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Research and Development, Innovation and Industrial Integration in Portugal: a success story?

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Portugal

Research and Development, Innovation and Industrial Integration in Portugal: a success story? [1]

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Topics

[1] Based on the presentation made at the 13th Solemn Plenary Session of the Hassan II Academy of Science and Technology, Rabat, Maroc, February 20-22, 2018

Abstract

In recent years, statistical data revealed a strong dynamism in terms of Research and Development (R&D) growth, of development of innovation structures and emergence of programs, and a growth in terms of industrial integration. However, the political and financial changes from 2007 at the global level revealed as well how fragile are these outcomes in terms of sustainable development strategy, and how far dependent are from the external markets and political structures. Based on the available information and data, we will present the changes observed in recent years, and understand how the industrial integration can be achieved with clear linkages to the national innovation system and the importance of R&D policy to structure the articulation between innovation and the economic market. The challenges and potential problems can be anticipated if the social implications are also present on the policy options, and if clear technology assessment procedures are taken. When this does not occur, the probability of endogenization of innovation and R&D will become problematic. For these reasons it can be difficult to talk about a "success story" when all these elements are not considered as a whole and are only seen through very specific angles and with very specialized approaches.

Key words: Research and Development, industrial integration, innovation, Portugal, Morocco

JEL codes: F62, F68, O32, O38, O57

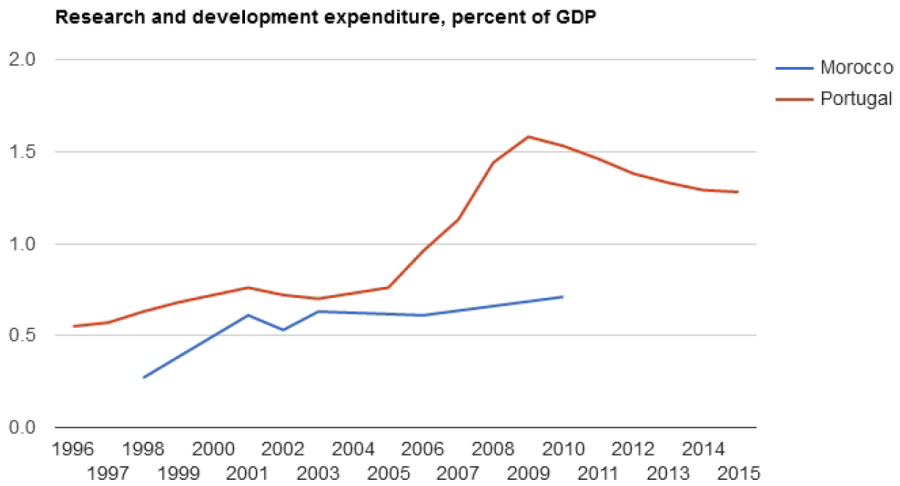
Introduction

This paper was presented at the session on “From research to technological innovation, industrial integration” that was held on the thirteen Solemn Plenary Session of the Hassan II Academy of Science and Technology in Rabat (Morocco) on 20-22 February 2018. The general theme of this plenary session was “Research and development, Technological Innovation and Industrialization” and the aim was to present some elements to the debate based on the recent case of Portuguese changes of its economy, society and policy making. The topic that was suggested for a presentation based on the Portuguese case was about the role of Research and Development (R&D) in the innovation process in a country like Portugal, and to understand how the industrial integration was succeeded in this European country. The aim was to present it as a success story. However, knowing the recent tensions and developments occurred in the national economy and society, such idea of success was puzzled with obstacles, difficulties, or policies based on the international markets and institutions. The hypothesis is that this considered “success story” is a coin with, at least, two faces, and the dynamics of innovation processes is strongly influenced by social and political factors. Therefore, my objective was to present some indicators that could be better understood considering the equivalent indicators for the Moroccan reality. The considered indicators should reflect the mentioned dynamics of the innovation processes in a context of financial crisis and economic transformation. Conclusion may be addressed on the Portugal case, but also suggestions can be designed for the Morocco case.

R&D and innovation

One of the first type of indicators that exemplify the dynamics of innovation is related with the evolution of expenditure of R&D in the national economy. The expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge. This knowledge includes the knowledge of humanity, culture, and society (social sciences and humanities), and the use of knowledge for new applications (mostly in the field of natural sciences and engineering). R&D covers basic research, applied research, and experimental development in all of these epistemological fields.

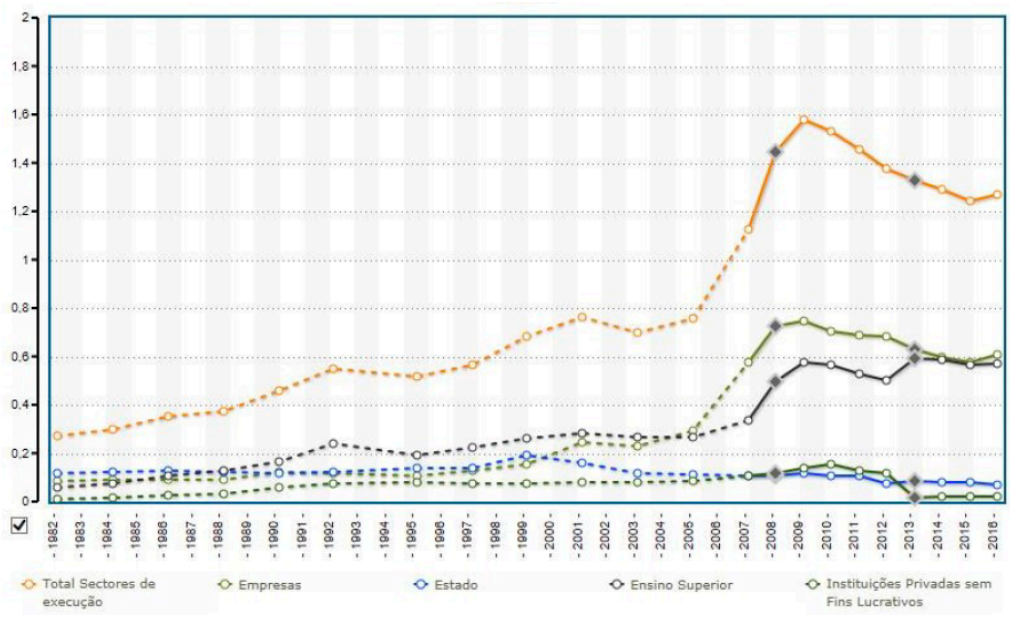
The next graphic presents the information on the Portuguese and Moroccan cases, although the statistical series is longer for Portugal. We have started with data from 1996 until 2015, once for Morocco we have (from the World Bank sources) data from 1998 until 2010. As this article is based on the Portuguese case, we would like to offer wider information from a longer series to understand the trends before 1998 and after 2010, as the next figure shows more explicitly.



