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The retreat of public research and its adverse consequences on innovation

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ABSTRACT

Does it matter whether research is conducted by the private business rather than in universities or government research centres? While most of the attention of science and innovation policy in the last decades has explored the relevance of the interconnections between public and business players in enhancing knowledge-based societies, a major trend has been ignored: both the quota of public R & D and its share over the total R & D investment has shrunk in the majority of OECD countries. As a result, a larger fraction of knowledge is today generated in the business sector. We argue that this is a major problem since public research and private research differ along a number of characteristics, e.g. public access, potential for future technological innovations, criteria of resource allocation. This trend can have adverse implications for long-term innovation and economic welfare in our societies. Through the lens of the public goods theory and of the sector of funding and execution of R & D for the period 1981–2013 we try to explain why.

1. Introduction: the shift from public R & D to business R & D

In the last decades a major attack has been directed against the public sector. Everything labelled public – from hospitals to drinking fountains, from airports to motorways – has been described as inefficient, costly and ultimately useless. This is hardly a solely intellectual fashion; it is strictly associated to an attempt to move as many as possible of these public infrastructures and their associated economic value to the profit-seeking sector. There have been important economic consequences: public expenditure has been reduced while many public utilities – from trains to telephones – have been privatised. This trend can be observed in virtually all advanced countries (see Megginson and Netter, 2001).

The realm of knowledge has not been immune from this overall mood. While governments and the business community continuously recognize the importance of knowledge and innovation as crucial components of economic development and human welfare, there has been a long-term trend to belittle the contribution of public institutions and to glorify the virtuous of business investment (see the enthusiastic call for the downsizing of public R & D by Kealey, 1996; and the critical rejoinder by David, 1997). This general reversal of policy emphasis was based from the presumption of a superior efficiency of markets over governments associate to a new view of knowledge as a "proprietary quasi-private good" (Antonelli, 2005). This is reflected in the most visible and measurable component of knowledge creation, namely the resources devoted to Research and Development (R & D) and knowledge development, as documented in Section 2.

Most of the attention of science and innovation policy in the last decades has been directed towards the relevance of the interconnections between universities, industry and the governments (as in the Triple Helix view) (Colombo et al., 2011; Etzkowitz and Leydesdorff, 2000; Filippetti and Savona, 2017; Lawton Smith and Bagchi-Sen, 2010), and the major institutional transformations that have followed in the production of knowledge, exemplified in the Mode 2 knowledge production (Gibbons et al., 1994). University-industry linkages have become imperative and ubiquitous in the political agenda as a means to boost technology transfer and to improving training in skills required by the industry (D'Este et al., 2013; Gander, 1986; Hsu et al., 2015). Much less concern has been devoted to the overall shrinking of public research and to its main effect on innovation, long-term economic growth and social welfare (Conceicao et al., 2004).

The so often anticipated knowledge economy is on its way, at least judging from the resources devoted to R & D and other scientific, technological and engineering activities, but the profit seeking sector is gaining positions at the expenses of the public sector. Is this a problem? Two optimist arguments support the view that this is not such a trouble.

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The first states that this is irrelevant provided that new knowledge is generated. The important thing is that we know more things and we invest enough resources for it while it is less relevant if new discoveries and inventions are made by public or business players. The second is that the private sector is more efficient than the public sector, and research carried out in the latter has greater impact on business innovation performance and on countries' competitiveness. If the business sector proves to be more efficient in the way it generates knowledge, there is no reason why this should be kept within the public sector. Therefore, our research question is: *does it matter whether research is conducted in universities or government research centres, rather than by the private business?*

We will argue that the so often applauded current privatization of research activity and knowledge (see Kealey, 1996; Ridley, 2015) can have major consequences on innovation and, ultimately, on long-term economic development and social welfare.[1] One of the central reasons why the threat to knowledge augmenting is largely ignored or underestimated is associated to an unclear understanding of the economic characteristics of knowledge. In this paper we first develop an analytical analysis of the differences between knowledge generated in the public sector and knowledge generated in the private sector. On the ground of data on R & D expenditure in OECD countries we then discuss a number of implications for innovation and science policy. We will argue that it does matter *where* knowledge is produced: knowledge produced in the public sector has very different economic characteristics compared to knowledge produced in the business sector. And these differences become crucial for future innovation and long-term economic development since knowledge produced today is the fundamental input for future knowledge generation. When this is taken into account, the change in the composition between public and private research has consequences for the current and future pace of technological innovation and long-term economic development.

