1st GLORIA WORKSHOP
Global Research & Innovation Analyses

COMPETITION, R&D AND INNOVATION DYNAMICS

18 October 2018

SUMMARY REPORT

Sara Amoroso and Alexander Tübke[1] [2]

Objective of the workshop

This workshop was part of the Global Research & Innovation Analyses (GLORIA) project undertaken jointly between the Commission's Joint Research Centre and DG-RTD.[3] The objective of these workshops is to obtain feed-back from policy-makers and experts about empirical evidence to support policy-making.[4]

This workshop focused on the relationship between competition on the one side and R&D&I (Research & Development & Innovation) on the other. Changes in competition can affect incentives to undertake R&D and to innovate. On the one hand, firms in markets characterized by high competition need to innovate to gain marginal competitive advantages to survive. On the other hand, when the level of competition is low, incumbent firms have incentives to invest in R&D to stave-off future competitors. Further, competition is undergoing new dynamics due to the increased globalization, new digital technologies, and corresponding network effects, which produce shifts in the competitive and innovation dynamics that are difficult to address with traditional policy approaches.

The relationships between competition and innovation have extensively been studied by many authors and in many cases also addressed subsequent effects on productivity. There is however no consensus as to the direction of these effects. Two prominent theoretical contributions defending linear relationships are those from Schumpeter (1943) and Arrow (1962). While the former stipulated that a higher number of firms lead to decreasing expected returns thus disincentivising innovation, the latter stated the opposite due to decreasing production costs. The more recent theoretical and empirical findings are pointing out a non-

[1] European Commission, Joint Research Centre (JRC), Directorate B Growth and Innovation, B3 Unit: Territorial Development, Edificio Expo, C/ Inca Garcilaso 3. 41092 Seville, Spain

[2] The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission

[3] See: http://iri.jrc.ec.europa.eu/home /. The activity is undertaken jointly by the Directorate General for Research and Innovation (DG RTD.A; see: http://ec.europa.eu/research/index.cfm?lg=en) and the Joint Research Centre, Directorate B Growth & Innovation (JRC-B; see: https://ec.europa.eu/jrc/en/science-area/innovation-and-growth).

[4] Per end 2018, nine previous workshops have been held (see: http://iri.jrc.ec.europa.eu/workshops.html).

monotonic impact of competition on firms' innovation and productivity growth: U-shaped (Boone, 2001) or inverse-U-shaped (Aghion et al., 2005).

The first presentation and keynote address by UNU-Merit gave a highly insightful overview of the literature and past studies on the relationship between competition and innovation. In general, the following factors have an impact on the relationship between competition and innovation:

- Profitability
  - Difference between pre- and post-innovation rents
  - Business environment and the general framework conditions of the economy
- Industry dynamics
  - Degree of neck-to-neck competition
  - Number of competitors
  - Difference in efficiency among firms
  - Degree of product substitutability
  - Barriers to entry
- Cost of innovation
  - Ease of imitation, degree of patent protection, patent policy
  - Ease of access to finance, level of interest rates, tax incentives and subsidies
  - Distance to the innovation frontier

With some examples on previous studies,[5] the **potential effects of competition on innovation** were outlined. **Positive impacts** on innovation come from the fact that more competition leads to ease of financing (by increasing internal funds from profits) and to a stronger fight for survival or for preserving monopoly positions, so at the end innovation is used to escape competition. **Negative impacts** from more competition come in when companies can no longer compete (too high entry costs and uneven level playing fields).

A number of **alternative measures of competition** were then presented, e.g. 1-average price/cost margin (Aghion et al, 2005), market concentration (e.g. C4), degree of substitutability, ease of entry (low entry cost), number of competitors, declared pressure of competition (ordinal measure) or elasticity of profit compared to marginal cost (Boone indicator).

However, **competition is not easy to measure**. For example, competition is quite different in industries characterized by few players but low entry costs and short-term entrants[6] with a leading firm and a competitive fringe, depending on whether the leader has the technological advantage (just innovated) or one of the small followers is catching up.

