equilibrium in both cases (a larger-size network in the first case and a superior standard in the latter), but the market may end in the inferior allocation if a *laissez-faire* approach is taken. Thus, there is no surprise that there have been several empirical attempts to quantify the importance of network externalities (Brynjolfsson and Kemerer, 1996; Goolsbee and Klenow, 2002; Gowrisankaran and Stavins, 2004; Ackerberg and Gowrisankaran, 2006).

A call externality is defined as the benefit that a user derives from receiving a message (e.g. call) from another user (Jeon et al., 2004).[3] As with network externalities, call externalities turn out to be important both theoretically as well as empirically. Both equilibrium and welfare-maximizing prices differ from those one would observe in absence of call externalities; further, the presence of call externalities can give rise to anticompetitive concerns. I review these effects of call externalities in the next paragraphs.

The critical role of call externalities from a theoretical point of view has been noted both in monopoly situations in which the network is faced with simpler pricing decisions, as well as in more complex environments (i.e. oligopoly) where interconnected networks need to set prices for both their users (retail prices) and their competitors (access or interconnection prices). Hahn (2003) and Hermalin and Katz (2004) study monopoly situations. Hahn (2003) studies a situation where the monopolist is only allowed to charge the users for outgoing messages (calls) and finds that the presence of the call externality in this case generates an inefficiency as the quantity of outgoing calls suffers a downward distortion. In line with this finding, Hermalin and Katz (2004), who allow the monopolist to charge for both incoming as well as outgoing prices, show that in the presence of call externalities efficient pricing involves charging a non-zero price to the receiving party (as well as to the sender) and that, consequently, social welfare will increase in this proposed efficient allocation.

In the case of multiple networks, firms compete for users who, in turn, can communicate with other users. The key difference with the monopoly case is that networks are interconnected with each other and consumers can thus communicate with users of all networks. The prime example for these models is the telecommunications industry, in particular the mobile phone market. In this type of network competition, strategic decisions by firms are made at two levels: the wholesale price at which a network will allow competitors to terminate messages (known as "access", "termination" or "interconnection" price),[4] and the retail price that consumers need to pay for sending (or receiving) a message. Thus, theoretical models in network competition have been concerned with characterization of equilibria and socially efficient outcomes at both levels.

At the wholesale level, given firms' high likelihood of exercising market power, the main focus in the policy debate has been on preventing networks from setting an interconnection charge that is too high. As a consequence, interconnection charges have been heavily regulated and their level has always been a subject of debate between regulators and industry. A commonly seen scenario across the world is that regulators are constantly pushing for (lower) interconnection charges that reflect socially efficient levels (i.e. charges reflecting those that would be observed in a competitive scenario). However, recent work shows that the socially efficient level depends heavily on the existence of call externalities. Intuitively, in order to internalize the positive externality that incoming calls generate (i.e. achieving a consumption level that is higher than that we would observe otherwise), it is necessary to reduce the price that networks pay to terminate calls that are directed to their rivals' infrastructures (DeGrabba, 2003; Jeon et al., 2004; Berger, 2004, 2005; Armstrong and Wright, 2009). In several cases, it has been argued that the optimal level should be set to zero (i.e. below cost; see DeGrabba, 2003; Berger, 2005). These findings fuel an important debate in Europe and elsewhere regarding what the optimal (regulated) interconnection charge should be (see Harbord and Pagnozzi, 2010). The importance of the call externality in this debate is clearly illustrated by Harbord and Hoernig's (2015) simulation study of in which the authors show that the level (and in some cases the sign) of welfare changes of lowering mobile interconnection charges in the UK depends on the magnitude of the assumed call externality.[5]

A similarly critical role of call externalities has been noted for retail pricing. In particular, in markets where firms engage in termination-based price discrimination (setting different prices depending on whether a user's call is directed to a customer connected to the same network or to a different network),[6] a feature that is ubiquitously seen in the mobile industry, call externalities can have an important distortionary effect on the price differential between on-net calls (calls terminated on the same network) and off-net calls (calls terminated on a rival's network). Several theoretical studies characterize the equilibrium in this situation (e.g. Jeon et al., 2004; Hoernig, 2007; Armstrong and Wright, 2009) and note that in the presence of call externalities the on-net price is inversely related to the importance of the call externality while the opposite occurs for the off-net price.

Of particular concern for policy makers has been the possibility that the termination-based price discrimination could (intentionally or unintentionally) create situations whereby smaller networks (or potential new entrants) face a competitive disadvantage as they would have to offer substantially lower prices (on-net and/or off-net) to effectively compete with the pricing structure of large networks (Laffont et al., 1998; Hoernig, 2007; Armstrong and Wright, 2009). This concern has been quite important for some competition authorities: some have contemplated the imposition of a ban on such price differentials;[7] some countries (Colombia and Chile) have already adopted this measure.[8] As shown by Hoernig (2008), however, the welfare impact of an intervention that imposes restrictions on the retail price in this type of market heavily depends on the magnitude of the call externality. Thus, the impact of such

[2] The authors also consider a "medium-sized" network equilibrium, but it is not a stable solution.

[3] The assumption here is that the average consumer values and incoming message, otherwise we would never answer our phone or read our email. With the availability of caller ID and more efficient junk mail filtering systems, this assumption seems reasonable.

[4] Sometimes the word "charge" is used in lieu of "price". I use both terms interchangeably.

[5] The authors also study the welfare effects of a proposed merger in this market; the role of call externalities in this exercise is even more critical for determining the sign of welfare changes.

[6] This practice is also called "tariff mediated price discrimination"; see Laffont, Rey and Tirole (1998).

[7] This ban is noteworthy as the trend, worldwide, has been for regulation to move away from direct intervention in retail pricing. Currently, retail price regulation is often seen as a last-resort intervention (e.g. Motta, 2004).

[8] In 2009 Colombia imposed such a ban on the dominant mobile operator Claro (a subsidiary of América Móvil; CRC 2009), whereas in 2014 Chile imposed it on all mobile operators (TDLC, 2012).