INNOVATION POLICIES FOR
INCREASING POTENTIAL GDP
IN CRISIS COUNTRIES

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Abstract: Countries at an advanced intermediate level vis-a-vis the world technology frontier and recovering from a deep economic crisis, require supply-side policies directed at innovation for increasing potential GDP growth. In this paper we concentrate on microeconomic and sector policies namely innovation and capital-market development, R&D and enterprise productivity, integration in global value-chains, enhancing competitiveness and productivity across the economy, clusters and reindustrialization as well as small and medium enterprise development. Problems of sequencing and complementarities are also discussed. The case of Portugal is taken as one case study but the best practices around the world are taken up. The case of Portugal show how inaccurate statistics can lead astray in the design of policies. State finance of R&D is now at par with developed countries, the rate of increase in PhDs is one of the highest in the world and most of the inputs in R&D and even publications are quite favourable by OECD terms. However, two statistics show that the country has not been able to translate those inputs into technological development. The ratio of patents by researcher and the ratio of high-tech exports over R&D expenditures are among the lowest in the OCED. The paper identifies the reasons for this low productivity and proposes a strategy for improvement based on a new scientific and technological policy and institutions and integrated policies to create clusters in knowledge-talent-industry and attract multinationals intensive in technology.
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1. Introduction

It is imperative to restore sustained and substantial growth in the economies most affected by the Euro crisis to generate a positive dynamic of expectations, productivity and investment. Moreover, this is the only way to make sustainable the high public and private debt in these economies. The Adjustment and Stabilization Programs have already led to a substantial reduction in the fiscal and external deficits. These programs were based on tax increases, public expenditure cuts and deep credit reduction which led to a substantial reduction in aggregate demand. Structural reforms in labour and product markets were supposed to facilitate the process of resource reallocation entailed by the cut in demand for non-tradables. However, these reforms are still incipient and need further deepening in all countries that experienced the crisis. Second, to change the production structure of the economy switching policies rebalancing prices and incentives are needed but are seriously limited by the Euro single currency rules. Third, to foster recovery and avoid a major expansion of imports policies to stimulate the supply (supply-side policies) need to take centre stage. To this end government needs to formulate and implement a coherent and credible program that sets a vision for medium and long term that is realistic, firmly anchored in a feasible economic model, and compatible with a realignment of the country within European economy and globalization. This paper contributes to this reflection by focussing on innovation and building technological capabilities.

The weight of exports of goods and services to GDP needs to continue to grow, implying a rebalancing of the production capacity towards production of industrial (and agro-industrial) goods and tradable services, including tourism. This process involves a thorough restructuring. The large destruction of firms in construction and wholesale and retail trade under the austerity program is releasing a substantial amount of resources. It needs to be complemented by two other processes: first, expansion of incumbent more productive and competitive firms in open markets, which absorb a significant part of the job losses; second, creation of new enterprises in competitive sectors and facing global competition. To accomplish these processes a strong transfer of productive factors needs to take place, facilitated by capital mobility with an efficient exit mechanism, involving banks and bankruptcy judicial decisions, and by labour mobility with the operation of an efficient labour market and re-training mechanisms.

This restructuring is part of innovation in a lactu sensu, and involves a process of technological transfer from best practices of more advanced countries. Given the present status of the Portuguese economy vis-à-vis the technological frontier, it represents roughly 70-80% of the innovation that needs to take place. But, we cannot undervalue also the remaining 20-30% of innovation that is related with leading technologies and participation in the global process of generating new scientific and technical knowledge. This process is more directly connected with the work of Universities, Laboratories and leading industrial firms and their activities in R&D. This paper is focussed on both these processes.

To achieve the rebalancing of the productive system in favour of tradables, in an international context where Europe has lost a major share of manufacturing to China and other East Asian

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1 See Acemoglu, D. et al. (2002).
countries, it is urgent to undertake measures for: (i) mobilization of foreign direct investment directed to exports, which can be a major source of technology transfer and modern management methods, (ii) internationalization of Portuguese companies, with full integration in the value chains, (iii) reinforcement and intensification of traditional exports by improving quality and technology content, opening new markets, especially in emerging markets economies.

In which sectors actions should be taken? Horizontal measures are always preferable because are less distortionary. If sectors are targeted, policies and measures should be diversified although recognizing the specificity of each sector. A simple map is to use the revealed comparative advantages such as those based on natural resources (agribusiness-wine, fruits, vegetables, forest-pulp, cork, sea fishing, and tourism), in order to increase productivity, value-added and expand markets. Industries with comparative advantages based on labour with intermediate qualification, such as the automotive sector, to increase value-added and densify participation in the value-chain. Industries based on highly skilled human capital, such as electronics, pharmaceutical or healthcare, software and business services may require support in terms of R & D, innovation, IPR and venture capital. These actions could create future competitive advantages endogenously and help climb the value-added chain.