Source: TheGlobalEconomy.com, World Bank

This chart shows and increase of R&D expenditure in both countries. But this increase was very significant between 2005 and 2009. At least in Portugal, the financial crisis of 2008 had an impact on the investment of R&D, and that was even stressed by the policies for the financial assistance to Portugal from 2011 (cf. Ferreira and Teixeira, 2016). The effects were crossing all sectors and was very evident in the high education and on the national innovation systems, that still today, suffers of prolonged divestment. The evolution in terms of R&D expenditure by sector can be seen in the following graphic based on Portuguese data.

R&D expenditure, % of GDP by sector

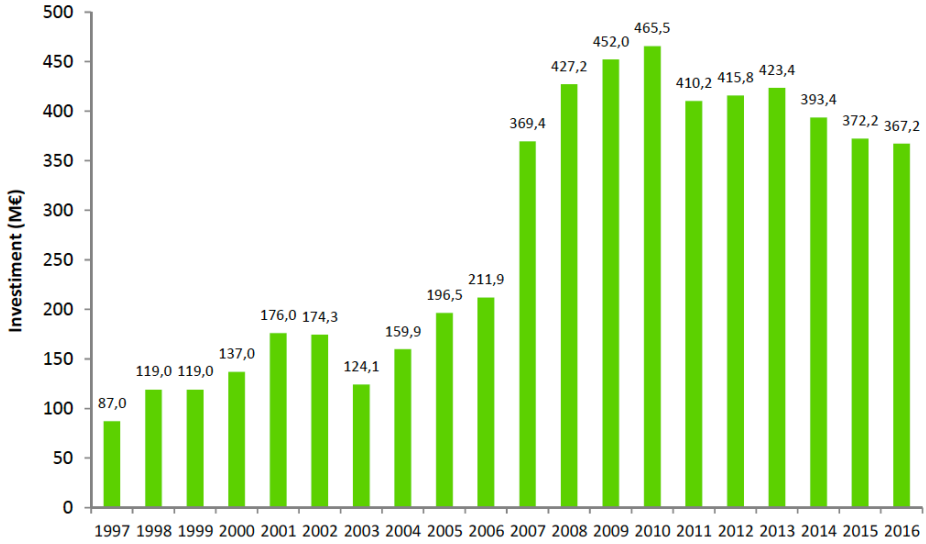


Source: FCT, 2017

During the decade of 1990 the high education absorbed most R&D expenditure (black curve). Since mid-2000 enterprises (green curve) take the lead. From 2009, and with the "troika" (IMF, EIB and ECB) the high education system suffered significantly with a very strong decrease on investment that also affected the R&D done in that sector. A small recovery was done in 2013 when some funding was eased. The other sectors (state and non-profit institutions) have diminished substantially their expenditure on R&D since 2011. Just the companies increase their investment in the period 2006-2010, and also decrease since then. Thus, the overall result is a serious decrease on the national investment on R&D that may happen implications on many different dimensions that we will analyse in the following pages.

One of the main sources of information about the investment on R&D is the statistics of the national Foundation on Science and Technology (FCT), institution that belongs to the national systems of science and technology (S&T) and is one of the most important entities that finances R&D. the next chart presents the recent investment measured in millions of euros.

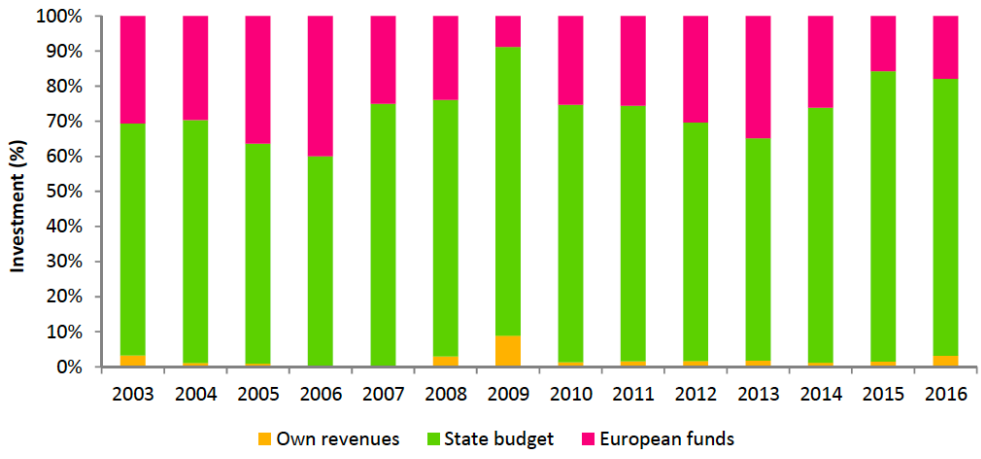
Annual investment of the national Foundation for Science and Technology



Source: FCT, 2017

As it can be clearly understood from this graphic, from 2011 on the investment made by the FCT has decreased constantly. That means there were very few new contracts and the expenditures made were almost only on running research activities. In fact, very few calls for new projects or for PhD and post-doc scholarships has been offered. After an initial investment effort made just before the financial crisis of 2008, very little more was done in the following years. In this investment is also included the programs of financing the research centres and of PhD programmes that have stopped after that period. If one considers the distribution of that investment according to the funding sources, one can get the following result.

Investment of FCT per source of funding (%)



Source: FCT, 2017

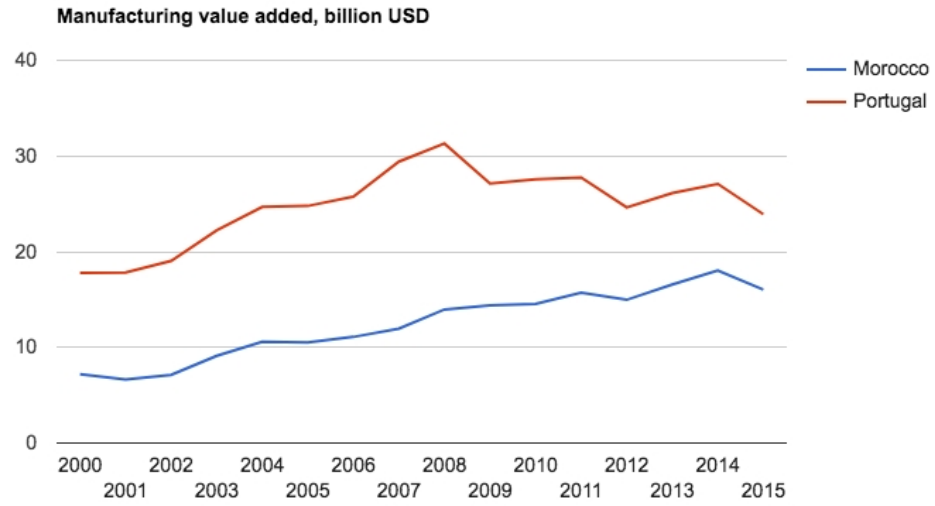
From this chart we can conclude that the state budget continues to be the most significant (almost 80% in recent years). It is worth to mention that before 2007 there was a slight growth of European funds as part of the FCT investment, and that was verified again (although less) in 2012 and 2013. Since then it has only decreased. One reason that might be pointed out is that FCT and the national agencies had been unable to promote and coordinate more efficiently the involvement of national research in European programs. That means the revenues from European funds are very low and the FCT has no capacity to become an intermediate between the national and the European research. Whenever the "own revenues" are evident in the above chart (especially for 2008, 2009 and 2016) that means also the overall investment has been low. To confirm that, it is visible the correlation between that and the relative amount of European funds in the total annual investment.

