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Iberia thirty years after Saramago's *Stone Raft*: Opportunities for technical change and challenges for science and technology policy under increasing uncertainty

1. Introduction

In Stone Raft (1986), José Saramago imagines a scenario where the Iberian Peninsula breaks up from Europe and drifts in the Atlantic Ocean in search of its Latin American and African roots. Along with deep political and philosophical underpinnings, this novel of the 1998 Nobel Prize for Literature is skeptical and cynical of many aspects of existence. Governments and police are shown to be capricious or incompetent. Human institutions and social organizations, such as science and public opinion, are dismissed and mocked. Saramago goes even further: understanding of history and the past is shown to be nearly impossible. In several instances both the origin of artifacts and historical battles are given alternate interpretations. Even basic universal constants are shown to be precarious, and cause and effect are shown to be ultimately inscrutable. Again and again the narrative emphasizes that we live on unstable ground, the bizarre and seemingly arbitrary movement of Iberian Peninsula being the ultimate example. Saramago does not present us with a philosophy of despair. Rather, he calls for our critical thinking about the impossible.

Spain and Portugal, as the two countries of the Iberian Peninsula, have their own specific cultural, social and economic traits that differentiate them, but share at the same time similarities that result from a relative common history (see Royo, 2007; Fishman and Lizardo, 2013). Both countries shared concurrently their epochs of supremacy (even global prominence) with the formation of transatlantic colonial empires which molded the thinking, institutions, and the social, cultural and economic characterization of their societies (and of the world; Crowley, 2015). They also divvied up their eras of decline, which some writers[2] and scholars associate with a strong catholic domination (in relation to the more entrepreneurial and freer thinking of the Protestantism of Western Europe and Britain), the decadence of the social classes in power associated to centralizing and accommodated absolutist monarchies, and even the economic dynamics strongly dependent on colonial merchandises that demanded low knowledge intensive products and services rather than industrialization processes based on more technologically complex production systems (Acemoglu and Robinson, 2012; Liu, 2005; Bérenger, 1993; Godinho, 1963; Ortega y Gasset, 1921).

Antero de Quental was one of the main exponents of a political, intellectual and labor movement, termed "Iberism" or "Iberian nationalism", aimed to develop stronger links between Portugal and Spain or even unite the two countries; it weakly blossomed in the late 19th and early 20th centuries. In the late 20th century, both Iberian states have become democracies, joined the European Union, developed fast and recovered some of the lost ground in relation to the rest of Western Europe. This lost ground started to widen in the 18th century and became particularly pronounced with the dynamics of the industrial revolution (Jin, 2005). After joining the European Union in the mid 1980s, both countries initiated a process of modernization while continuing to face a substantial development gap, related to poorly qualified populations – including levels of literacy that were among the lowest in Europe (see Tabellini, 2010), lack of trust in institutions, fatalist societies, scant levels of scientific engagement and organization, and low productivity (Heitor and Horta, 2012; Magone, 2002; Gago, 1990).

Data from the OECD and the World Bank are indicative of the development gap that both countries had in relation to the rest of Europe and most developed countries in the world. In 1985 the gross expenditure in research and development (GERD) as a percentage of the GDP of Spain was 0.51%; the Portuguese figure was 0.34%, far from 1.76% of the European Union with 15 countries and even farther from the average of the OECD countries with 2.15% (OECD, 2016). Concurrently, in Portugal only 11% of the labor force had a tertiary education degree and 12% completed secondary education (which in terms of qualifications of the labor force would place the country with a less qualified labor force than Mexico, El Salvador and Panama in the 1990s); Spain had 21.2% of the labor force with tertiary education and 17.1% with secondary education – similar to the qualifications of the labor force in Colombia and Peru (World Bank, 2015).

