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Discussions

Interactive comment on "International collaboration, mobility and team diversity in the life sciences: impact on research performance" *by* F. Barjak and S. Robinson

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Comments Reviewer 1 (Author response after >>>) 1. What theoretical debates does the study relate to? A theoretical/conceptual framework would assist the reader because the empirical evidence has produced contradictory results in the past (pp. 124-127). Please present research questions and then theoretically derived hypotheses. The paper does not theoretically explore why diversity of geographic origin is central. Which theoretical discussions support the author hypothesis that diversity of geographic origin has a significant impact on research performance? >>> The paper did not originate in scientific discussions but in contract work with a specific set of questions done for the EC and there is no such thing as a theory of group or team performance, as the literature review presented in the paper shows. This is the main

reason, why its content is largely empirical. However, we believe that the paper can be related to discussions on the internationalization of science and diversity which could be the background for contradicting hypotheses. In particular, we would like to refer to the denationalization of science which has been found as a very strong pattern on the one hand, with increased international co-authorship, cross-national funding, and more global knowledge sourcing by private enterprises (Crawford, Shinn and Sörlin 1993). However, in relation to migration significant effects are only conceded for large-scale migrations such as the emigration of German physicists to the US during the Nazi area (Hoch and Platt 1993); according to this literature smaller migrations would not lead to any significant effects and impact on scientific knowledge or practices, as the migrants are assimilated into their new scientific communities. This is somewhat at odds with another argument that has been advanced by geographers and regional scientists who see the combination of talented people with diverse backgrounds as a key contribution to higher regional income (Florida 2002a, 2002b). Along the lines of this argumentation we would expect that higher diversity has positive effects on performance and that this should also be visible in science and at the micro-level of research teams. We offer to elaborate this some more in the revision of the paper. We disagree, however, with the opinion that the paper does not present research questions. At the end of the first section it points to research gaps and objectives which can easily be rephrased as questions; in our opinion this is a style question and not a content issue. 2. Why limit the diversity analysis to young researchers? Why is it important to differentiate between PhD candidates and Post Doctoral Fellows with respect to diversity of geographic origin? >>> Young researchers are the most mobile group of researchers (see for instance the paper by Mattsson in this special issue). In our case the limitation was due to the empirical focus and restrictions of the method: 1) the focus was on doctoral students and post-docs and data for other personnel categories is insufficient; 2) taking young researchers we can assume that their mobility measured in the survey is a good indication of their actual mobility and the diversity introduced through this into the teams. For older researchers we would need different methods,

e.g. biographical analysis, to properly represent their experiences abroad over longer time spans and to what extent their knowledge is influenced by what has been learned abroad. 3. Why it is important to differentiate between EU and US collaborations? >>> We expect higher costs for collaboration with US-based researchers than with European researchers, as it is more demanding to obtain funding (e.g. matched funding from European and US agencies required) and communication is hampered by different time zones and higher costs for necessary face-to-face meetings. Hence, we would also expect higher pay-offs from these collaborations. 4. The article seems to be very empirically driven. I think by including a theoretical/conceptual section, the results presented in this article can be related to existing work more meaningfully. By doing so, the choice for the dependent and independent variables can be related more easily to this theoretical/conceptual framework. >>> See above comment 1 5. With respect to the empirical analyses the authors should present the correlations between the variables, since it could be expected that at least some of the variables are highly correlated and possibly cause multicollinearity problems. The means, standard deviations, tolerance and VIF scores could be reported for all variables. >>> This can be done in the revised paper. 6. The authors would help the reader by discussing in more detail the limitations of their statistical approach, e.g. many insignificant variables (table 6 in particular) and the low explanatory power of the models (R square). >>> The analysis is clearly a partial analysis that includes variables on the sourcing of knowledge from different backgrounds and some control variables on the teams and their leaders. It omits, however, several influences on team performance: financial resources of the group and available research infrastructure (Baird 1986, Ramesh Babu and Singh 1998, Johnston 1994) and several “soft” issues like the quality of group interactions, climate and leadership that have been considered influential in older studies (Knorr et al. 1979; Stankiewicz 1979, Fox 1983, Bland and Ruffin 1992 among others). Therefore, the low coefficient of determination is a reflection of this necessarily partial approach. 7. What points in real time do all dependent and independent variables relate to? Please show results for all variables in both tables (if

possible). >>> Can be done in an overview table describing the variables that has been suggested in comment 5 above. 8. Please precisely state all variables and exact definitions in an Appendix to avoid confusion when interpreting the data. >>> See previous response 9. Finally, a more lengthy discussion of population and sampling issues would be helpful because data quality is as important as data quantity. >>> Can be done in the revised paper. 10. I think table 2 could be excluded. Most figures could be eliminated as well as they show insignificant differences between groups (ANOVA). >>> We suggest to delete table 2 and figures 1-4, but keep figures 5 and 6. 11. The novel theoretical/methodological contribution of the study needs to be stated in the abstract. >>> See comment 1 on the empirical testing of theoretical propositions. The paper has a methodological contribution that is in our view quite interesting, but it is not the issue of this paper and would require a more extensive explanation and discussion. In particular, we used a novel way of obtaining a (representative) sample of research teams that used publicly available information from the internet and enhanced it with search engine results. We suggest to refer to project reports that can be made available on the internet and include a more extensive discussion of the method. 12. The introduction and subsequent sections should state more precisely the current knowledge base and the gaps in the knowledge base. >>> Can be done in the revised paper. 13. The results on international collaboration mainly confirm previous studies: Any surprises based on the new survey data? >>> No, there is nothing that we are aware of. However, as the sourcing of knowledge through international collaborations might be substitutive to team diversity in cultural/national regards, we suggest keeping it in the analysis. Moreover, as our findings corroborate previous findings on international collaboration, it raises our trust in both, the overall quality of the data as well as the analysis. 14. The empirical part of the paper should relate the findings to the theoretical discussion. >>> See above responses to comments 1 and 4. 15. The final section should draw the attention of the reader to the novel contribution(s) of the study. >>> Can be done in the revised paper. 16. Please check variable names in tables (spelling mistakes). >>> Can be done in the revised paper.