A conclusion that we can underline for this, is the fact a country needs a strong national agency able to articulate the available funds for R&D. In the Portuguese case that would be the need to articulate with the European funds, in Morocco there would, eventually, point out to the need to promote with African or Maghrebian joint funds for R&D (Agénor and El Aynaoui, 2015). Such agency functions are vital to enable a sustainable growth of innovation processes through an increase of R&D investment. The capacity for innovation lays on available funding, and that would not be found only at the national level, but also at the international level.

Implications on the economy capacity

The need for R&D investment is closely related with the capacity to renovate the production infrastructures. That means, with less R&D the economy is not able to become competitive in more demanding markets. The result for such situation is usually the dependence of an economy structure from external influences. That implies the fact innovation that might occur will be governed by other national economy, international banks or multinational companies. It can be done through technology transfer rules with higher patent rights or with lower technology readiness levels. This may create a technology dependency towards some companies or national economies. In some historical conditions, that could be the only available condition to develop more competences in the production structures at the national level. The cases of foreign direct investment (FDI) can be provide further capital flows but it can imply also tighter links to other economy structures. But remaining such dependence implies that other sectors become also dependent from external capacities.

The manufacturing value added can be considered as a reflex of the capacity of a national economy to integrate and articulate the FDI and the investment on R&D. The next chart presents the recent evolution of this indicators in the two mentioned countries.



Source: TheGlobalEconomy.com, World Bank

Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added [2] is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is usually calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The data above presented is in current U.S. dollars and was provided by World Bank. It shows more clearly how the financial changes occurred from 2008 affected the Portuguese economy more than the Moroccan.

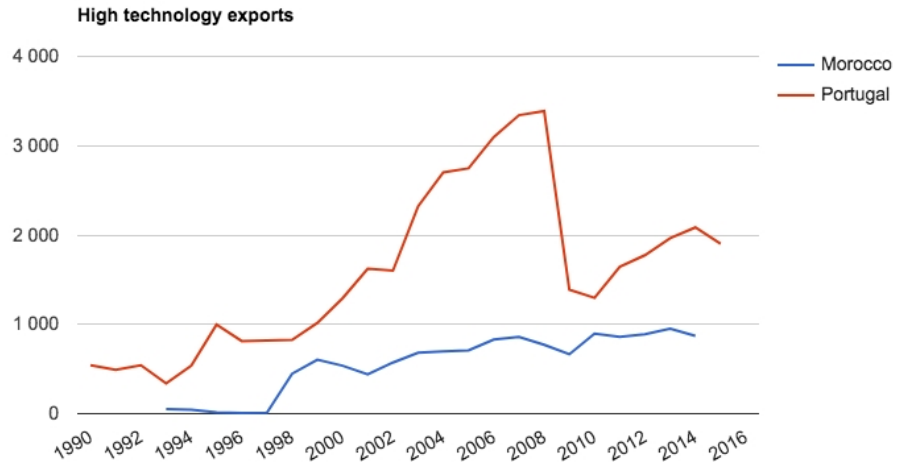
As it can be verified in this chart, the highest peak for the manufacturing value added was achieved in 2007-08, and since then there was no clear recovery. The European policies were not able to help the reversal of that trend. As Reinhart and Rogoff mentioned on their boon *This Time is Different* (2009), "absent the pull of an outside political anchor (e.g., the European Union for countries like Greece and Portugal), recovery may take decades or even centuries. As of this writing, even the commitment device of an outside political anchor must be regarded as a promising experimental treatment in overcoming debt intolerance, not a definitive cure" (Reinhart and Rogoff, 2009: 30).

That has been shown in the following years: the political anchor was not sufficient or strong enough to become a "promising experimental treatment", and these economies were left hostages of international financial markets. The devastating implications affected not only the whole social life, but also the basic structures of R&D and innovation. Manufacturing companies were the first to be affected by this lack of inflows of capital and knowledge.

An indicator of this process may be seen in the following chart that presents the recent evolution of high technology exports.

High technology exports, World Bank, Portugal and Morocco

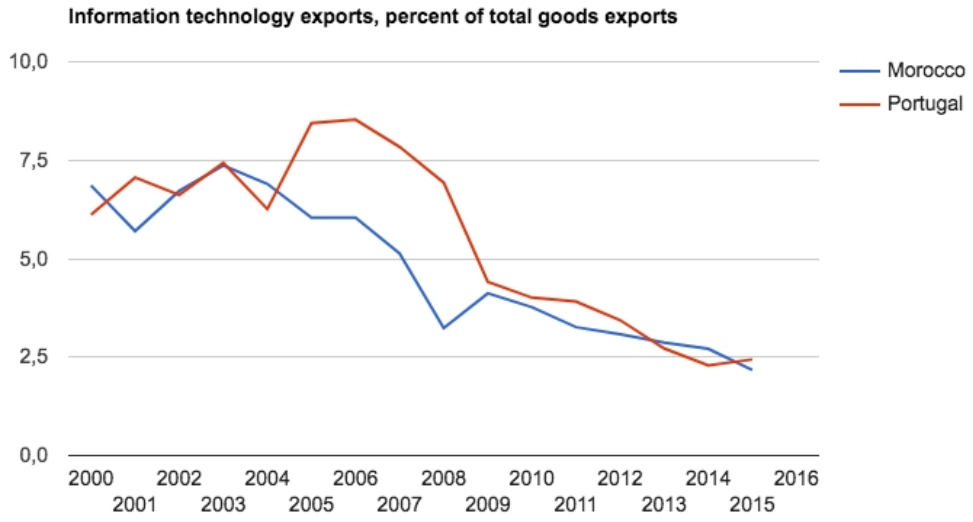
[2] The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3.



