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The telecommunications industry and economic growth: How the market structure matters☆

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ABSTRACT

This paper presents an endogenous growth model where the telecommunications industry is the engine of growth. In such a framework, it analyzes how the market structure of the telecommunications industry can matter for its contribution to long-run growth. It shows that policies which increase the number of firms and/or toughen competition imply higher innovative effort in the telecommunications industry and strengthen its contribution. Modeling entry into the telecommunications industry, this paper also shows that the entry either stops after a number of firms have entered or continues permanently. In the long-run, it is socially optimal to have permanent entry. This can necessitate subsidies to entry into the telecommunications industry.

1. Introduction

A vast empirical literature suggests that the telecommunications industry makes a significant contribution to economic growth (e.g., Röller and Waverman, 2001).[1] According to the theory and many empirical studies, this contribution can depend on the market structure of the telecommunications industry since the market structure can affect, for example, competitive pressure in the industry and therefore the incentives to innovate (e.g., Blundell et al., 1999; Vives, 2008). The market structure can also determine the inefficiencies stemming from the market power of telecommunication firms (telecom firms). These inefficiencies can alter the demand for the goods produced in the telecommunications industry, which can also affect its contribution to economic growth.

This type of inefficiencies have motivated, for instance, the Telecommunications Act of 1996 in the US and Directives 90/388/EEC, 96/19/EEC, 2002/22/EC, and 2002/58/EC in the EU. These policies propose and have motivated already changes in the market structure of the telecommunications industry in the US and EU countries. Recently, the wave of privatization of state owned telecom firms and the entry of new firms into the telecommunications industry has been the norm almost everywhere. As a result, telecommunications markets have become less concentrated commonly featuring more than a handful of big firms. These policies aim also at promoting the demand for telecommunications and innovation in the telecommunications industry. Policy makers motivate the promotion of the demand, for instance, by the external benefits from the use of telecommunications.

This paper models the telecommunications industry as the engine of economic growth in a general equilibrium framework. It assumes that telecom firms have market power and models intra-firm R&D that improves the productivity of telecom firms (or the quality of telecommunications goods; e.g., the discovery and application of digital technologies). The theoretical framework of this paper also allows the telecom firms to engage in R&D partnerships and cross-licensing activities. The significance of such partnerships and activities is largely documented for the telecommunications industry and other high-tech industries (see, for instance, Hagedoorn, 1993, 2002).[2] According to anecdotal and empirical evidence it can significantly amplify the innovation in such industries (see, for instance, Grindley and Teece, 1997; Belderbos et al., 2004).

In such a framework, this paper analyzes how the market structure of the telecommunications industry can affect its contribution to growth, while focusing on a symmetric equilibrium and balanced growth path analysis.[3] Given that the market structure matters, the type of competition in the telecommunications industry (i.e., Cournot or Bertrand) can also play a role. Therefore, in addition, this paper

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[1] See also Oulton (2012) for a growth accounting exercise for information and communication technologies, which include telecommunications.

[2] The telecom firms' final outputs are, for instance, telephone calls and the internet. Although part of the innovation/R&D for the telecommunications industry may not take place in this industry per se, in this paper the R&D process is modeled within telecom firms and the licensing activities are modeled across these firms. As long as innovation is paid its fair price, these assumptions do not drive the results of this paper.

[3] See Bourreau and Doğan (2001) for a discussion of a relationship between regulation and innovation in the telecommunications industry.

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suggests a link between economic growth and the type of competition in the telecommunications industry.

In line with the network economics literature (e.g., Gandal, 1995), this paper incorporates (direct) network externalities which increase the value of using telecommunications (telecom goods) with the level of adoption and use of telecommunications.[4] In light of productivity improvements in telecom goods production, however, this paper replaces the level of adoption and use by the *effective* level of adoption and use, which seems to be novel at least in the aggregate level studies related to telecommunications.[5] The intuition for such replacement is as follows: both the number of users and, for instance, the fault rate of lines, can affect the network externalities.

The theoretical results suggest that policies which increase the number of firms promote innovative effort in the telecommunications industry. Therefore, such policies increase the contribution of this industry to long-run growth. The driver behind this result are the relative price distortions. These distortions stem from the market power of telecom firms and increase the relative price of R&D inputs of telecom firms. Increasing the number of telecom firms increases competitive pressure and reduces relative price distortions, which motives higher investments in R&D. The same result holds if competition type changes and becomes tougher (Bertrand vs. Cournot). The telecommunications industry also contributes more to long-run growth if network externalities are stronger.

Further, I consider the case when entry into the telecommunications industry is deregulated and endogenize entry into the telecommunications industry assuming that it entails endogenous sunk costs. These entry costs represent the capital investments of entrant telecom firms.