Policies should reflect a scheme where the state is just a facilitator of the process, eliminating rigidities and solving market failures, since only entrepreneurs could identify concrete market opportunities and develop productive activities. Industrial policy should therefore respect two principles - one that was not respected in the past and caused the current financial and economic crisis: incentives should not distort resource allocation in the market of an open economy, but encourage priority to production and world market expansion of tradable goods. The other is to expand technological capabilities and generate endogenous growth with improved resource mobility.

We now summarize major policies to stimulate and re-launch the supply-side:

1. Policies to stimulate the supply by improving technological capabilities: improving methods of production and skills from management to the factory floor and introducing new products and services. Financing and re-capitalization of corporates and SMEs: this policy is now central to the revival of activity and investment. Measures to revitalize the credit for SMEs, trade finance activities linked to international trade, creation of a development bank and development of capital markets with special reference to SMEs.

2. Upgrading and training of manpower at the intermediate and higher education responding to needs of companies in technical personnel, using dual education systems similar to vocational training in Germanic countries. This policy should use resources used so far in inefficient training programs and requires a joint initiative of the Ministries of Education, Employment and Economy.
3. Upgrading and development of entrepreneurial and managerial skills. One of the serious problems the country is the quality of management of many businesses, particularly SMEs. Various training programs should be undertaken in close collaboration with the best management colleges. Also effective could be a "Twinning technical-assistance" program with experienced entrepreneurs (some retired) of Germany, the Netherlands and Sweden.

4. Continue and strengthen efforts to expand exports and internationalization of enterprises, particularly SMEs: studies show that the success of exports of countries like Germany is based on a relatively small number of large and medium-sized companies that have productivity higher than the average of the economy and are more innovative. However, these companies have a large number of local suppliers that are usually of a smaller dimension. Portugal still has a very small number of large exporting companies as well as medium-sized companies that can make the leap to export. Besides programs for increasing productivity and innovation further effort should be made in the promotion and exploitation of foreign markets, especially to penetrate emerging markets, but without forgetting traditional EU markets, with lower costs of penetration. To reduce the fixed costs of penetrating these markets the Agency for External Trade and Investment should encourage setting-up trading companies who act as aggregators of exports to SMEs, like the Asian countries.

5. Research and Development and innovation frontier. The country is in an intermediate level of development among developed countries. To access the group of most developed countries an effort is required to develop endogenous capacities at the technological frontier. There are some success cases in IT and agribusiness and opportunities in life sciences. However, it is necessary to enhance and expand these capabilities for innovation. It is important to restructure public research institutions and laboratories to align them with a strategy to develop the competitive potential of the country, enhance joint research with companies, use applied research to solve concrete problems of enterprises, and increase international networks. These programs should develop the system of research and innovation extension to SMEs.
Korea has been the country with the most successful convergence process in the last fifty years. One of the core policies behind that sustained process has been the continuous improvement in technological capabilities of the country. Four different stages were pursued. The first, from the 1960s to half of the 1970s was characterized by the export-led strategy of growth with large imports of capital goods embodying developed technologies. Exports were based on textiles – clothing represented about 30% of exports in early 1970s – and other low-tech goods. It founded the Korean Institute of Science and Technology and several institutions to promote the infrastructure of technology and human capital. A large number of graduates had started to study in top US universities. There was little investment in R&D (.5% of GDP), provided mainly by the state, and the leading manufacturing firms were dedicated to assembly and packaging. Besides transfer of foreign technology through equipment, most of the progress was achieved by learning-by-doing.

In the second stage, from mid-1970s to mid-1980s, most of the progress achieved by firms relied on imitation and reverse engineering. They started to invest in licensing foreign technology and contracts for technology transfer and know-how with multinationals installed in the country. Public R&D expanded to 1.5% of GDP with close public-private cooperation. Exports moved to electrical equipment: in the mid-1980s electrical equipment had overtaken clothing as the main export, with 15% each.