Source: TheGlobalEconomy.com, World Bank

High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Data presented above are also in current U.S. dollars. In the Portuguese case it is mostly produced by the IT and pharmaceutical sectors (cf. Boavida and Moniz, 2012). If the evolution of this type of export products was very strong since the end of the decade of 1990 (and much stronger in comparison to the evolution of the Moroccan high technology exports in the same period), from 2008 the level of export became very close in these two economies. The new "take-off" of Portuguese high technology exports from 2011 has not yet been similar to the previous periods.

Apart from this type of product exports, we can also observe more particularly the evolution of information technology (IT) exports considered in relation to the total good exports. That is expressed in the next chart.

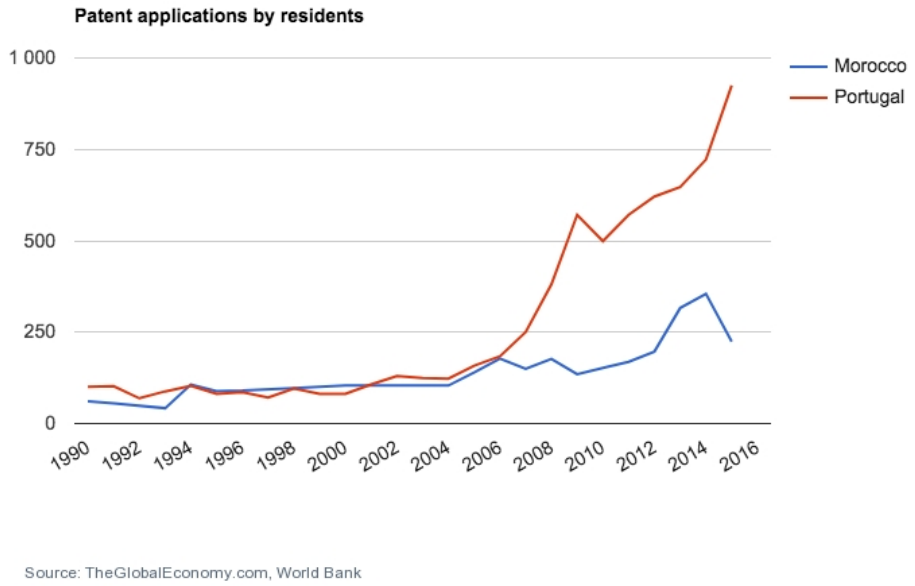


Source: TheGlobalEconomy.com, World Bank

Just for record, the information and communication technology (ICT) goods exports include computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods (miscellaneous). This chart shows two aspects: a) the similar capacity of the IT sector in both countries, and b) the divergent trend observed in the 2004-06 period for Portugal was not replicated anymore.

It was mentioned by Boavida and Moniz (2012) that "since 1995, the manufacture of goods and equipment related to radio, TV and communications (CEA 32 [3]) is the activity of high technology intensity with the greatest R&D expenditure in Portugal. In addition, this expenditure increased at the average annual rate of 56 per cent between 2003 and 2005" (2012). In the same paper, they noted that the IT sector was responsible in 2005 for "7 per cent of the total R&D expenditure, despite only representing 2 per cent of the total number of companies with R&D activities. This reveals that the growth between 2003 and 2005 is probably related to the influence of big established firms in Portugal that resulted from foreign investment" (Boavida and Moniz, 2012: 15).

In spite the decrease of high technology products and IT in terms of total goods, the number of issued patents has increased, as shown in following chart.



Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention, a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years. This means that, according to the above World Bank chart, from 2006 the increased number of patents in Portugal will have an impact in the national economy at some point in the next years. Unfortunately, that seems not the case for Morocco.

The increased number of issued patents is probably influencing better economic innovation performance, and could also be a result of recent investments on R&D. As mentioned by Oliveira and Teixeira the higher technology transfer efficiency levels are associated to innovation policies more supportive to technology transfer efforts (Oliveira and Teixeira, 2009: 36). However, that does not mean such innovation policies are enough to improve the economy capacity to develop new

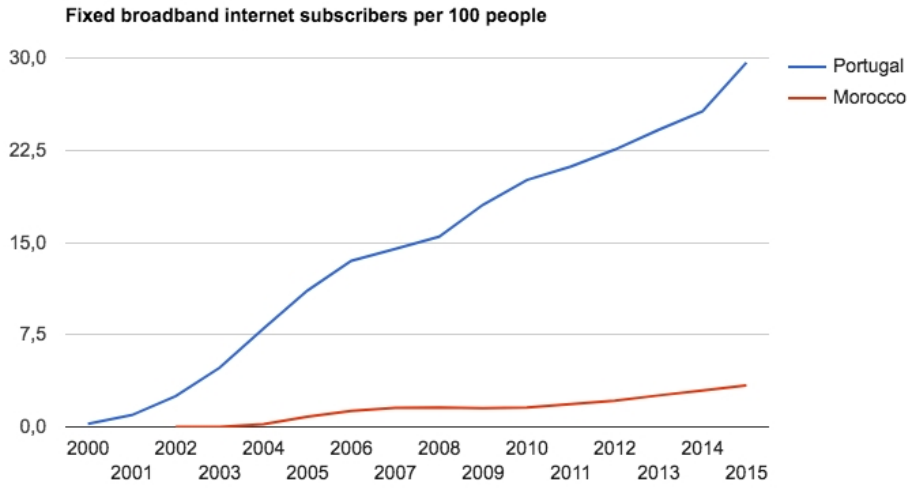
[3] CEA – Classification of Economic Activity

innovative products, to enable increased exports of high technology products and to perform more value added on the economy activities.

Technology infrastructures and social changes

Some ways to understand the problems and obstacles to the economy innovation processes is to relate it to the available technology infrastructures. In other words, if the technology infrastructure is available and used by the whole society members, then it can contribute to improved social changes and quality of living conditions. One can measure such changes through indicators as internet subscribers, innovation index, human development index, school enrollment, renewable power, coal and oil consumption, and social globalization index. All of those indicators can reveal the capacity to innovate through means that enable meaningful developments on the economy and on society.