This paper is related to a broad discussion which is taking place both in academia and in policy circles: is science, through its application to technological innovation, an essential engine of long-term economic development? (Deiaco et al., 2012; Havas, 2008). The emergence of a new institutional reconfiguration of universities, as increasingly nested into the economic production process along with the industry and the government has been described as a major break in the production of knowledge, as in the “Mode 2” (Etzkowitz and Leydesdorff, 2000) or as an emerging system in which public and private institutions tend to overlap, as in the “Triple Helix” view (Leydesdorff and Etzkowitz, 1996). According to these scholars, these major changes have basically blurred the functional differentiation between *science and markets*, and that between *public and private* (Leydesdorff and Etzkowitz, 1996). Political scientists and sociologists have fiercely discussed the way in which neoliberal forces have been shaping the production and diffusion of knowledge, coining the term ‘science regime’ to describe a simple fact – and yet much disregarded in the realm of economics – namely that the practice of scientists is shaped by the environment they work in (Pestre, 2003).

Mazzucato (2013) has re-fuelled the debate about the role that the state, through investment in basic science, has played for technological development in the industry, somehow restating the value of the linear model of innovation (Balconi et al., 2010; Godin, 2006). We are therefore addressing the much heated debate about the economic relevance of the public funding of science. In brief, this debate opposes those arguing that government-funded basic research is an idle path towards innovations and that the market can do it better, to others countering that publicly-funded research provides benefits which cannot be substituted by private research. In the end, the debate seems to boil down to differences in opinion about *how much science should be publicly or privately funded*. This is what we are concerned about in this paper.

In the next section we develop our analytical distinction about public-generated and private-generated knowledge. In the third section we analyse data on public and private R & D. Section 4 puts forward some implications of our findings, while Section 5 discusses the implications for policy and Section 6 concludes.

2. Main trends in R & D expenditure, total government expenditure, military spending and basic research

2.1. R & D expenditure

Figs. 1 and 2 report data for, respectively, industry and government financed R & D. In most OECD countries a significant shift in the effort to finance public R & D has occurred: from 1981 to 2013 the share of public-financed R & D to GDP has been reduced from 0.82% to 0.67%. By contrast, the industry-financed R & D has increased from 0.96% of GDP in 1981 to 1.44% in 2013. There are significant differences across countries. Japan and Korea, Rep. exhibit a virtuous trend where both the business and the government have increased their own R & D expenditure; in Korea, Rep., particularly, the government expenditure increase has been spectacular. In the US, the UK, Canada, France and Germany, by contrast, we assist simultaneously to the growth of industry-financed R & D and to the decline of government-financed R & D. The temporary slowdown in Germany can be attributed to the unification of 1989, while for the UK a larger fraction of private-financed R & D comes from foreign sources and therefore it is not accounted for in these figures (see note on Table 1).

The consequence on the composition of R & D is remarkable (Table 1). On the one hand, the percentage of gross expenditure of R & D financed by the government has, in the OECD, shrunk from 44.2% in 1981 to 28.3% in 2013. The drop has been considerable in every country, particularly in the UK and in the US, while Korea, Rep. represents the only exception. On the other hand, the percentage of gross expenditure financed by industry has increased from 51.6% of 1981 to 60.8% of 2013. The increase is particularly strong in the US, Germany, and the UK. These trends show a clear structural change: the business sector is becoming more and more important in knowledge creation, while the public sector is slowly retracting (on this trend see also Conceicao et al., 2004; Dinges et al., 2007; Van Pottelsberghe De La Potterie, 2008).

A major shift has also occurred within the composition of public R & D expenditure. By looking at the trends in OECD R & D expenditure as a share of GDP by the higher education and government sectors, 1981–2012, OECD (2014) shows a steady decline of *government* R & D expenditure, from 0.34 to 0.28; by contrast, in the same period *Higher education* R & D expenditure increases by 0.27 to 0.43.

2.2. Public R & D, total government expenditure and basic research

The fall of government R & D can be examined within the broader trend of general government spending, as well as the specific trend of general government spending in defence. Data on general government spending show different patterns across countries (see Table 2). Countries in which spending was high in 1981, such as France and Germany, exhibit a moderate increase and a significant decline respectively. By contrast, government spending has risen in countries which scored low levels in 1995, particularly in Korea, Rep. and Japan. Military spending shows a considerable decline in all the considered countries, with the exception of Japan, although the share on GDP is still quite lower than other countries.

Fig. 3.a reports the percentage rate of change (2013 to 1981) of general government spending in major OECD countries on the horizontal axe, and the rate of change of government-funded R & D on the vertical axe. Similarly, Fig. 3.b reports the percentage rate of change (2013 to 1988) of military spending on the horizontal axe and the rate of change of

[1] For opinions which go against the stream see Mazzucato (2013) and M.I.T (2015).