Introduction

Public research – i.e. research primarily funded with public resources and carried out by public research institutions (PRIs) and research universities (hereafter both referred to as public research organisations [PROs]) – plays an extremely important role in innovation systems. Its sphere of influence touches education, training, skills development, problem solving, creation and diffusion of knowledge, development of new instrumentation, and the storage and transmission of knowledge. But public research has been also the source of significant scientific and technological breakthroughs that have become major innovations, sometimes as by-products of basic scientific research goals and sometimes with no vision of any direct application to a valuable commercial activity. Well-known examples include recombinant DNA techniques, the Internet, the scanning electron microscope and superconducting magnets. While it is inherently difficult to quantify the impact of public research, it has been suggested that around a tenth of innovations would have been delayed in the absence of public research (Mansfield, 1991). In some sectors – such as pharmaceuticals and semiconductors – innovation is far more dependent on public research results.

Shifting missions and growing demands

Awareness of the substantial economic benefits from public research, and demands by governments to reap those benefits, have changed the rationales for supporting PRIs and universities in particular. This has led to increased efforts – and a growing number of approaches – toward more direct engagement in downstream commercialisation activities. In large part, this awareness reflects the recognition that in some cases, simply placing public sector knowledge on the market for knowledge is not sufficient to generate social and economic benefits from research. While public research continues to be considered central to advancing scientific training and supporting social needs, generating knowledge to support innovation, it is no longer considered independently from commercialisation purposes.

The idea that pubic research should contribute more directly to economic growth and society is not new. The notion has been discussed most notably in relation to the concepts of "mode 2", the "triple helix approach" and the "engaged university", of which all take an activity-oriented and goal-oriented view of public research (see Brehm and Lundin, 2012 and, for an overview, Mowery and Sampat, 2005). Indeed, the move toward engagement in commercialising public research can be seen as a consequence of a longer-term shift towards a knowledge economy. For example, interactions between university professors and industry in the chemicals sector can be dated back to the 19th century (Meyer-Thurow, 1982). Foray and Lissoni (2010) argue that neglecting the potential of commercialisation of public research may be seen as lost opportunities, as some of the most radical innovations may not have been disclosed.

Some observers argue that public research has become too responsive to commercialisation incentives at the expense of core university missions, such as the dissemination of knowledge and teaching, or has added to the multitude of missions of universities and PRIs (i.e. the risk of a "mission creep") (OECD, 2011). Moreover, academic inventions

tend to be far from marketable, and substantial further innovative effort is needed to turn them into commercial products.

Others point out that because public funds are used to support public research, researchers and PROs should not only be held accountable to society for their results, but also be concerned about achieving a higher social and private rate of return from public investments in research.

Driving factors for the increased focus on commercialisation

The role of PROs in contributing more actively to the transfer and commercialisation of public research is being driven by various factors. Some have been pursued more actively by governments, while others have followed changing corporate policies (i.e. open innovation) or have been subject to external factors such as budgetary pressures on universities. The list below highlights some of the longstanding and more recent drivers (OECD, 2002, 2003, 2008, 2012; Larsen, 2011; Deiaco, Hughes and McKelvey, 2012; Arora, Fosfuri and Gambardella, 2001; Chesbrough, 2003).

- **Willingness to improve national competitiveness in industry.** Many OECD countries are again expressing concern about the deterioration of national competitiveness, and in particular the increasing competition from emerging economies.
- **Dissatisfaction with the measurable and direct returns of public research results.** The dissatisfaction of policy makers with the measurable returns (e.g. in terms of academic patents, spin-offs and the licensing income generated) has increased interest in new ways to improve commercialisation results. In addition, downward pressure on funding for university research has led to increased pressure to demonstrate social and economic impact.
- **Legislative reform on ownership of public research results.** The Bayh-Dole Act in the United States allowed universities to own the patents arising from federal research funding, and provided incentives for their commercialisation. Bayh-Dole legislation has been emulated across and beyond OECD countries. As a result, policy makers and legislators are increasingly encouraging (and in some OECD countries requiring) universities to patent inventions and to pursue commercialisation activities.
- **The increasing costs of scientific research and budgetary pressure.** The increasing costs of scientific research and budgetary pressure have led PRIs and universities to search for additional funding sources, even though income from commercialisation activities for most PROs account for a small share of the overall budget. As OECD analysis shows, researchers pursue a growing proportion of their research funding from project funding, much of which supports mission research areas (e.g. health, defence, green), and from firms focused on applied research of commercial relevance.
- **Competition for human resources and funding.** The successful patenting and commercialisation of a number of academic inventions by US universities and some European universities have drawn attention to a potential income source from public research. In addition, it is perceived that this also enhances the visibility and status of PROs in industry and society, and may therefore help attract top students, faculty and funding.

- **Emergence of "open access and open research data".** The Internet and the societal push for greater transparency and accountability in government and public research institutions has increased calls for more openness in science. In light of the ICT-led transformation of research, PROs and researchers themselves are adopting open science tools to promote increased access to and sharing of research data and publications. For example, in the life sciences this model has been promoted by the research community and leading international organisations (e.g. UNESCO's Universal Declaration on the Human Genome & Human Rights, The International Organisation of the Human Genome [HUGO]).
- **"Open innovation".** Many firms at the end of the 20th century had closed, scaled back or outsourced their central R&D research facilities. Co-operative R&D alliances of all kinds were of much greater importance. To source external knowledge and widen their knowledge base, firms are increasingly looking to universities and PRIs for much of their basic or fundamental research, following an "open" or collaborative innovation process.

Report structure

This report presents the results of the TIP project and is structured as follows:

- Chapter 1 sheds some light on the various **channels of knowledge transfer and commercialisation**, and links those to different criteria.
- Chapter 2 provides a **statistical overview of knowledge transfer and commercialisation** based on both traditional and new indicators that cover a set of OECD countries and PROs over time.
- Chapters 3 and 4 present the findings from survey of country policies, case studies and an inventory of **new initiatives pursued by governments and PROs**. This qualitative information complements the data presented in Chapter 2 and helps contextualise patterns and trends.
- The report concludes with Chapter 5, which outlines a possible **future policy agenda**.

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