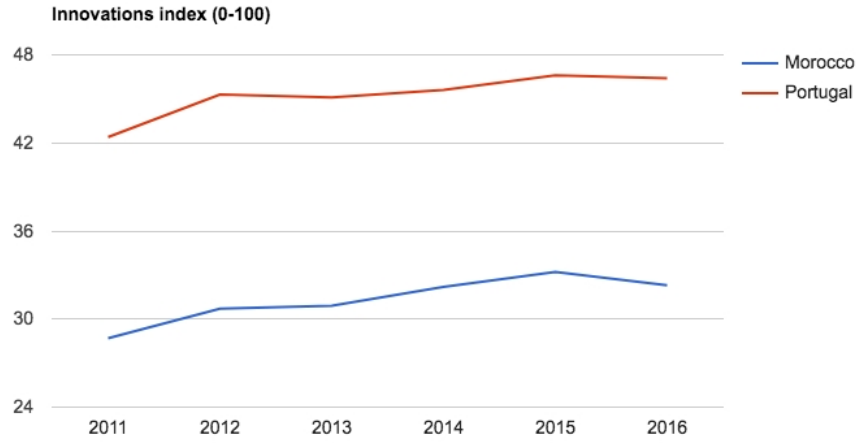
Let's take the example of internet. One indicator that can reveal a better capacity to use information, to improve education services, or to enable the national integration in global communication systems, is the number of fixed broadband internet subscribers per hundred people. The following graph present that recent evolution.



Source: TheGlobalEconomy.com, World Bank

The fixed broadband subscriptions refer to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, DSL, fiber-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband. Using the comparison, we are doing in the last pages, we can conclude the Portugal has been a successful case. Such evolution means a strong investment on the communications infrastructure in the last years (especially in the decade of 2000), and on the telecommunication services. As mentioned before, this sector (ICT) was also the sector with the highest investment on R&D during several years. That produced a clear effect.

Although it is not possible to conclude that such investment influences directly the innovation process, what is clear is that there are several potential correlations with such indicators. The following chart presents the evolution of the global innovation index with the reference for the two mentioned cases.

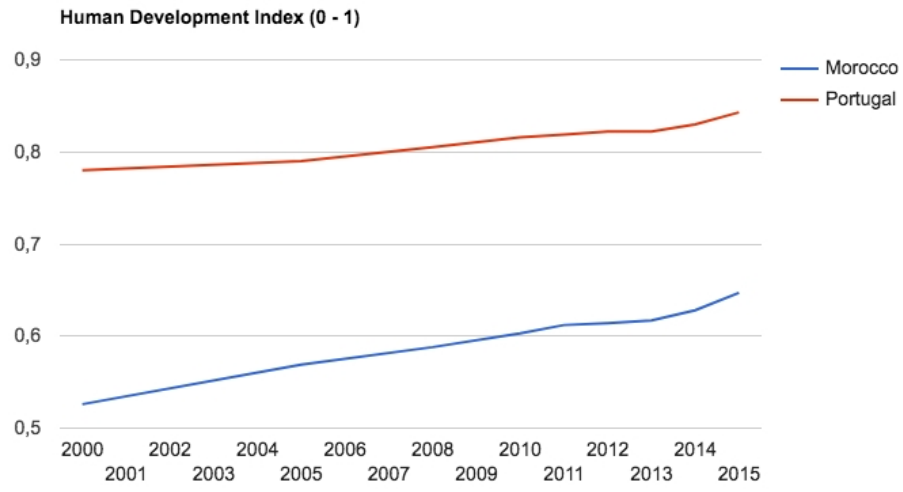


Source: TheGlobalEconomy.com, World Bank

The Global Innovation Index of the World Bank includes two sub-indices:

a. the Innovation Input Sub-Index and
b. the Innovation Output Sub-Index.

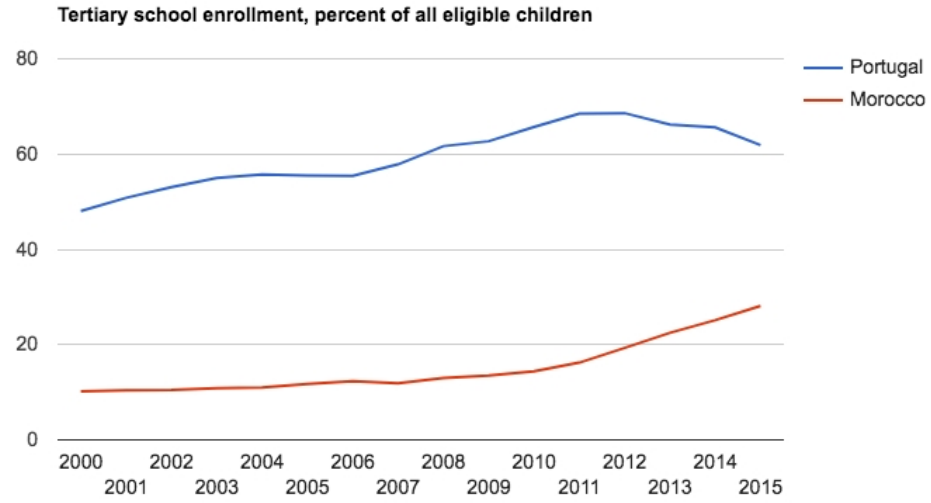
The first sub-index (input) is based on five pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. The second sub-index (output) is based on two pillars: Knowledge and technology outputs and Creative outputs. Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators that we will not discuss here. Both cases present similar growth process. This means that an increased innovation from the input side (technology, economy and social infrastructures) will reflect an increased output (level of knowledge produced and its integration on technology). Using also the index associated to the human development, as in the following chart, we may reach interesting conclusions.



Source: TheGlobalEconomy.com, World Bank

The Human Development Index measures three basic dimensions of human development: long and healthy life, knowledge, and a decent standard of living. Four indicators are used to calculate the index: life expectancy at birth, mean years of schooling, expected years of schooling, and gross national income per capita. Considering the data above presented, the departing position of Portugal and Morocco were very different in 2000. But the increase that is followed in this last country approaches it to similar levels as Portugal in the next 2 to 3 decades (if continues with an increase of 10% each 15 years).

One component of that index is the education. The following chart presents the evolution in terms of tertiary school enrollment.



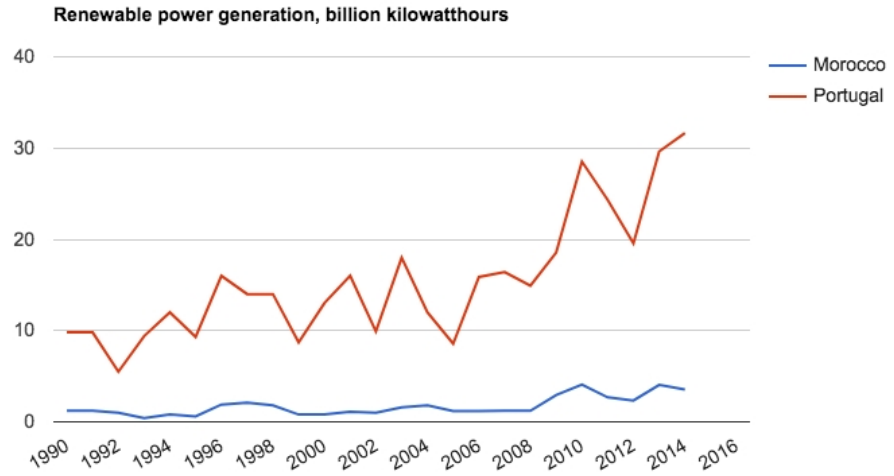
Source: TheGlobalEconomy.com, World Bank

Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether (or not) to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.