After the mid-1980s, both countries managed to tackle several challenges and substantial changes occurred, mainly developing physical infrastructure (e.g., roads) and consolidating democratic values, and to a lesser extent, increasing the qualifications of the younger generations and investing more in knowledge.[3] This effort was not straightforward as it had significant costs in terms of profound social and economic changes and adjustments, including the loss of sovereignty (Royo, 2007). Yet, while some changes occurred at a fast pace, others either moved at a slower pace or were outright resisted (Karamessini, 2008;

[2] See speech by Antero de Quental in Lisbon, May 27th of 1871 during the 1st session of the democratic conferences: http://www.arqnet.pt/portal/discursos/maio01.html [accessed 20th March 2016].

[3] This qualification effort of the young generations in the last decades in Portugal and Spain is substantial, considering the numerous challenges that the educational systems of the two countries faced in all educational levels: poorly professionalized teachers, obsolete curricula and teaching methods, severe social and economic inequalities in education, conservative mindsets, dropouts, problematic reforms, among others (e.g., Teixeira and Koryakina, 2016; Coronel and Gómez-Hurtado, 2015; Vallejo and Dooly, 2013; Crujeiras and Jiménez-Aleixandre, 2013; Da Costa, 2011; Soares, 2010; Forte and Flores, 2014; Meijer, 1991).

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Royo and Manuel, 2003). This process placed Portugal and Spain, countries in the semi-periphery of Europe, as countries in "intermediate" stages of development where conjoint dualisms of innovation and conservative values, norms and behaviors coexist, a somewhat contradictory multifactorial dynamic that combines change, inertia, resistance, backwardness and progress (Pinto, 2012; McVeigh, 2005). In both countries, advancements in civic and political rights, and in the modernization of the social economic fabric co-occurred with considerable socio-economic inequalities and continuous distrust in the State (Torcal, 2014; Magone, 2003). Scholars argue the scientific and educational levels of the population are in part responsible for this duality between the socio-economic modernization of the countries and the persistence of more traditional mentalities (Ossenbach and Boom, 2011; Magone, 2003).

Nevertheless, the combined growth of the Spanish and Portuguese economies after joining the European Union was considerable (they grew by a factor of 4 from 1985 to 2012), but the share of the two countries of the gross domestic product (GDP) of the European Union (15 countries only for time comparison purposes) only evolved from 9.5% in 1985 to a maximum of 12.7% in 2009, dropping to 11.9% in 2012 due to the economic crisis of recent years. This suggests that, economically speaking, Portugal and Spain have only marginally closed up the gap with the most developed countries in Europe. For example, the Iberian share of the European Union economy continues to be smaller than the relative share of the population (14%).

At the same time, while the research and educational capacity of both Spain and Portugal evolved at a fast pace, that evolution did not have the necessary time to mature, to build the necessary absorptive capacity and to be able to impact the economy (Heitor, 2015). For example, in 2014, 22% of the Portuguese and 35% of the Spanish population aged 25–64 had a tertiary education degree, which showed that, no matter how fast the growth was, the citizens of the two countries were still counted as the least qualified in the European Union (OECD, 2016). The combined share of the GERD of Portugal and Spain in relation to the European Union also grew from 2.8% in 1985 to a maximum of 8.4% in 2008 and 2009, to drop to 7.4% in 2012. It is, therefore, far smaller than the relative share of the population.

The fact that the investment in knowledge did not have sufficient time to impact the economy is not surprising since the investment in research and development (R&D) and education are "endogenous" variables in the long run of economic expansions, where strong emphasis is placed on the role played by knowledge creation and commercialization in promoting economic growth (Barlevy, 2007; Aghion and Howitt, 1998).