In the third stage, from mid-1980s to mid-1990s convergence proceeded rapidly with the large enterprises starting to invest in local R&D with specialization moving to industries with medium-high technologies (consumer durables, TV and media equipment) as well as production of chips and automobiles. R&D increased to further to 2.4% of GDP by 1994 with impulse from private firms. The fourth stage from mid-1990s to the present saw the intensification of the efforts of leading large firms (chaebols) in improving technologies with the intense competitive pressures coming from China and other emerging economies. As Korea approaches the world technology frontier the model of creative technologies becomes more important and has demanded increasing levels of R&D. Korea became one of the countries in the world with the highest share of R&D over GDP and with a largest share of private sector. The structure of exports changed again with cars taking 15%, electrical equipment close to 30% and clothing had almost disappeared.

In the present era of globalization, with open markets highly competitive, the only way for firms to survive and grow is to move up the value-added scale by improving technology and product quality and design. In the case of Korea, the front runners tended also to generate new industries that have also higher value-added. The experience of Korea also shows that foreign multinationals that have branches in the country were unable to sustain continuous technological upgrading, since they usually locate in developing countries to exploit lower costs or a large consumer market. Another lesson is that industries may need to start by simpler tasks (e.g. assembly) and then move gradually upstream by imitation, learning-by-doing, licensing and joint ventures.
The Chinese experience is not very different. E.g., semiconductor firms in Korea and Taiwan started from integrated circuit testing and packaging than moved to fabrication and later to designing.

Korea’s exceptional economic success over the last half century has few parallels and has been driven by strong accumulation of human capital (especially graduate engineering and sciences) and in no small part by a firm commitment to innovation. Among its strengths, Korea has one of the highest rates of spending on R&D in the world, much of is performed by private firms. At the beginning of the 1980s Korea was filling 50 US patents per year, similarly to a number of Latin American countries. By the 2000s it had jumped to 5000 patents, while no Latin American country had more than a thousand. It also has a highly educated labour force – as signalled by its impressive PISA performance and exceptionally high rates of tertiary level graduation – with a strong interest in science and technology. The core difference between East Asian model and the Washington Consensus was that while the first emphasized technological capability and technical higher education the second emphasized resource allocation through trade liberalization and other instruments. We believe that both are important but the second is not a sufficient condition for growth.

However, a number of bottlenecks persist that hamper Korea’s economic convergence with the leading OECD economies. These include a relatively weak SME sector and weak performance in services, as well as lagging capacities to conduct leading-edge research in many areas. Furthermore, Korea faces numerous threats in the mid-term, notably increased levels of competition from China and other newly-industrialising economies, the lowest fertility rate in the OECD and an ageing society, and a continuing high dependency on imports of natural resources, particularly hydrocarbons. In the shorter term, the economic crisis offers its own challenges, with the need for some policy adjustments to deal with expected falls in business investment in R&D and growing levels of unemployment among the highly skilled.
Improving productivity and innovation-diffusion is the most important policy for increasing the growth potential of any economy. Productivity in Portugal has been almost stagnant for over a decade, the aggregate level, although there is progress in some industries. The Battle of productivity requires a wide range of corporate restructuring, improving production processes and small innovations that have to cover the entire production chain and complementary services effort. To facilitate this process will need to develop enabling policies (professional and educational improvement) as well as oriented to solve the bottlenecks and market failures sectoral policies, as well as investment and human capital development (design and technology) targeted at certain sectors and regions.

Potentiation of endogenous comparative advantages: Building an efficient innovation system (national innovation system), following international best practices, mapping technology scenarios and defining targets for future science and technology policy. Define a set of investment policies, fiscal support and credit support for R & D, and the creation of markets to develop these endogenous capacities, similar to what is best internationally. Competition policy and market development: a new law is not enough, there must be a body of judicial decisions to deter companies from restrictive practices; Competition policies in key sectors such as communications, energy, fuel, financial services and transport; Economic regulation must be effective and pressure regulated to increase productivity and quality of services, which should translate into reduced costs for businesses.

Complementary initiatives such as revitalizing urban centres: The revitalization of urban centres, starting with downtown Lisbon, may be not just a "flag" of hope and vitality, how revive the effort investment, modernization of services and to attract more investment and foreign tourism. These programs have played in many countries an important role in boosting growth at regional and national level.

Creating incentives for investment in the framework of the Single Market: more important than supporting the lending process from external sources, would be foreign direct investment and technology transfer of the most advanced European countries such as Germany, France, Netherlands, Sweden and UK. To attract FDI, and given that the country cannot devalue to improve competitiveness, we need to build some regimes of exception to the rules of the single market. In particular, could be created tax incentives or temporary subsidies schemes for those investments in Portugal (and Greece) while they are in crisis.