We have chosen this indicator, because the human resources with tertiary education as background, is the condition to provide innovation capacity in a society and economy. Without that it is not possible to achieve an innovation integration. In the above chart we can observe a higher enrollment in Portugal than in Morocco. However, since 2011, that enrollment has decreased.

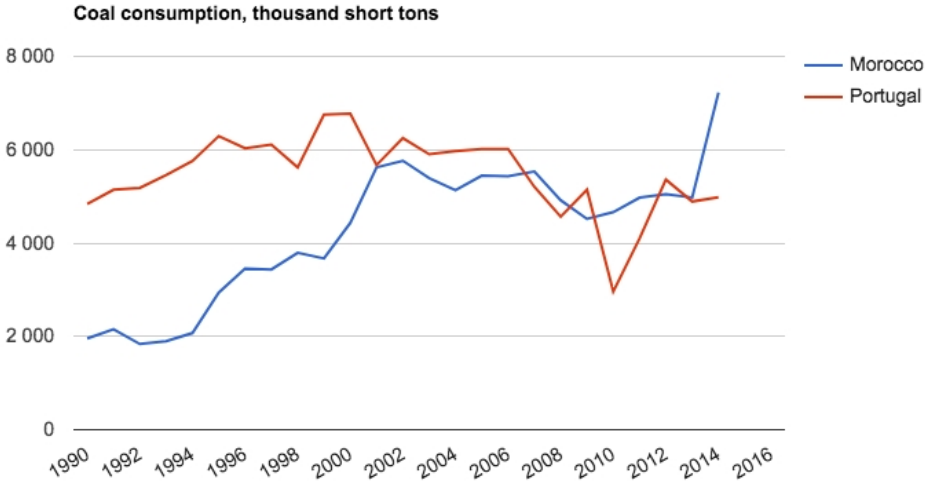
In order to face the debt crisis that followed the financial crisis, the government made less investments in this level of education, and much younger students entered the labour market to face economic difficulties and household scarcities. The levels of school drop outs were reaching levels similar to the decade of 1970. With recent policy changes, it is possible that such curve takes a new shape as it has in 2005 and following years.

The renewable power generation is another indicator of the technology infrastructure that is related to policy options and increased innovation in the energy sector. It has also a strong influence on the costs of the energy substitution.



Source: TheGlobalEconomy.com, World Bank

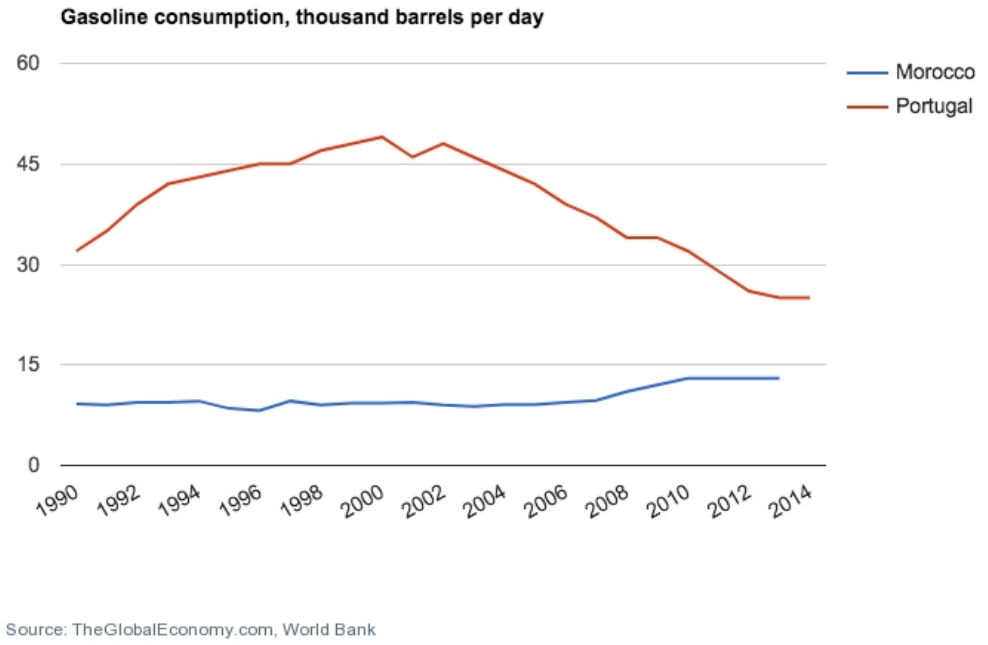
This chart presents the total Renewables Electricity Net Generation. This net generation excludes the energy consumed by the generating units and also excludes generation from hydroelectric pumped storage. There are clear annual variations, but the overall trend is positive. Portugal reached in 2018 several moments of total energy autonomy based just on renewable power generation. This increase has (at least in the Portuguese case) a direct influence on the coal consumption, as shown in the following chart:



Source: TheGlobalEconomy.com, World Bank

Coal consumption includes anthracite, sub-anthracite, bituminous, sub-bituminous, lignite, brown coal, and oil shale. It also includes net imports of metallurgical coke. As there are only two coal-based

power plants in Portugal [4], the decrease can be obvious. These plants will be deactivated in 2030 or even before. Besides this use for energy production, also many industrial companies use coal for their production activities. Based also on the international compromises assumed by the national government (Paris Environment Summit agreement), the source of energy will be discontinued in the short term. Parallel to this, the gasoline consumption evolution can also reveal a change of paradigm on consumer behaviour, and on energy policies. The following chart gives argument for further discussion [5].



