What lies beneath the surface?

A review of academic and policy studies on collaboration between public research and private firms

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This booklet
presents a summary
of the findings from
the literature review
To delve beneath the
surface of the review, please
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Bon voyage!

ABOUT THE STUDY

This is the executive summary of a review of academic and policy-oriented literature on collaboration between public research institutions and private firms. The aim of the review was to identify and communicate "state-of-the-art" knowledge about mechanisms, motivations, and barriers for collaboration between public science and industry.

The review was commissioned by the Danish Council for Research and Innovation Policy and undertaken by DEA, a Danish non-profit think tank on education, science and innovation policy. The work behind the report was financed jointly by the Danish Council for Research and Innovation Policy and DEA.

With this review, we have sought to provide an overview of key themes, conclusions and implications from the literature for policymakers and university managers looking to promote and support university-industry collaboration.

The review builds on a wide search for academic and policy literature, primarily from the past ten years, but supplemented with relevant earlier texts, particularly from the academic literature. In the search for literature, emphasis has been placed on peer reviewed academic publications, supplemented with some of the most comprehensive or relevant policy-oriented publications on the topic.

Although the themes and issues covered in the review are global, the primary target group of the review are the members of the Danish Council for Research and Innovation Policy and policymakers and other relevant stakeholders in Denmark. This is reflected in the selection of literature included in the review, and in the discussion of key findings from this literature. For example, certain sections are dedicated to a presentation of recent findings from Denmark.

While we acknowledge that a substantial part of the interaction that universities are involved in is with the public sector, this particular review focuses on the interplay between public research and the private sector. We also recognize that public research organizations include a variety of institutions; however, the review focuses primarily on universities, which dominate the public research sector in Denmark, and which are most heavily studied in the literature.

The full report, including an extended summary and a list of references, is available for download from www.dea.nu/iceberg

EXECUTIVE SUMMARY

Universities are increasingly expected not just to undertake and disseminate fundamental research and churn out highly skilled graduates, but also to contribute more directly to economic growth, notably through direct collaboration with industry and active efforts to commercialize academic research results. The positive impact of public investments in university research is well-documented, with conservative estimates of the return on such investments ranging from 20 to 40 percent. The payoff for firms who engage directly in collaboration with universities is similarly well-documented, both in the form of increased innovation and improved financial performance.

University-industry collaboration is not a new phenomenon, but has in recent decades increased in both volume and the variety of types of collaboration.

The literature points to a strong relationship between high quality research and collaboration with industry, indicating that high-quality, independent academic research is a prerequisite for effective university-industry collaboration and underlining the importance of long-term support for excellent academic research.

Science policy has focused too narrowly on patents, university spinouts, and formal R&D collaboration as mechanisms for commercial exploitation of science. These mechanisms account for merely "the tip of the iceberg" , so to speak, and have overshadowed other, less visible mechanisms – e.g. contract research and consulting, informal collaboration, employee exchanges and job mobility – that are often more valuable in terms of enabling a productive exchange of tacit knowledge and technology between universities and industry. There are also significant interdependencies between mechanisms, implying that it does not make sense to simply push for e.g. more university patents: boosting university-industry interaction requires stimulating several mechanisms and the underlying personal ties.

Policymakers' (and some universities') hopes that technology transfer would generate financial profit for universities have, by and large, been crushed. Only a handful of universities in the world succeed in making money from their patents. This money can moreover be traced to a very small number of exceptionally lucrative patents; most patents make no money. Even the universities that receive the most licensing income struggle to make a profit: among the 20 top-earning universities in the US, only five make a profit.

For most universities, costs of technology transfer should therefore be seen not as a source of income, but rather as investments in research dissemination; this has important implications for how resources for technology transfer activities are prioritized and used.

Spinouts are not always an effective means of commercializing research. Moreover, most academic spinouts remain small and grow less than other high tech companies. However, it's been argued that profit and growth may not be the only success parameters for university spinouts: by virtue of their research-based nature, even lossmaking firms may still make a significant contribution by translating cutting-edge research and making it available to other firms.

Quantitative indicators have reinforced the single-minded emphasis on easily measurable outputs. Quantitative indicators for knowledge exchange can give universities undesirable incentives to deliver measurable outputs (e.g. patents), while potentially penalizing productive efforts to bring academic research to commercial use (e.g. through informal collaboration or consulting). Use of quantitative indicators should thus be informed by qualitative insight.

Industry orientation and good science go hand in hand: researchers who engage with the private sector are likely to show strong scientific performance in terms of high productivity and scientific impact. However, the relationship between industry orientation and scientific performance is curvilinear, suggesting that it is possible for researchers to work too closely with industry. Moreover, the direction of causality is unclear: are collaborating researchers better scientific performers because they engage with industry, or are they better at engaging with industry because they are excellent researchers?

Delays and restrictions on access to public research as a result of collaboration with industry do not appear to be a widespread or large-scale problem. However, there do appear to be instances where delays or restrictions occur. More study is needed to determine when and why they occur, as well as their severity and wider consequences.