Restructuring of private (and insolvency) debt: The success of Sweden and Korea in contrast to Japan show how quick and resolute solution of ill-standing impairments and credits attributable to the private sector are key to boosting growth. Once the necessary reforms of insolvency proceedings are undertaken (as in Portugal) complementary measures that make it more effective are required: separate the process of business failures due to cases of extreme and unpredictable shocks from frauds and corporate corruption, separate cases of liquidity gaps from structural insolvency. Facilitate the transfer of resources from less to more productive firms by speeding the closure of inefficient firms, lending for tying up liquidity shortages and reward good entrepreneurship.

Structural reforms are not made, are always unfinished process. Because it is a process of "learning by doing" beset with trials and errors require constant monitoring and realignment. And, the European economic and global dynamics are constantly changing, requiring
readjustment of the productive structures to the competitive advantages that the country faces and can create, move up the value chain.

It is no great surprise that the countries with the highest rates of innovation performance, as defined by the European Commission are also countries with the highest GDP per capita — after all they are in the global technological frontier. The highest ranked countries are Switzerland, Sweden, USA, Finland, Netherlands, Denmark and Germany (Figure 1), closely followed by the UK and recent up-comers Korea, Ireland and Israel, all ranked by the Innovation Performance Index of the European Commission and Global Innovation Index of Cornell University. Among the countries with an intermediate rank are Spain, Italy, Portugal and Greece followed by some Central European and Baltic advanced transition countries. China is a fast rising star that according to the Cornell index is already in the intermediate group. The rest of the Brics as well as Southern Eastern European countries are in the lower ranks, among the top 40 countries.

Figure 1: Innovation Indices

Figure 2 presents two of the most well-known indices of innovation and creativity indices. There is a high correlation between the two. The countries with the highest scores are the Nordics, Switzerland, Germany, Netherlands and Belgium. Other group of countries with a high level of creativity but not yet among the highest innovators are Korea, Japan and Israel.

Among the countries with an intermediate level of both indices are Portugal, Greece, Spain, Italy and some of the advanced transition economies (Slovenia, Estonia, Czech Republic and Hungary).

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2 Excluding countries rich in oil and gas or natural resources.
3 See European Commission (2014).
4 See Cornell University (2014).
5 The regression coefficient between the two indices is .821.
At lower level are Romania and Bulgaria, at creativity level comparable with India, Turkey and already surpassed by China.

Figure 2: Innovation and Creativity Indices

Portugal is the country of the EU with the highest growth rate of the Innovation Performance Index in 2006-2013, particularly in the 2006-2010 years after the enactment of the first technological plan. At global level is China. Analysing the factors behind the performance of the innovation capacity of the crisis countries and the best of the EU, Figure 3 illustrates the eight factors computed by the European Commission. For Portugal, the most restrictive factors are human resources (HR), due to the traditional low level of tertiary education outputs, followed by business investments in R&D (INV) and intellectual assets (HK) embodied in patents, trademarks and designs. In contrast, Sweden is the EU highest ranked country. The high performance of the Swedish system is due to the interplay between large multinationals, industrial policy, university research, dynamic public sector organizations and banking sector. Sweden is particularly strong in General and Business R&D, venture capital, triadic patents, scientific publications, new-to-market product innovations, firm collaboration, and S&T human resources.

Ireland is also among the innovation leaders largely as a result of leading technological multinationals that moved to the country in the 1980s and 1990s (pharmaceuticals and computer software). Greece is close to Portugal with the most constraining factors: finance of innovation and patent applications. OECD data shows that the level of venture capital in both

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7 OECD (2013).
Portugal and Greece is among the lowest in that group of countries: Portugal has a share of .01% of GDP, Greece half of that in contrast with Israel .36% of GDP and USA with .17%. It should be remarked that both Greece and Portugal have a substantial diaspora of scientists that could potentially contribute to the development of the country.