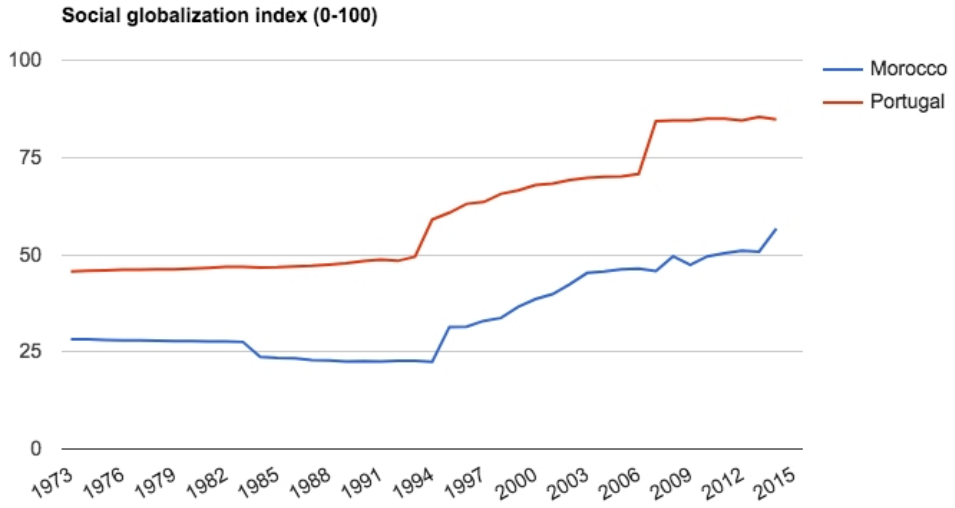
Source: TheGlobalEconomy.com, World Bank

The gasoline consumption is measured by thousand barrels per day. That can be done either for manufacturing purposes, or for transport. In the later case there are two possible reasons for that: a) application of policy measures to promote a more sustainable energy consumption for transport vehicles, and b) a decrease on household income with impact on the use of private transport solutions. Both are reason for such a decrease, even in a context of increase of imports of private automobile in the last years.

There is no updated information but is observable a wider use of public transport in large urban areas, as well in smaller cities and inter-cities. The new usage of bicycles in urban areas, the policies for promoting electric vehicles, are also elements of this cultural change. That is also a process of integration in a globalized trend for other consumption behaviours, and for prevention of climate change.

[4] Thermoelectrical power station of Pego (https://www.tejoenergia.com/en/central/) and the EDP power station of Sines (http://www.a-nossa-energia.edp.pt/centros_produtores/info_tecnica.php?item_id=76&cp_type=te&section_type=info_tecnica)

[5] Source: The Global Economy.com, The U.S. Energy Information Administration



Source: TheGlobalEconomy.com, World Bank

In the above chart we present the information on the social globalization index that has three dimensions: personal contacts, information flows, and cultural proximity. The sub-index on personal contacts includes international telecom traffic, degree of tourism, transfers, foreign population, and number of international letters. The sub-index on information flows includes number of internet users, share of households with a television set, and trade in newspapers. The sub-index on cultural proximity includes trade in books and number of McDonald's restaurants and Ikea located in a country. On this respect, both Portuguese and Moroccan societies seem to develop in similar way, especially since mid-1990. We can point some general aspects that characterize the Portuguese society and economy development in the last years:

- In terms of R&D, the national investment increase in the last decades in comparison to the last decades of 20th century.
- Innovation policies implied an overall improvement of the economy structures and wealth.
- Financial crisis and the international assistance to prevent bankruptcy (IMF, EIB, ECB) eased bureaucratic burdens but had negative impacts on the social environment and economic growth.
- The capacity to use information, to improve education services, or to enable the national integration in global communication systems has grown quickly in the last years.
- An increased innovation from the input side (technology, economy and social infrastructures) is been reflected in an increased output (level of knowledge produced and its integration on technology).
- Portugal reached in 2018 several moments of total energy autonomy based just on renewable power generation. The decease on coal and gasoline consumption are also recent important facts that characterize the whole economy.

These recent trends are the context to some experiences on industrial integration through the implementation of innovation platforms or cluster (Santos, 2015; Ferreira, Teixeira, Dantas, 2015). We will develop some items concerning such experiences in the next chapter.

Trends on industrial integration: the innovation clusters

The clustering different sectors around a common development field has been persued with supportive policies from several governments in Portugal in the last years. The motivation and approach has been the same as the establishment of technology platforms at the European level. They are known at competitive and technology poles [6] and they are framed by the so-called Collective Efficiency Strategy, and financially supported by the European strategy funds (Ferreira and Serra, 2008; Santos, 2015). The aims are:

- To foster a strategic market-oriented vision;
- The international assertion of national and regional companies, products and technologies, thereby helping to increase exports and market shares, improve the country's technological balance, increase productivity and generate qualified employment;
- To undertake structural projects with an important impact on the country;
- To undertake technology research and development projects that increase the value added of national products and their exports;
- And to organise and promote joint, common and cooperation projects between companies and with support organisations.

There are supported 19 cluster (PCT) in different areas, as Engineering & Tooling, Technology of Mobility Industries, Petrochemical technologies, Production Technologies, Energy, Forest-based Industries, Furniture, Sustainable Habitat, Natural Stone, Tourism, Agro-industry, Wine, ICT, Fashion, Health, Ocean economy, among others. We considered here three of those cases

- Health Cluster Portugal (HCP) – *http://www.healthportugal-directory.com/en/*
- Aeronautics, Space and Defence Cluster (AED) – *http://www.aedportugal.pt/*
- TICE- ICT cluster – *https://www.tice.pt/*

The HCP was founded in 2008, currently brings together over 170 members, including R&D institutions, universities, hospitals, organisations from civil society and companies in the areas of pharmaceuticals, biotechnology, medical devices, ICT and services. Their turnover is around 27 thousand million euros (2015) and the value added 8.7 thousand million involving around 90 thousand companies and institutions. That represent almost 280 thousand workers (5.6 thousand of them are FTE on R&D activities).

The AED was formed in 2016 and integrates sector associations for aeronautics (PEMAS), for space (PROESPAÇO) and defence (DANOTEC). It integrates some high education and research institutions (Polytechnic Leiria, INESC and University of Porto) [7]. The majority are industries or services to

[6] Pólos de Competitividade e Tecnologia (PCT). For more information: http://www.pofc.qren.pt/areas/poles-and-other-clusters

[7] There are some similitudes with the presentation of Pacheco on the "R&D, technology innovation and industrial integration in Brazil" on this same session of the Hassan II Academy of Sciences and Technology (2018)

industry (68). It involves 18.5 thousand jobs (64% industry, 32% systems and ICT, and 4% R&D). they develop several cooperation with similar cluster of other countries (Spain, France, Germany, and Canada.

The TICE (or the ICT cluster) was created in 2008. Areas are: a) Information Systems; b) Telecommunications; and c) Electronics the sectors involved are:

- Energy Efficiency and Sustainable Environment;
- Education;
- Organisational Efficiency;
- Health and Quality of Life;
- Public Service;
- Mobility;
- Culture and Leisure.

They integrate as well as universities, polytechnics, research institutions (15) as well as companies (61), sector associations and interface institutions (15).