But **also innovation measurement has many challenges**. While on the input side, R&D investment or innovation expenditure are the most common measures of innovation, on the output side, patents are the most clearly identifiable indicator. However, innovation surveys

[5] Gilbert and Levin (2006), Cohen (1989), and Kamien and Schwartz (1982)

[6] Baumol's (1982) idea of "contestable markets". An example of such contestable market is the electronic fit devices one; it is easy to enter and it has very low sunk costs.

often rely on innovation counts, share of innovative sales or recur to indirect measurement via dummies for different types of innovation.

After an overview of the factors at play when examining the relation between competition and innovation, the keynote speaker presented a work in progress on **price and non-price competition effects on innovation**, using Swiss Innovation Survey data containing information on the number of competitors and behavioural price/non-price competition. Regressing TFP on price and non-price competition controlling for sector (2-digit) and time fixed effects shows higher price and non-price competition associated with higher TFP levels, stronger marginal effects of price competition at the lower end of the conditional TFP distribution and a stronger marginal effects of non-price competition at the high end of the conditional TFP distribution.

Possible explanations presented and discussed were that, on the one side, firms which are **closer to the technology frontier (higher end of the TFP distribution) tend to resort to non-price competition (product innovation)** to differentiate from their competitors. In this way, they increase productivity and shift out the best-practice frontier. On the other side, firms which are **further away from the best practice frontier resort to price competition (process innovation to decrease average cost)** to survive, thereby getting closer to the technology frontier. These effects were more visible for smaller firms in the sample. The interesting discussion focused on the **differences between service and manufacturing** companies, for which the results suggests few differences. Suggestions were to add more interaction terms and control for endogeneity as well as to examine the differences between the most and least competitive companies by examining the changes in distribution.

Then followed a presentation on the impact of industrial linkages on cross-border acquisitions on R&D by University College Dublin, UCD. **Mergers & Acquisitions (M&A) have an impact on competition** (firm concentration) which at the same time **closely relates to innovation**. M&A may produce synergies increasing productivity of research and innovation processes, produce cost and market size efficiencies benefitting innovation, increase competitive advantage and reduce the number of competitors which might benefit the M&A stakeholders. The effect of M&A on competition is however somewhat ambiguous and depends on the degree of competition and distance to the competitive/innovative frontier. M&A are a form of Foreign Direct Investment (FDI) different from e.g. greenfield investment.

Based on a **matching between Orbis indicators with Zephyr M&A data at the firm-level**, the presentation showed the impact of FDI on local firms depending on industrial linkages. All types of linkages were examined in an econometric approach, i.e. horizontal (within industry), forwards (customers of FDI) and backwards (suppliers to FDI). The study examines **how the relation between M&A and innovation depends on these industrial linkages** estimating the impact of acquisition on acquirer R&D intensity. It accounts for sector effects (manufacturing vs. non-manufacturing) and industrial linkages in 1875 cross-border acquisitions by 1501 acquirers between 2009 and 2017. **Most of the M&A activity** in the sample in terms of number and deal size is **concentrated within the same**

(manufacturing or non-manufacturing) **sector** of acquirer and target; however a lot of **cross-industry M&A activity** centres on wholesale trade, computer manufacturing and R&D.

The main findings are that **acquisitions in non-manufacturing boost innovation** for manufacturing and non-manufacturing. Acquiring non-manufacturing targets increases the R&D intensity of the acquirer by 8%. Reasons for this may be the relevance of the internet of things (Bradley, et al. (2013)) or the fact that most trade in services comes from manufacturing exporters (Lodefalk, 2014). In addition, **high R&D intensity of the target company boosts innovation** in case of horizontal links (forward reduction).

However, these effects are **dampened by higher concentration and for Chinese acquirers**. These results suggest that the **acquisition of non-manufacturing and high R&D intensive targets in the same industry could be a policy target** for boosting the R&D intensity of EU-based acquirers. For Chinese companies, the question if different time lags and longer-term motive can be distinguished in the study was raised. However, this does not seem the case. Further, the discussion revealed the need to consider more motives and longer time-lags for deepening the understanding such activities, especially when trying to link to the impact on employment and profits. For all companies in the sample, the biggest boost comes two years after the M&A deal with the biggest effects where manufacturing companies acquire those from services.