Better understanding of individual researchers' attitudes is key to increasing university-industry collaboration, because such collaboration ultimately depends on individual researchers' decisions about how to prioritize their time, which in turn is largely based on the perceived costs and benefits of collaborating with industry. More attention ought therefore to be paid to obstacles and incentives as perceived by the individual researcher. Moreover, researchers' perceptions differ based on e.g. their scientific performance, academic position, age and motivations to engage with industry, suggesting the need to consider how new policy initiatives are likely to impact different subsets of researchers in different ways.

Researchers who collaborate with industry do so not for financial gain but to reap valuable inputs for their research and teaching, e.g. research funding, ideas for new research paths, or access to materials or equipment. An important means to motivate more researchers to engage in collaboration is therefore to help them realize benefits for their research and teaching activities. Key barriers to collaboration with industry are lack of prioritization/reward from university management, and conflicting timeframes and goals in academia and industry; these barriers, whether real or perceived, should be addressed.

R&D collaborations often fail or fall short of expectations. Factors that may increase the chance of success in university-industry collaborations include: prior collaboration experience, employing multiple mechanisms for collaboration between parties, building trust among partners, higher R&D intensity (in industry partners), higher research quality (in university partners), geographical proximity and professional (rather than ad hoc) management of the collaboration.

Universities are often expected to play a leading role in driving growth in regional/local innovation systems, even though there is little evidence to support that universities are effective in creating such systems. At minimum, policymakers should avoid generic approaches and instead tailor policies to the particular resources and challenges of the university and the innovation system in question. Research also calls for a more selective approach, allowing universities to focus their resources on local/regional firms that have sufficient R&D intensity and absorptive capacity and the specialized R&D needs necessary to engage productively with academic researchers.

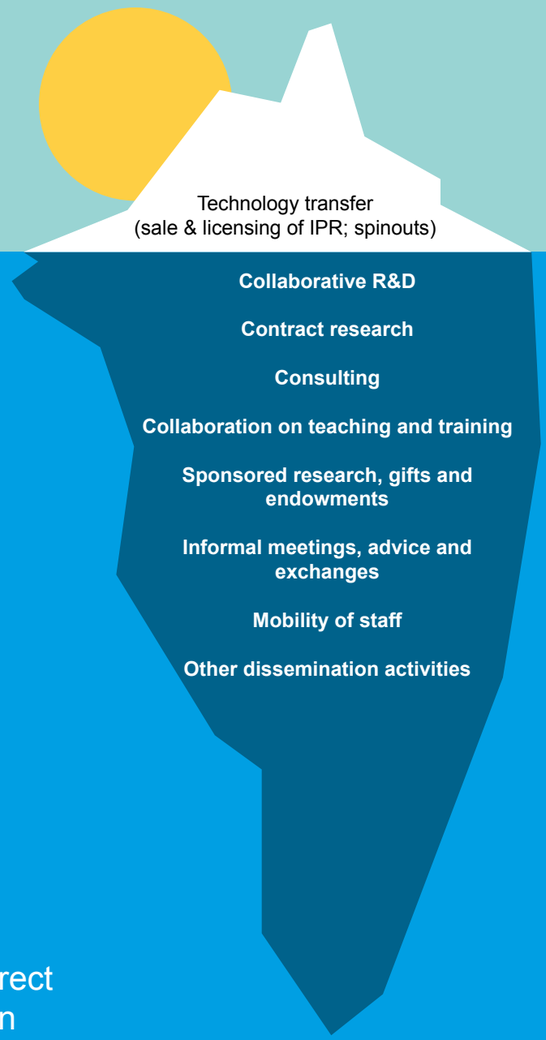
The contribution of public science to economic growth also depends on firms' willingness and ability to translate that science into new products and processes. Public science is but one of many inputs to private innovation, and one that very few firms tap into. In addition, private investments in R&D in Denmark have stagnated since 2010. Stimulating private investments requi-

res either greater financial slack within the firms or providing public R&D grants that can supplement firms' in-house R&D funding.

Do public grants for R&D collaboration, e.g. between universities and firms, work? There is no conclusive evidence that public R&D subsidies crowd out private investment, yet studies also fail to find evidence of substantial additionality. Why aren't studies of public grants for collaborative R&D finding better results? Part of the explanation might lie in the substantial variation in the performance of projects supported by such grants; many projects simply aren't as well designed or managed as they could or should be. Moreover, research shows that "research" subsidies are likely to stimulate R&D spending by firms, while "development" subsidies appear to substitute such spending, suggesting that public programs should focus on research rather than development projects in order to stimulate more R&D.

"Proof of concept" funding: the missing link in translating science to innovation? Studies suggest the need to assess whether there is at present sufficient funding available to bring promising, early-stage university inventions across the "Valley of Death" to a point where they become attractive to private investors.

All in all, the review of the literature suggests the need for an increased focus on quality, rather than quantity, in university-industry knowledge exchange. It also points to the need for flexible rather than "one size fits all" policies in order to accommodate variations across geographical regions, scientific disciplines, universities and even individual researchers into account. Finally, better policymaking requires more systematic, higher-quality evaluations of collaboration between universities and firms - and of policies and instruments aimed at stimulating such collaboration.



Mechanisms for direct interaction between universities and firms