Figure 3: Innovation Performance Index components

The 2014 Report on Innovation by OECD highlights that R&D is also under an intense process of globalization with the formation of national, regional and global research networks, sometimes linked with global value chains. A fact seldom emphasized is that for the Central Eastern European countries that are making rapid progress in the R&D scales are largely fed by multinationals that set up operations in those countries. The share of foreign-affiliated R&D in total business R&D was 71% in Ireland in 2011, and was above 55% in Belgium, Israel, Czech Republic, Austria, Hungary and the UK. (OECD, 2014, p. 43). Except for the Nordic countries, including Netherlands, which have already a significant history of R&D and a top-notch framework for innovation, no other small country in Europe has achieved a significant level of business R&D without the contribution of multinationals – this shows how important nowadays are the two factors we referred above: global networks and value chains. How to attract those multinationals with intensive S&T is thus a major component on any strategy for innovation policy.
What types of innovations predominate in Portugal and other crisis countries? According to OECD data, more than 90% of all large enterprises in Germany, Estonia and Israel have innovated in the 2008-2010 period. Portugal, Austria and Belgium also rank at the top with more than 86%. The combination of simultaneous innovations (product, process and marketing and organizational innovation) predominates in these countries. The countries with a lower share were UK, Slovenia and Japan. The picture is different when we consider SMEs, with a much lower share in all countries. Germany and Israel are quite ahead of all the other countries with more than 75% of SMEs reporting some type of innovation, followed by Portugal, Belgium, Sweden and Ireland with more than 58%. At the bottom are Poland and Hungary. Once again the combined innovations predominate.

Other interesting results\(^8\) are: (i) innovations resulting from R&D predominate in technologically more advanced countries (Netherlands, Belgium, Sweden, Finland and Korea), while non-R&D product innovation (like imitation) predominate in the technologically less sophisticated countries (Brazil, Turkey). However, France and the USA have a balanced source of innovations. Portugal, Italy and Spain occupy an intermediate position; (ii) while Germany has a more active manufacturing sector in innovation, in countries like Portugal and Denmark the services sector supplants the others.

\(^8\) OECD (2013).
Aggregate data has shown that Total Factor Productivity (TFP) is the major driving force of GDP growth. Development accounting has shown that it represents about 50 to 70 percent of country income per capita differences. However, as Mateus (2014) has shown, these estimates are quite sensitive to the inclusion of human capital and there is substantial endogeneity between accumulation of human and physical capital and TFP. E.g. it is hard to comprehend how labour productivity can increase without more and better schooling of the labour force. For Portugal the accounting shows distinctive results: in the period of 1955-1990 physical capital contributed with 47%, a much higher contribution than in most EU countries,

9 See Hsieh and Klenow (2010) and Mateus (2014). The remainder is explained by human capital (20-30%) and physical capital (20%).
human capital contributed with 23% and the residual factor with 27%. Figure 6 reports average annual growth rates for OECD countries with raw labour and physical capital. The countries with the highest growth in TFP were Korea and Ireland for the period 1985-2009. Portugal had a growth rate about the average. Italy, Canada and Switzerland had the lowest growth rates. Since the mid-1990s the growth rate of TFP has been negative, largely due to a massive misallocation of resources and major macroeconomic disequilibria. This result is not difficult to understand since the growth rate of labour productivity was close to zero and there was a significant increase in both human and physical capital.

Based on a sample of about one thousand firms, Faria (2001) estimates a technological level of inefficiency of 31% among manufacturing firms in Portugal, using a stochastic frontier model. The rate of adoption of an advanced flexible production technology was only 23% around 1990 in contrast with 75% of American and 58% of Canadian firms. The sectors with the highest rates of adoption were electrical and non-electrical machinery and textiles, clothing and shoes, followed by food and beverages.

The most widely used model of the impact of innovation on productivity at the firm level is the CDM model. We are not aware of any studies for Portugal, however there have been several studies applying the model for EU countries. Conclusions for European firms are that (i) innovation is more intense in highly technology or knowledge intensive sectors. The elasticity of output with respect to the innovative sales share is .26 to .28; (ii) for the remaining sectors

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10 Mateus (2013)
11 See Hall (2011) for a recent survey.
in Western Europe the elasticity is between .09 and .13; (iii) for developing countries and the services sector this elasticity is usually below .09. In a typical Western European firm doubling the share of innovative sales increases revenue productivity by 11 percent. Another result is that product innovation usually generates a larger impact on productivity than process innovation.

Productivity increases due to two main processes. (i) accumulation of production factors embodying improved processes or new products in physical capital or workers with more knowledge of technical tasks, (ii) resource reallocation from less to more productive sectors or firms. In a dynamic context it is difficult to distinguish the impact of each one: e.g. assume a distortionary tax that reduces allocation in a more productive industry, at the same time it will also reduce investment in both physical and human capital. But the emphasis on policies are quite different: an education policy for improving worker skills is an example of the first, while reducing tax or import tariff dispersion will be an example of the second. A study by Hiesh and Klenow (2007) using a monopolistic model of heterogeneous firms a la Melitz computed that if China approached the US in its distribution of firms by revenue marginal productivity in manufacturing it would increase its Total Factor Productivity by 30-50% and India by 40-60%. Is this large or small? To reach the level of TFP of the US China would need to increase the level of 2010 TFP by a factor of 2.5 to 3, so the improvement in allocation would not represent more than around 20% of that gap.

