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Differences in the rates of return to R&D for European and US young leading R&D firms

Michele Cincera[a,*], Reinhilde Veugelers[b]

[a] Université Libre de Bruxelles, Solvay Brussels School of Economics and Management, iCite, Brussels, Belgium
[b] Faculty of Economics & Business, Department of Management Strategy & Innovation, University of Leuven (K.U.L.), Leuven, Belgium

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ABSTRACT

This paper examines the sources of Europe's lagging business R&D performance relative to the US, particularly the role played by missing young leading innovators in high technology intensive sectors in Europe. It investigates through econometric analysis differences in the rates of return to R&D of European and US large R&D firms. It finds that, while in the US, young firms succeed in realizing significantly higher rates of return to R&D as compared to their older counterparts, including in high-tech sectors, European firms fail to generate significant rates of return, even if they are Yollies and even if they are in high-tech sectors. These findings can at least partly explain why Europe has less R&D intensive young leading innovators in high technology intensive sectors.

1. Introduction

Innovation in the European Union remains weak, especially R&D investment by the business sector. Furthermore, there are relatively few signs of progress despite the 3% Barcelona target which was set in 2000 (European Commission, 2012).

A common explanation raised for the EU's tame business R&D performance is its failure to change to new areas of growth. At the sectoral level, the EU continues to specialize in medium-tech sectors, lacking strong positions in new high-technology sectors. The EU is especially lagging in new key information technology sectors, which were the drivers of growth in the late 1990s in the US (e.g. Van Ark et al., 2008; Denis et al., 2005; European Commission, 2007; Moncada-Paterno-Castello et al., 2010). It also lagged behind in the use of ICT technologies for productivity enhancing investments (e.g. Van Ark et al., 2008), related to a.o. shortcomings in management and organizational practices in European firms (Bloom and Van Reenen, 2010).

It is particularly fast growing technology based entrants which are key players in the industrial dynamics of economies. Cohen and Lorenzi (2000) already argued that the US economy is a more hospitable environment than the EU for new firms to grow large in Information Technology. Also Freeman (2001) acknowledged that ICT was more successful in the US than anywhere else, which he attributes to the outstanding characteristics of the US national innovation system: the role of new small firms in the American economy, the role of the US government (both at Federal and State level) and the role of universities. Mowery and Rosenberg (1993) in their analysis of the United States national innovation system emphasized that 'the successive waves of new product technologies that have swept through the post-war US economy . . . have been commercialized in large part through the efforts of new firms', this in sharp contrast with European countries and Japan (Mowery and Rosenberg, 1993, pp. 48–49). They point out that 'the large basic research establishments in universities, government and a number of private firms served as important 'incubators' for the development of innovations' which were commercialized by individuals who 'walked out of the door' to become innovative entrepreneurs.

New firms are particularly pivotal in the early stages of development of new sectors, being the drivers of "creative destruction" in the Schumpeter Mark I model (Klepper, 1996, Malerba, 2002). It is only when new sectors have achieved a high rate of growth for a long time before they have a big enough weight and a strong enough influence on other sectors to adapt to the innovations, that they start to drive the overall economy's performance (Freeman and Louca, 2001). Nevertheless, with young leading innovators being more (radical) R&D intensive and/or their presence inciting other (incumbent) firms to be more (incremental) R&D intensive, a nation

* Corresponding author. Tel.: +32 26504151.
E-mail address: mcincera@ulb.ac.be (M. Cincera).

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that fails to generate new innovative firms and let them grow to a worldwide leading R&D position, will eventually suffer in terms of its overall innovative capacity.

The proposition that Europe's deficient innovative capacity is driven by a failing creative destruction capacity, missing young innovators and new sectors, has attracted many supporters (O'Sullivan, 2007). But it has received little empirical investigation. Aghion et al. (2008) provide firm level evidence in support of the proposition that Europe has less productivity gains from fast growing technology based entrants, compared to the US. In a recent contribution, Cincera and Veugelers (2013) use the EC-JRC-IPTS Industrial R&D Scoreboard (European Commission, 2008) of largest global R&D spending firms to compare the sectoral and age composition of EU business R&D performance relative to the US. Their findings confirm that the EU has fewer young firms among its leading innovators, called "Yollies". Furthermore, European "Yollies" have a lower R&D intensity than their US counterparts, being less in new high technology intensive sectors. They find that missing 'Yollies' in the right sectors accounts for almost all of the EU's overall business R&D deficit relative to the US.

This paper tries to answer why there are less young leading innovators ("Yollies") in Europe compared to the US, particularly in high-tech sectors, and why they would invest less in R&D, as documented in Cincera and Veugelers (2013). It looks at differences in rates of return on R&D investments as a possible explanation. To this end, an econometric analysis is performed, estimating production functions for the largest global R&D spending firms. The findings confirm, while in the US, young firms succeed in realizing significantly higher rates of return to R&D as compared to their older counterparts, including in high-tech sectors, European firms fail to generate significant rates of return, even if they are Yollies and even if they are in high-tech sectors. These results would suggest that in order to nurture more young new firms in young high-tech sectors, as pivotal agents of a dynamic business R&D structure, the barriers that lower the rates of return to R&D for these firms need to be better understood and addressed.