Comments Reviewer 3 (Author response after >>>) 1. A conceptual framework and discussion of why the life sciences, the ten European countries and the quantitative approach were chosen for this study (3.1 just explains why the research team is the unit of analysis). And why is cultural diversity analysed instead of disciplinary diversity? Could it be that cultural diversity in fact mirrors different schools of thought and thus indicates different approaches to a certain topic? >>> See response to reviewer 1 on the conceptual framework; we also analysed the role of disciplinary diversity, i.e. the presence of different research fields in a team, in the project on which the paper draws, but we did not find any clear results on this. Disciplinary diversity and origin diversity might both measure the presence of different schools of thought, as suggested by the reviewer. However, this would need to be assessed in a separate study with different methods. 2. Key research questions and hypothesis derived from the literature review in sections 2.1 and 2.2 (these could be presented at the end of the second section). >>> We suggest to reformulate questions into the end of section 1 and hypotheses at the end of sections 2.1 and 2.2 to take this comment into account. 3. A language check by a native speaker, particularly in sections one and two, and also a rethinking of core terms such as origin diversity. My suggestion would be to use the term cultural diversity instead and explain it as team diversity resulting from researchers with different countries of origin. >>> Can be done in the revised paper. 4. The empirical results are mainly presented but not interpreted in the wider literature context. Therefore, the reader is often left wondering how the empirical results in sections four and five might be explained. For example, why do „teams with high or low origin diversity of post-docs attract more citations per publication than teams with average origin diversity of post-docs.“ (Barjak and Robinson, 2007, 134)? And how could one explain this finding: „We see in both cases that team productivity is higher for teams with collaboration compared to teams without. It also appears that teams collaborating internationally achieve a higher quality of publications, measured by MOCR, than teams with no international collaboration. However, only in the specific case of collaboration with the USA is the difference in research output quality statistically significant“

(Barjak and Robinson, 2007, 135). Furthermore, does it matter from which country the team members and the collaborators come from? >>> Additional explanations can be added in the revised paper. The first finding on the relationship between origin diversity of post-docs and the MOCR is a result of the bivariate analysis that is not confirmed in the multivariate regressions. Hence, it is possibly an artefact caused by other influences. On the second finding that is quoted, the relationship between US collaborations and the MOCR, see the response to comment 3 made by reviewer 1. As the collaboration with US teams is more costly, it should also create more benefits, i.e. more output (publications) or better/more visible output (more citations). This can be confirmed with the estimation results and we propose to add this interpretation in the text. We did not analyse whether there is a particular influence of PhD students or post-docs from certain countries on the team performance. 5. p. 122, 5-8, replace sentence We distinguish between international collaboration of researchers from different countries and team diversity resulting from researchers with different countries of origin. >>> Ok, sounds a lot better. 6. p. 122, 9, replace sentence and clarify to what extent they engage in collaboration ... and engage in collaborations leading to leading to joint publications ... >>> We propose the following change: „Our results show that the most successful teams have a moderate level of team diversity; in addition, successful teams engage in collaboration activities with teams from other European and US countries leading to joint publications.“ We did not consider the intensity of international collaborations in this paper and it would require new calculations with different variable specifications to do so. p. 122, 25, meaning? ... some kind of global „matching“ of scientific excellence >>> We propose the following change: „It seems reasonable to speculate that scientists draw some benefit from working and speaking with their colleagues from other countries. According to economic logic, the sourcing of partners from the larger global market of scientific competencies and skills produces better matching results.“ 7. p. 123, 2-4: Who says this? References needed or clarification that these are hypotheses >>> Add reference to Georghiou 1998 8. p. 123, 15, replace policy, empirical studies have

pointed out how geographical mobility helps to generate a productive... >>> Ok, to be done in revision. 9. p. 123, 21-22: no new paragraph >>> Ok, to be deleted in revision. 10. p. 123, 22-23, rethink phrase „with the diversity of teams by origin it causes“ : cultural diversity? >>> See above, response to comment 3 p. 124, 3: Why were the life sciences chosen? >>> Because the life sciences are a large and growing scientific domain. The study needed to focus on one discipline, as the number of influences that could not be considered would have gotten even larger otherwise and introduced more noise into the analysis. p. 124, 4, rethink phrase Pooling knowledge for research >>> We propose „Sourcing knowledge internationally“ instead p. 124, 5, replace? 2.1 Team diversity through researchers from different countries of origin >>> Ok, sounds a lot better.

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