The role of innovation networks

Innovation occurs as a social process within given cultural, scientific, institutional, and technological "configurations", trajectories and regimes and regime shifts (see e.g. Nelson/Winter 1977). In all this means that other elements than the technological ones, or even the economic context, have to be considered to understand the success factors of innovation policies. In the Portuguese case, the policies for promoting national networks can be pointed as one of the most important.

The fact Portugal is in a supra-national system that influences the economic and financial options (European Union) has positive aspects, as the facilitation of supporting links in the wide European space, enhancement of cooperation among firms from different countries, policy alignment for supporting tools on innovation. That created a "regime shift" before and after the economic integration in the EEC and later in the EU. But has also the negative aspects (already mentioned) when the financial policies in a critical circumstance (especially after 2008) pushed the economy and society into major difficulties that still have impacts on the capacity of the economy to recover.

Industrial development implies the formation and growth of a range of innovation systems centred on specific technologies or industries. Such a system is made up of three components: firms and other organisations, networks and institutions (Jacobsson and Bergek, 2007; Driouchi and Zouag, 2011). The cases of innovation clusters in Portugal cover this reorganization principles. Just in recent years it could be possible to join in the same organization or network different agents as university and companies. Usually they act in different "worlds". But this has changed in recent years when industry finds on the research field a very competent and helpful counterpart. There are still much steps to be taken, but the process is under way.

Networks constitute important modes for the transfer of tacit (Metcalfe, 1992) and explicit knowledge. They also influence the perception of what is possible and desirable, i.e. expectations of the future, which guides specific investment decisions (Carlson and Jacobsson, 1993; Geels and Raven, 2006). The industrial integration had also that specific positive outcome, when recently the industry firms are finding their capacity and paths for a more competitive solution, not based on cost reduction, but on the increase of innovation of their products and relation in a globalized world.

Institutional alignment and innovation policies

Institutional alignment is at the heart of the innovation process (Freeman and Louçã, 2002). They mean changes in the legal and regulatory aspects as well as in norms and culture. This is a very important dimension of the integration process. As mentioned, the R&D system has not the same organizational or regulatory model as the companies. The allocation of resources is done with different approaches. This alignment needs a longer process of cooperation and joint projects to enable a mutual understanding of these different cultures and processes [8].

Institutions regulate interactions between actors (Edquist and Johnson, 1997) and define the value base of various segments in society (Haveman and Rao, 1997). When we consider the role of these cluster in the industry integration, such regulation assumes a central role. Institutions also refer to beliefs (cognition) that influence firms' decision in the form of frames that structure learning processes (Geels and Raven, 2006). When networks (and clusters) become institutionalized, they are balancing and articulating their (mutual) learning processes and their capacities to become essential to the global market.

Towards a capacity building in Morocco?

Presenting these themes and data at the Academy of Sciences and Technology of Morocco raised several questions related with policy strategies options and on technology capacities. From the different presentations a focus on the competitive elements was raised. It seemed that the mining sector and the agro-industrial were the most competitive sectors for Morocco, as it has been the sectors of ICT and automobile for the Portuguese case. However, in both countries the issues on how to leverage the innovation capacity can be very similar. It would be needed, at the level of universities, for Morocco to establish further steps, as:

- To invest on infrastructure (internet broadband in all campuses, laboratories, communication platforms)
- To finance a large number of scholarships in all scientific fields, in special in less favoured regions (eastern and southern Morocco)
- To support at least one innovation and technology transfer office in each university campus
- To support a network of science parks at the university campuses where there are capacities of technology development education and research (faculties of engineering and sciences, and polytechnic institutes)

Such initiatives were highly successful in Portugal and enabled the national capacity building on the field of technology innovations and transfer towards industry of to design centres. In terms of policy strategy definition, some questions can also be raised, as follows:

- What are the main policy orientations on technology innovation and industry integration? Is Morocco aiming to increase its cooperation with France? And what about its neighboring countries? It is knowns that there are political and military tensions among these countries, but those remaining tensions would not affect the national capacity building? The international recognition and supporting instruments are not related with these problems? If they are, what are the next steps?

[8] This was also mentioned in the presentation of Hatchuel and Bergendahl on "The university-industry cooperation as na engine to growth" based on the Swedish case.

- There are consensual themes where the academy, government and industry can find joint interests? Which they are? Would it not be possible to enhance those topics and find new cooperation links?
- Which are the most controversial topics? Is it possible to develop an assessment over those topics? What can be the role of the national parliament on this assessment, as in other countries that include the technology assessment as a parliamentary priority (as Germany with TAB, or the European Parliament with STOA, France with the OEST, among others)? What could be role of the Hassan II Academy of Sciences and Technology?

In general, it is not clear if there are still political problems that are not yet solved. Knowing the discussion at the global fora and in particular, at the United Nations or the OUA, how far the international community is influencing the national civil society options, and in particular the academic and the industry initiatives for innovation? Related with this, what is the role and the geo-political place of Morocco? Its location in the Maghreb enables to become a main national actor to promote a stronger Arabic cooperation in the field of industry innovation? Or would it be mostly a national actor to promote new policies in Africa? Or just a bridge between Africa and Europe? Or would it play a central role on the Mediterranean region?

In the debate it seemed that some further basic steps are still to be taken. From the fundamental recognition of rights for an increased social balance, towards the enabling the opportunity to access employment and education in all levels, such steps are very important. In many cases it seemed to be very similar the evolution of economy indicators, as well as some social ones. That means there is a large field of capacity for innovation development and industrial integration in both economies (Driouchi and Zouag, 2011; Bouoiyour, 2003; Benner, 2013). In both cases, the central issue is the definition of an own strategy for technology and socio-economic development.

Outcomes

The main result of this comparative exercise, based mostly on the Portuguese case, was to demonstrate the positive and the problematic factors of innovation performance in a country. We can conclude that even when some empirical evidences show several positive outcomes, the analysis much also include all other elements. Without a critical perspective the scientific analysis will just be conform to the media opinions, and not verifiable. We have tried to bring as much empirical data as possible for the dimension of this chapter.

As we have mentioned in the beginning, there is a strong dynamism in terms of R&D growth in Portugal, that is funded on the development of innovation structures and on the emergence of innovation policy programs. That has enabled the growth of industrial integration. When the researcher of these themes has a whole sort of available data, the challenges and the potential problems can be anticipated.

We can also conclude that if the social implications are also present on the policy options, and if clear technology assessment procedures are taken, such anticipate can help a wiser decision making by all actors in the innovation system (government, industry, research). Our findings tell that it is difficult to talk about a “success story” when all these elements (social implications, technology assessment, data) are not considered as a whole and are only seen through different angles and perspectives. Just with very specialized discipline approaches we cannot reach such aims.

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