Davide Antonioli[1], Alberto Marzucchi[2] and Maria Savona[3].

[1] Dept. of Economics and Management - University of Ferrara, Italy.
[2] Catholic University of Milan & INGENIO (CSIC-UPV), Italy.
[3] SPRU University of Sussex, UK.

Shared pain, half a pain? 'Overcoming' barriers to innovation through cooperation

Abstract: In recent empirical literature an increasing attention is devoted to the obstacles that hamper innovation, their impact on firms' engagement in innovation and their effect on the propensity to innovate (e.g. Baldwin and Lin, 2002; Galia and Legros, 2004; Tiwari et al., 2008; Savignac, 2008; Iammarino et al., 2009; Mancusi and Vezzulli, 2010; Galia et al., 2012; Blanchard et al., 2013).

Investigating innovation obstacles is of obvious policy relevance. It is crucial to enlarge the population of innovators and increase the innovation performance of the existing base of innovative firms (D'Este et al., 2012; 2014; Pellegrino and Savona, 2013). From both an innovation management and policy perspectives, it is particularly important to identify the factors that are more likely to attenuate or overcome the negative impact of innovation barriers (e.g. D'Este et al., 2014).

In the paper we shed new light on the relation between cooperation and barriers to innovation. While it might well be likely that cooperation itself is a source of failure (e.g. Lhuillery and Pfister, 2009), it is interesting to ask whether firms perceiving obstacles to innovation tend to overcome them by establishing cooperation agreements with external partners. We argue that firms experiencing obstacles to innovation undertake cooperative activities in order to mitigate the negative effects of such barriers on innovation. Following this reasoning the presence of barriers to innovation becomes a 'driver' of cooperation. In addition, it can be stated that different kinds of barriers may lead to different kinds of cooperation (e.g. with research organizations or firms) depending on what the firm is searching for and on what kind of barrier-related negative effects is trying to mitigate. As a further step in our analysis, we question whether different types of barriers are complements or rather substitutes in influencing the cooperation propensity.

We exploit the not micro-aggregated information of CIS4 database for France. We restrict our focus to manufacturing firms. In addition, the sample is constrained to innovating firms, because of the CIS questionnaire structure (i.e. cooperation activities are only pursued by those firms declaring to have introduced some kind of innovation).

The model we apply has the following baseline form:

$$Cooperation_i = a + b_1 Barriers_i + b_2 CTRL_i + \varepsilon_i$$

where Cooperation is a vector of cooperation activities/partners, Barriers is a vector of specific types of obstacles to innovation perceived by the firm, CTRL is a vector of controls

and ε is the error term. The estimation technique is based on a set of simple probit regressions, which allows us to point out the relations between innovation barriers (cost -COST-, market -MKT- and knowledge -KNOW- ones) and cooperation (general -COOP-; cooperation with other firms -COOP_FIRM-; and cooperation with research organisations -COOP_ORG-).

The second part of the empirical analysis tests for the complementary/substitution effects between couples of barriers on the propensity to cooperate. In order to implement the tests we consider the 'cooperation function' of firm i (COOP_i) as the firm's objective function; we focus on two types of barriers at a time that can affect the firm's cooperation function, b' and b'':

COOP_i= COOP_i(b', b'', θ_i), ∀i

Each firm i faces a combination of the two barriers, (b', b'' ∈ B) and a set of controls θ_i, including the remaining barrier. Complementarity between the two different barriers may be analysed by testing whether COOP_i(b', b'', θ_i) is supermodular in b'and b''. Our aim is to derive a set of inequalities that are tested in the empirical analysis. Each firm is in one of the 4 following states of the world: it faces both b'and b'', neither of the two, or one but not the other, giving birth to four consequent elements in the set B (forming a lattice): B={{00},{01},{10},{11}}. It is possible to demonstrate that b' and b''are complements and hence COOP_i is supermodular if and only if:

COOP_i(11,θ_i) + COOP_i(00,θ_i) ≥ COOP_i(10,θ_i) + COOP_i(01,θ_i)
or
COOP_i(11,θ_i) - COOP_i(00,θ_i) ≥ [COOP_i(10,θ_i)-COOP_i(00,θ_i)] + [COOP_i(01,θ_i)-COOP_i(00,θ_i)]

In order to test for complementarities or for substitution effects we operationalise the methodological framework in two steps. In the first step we set up the 'Cooperation function', that can be modelled as follows using two types of barriers BARR1 and BARR2, while we control for BARR3:

