Referee Report for Economics E-Journal

"Diversity of Science Linkages and Innovation Performance: Some Empirical Evidence from Flemish Firms"

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Submitted to the Special Issue:
"The Knowledge-Based Economy: Transition, Geography, and Competition Policy"

Summary

The paper explores the relationship between firms' types of industry-science links (ISL) and performance on the firm and invention level for a sample of Flemish firms. The authors use information from the CIS Survey, Eurostat and data on firms' publications from the ISI-Web of Knowledge database. The authors find three main sets of results:

- Firms with ISL show a higher firm innovation performance (measured by innovation turnover ratio, new to market innovation turnover, and % of innovations new to market) than firms without ISL
- Patents of firms with ISL have more citations, are more general and more geographically dispersedly cited than patents of firms without ISL
- Patents with non-patent references (NPRs) listed in the patent search report are not cited as frequently as patents without non-patent references. However, the former are cited in a greater number of different technological classes and have a higher geographical dispersion.

General Comments

The paper addresses an important topic that is closely linked to the topic of the Special Issue. The second and third sets of results (see above) are very promising with regard to their novelty. The analysis has the potential of yielding some interesting insights. However, this potential is not fully (but nearly) realized in the current version, and some additional work will be necessary before the paper can be published.

1) One issue is that in some fields, it is more natural (or easier) to establish links with science than in other fields. These fields are typically the more innovative fields, where the percentage of innovations that are new to the market is higher. Hence, the presence of ISL might, to a certain extent, be explained by field. In table 1 and 2, the authors report the distribution of firms across the different measures of ISL and across industries. This distribution pattern suggests that firms in highly R&D intensive fields are more likely to have a science linkage. I am wondering whether the number of your observations allows you to elaborate and test for differences in the association of ISL

with your (firm and invention level) measures of performance between firms in low/medium R&D intensive and highly R&D intensive fields. In addition or alternatively, you could add a paragraph and discuss this issue. For example, Stokes (1997) points out that in some areas science and technology go hand in hand (the Pasteur's Quadrant). Murray (2002) builds on this in her work on patent-paper pairs.

2) A major issue is the timing of your variables. Your data stem from different sources and are related to firm and patent characteristics that date back to different years, e.g.:
   - Importance of sources of information from survey in year 2000
   - Percentage of innovations new to the market from survey in year 2000
   - Economic performance: turnover due to innovations introduced in the last 2 years (from Survey referring to (?) 1998 and 1999)
   - Publication activity in years 1990-1995
   - Non patent references listed in the search reports of patents granted between 1995 and 2001

   One problem concerning the way you build your dataset is that you relate firms' use of public scientific sources of innovation (your measure of ISL) in the year 2000 to patents granted between 1995 and 2001. If we assume an average grant lag of 4 years, you relate patent applications filed between 1991 and 1997 to sources of innovation in 2000. You cannot assume that today, firms make use of public scientific sources to the same extent as they did 3-9 years ago. I am wondering why you do not sample patents which were filed in 1999 or 2000 (approximately granted in 2003). You would still have enough years to count the citations. Moreover, the timing of your variables suggests that the causality works the opposite way than you propose in your paper (see 1st sentence of abstract). In addition, I would like to know how many firms in your sample did not exist before 1997 (and therefore have no patents) and whether your analysis suffers from a survivor bias. I think the suggested approach would also increase the sample size for your analysis on the invention level (III.B), as the patenting activity of firms has significantly increased within the last decade.

3) I learn from the description of the survey that you have much more detailed information about the public sources of innovation than you use in your analysis. Why do you not present the different sources of information listed on p. 9 separately (i.e., universities, PROs and conferences/meetings/publications)? I think that a more finely grained analysis could provide interesting insights. A side remark: In Table 1, you even note that you have information about the government as a source of information, but you do not mention the government as a source in the main body of the text on p. 9.

4) Furthermore, I think your finding that only few firms use ISL as a source of information is not as surprising as it is presented to be in section II. Your finding might be explained by your coding of the variable to a certain extent. You only consider "public information" to be used if the respondents indicate that public information is a "very important" source of information (on a 4 point Likert ranging from unimportant (0) to very important (3)). In other words, firms that only use public information on a minor important or on an important level are treated as if they did not have an ISL. I am wondering to which extent your results would change if you coded the variable

differently, e.g. if use of public source was 1 in case that the respondent considers public sources to be important and very important for a firm's research activities.

Minor Comments

Abstract

- You promise more than you were able to test. In the 1st sentence you say that you test **the effect of** various types of links **on** innovation performance. However, your descriptive analysis only allows you to report about correlations/associations.

Section I "The value of science":

- I like the fact that you also point to the potential drawbacks of ISL.

Section II "The diversity of linkages to science"

- You focus your sample on manufacturing firms. In doing so you lose 46% of the surveyed firms. Why do you exclude non-manufacturing firms? I imagine that your RQs are also interesting with regard to service firms (maybe less interesting for supplier firms). Please explain the rationale of your decision.
- Please be careful with your language: p. 11, last sentence: "if we consider only the population of patenting firms, 24% [...] of these firms report an ISL in their patents". It is not that the firms report but that the patent examiner notes this in the search report. Please rewrite.

III. Performance of Linkages to Science

- p. 13: please be more detailed concerning your measure of % of innovations that are new to the market. Is that related to innovations introduced in 1998-2000 (past two years)?

IV. Conclusion

- You make a strong claim that direct science links on the invention level and indirect science links on the firm level should be distinguished. You even emphasize in your conclusion that "to bring out the true effect of these links [ISL], firm and invention level indicators need to be interacted". You have findings that support your argument but I would not "be too loud", as your measure of ISL on the invention level are NPRs listed in the search report which are added by the patent examiner.

Typos/incomplete sentences/tables – please fix:

- P. 5, 3rd Sentence starting "Evidence from ..." is incomplete.
- P. 6, 2nd paragraph, 2nd sentence "boost" instead of "boast"
- P. 10, iv) 2nd sentence starting "This measure takes..." is incomplete.
- Table 1, note 1: "importante"
- P. 15, 2nd paragraph, 5th sentence: eliminate "the"
- All tables: a mix of comma and full stop as decimal separator