Recent research by Haltiwanger and others (Foster et al. (2005)) has found that a large part of the innovation and productivity growth is due to the entry of new firms.

Closely related with the innovation activity is the business dynamics captured by the creation and exit of enterprises (Figure 7). Portugal has entry and exit rates comparable with other OECD countries, although these rates are pro-cyclical.

Figure 7: Rates of net creation of enterprises

Source: Eurostat
Figure 8 shows a very severe impact of the 2012 recession, one of the most severe in Portuguese economic history, on the closing of incorporated enterprises.

Figure 8.1: Entry and exit of incorporated enterprises by capital

![PT: Demographics of Enterprises](image)

Figure 8.2: Number of incorporated enterprises created and closed

![Net creation](image)
The traditional concept of R&D and Innovation has been reformulated in order to catch the process at firm level. One of the avenues pursued in the UK by NESTA,\(^\text{12}\) is to use the concept of investment in intangibles that is nowadays part of all balance sheets.

According to NESTA estimates investment in innovation in developed countries contributes 20 to 30% to GDP growth (Figure 9). However, R&D represents only 12% of the contribution of innovation to economic growth (Figure 10). Design, organizational improvements, training and skills

\(^{12}\) See Mason et al.(2009) and NESTA (2009).
development, software development and advertising and market development contribute equally and even in larger amounts to innovation. We adopt this larger concept in the present paper.

2. DEVELOPING THE NATIONAL INNOVATION SYSTEM

The National Innovation System (NIS) is the complex of agents, resources and networks that generates and expands knowledge in order to produce innovations, i.e. generates inventions that are then developed into new products, processes or technologies in the economic activity.\textsuperscript{13} The system concentrates on innovation and technology development. The actors involve enterprises, universities and research institutes that act and are conditioned (incentivized) via government policies and market relationships. The triangle in Figure 11 tries to capture the three main factors that determine the operation of the national innovation system.

The first is the Business Environment: factors influencing enterprise creation, growth and exit; contract enforcement and the all judicial system that influences the life of enterprises; geography; economic integration; banking and capital markets and competition: level-playing field. These factors have been generically been captured by surveys like the Doing Business of the World Bank.

Figure 11: National Innovation System

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\textsuperscript{13} See OECD (1997)
The second factors are the trade, tax and regulatory environments: they establish the game rules of the market place defined by the exposure to the global market and government policies like tax, regulatory and competition policies. Access to open networks is also essential.

The third type of factors relate specifically to innovation policies: education at different levels, research and development, transfer and diffusion of technology, including extension services, and entrepreneurship.

The following taxonomy of innovation policies (Table 1) is useful and distinguishes between provision of public goods and market interventions as well as between horizontal policies that are general policies directed at all sectors, and vertical policies that are directed at a given industry. Among general public goods generally supplied by the state is education and training or laying down the legal framework for property rights. These types of policies are the less distortionary. The state can also establish and fund technological institutes, but they always have to specialize in a given sector and built at a particular location which implies choosing industries and regions. Being selective they always represent a distortion in resource allocation. Instead of supplying public goods the state can intervene directly in the markets by enacting R&D subsidies or tax credits as an horizontal policy or procuring a special type of good or service, like the US Defence Department does in launching a project for building the next generation fighter plane. In the last case it also entails a market distortion.

Table 1: Taxonomy of innovation policies

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<tr>
<th>TYPE</th>
<th>HORIZONTAL</th>
<th>VERTICAL</th>
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<tbody>
<tr>
<td>PUBLIC GOOD</td>
<td>Supplying education, training, support to scientific research, ensuring property rights, creating research infrastructure, attracting human capital, competition and regulation policies</td>
<td>Technological institutes, standardization, financing to specific sectors, technological consortia</td>
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<tr>
<td>MARKET INTERVENTION</td>
<td>R&amp;D subsidies, tax credits to R&amp;D, subsidies for technological adoption, guarantees and financing of technological investments</td>
<td>Procurement, incentives to strategic sectors, incentives to general technologies, defence procurement and manufacturing</td>
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Figure 12 illustrates the type of actors that nowadays generate most of the innovation. First, researchers working in universities, technological institutes and laboratories, that developed a particular product, service or technology, can enter in the process of start-up, early stage, expansion and late stage of innovation. The same process is also travelled even more frequently by individual entrepreneurs. Incumbent enterprises (corporations, SMEs, NGOs or administrations) are also a major source of innovation by developing new products, services or technologies, or incorporating technologies from other enterprises or abroad, or by simple learning-by-doing. It is also important to recognize collaboration among all these agents and networks of agents that can also contribute to innovations.