The remaining of this article in organized as follows. Section 2 presents a summary of data and figures regarding the evolution of investment in science and technology in Spain, Portugal and in Europe over the past decades. By considering the Iberian countries in their European context, the analysis emphasizes the accumulation of knowledge investment and its relative impact across Europe. Section 3 discusses the results in terms of the qualification of human resources and considers the evolution of national science policies into perspective by linking public investment in science and technology to the systematic reinforcement of human capital. Section 4 considers the impact of science and technology policies on the economy in terms of the absorptive capacity of each country and discusses the need to foster their relative diversification and internationalization in order to better promote the impact of knowledge-based investments. Section 5 presents a comparative analysis of Spanish and Portuguese patterns of science and technology policies and introduces major policy research issues for both countries. The analysis is discussed in Section 6 in terms of ways to foster a harmonized development of Iberia in the context of a large and fully European integrated knowledge-based society. The article concludes with a short introduction of the collection of all the articles included in this Special issue about science and technology policies in Iberia.

2. Building evidence: Spain and Portugal towards an Europe of science and knowledge

It is well known that Spain and Portugal, as well as other southern and peripheral European countries, have been seriously affected by recession and economic and budgetary problems since 2010, with a major impact in the budgets allocated to science and technology and higher education. This has occurred after three to four decades of a serious attempt to reduce the knowledge gap in terms of an effective presence in "scientific Europe", with significant results, although still far beyond the status of developed countries in western and northern European regions.

The investment in R&D and in education need to be constantly supported, but its results are always susceptible to inconstant politics and funding oscillations (see, for example, Romer, 1986, for R&D and Gemmell, 1996, for education). Fig. 1 shows that the cumulative investment in knowledge by both Spain and Portugal, although growing fast, was not comparable to the gross investment made by other countries. The figure shows two trends. First, the gap continued to be wide vis-à-vis the rest of the European countries even in the periods of fast growth of the Iberian economies. Second, the cumulative effect of investment in knowledge by the two countries is still small when compared with the other European countries, and thus, the most vulnerable since the relative accumulation of knowledge represents one of the pillars of modern societies (Conceição and Heitor, 2005).

This vulnerability of the scientific, educational and socio-economic systems became evident in the earlier stages of the recent financial crisis. It had an immediate detrimental effect on the investment in knowledge generation by both the public and the private sectors of the two countries. Official statistics show that the maximum values attained in many relevant science and technology indicators by both countries, including R&D expenditure, are always achieved in the period 2009–2010, the years the crisis hit the two countries, and from there on the indicators show a declining trend, leading again to a gap widening between Iberian countries and the rest of Europe (Heitor, 2015).

This widening gap to a large extent reflects budget cuts imposed from 2011. These were often "blind" cuts aimed to help reducing public deficit, to the detriment of other strategic goals that countries were pursuing, some of them requiring stability and long-term investment in knowledge (Monastiriotis et al., 2013). It should be noted that the Government Budget Appropriations or Outlays for R&D (GBOARD) of Spain decreased almost 20% from 2009 to 2013, while in Portugal it decreased more than 10% in the same period.

These declining trends of the public R&D funding are of concern in these two countries because: i) the distribution of GBOARD across Europe is already highly concentrated in Western and Northern Europe and a declining trend of investment in Portugal and Spain widens the gap between Iberia and the former regions, and represents a retrocession from the lessening differences of the last decades (Heitor, 2015); and ii) in Portugal and Spain, the public investment in R&D is critical not only to drive private R&D growth, but also to establish a more consolidated scientific culture and a general understanding that there is a pressing need to invest in intangibles (Heitor and Horta, 2014; Bayona-Sáez et al., 2013).

It should be noted that the interruption of the route of European convergence since 2011 in Spain and Portugal occurred together with significant shifts in the political commitment to science. It was, above all, broken by using the argument of financing only 'excellence' and enhancing the selectivity of the access to science, together with dramatic changes in research assessment procedures, particularly in Portugal. There is no scientific system that is sustainable if based only on a limited and exclusive group of scientists (Stilgoe et al., 2013; Stilgoe, 2014). This is indeed a dangerously close view of all that prevented Spain and Portugal take on the challenge of early science before the 1970s.

It should also be noted that two types of arguments were put forward, which are often conflicting to each other and may result from