After a review of the literature on young innovative companies in Section 2, Section 3 presents the data being used in the econometric analysis. Section 4 presents our econometric findings on differences in rates of return to R&D for young leading innovators in the EU vs. the US. A final section summarizes and discusses policy implications of our findings.

2. Young companies and R&D: insights from the literature

The innovation literature provides multiple points of view as to why having young firms might matter for an economy's R&D performance. Dating back to Schumpeter, young entrepreneurial firms are at the heart of the creative destruction process (Schumpeter, 1934; the so-called Schumpeter Mark I). Young entrepreneurial firms are more likely to be introducing innovations, particularly of the radical type, displacing existing products and processes. This is because young, small, lenient firms, unlike their large incumbent counterparts are not bothered by safeguarding incumbent positions and suffer less from bureaucratization of the innovation process. With new firms entering with new technology or focusing on new types of demand, a stable innovation structure characterized by large incumbents (Schumpeter Mark II) may be displaced by a more turbulent Schumpeter Mark I (Reinganum, 1983; Henderson and Clark, 1990). The introduction and further diffusion of new technologies brings about a crisis of structural adjustment in which the incumbent institutions are challenged to adapt their framework to a system more compatible with the new rising technology (Perez, 2010). These changes may take a long time, as they require new infrastructure, new standards, changes to education and training for new skills, new management and organizational systems (Freeman and Louca, 2001).

At the same time, arguments abound on why large incumbent firms are the driver of innovations (Schumpeter, 1943; Schumpeter Mark II). Large incumbent firms can benefit from economies of scale and scope in the R&D process and complementarities with other competences needed to commercialize the innovations. Large incumbent firms can benefit from learning by doing, having accumulated experience to drive down costs (Malerba, 1992). With higher liquidity at their disposal and collateral, they have easier access to finance (Cincera and Ravet, 2010). Small and particularly young firms, lacking internal funds, collateral and reputation are more likely to be financially constrained, particularly if they are looking to finance high growth-high risk projects (Cincera, 2003; Hall and Lerner, 2010). Large incumbent firms may also find it easier to appropriate the benefits from innovation, having the scale for developing a portfolio of appropriation strategies (Schneider and Veugelers, 2012) and complementary assets (Teece, 1986; Gans and Stern, 2000). And finally, the threat of entrants may spur incumbent's innovations, motivated by the fear of being displaced (Gilbert and Newbery, 1982).

Large incumbents and small entrants should not only be seen as direct competitors. Both types of firms can also complement each other in the innovation eco-system. Small new entrepreneurial firms introduce new drastic innovations on which the large incumbent firms build further with their follow-up innovations, thus further improving and developing the full potential of these innovations. How effective the market for ideas is, where large incumbent firms take on and further develop the ideas launched by young innovators, depends inter alia on the strength of the intellectual property protection (Anton and Yao, 1994) and the control over complementary assets (Gans and Stern, 2000; Gans et al., 2002). When the new ideas eventually mature and start following well defined trajectories, economies of scale, learning curves, barriers to entry and financial resources become important in the competitive process (Klepper, 1996), thus favoring large firms with deeper pockets: large incumbent firms or new firms grown to critical size.

Overall, with arguments in favor as well as against young innovators, it remains an empirical question to identify whether, when and how young firms will be more innovative than large incumbent firms.

Much of the multivariate empirical analysis in the literature studying the relationship between firm size, age and innovation, incorporating a wide set of firm and industry characteristics as control, has failed to find significant results for a positive (or negative) effect of firm size and age (Kamien and Schwartz, 1982; Cohen and Levin, 1989). Other characteristics like market concentration, technological opportunities, the stage of the technology life cycle, all matter as intervening variables for the effect of firm size and age for innovation. Small young firms are more important for innovation in less concentrated industries (Acs and Audretsch, 1987) and in the early stages of the life cycle of an industry (Utterback, 1994).

When it comes to radical innovations, there is more support to be found for small, new firms compared to large incumbents. Henderson (1993) examined two theories of why large incumbent firms fail to create radical innovations: (1) lack of motivation (the economic perspective), and (2) lack of ability (the organizational perspective). Her analysis, using data from the semiconductor photolithography equipment industry, showed support for both theories. Shane (2001) similarly finds evidence in favor of small firms introducing radical innovations. His research on MIT based patents finds that radical patents have a higher probability that the invention will be commercialized through start-ups. Schneider and Veugelers (2010) provide micro-econometric evidence from German CIS data in support of young, small highly innovative companies (YICs) for the introduction of more radical innovations.