Figure 13 captures the most common indicators of the inputs of innovation policies: on the vertical axis the expenditures on R&D by the business sector, as a percentage of GDP, on the horizontal axis the number of researchers per capita. The statistics for Portugal\textsuperscript{14} show a number of researchers at par with countries intermediate to high level of GDP per capita and technological level, but a level of business expenditures comparable with countries with low intermediate levels of GDP and technology. This pair signals already a recurring theme in this paper, the low productivity and efficiency of the NIS in Portugal. It is enlightening to compare it with countries like US, Germany and Korea.

\textsuperscript{14} For a description of the Portuguese NIS see the country reports at Erawatch.
SWAT analysis of the Portuguese NIS

We start the analysis of the Portuguese NIS by carrying out a SWAT analysis (Table 2). The most relevant strengths are EU membership and openness to global markets as well as excellent transport and communication infrastructure. Opportunities are its geographic situation, one of the largest diaspora relative to the domestic population and its relationship with Portuguese speaking countries.

Table 2: SWAT analysis of the Portuguese NIS

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
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<tr>
<td>- EU Membership and free access to the largest world market</td>
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<td>- Inflow of large structural funds</td>
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<td>- Good framework for innovation</td>
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<td>- Openness of the economy</td>
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<td>- Good level of doctorates and pockets of good skilled S&amp;T graduates</td>
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<td>- Excellent transport and communication infrastructures</td>
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<td>- Macroeconomic equilibria re-established</td>
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<td>- Globalization and geographic situation</td>
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<td>- Diaspora: 20% of population living abroad</td>
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<td>- Member of the Portuguese Speaking Countries commonwealth, with links to Brazil and Africa</td>
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<td>- Good entrepreneurship tradition</td>
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<tr>
<td>Weaknesses</td>
<td>Threats</td>
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<tr>
<td>- Firms, households and State with high leverage</td>
<td>- Aging population</td>
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<tr>
<td>- Low levels of human capital</td>
<td>- Caught between high-tech industries of more advanced EU countries and low-tech of Eastern Europe, North Africa and China</td>
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<td>- High tax rates</td>
<td>- Competitiveness threat of Eastern Europe</td>
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<tr>
<td>- Moderate levels of competitiveness</td>
<td>- Brain drain</td>
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<tr>
<td>- Low level of vocational training</td>
<td>- Low level of research international connections</td>
</tr>
<tr>
<td>- Low level of R&amp;D by enterprises</td>
<td>- Lack of commercialization of innovations</td>
</tr>
<tr>
<td>- Lack of university-enterprises linkages</td>
<td>- Lack of technological extension</td>
</tr>
<tr>
<td>- Lack of laboratories-enterprises linkages</td>
<td>- Lack of risk capital</td>
</tr>
<tr>
<td>- Lack of research international connections</td>
<td>- Low level of research international connections</td>
</tr>
<tr>
<td>- Lack of commercialization of innovations</td>
<td>- Lack of technological extension</td>
</tr>
</tbody>
</table>

The weaknesses are the high level of leverage of all economic agents, high tax rates and low level of human capital. More specifically, relative to the NIS is the low level of enterprise R&D, lack of linkages among potential innovation agents, lack of insertion in international networks, lack of orientation of applied research to increasing competitiveness of the economy and lack of commercialization of research, low level of risk capital and finally lack of technological extension services to SMEs.

Finally, the threats come from being caught between the low and high technological levels of Eastern Europe, North Afric and China versus the more advanced European countries, aging population and brain drain.
Governance of the NIS: coordination mechanisms for science, technology and innovation

The Portuguese research system is still marked by a high degree of centralization, both in fund allocation and political coordination. The formal structures for hearing the main stakeholders are seldom used, and the country does not undertake multi-annual planning, with national R&D budgets being announced annually together with the preparation of the national government budget.

