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The development of technology infrastructure in Portugal and the need to pull innovation using proactive intermediation policies

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Abstract

It was not until the 1980s that governments in Portugal began to develop a national technology infrastructure (TI). Although there is no general accepted definition of what constitutes a TI, we define it as comprising different kinds of public, semi-public and private centres and institutes of research and technology. Following a latecomer supply side technology-push rationale and using European structural funds, successive governments in Portugal invested in building a comprehensive TI-system. However, the development of such system overlooked the support needs of the enterprise sector. Hence, questions are now being raised as to whether current policies and structures of support to technology transfer and innovation are relevant and operating effectively. This, in turn, is generating a need to consider new policies oriented to stimulate demand-pull and the use of the capabilities already existent. This paper contributes to assess the outcomes of the efforts undertaken in Portugal to build an effective TI-system to support innovation and technology transfer and suggests new demand-oriented policies.

Keywords: Technology infrastructure; Technology policy; Innovation policy; Proactive intermediation policies

1. Introduction

It was not until the late 1980s that governments in Portugal began to develop a national technology infrastructure (TI). Concerns about economic competitiveness and technological diffusion, on the one hand, and the low levels of gross domestic expenditure on R&D—GERD (only 0.31% of GDP in 1982), on the other hand, motivated the 1980s' strong policy focus on expanding and re-organising the national TI.

Different types of new and existing public and semi-public technology support organisations were therefore newly established or re-organised under the assumption that they could or should produce, disseminate and promote the adoption of new technologies and innovation in enterprises. Almost two decades later, these efforts contributed to an increase in overall R&D expenditures, amounting in 2003 to 0.74% of GDP, and in particular they contributed to maintain the government as both the primary source of R&D funding and the main executer of R&D activities. Business R&D expenditures and the aggregate innovation performance (as measured by community innovation surveys (CIS), for example) remain, however, one of the lowest in Europe.

In other European countries, the development of TI was associated either with large scientific endeavours or with an incremental increase in demand for public technical assistance services, delivered by different types of centres and institutes. Taking the particular historical context of technology policies in Portugal, which contrasts with similar policies in other countries, there is a need to examine the balance of different functions performed by the Portuguese TI, its sustainability and relevance to local companies. It appears that the technology-push strategy initiated by Portugal in the 1980s and continued throughout the 1990s overlooked the level of capabilities and corresponding support needs of the enterprise sector, hence raising questions of how to orient future policies to stimulate demand and the use of the available TI.

Using secondary sources such as the science and technology policy reviews undertaken by OCDE (1986,

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1993), annual reviews and financial reporting of different TI-organisations and evaluation reports of the Portuguese TI, commissioned by the Ministry of Economy at different points in time (Coopers and Lybrand, 1992; INETI, 1996; Deloite et al., 2000; AdI, 2006), the latter often containing information on the views of the firms about the relevance of the available TI, we present in this paper a first attempt to understand the outcomes of the efforts undertaken by Portuguese governments in the past two decades to build an effective system to support innovation and technology transfer.

Section 2 begins with a conceptual discussion about technology, technology transfer and the role of TI. Section 3 discusses the development of TI, contrasting Portugal with other countries. Section 4 examines the relevance and effectiveness of three types of public, semi-public and private TI-organisations: large public research establishments (PREs), technology centres (TCs) and institutes interfacing universities. Section 5 summarises what we can learn from innovation surveys and other more specific studies on the views of the firms regarding the available TI in Portugal. Finally, in Section 6, the paper concludes with discussion and suggestions for demand-oriented technology policies.

2. A conceptual discussion about technology, technology transfer and TI

2.1. What is technology transfer?

Technology transfer is a concept largely influenced by the linear model of innovation and by the neoclassical treatment of technology as information. That is, technology is seen as available information and technology transfer is reduced to information transmission (Lipsey and Carlaw, 1998; Teubal, 1998). In this perspective, the "information transmission process" is subject to the usual market imperfections used by policymakers to justify public intervention in various forms.

One form of intervention is the creation of public technology institutes or centres, not only as a compensation for the less than optimal R&D performed by private firms, but also because these organisations are seen as suppliers and/or as *passive* mediators of information that should produce, disseminate and promote the adoption of new technologies and innovation in enterprises. That is, another form of tackling market failures in information transmission is to promote a *passive* intermediary function that helps recipient firms to contact technology-information suppliers.

In the neoclassical perspective, this type of "linear" intermediation is particularly important, not just to ensure equal access to information by all firms but also because of the need to support technology diffusion from high-tech sectors (where advanced technology is generated) to less technologically intense sectors or from technologically more advanced countries to less developed countries (Vernon, 1988). This concept of intermediation inspired the creation of "liaison offices" in large PREs (such as NASA in the US or CERN in Europe) and in universities. It also inspired the creation in the 1980s of the so-called innovation relay centres supported by the European Commission. The basic idea was that large public research organisations or universities would be "suppliers" seeking to sell R&D outputs and information to interested businesses, through patenting or licensing. Information could also be transferred by contracting-out research capacity to interested companies. Because intermediation obstacles to this information-diffusion process are seen as mainly associated with the costs of seeking and distributing information, neoclassical policies to support technology transfer are predominantly focused on reinforcing the mediated distribution of information.

However, this idea of "liaison" or *passive* intermediation assumes that technology spreads unidirectionally, from advanced scientific R&D to multiple applications in different sectors. Also, this approach assumes that the recipient has the capacity to absorb the technology-information and that the mediator does not need to provide any type of training and up-skilling services to the recipient. Transfer of technology is therefore a question of mediating the flow of information and not a process of providing support to enhance the recipient's learning capabilities to effectively use and absorb new technologies and to undertake the associated organisational and managerial changes.

However, if we accept the idea that technology is not the same as information, then the mediating function and the way in which technology is transferred and diffused becomes rather more complex than a mere "information transmission" process. In fact, in contrast with the neoclassical treatment of technology, the so-called evolutionary/structuralist (Nelson and Winter, 1982) approach defines technology as useful, applicable knowledge, oriented towards the creation of economic or social value. Because this knowledge is only partially appropriable, some of it being tacit and specific to the entities that have accumulated it through learning, technology transfer cannot be reduced to a linear "information transmission". Rather than a linear supplier–mediator–recipient process, technology transfer and diffusion should be considered as a process of reciprocal learning. Also, because the knowledge that needs to be transferred does not come from one single supplier and is scattered by different actors, the technology adoption and transfer process is increasingly determined by the ability of different private and public actors to create networks to assist with developing, combining and applying new knowledge. Technology transfer stops being a linear, automatic and cost-free process as the neoclassical approach would have us believe, and becomes a complex interactive learning process in which multiple players have different roles and intervene as consumers, mediators or producers of knowledge (Cohendet, 1996). The costs attached to acquiring technology may be high and they