[COOP]i = b0i[Controls] + aBARR3+
+b1i[BARR1_D(1)/BARR2_D(1)] +
+b2i[BARR1_D(1)/BARR2_D (0)]+
+b3i[BARR1_D(0)/BARR2_D (1)] +
+b4i[BARR1_D(0)/BARR2_D (0)] + ui

Since the cooperation variable COOP is a dummy variable (as the two sub-types of cooperation COOP_ORG and COOP_FIRM), a set of probit regressions is run, excluding the constant term, given that all the four states of the world must be included in the specification and provided with a specific coefficient each: b1, b2, b3 and b4. Once the coefficients are retrieved by the probit, the next step of the analysis is to test the hypotheses implementing a set of Wald tests, which allows us to test the following linear restriction on the state-of-the-world-dummies coefficients: b1+b4=b2+b3. Where b1 is associated to the (1,1) state of the world; b2 is associated to the (1,0) state of the world; b3 is associated to the (0,1) state of the world and b4 is associated to the (0,0) state of the world. Coupling the information provided by the Wald tests with the sign of the inequalities -also confirmed by one-sided tests on the linear combination of the parameters- we know the direction towards which a rejection of the null leads us in terms of supermodularity (complementarity) or submodularity (substitutability). On the one hand, if $b1+b4-b2-b3\geq 0$ and the Wald test leads us to reject the null, then we can argue that we are in presence of supermodularity and hence of complementary barriers; on the other hand, submodularity holds if $b1+b4-b2-b3\leq 0$ and the Wald test null is rejected as well.

Results show linkages among barriers and cooperation strategies. Cost barriers are positively related to all types of cooperation. Firms thus resort to cooperation as a result of a cost-sharing strategy. We also notice that cooperation with research organisations is triggered by knowledge obstacles: as expected firms collaborate with research institutes and universities to mitigate shortages of skills and competencies. Concerning the analysis of the supermodularity/submodularity among the barriers, we notice the absence of complementarity and the presence of substitutability effects. In other terms, jointly experiencing high levels of different barriers to innovation does not lead to more cooperation. On the contrary, the joint presence of barriers which involve high knowledge obstacles reduces the propensity to cooperate. A spectrum of innovation obstacles that includes knowledge shortages, and thus possibly involves the lack of sufficient absorptive capacity, leads the firm to refocus on internal innovation activities, abandoning cooperation.

References

Baldwin, J., Lin, Z., 2002. Impediments to Advanced Technology Adoption for Canadian Manufacturers. Research Policy 31, 1–18.
Blanchard, P., Huiban, J.-P., Musolesi, A., Sevestre, P., 2013. Where There Is a Will, There Is a Way? Assessing the Impact of Obstacles to Innovation. Industrial and Corporate Change, 22 (3): 679-710.
D'Este, P., Iammarino, S., Savona, M., Von Tunzelmann, N., 2012. What Hampers Innovation? Revealed Barriers Versus Deterring Barriers. Research Policy 41, 482–488.
D'Este, P., Rentocchini, F., Vega Jurado, J., 2014. Lowering Barriers to Engage in Innovation: Evidence from the Spanish Innovation Survey. Industry and Innovation 21 (1): 1-19
Galia, F., Legros, D., 2004. Complementarities between Obstacles to Innovation: Evidence from France. Research Policy 33, 1185–1199.
Galia, F., Mancini, Morandi (2012), Obstacles to innovation and firms innovation profiles: are challenges different for policy makers?. Proceedings of the 12th European Academy of Management (EURAM) conference University of Rotterdam, Erasmus Unviersity.
Iammarino, S., Sanna-Randaccio, R., Savona, M., 2009. The Perception of Obstacles to Innovation. Foreign Multinationals and Domestic Firms in Italy. Revue d'économieindustrielle n° 125, 75–104.
Lhuillery, S. and Pfister, E. (2009): R&D cooperation and failures in innovation projects: Empirical evidence from French CIS data. Research Policy 38, 45-57
Mancusi, M.L., Vezzulli, A., 2010. R&D, Innovation, and Liquidity Constraints. KITeS Working Papers 30/2010, Bocconi University.
Pellegrino, G. and Savona, M. (2013). Is Money All? Financing versus Knowledge and Demand Constraints to Innovation. Institute of Economics of Barcelona WP Series (forthcoming).

Savignac, F., 2008. Impact of Financial Constraints on Innovation: What Can Be Learned from a Direct Measure? Economics of Innovation and New Technology 17, 553–569.
Tiwari, A., Mohnen, P., Palm, F., Schim van der Loeff, S., 2008. Financial Constraint and R&D Investment: Evidence from CIS, in: Determinants of Innovative Behaviours: A Firm's Internal Practice and Its External Environments. London, pp. 217–242.