The following presentation by the JRC continued to present evidence on the effects of M&A on innovation, focusing on the M&A strategies of top R&D investors. This study is based on a subset of the above study using companies from the European Commission's R&D Investment Scoreboards,[7] thus **focusing on very large firms that can be considered at the technological frontier**. Literature shows that, for such companies, technology sourcing is an important motive for M&A (Neven&Siotis, 1996), with positive impact on R&D (Bertrand&Zuniga, 2006) and the more so in the pharmaceuticals and biotech sectors (Cassiman et al., 2005 and Ruckman, 2008).

For the 2500 world R&D investing firms over 2007-2016, around two thirds were active in M&A and a total of almost 15,000 deals. Around one third of the deals originate from companies headquartered in the EU and the US each, followed by those from the Rest of the World, Japan, and China. While **most of the deals are within each world region (around 60%)**, deals in China happen in especially among Chinese companies (80%). Further, the target shares are proportionally higher for EU, US and Japanese companies acquiring targets in the Rest of the World. The share of Chinese companies acquiring targets in the EU, US and Rest of the World is much higher than vice-versa. Most acquirers come from manufacturing and ICT sectors, whereas the targets are also from the services sectors.

The results show that most M&A activity in this Scoreboard company sample is **performed by those which are less R&D intensive and larger than their peers**. Post-acquisition, these companies show improved labour productivity growth, net sales growth and profit margins. The discussion addressed the degree to which one can distinguish internal and externally

[7] See: http://iri.jrc.ec.europa.eu/scoreboard.html

acquired R&D, as well as how much the R&D of the target firms is translated into a larger intangible asset base of the acquiring firm.

As policy conclusion, this suggests **that M&A may be a new strategy to acquire complementary R&D assets** among these very large firms enabling renewal and increased efficiency inside these companies. This may however have **negative impacts on high-tech industry concentration**, **providing challenges for organic firm growth** and calls for an **efficient organisation of M&A markets**.

The last presentation by Université Libre de Bruxelles, ULB showed the results from an analysis of **competition, innovation and productivity based on worldwide corporate top R&D spenders** from the aforementioned EU Scoreboard. The study uses Lerner (1934) index for the level of competition. Based on the Scoreboard containing audited financial indicators from corporate accounts, the industry-year competition indicator was calculated as a weighted mean of the profitability of each firm. Market concentration was calculated at NACE-2 level and geography at the company's headquarter location (not in terms of national territory). The analysis was performed as regressions controlling for other variables, firms' specific unobserved and endogeneity effects.

The robust results indicate an **inverse U-shaped impact of competition on innovation and productivity growth**, confirming the findings of Aghion et al. (2005). This is however not observed EU-based and smaller firms (i.e. firms from the R&D Scoreboard ranked after the 250th position in terms of R&D expenditures). **Here the relationship is U-shaped**, confirming Boone (2001) and suggesting that too much (or to less) competition is conducive to more innovation. Regarding the age, an "escape competition effect" seems to prevail for Young Leading Innovators (i.e. firms from the R&D Scoreboard created after 1999 or Yollies). For these **Yollies, which are close to the technological frontier, competition provides incentives to innovate more than for their older peers**. Results for the EU-based firms hint to a "Schumpeterian effect", i.e. **firms far away from the technological frontier are discouraged from innovating** since it will be difficult for them to catch-up with the leaders.

Policy implications from this study need to consider that the EU R&D Scoreboards contain mainly very large firms at the technological frontier. The results imply that **competition policy should be implemented in a targeted fashion depending on the company, technology and sector characteristics**. Yollies are distinguished as the better performers in innovation and productivity, whereas older companies still provide a high number of jobs and an important skill base. Comparative headwinds faced by smaller and EU-based companies are found in the study **especially regarding the impact on innovation rather than productivity**. This indicates that highly tailored policy approaches are necessary.[8]

[8] See also: Moncada et al. (2018): "For a transformative Industry and Innovation Strategy", INDUSTRIAL R&I - JRC Policy Insights, European Commission, Joint Research Centre, 2018, http://iri.jrc.ec.europa.eu/documents/10180/12238/FOR%20A%20TRANSFORMATIVE%20INDUSTRY%20%26%20INNOVATION%20STRATEGY

The discussion centred on the differences between EU- and US-based as well as smaller and larger firms in the sample. While the results remain stable even when using different subsamples, the **needs for more detailed sector classification and improved firm characterisation were outlined**.