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Defensive strategies in quality ladders

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ABSTRACT

This paper analyses the potentially defensive behaviour of patent-race winners and the ensuing effect on aggregate R&D effort. We propose a quality-ladder model where leaders strategically acquire a technology advantage and are able to innovate. In this context, product-market regulation, by affecting this strategic behaviour, may have either a positive or negative effect on aggregate R&D intensity. The negative effect is likely to pertain in liberal markets, whereas the positive influence arises in more regulated environments, and can be stronger for larger jumps in innovation. These steady-state equilibrium outcomes are consistent with the puzzling patterns in data from manufacturing industries in 14 OECD countries over the 1987–2003 period.

1. Introduction

A number of pieces of empirical work on R&D surveys have shown that firms use a variety of strategies to protect the value of their innovations (Levin et al., 1987; Cohen et al., 2000, 2002). We argue in this paper that this multiplicity is key for the understanding of the effect of product-market regulation (PMR) on R&D incentives. If firms have various alternative methods to keep their profits, then competitive pressures may not necessarily act as a neutral slack-reducing device. The threat of competition can in practice trigger a defensive reaction from incumbents, who will construct different types of strategic barriers to reduce the risk of losing innovation contests.[1]

Since the appropriation of innovation returns relies on the exploitation of asymmetries in private knowledge and capabilities, PMR will likely have a different effect on innovation incentives according to firms' business positions. It is then important to estimate the net effect at the aggregate level, taking into account winners' and losers' reactions in equilibrium. Industry-level data actually reveal interesting empirical patterns which motivate the theoretical discussion that follows. We analyse a sample of 14 manufacturing industries in 14 OECD countries in 1987–2003, a period marked by considerable market reform. We test the link between PMR, proxied via the regulation impact indicator (henceforth REGIMP) from the OECD, and R&D intensity. REGIMP measures the extent to which industries are constrained by administrative burdens, entry regulation

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[1] Consistent with the findings in R&D surveys, Crépon and Duguet (1997) provide evidence of negative R&D externalities amongst French manufacturing firms in narrowly defined industries, a result interpreted by the authors as the outcome of competitors' rivalry.

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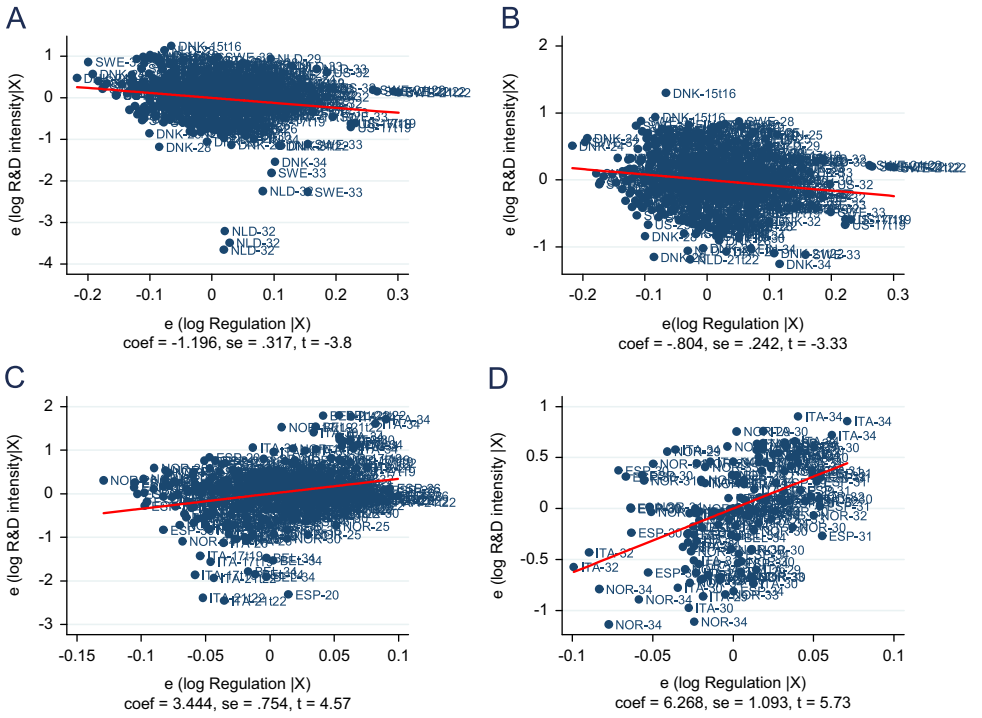

Fig. 1. Regulation and R&D intensity (expected conditional residuals). *Note*: All specifications are in log and control for time, country and industry fixed effects. The sample is split as follows. Graph A considers the 10% least regulated individuals (country-industry couples) over the full time period, Graph B the 10% least regulated without visible outliers at the south of the graph, Graph C the 25% most regulated individuals and Graph D the 25% most regulated in 29-34 ISIC-Rev.3 industries. (A) Less-regulated, (B) less-regulated & filtered, (C) more-regulated and (D) more-regulated & high-tech.

and other market barriers in key input sectors, mainly network services. This type of vertical linkages makes the connexion to the theory more direct, as we shall see. Appendix A.2.1 contains details on the data construction and variables. Fig. 1 presents the PMR elasticities when controlling for time, country and industry fixed effects. In less-regulated markets, higher PMR reduces R&D intensity; however, the opposite is true in more-regulated environments. Moreover, this latter positive link between PMR and R&D intensity is stronger when manufacturing activities relate to the production or to the use of high-technology goods. We show in Appendix A.3 that positive slopes appear in a number of tests including more time-varying controls, fixed-effects as well as other alternative specifications. More importantly, findings pointing out ambiguities in the relationship between PMR and economic performances are indeed not new in industry-level studies.[2]

We investigate the theoretical channels through which PMR, by setting the limits to firm strategies, may lead to such outcomes. We propose a quality-ladder model that emphasises the role of strategic behaviour in vertical innovation. In our model, each vintage is characterised by a vector composed of several quality dimensions. This vector contains information on two important aspects of quality. Its magnitude measures the *level* of quality of the vintage and we shall referred to as the *intensive* margin of quality. Its direction summarises the *mix* of quality dimensions offered by the good and hence relates to what can be called the *extensive* margin of quality. To date, standard unidimensional quality-ladder representations have only focused on the former aspect. Our model underlines that a given level of quality can be potentially provided by a number of mixes of quality dimensions so that vertical innovation will also likely affect the extensive margin. In order to fend off the threat from followers, after discovering a new idea and before manufacturing, the innovator can introduce additional complexity into the good by adding new dimensions of quality.

This vectorial representation is introduced into a standard R&D race with constant returns to scale (CRS) in R&D technologies and Nash–Cournot equilibrium behaviour. By strategically manipulating the extensive margin of quality, the new successful innovative firm acquires an R&D cost advantage vis-à-vis its competitors. This advantage may be large enough to render R&D attractive to leaders despite the cannibalisation of their current rents. Incumbents may then be able to overcome the so called Arrow effect. If this is the case, the R&D investment of outsiders is not worthwhile, and their optimal strategy is not to invest. Conversely, with smaller resulting R&D cost advantages, the leader is absent from R&D races and innovation relies only on outsiders.

This is where PMR enters into the story, as it increases the costs of upgrading both the intensive and extensive quality margins. Since the new innovative firm is the sole producer that has the knowledge to implement the new idea it is also

[2] Jamasb and Pollitt (2011) make the case for the UK electricity; for evidence on positive interactions between PMR and the closeness to the technology frontier in explaining patent intensity see Amable et al. (2010), who also discuss related evidence.