The results suggest that, depending on the economy, the entry either stops after some number of firms have entered or it continues forever. In the first case, the number of firms in the economy will be always finite, while in the second case it grows permanently. The drivers of this result are the investments in innovation for productivity improvement, which are fixed costs. The entry of firms erodes the revenues per firm, and these costs can be so high that the new entrant would have negative profits. Although, the case when the number of firms is finite in the long-run seems to be more plausible, it seems hard to rule out the case when it grows permanently. In turn, according to the results, in the social optimum (the Social Planner's optimal choice) there is permanent entry in the long-run. This can necessitate subsidies to the entry into the telecommunications industry.

The result that more intensive competition, because of entry into the telecommunications industry, promotes innovation and growth is consistent with empirical findings of Boylaud and Nicoletti (2001), Li and Xu (2004) and Paleologos and Polemis (2013). It is also consistent with more aggregate-level empirical findings of Blundell et al. (1999), Griffith et al. (2010), and Barone and Cingano (2011).[6]

This paper is related to studies which suggest how economic growth can be affected by imperfect competition in an industry where the firms engage in intra-firm R&D and to studies which analyze the impact of information and communication technologies on growth (e.g., Smulders and van de Klundert, 1995; Venturini, 2007; Vourvachaki, 2009; Jerbashian, 2014). It contributes to these studies by showing how the continuous entry of firms can affect the intra-firm R&D process when there is knowledge licensing. It also contributes by showing that depending on the economy the entry of firms either stops after a finite number of firms have entered or continues permanently.

This paper is also closely related to the literature which suggests a positive impact of telecommunications on the aggregate economy (e.g., Röller and Waverman, 2001; Koutroumpis, 2009; Czernich et al., 2011; Paleologos and Polemis, 2013). It contributes to this literature by showing how the market structure of the telecommunications industry and the type of competition in that industry can affect the contribution of the telecommunications industry to long-run growth. It also suggests the market structure of the telecommunications industry that is socially optimal in the long-run, which seems to be an open question in the literature (see Röller and Waverman, 2001).

The model presented in this paper is a general endogenous growth model (for similar models see Romer, 1990; van de Klundert and Smulders, 1997; Minniti, 2010). The adoption of such a model involves trade-offs. This model is well suited for the purpose of this paper since it allows explicit accounting for the channels through which the telecommunications industry and its market structure can affect the aggregate performance and long-run growth. On the other hand, however, this model abstracts from many of the complex details of the telecommunications industry. For example, it abstracts from market interactions at platform level (e.g., broadband vs. fixed line telephony) as well as interactions at platform-service level (e.g., broadband and television services). It does not capture product-level differences (e.g., cable and broadband) and differences in the demand for telecommunications (e.g., small vs. large firms). It also abstracts from state ownership of telecom firms as can be observed in some countries. Admittedly, this limits the sharpness of its inference for the telecommunications industry and policy recommendations.

From another perspective, this general model can have other applications as well. The only part of the model that might be hard to justify for other industries is the externalities associated with the use of telecommunications. For non-high-tech industries it can also be hard to justify the intra-firm R&D process and knowledge (patent) licensing.

The next section presents the model and offers the optimal rules. Section 3 analyzes the features of dynamic equilibrium. It also offers the socially optimal allocations, compares these with the decentralized equilibrium allocations and suggests some comparative statics. Section 4 concludes. Proofs of propositions offered in the text are available in online appendices of this paper.

2. The model

2.1. Households

The economy is populated by a continuum of identical and infinitely lived households of mass one. The representative household is endowed with a fixed amount of labor (L). It inelastically supplies the labor to firms which produce homogenous final goods and to telecom firms. The household has a CIES instantaneous utility function with an intertemporal substitution parameter $1/\theta$ and discounts the future streams of utility with rate ρ ($\theta, \rho > 0$). The utility gains are from the consumption of amount C of final goods. The lifetime utility of the household is

$$U = \int_0^{+\infty} \frac{C_t^{1-\theta} - 1}{1-\theta} \exp(-\rho t) dt. \tag{1}$$

The household finances its expenses through labor income wL and through returns r on its asset holdings A. The household's expenses include its consumption expenditures and the accumulation of assets $\dot{A}$:

$$\dot{A} = rA + wL - C. \tag{2}$$

[4] The existence of such externalities, although seems to be intuitive, does not have universal empirical support (e.g., see Röller and Waverman, 2001; Stiroh, 2003).

[5] To my best knowledge this is novel also for micro level studies related to telecommunications.

[6] The empirical debate about the relationship between competition and innovation seems far from being settled. For example, in contrast to these papers, Aghion et al. (2005) find that the relationship has an inverted-U shape, while Hashmi (2013) finds a mildly negative relationship.