One of the two highest bodies steering the NIS is the National Council for Science and Technology - Conselho Nacional de Ciência e Tecnologia (CNCT).\(^\text{15}\) It is headed by the Prime Minister, comprising 20 personalities (university professors) and meets once a year. Its mission is to advise the Government on science and technology matters, priorities for policies, internationalization of science and coordination of policies of science, technology and innovation. It is supported by Ministry of Education and Science and Ministry of Economy. The other is the National Council for Entrepreneurship and Innovation - Conselho Nacional para o Empreendedorismo e a Inovação (CNEI)\(^\text{16}\) – also presided by the Prime Minister, and its mission is to advise the government in issues related with entrepreneurship and innovation, and to execute the strategic plan +E+I. It is also comprised of 20 personalities and meets once or twice a year. These two bodies are purely consultative and as we saw seldom meet. At the second level there are: Ministry of Education and Science with several advisory councils (Higher Education and Science and Technology) and consultative councils (Heads of Universities and Technological Institutes); Ministry of Economy with a consultative council (Competitiveness and Industrialization) and with executive power over some of the laboratories (LNETI); Ministry of Public Works also with executive power over some of the laboratories (LNCE), among others. The financial arm for allocating financial resources to research is the Science and Technology Foundation: Fundação Ciência e Tecnologia.

Let us review some of the best practices around the world. In Finland, the Research and Innovation Council is composed of representatives from the Ministry of Education and Culture and the Ministry of Employment and the Economy and is chaired by the Prime Minister. It seeks to promote economic development, strengthen business and industry, disseminate new knowledge, and augment the knowledge base. As an advisory body to the government, it tracks developments in R&D and S&T more generally, including the impact of those developments on Finland. The Council is credited with important initiatives. Finland has also several government organizations that analyse market trends. Tekes, Sitra, and the RIC keep apprised of technological, economic, and societal developments that could impact the nation’s economy.

In Israel the Office of the Chief Scientist has the following tasks: (i) funding R&D projects for up to 50%, and repayable only if successful, (ii) give the status of high-technology firm with fiscal benefits, (iii) small staff of highly qualified VC and tech specialists to advise industries and build networks, (iv) create public-private partnerships with R&D public institutions to encourage more responsive, industry-oriented behaviour, with matching 1:1 grants; and (v) build

\(^{15}\) Established by Resolution of Council of Ministers 47/2011 of November 15\(^{\text{th}}\), 2011.

\(^{16}\) Created by Resolution of Council of Ministers 55/2011 of December 16\(^{\text{th}}\), 2011.
international partnerships in technological development (with support from a Foundation - BIRD).

In 2001 Japan set-up the Council for Science and Technology Policy (SCTP) headed by the Prime Minister, comprising the Ministers of State for Science and Technology, Finance, Economy and Education, and seven members of universities and academia and the President of Science Council of Japan, a large organization grouping more than 2,000 scientists. It sets policy in Japan. It has 7 panels. For a strategic and prioritized promotion of science and technology, the CSTP presented in September 2001 a “Promotion Strategy for Eight Prioritized Areas”: Life sciences; Information and communication technology; Environmental sciences; Nanotechnology/materials; Energy; Manufacturing; Technology; and Frontiers (outer space and the oceans). The CSTP also issued guidelines and recommendations to encourage, improve and coordinate the S&T policies of the relevant ministries: Strategy on management of intellectual property, Promotion of business-academia-government collaboration, Basic policy for space development, Promotion of R&D for biotechnology, Promotion of the ITER (International Thermonuclear Experimentation Reactor) project, among others. Japan places a lot of effort to identify the upcoming technological trends by drawing on interactive surveys and discussions involving scientists, engineers, policy makers and people from industry about likely future technological developments (Delphi method).

In the USA the Office of Science and Technology Policy (OSTP) was started in 1976, by Congress, growing out of the Office of Science and Technology formed by President John F. Kennedy in 1961 advises the President and others within the Executive Office of the President, on the effects of S&T on domestic and international affairs.

As we see in all these cases there is a centralized body with advising and also executive functions. In several cases this body is also in charge of funding R&D. There are pros and cons of centralizing the executive function of implementing the science and technology policies or splitting it by the different ministries. There are also pros and cons of separating the execution and funding functions. Whatever is the design there is a need of more coordination and leadership in an integrated policy. It is also important to integrate science and technology with innovation into a single NIS.

The creation of the two Councils in Portugal has been an important initiative. However, it is suggested that the Councils meet at least every quarter. However, there is a need to give “teeth” to those bodies, by: (a) enhancing their executive and coordinating power, (b) using the Councils to define, approve and monitor strategic plans in the areas of science, technology and innovation. These Councils also need to be complemented by (c) an Executive Committee to implement, monitor and execute the initiatives approved by the Councils, (d) create industry-centred groups for forecasting technologies and define technological scenarios.

Thus, we recommend that the Portuguese government endows current science and technology policy councils to have more competences, with some executive and enforcing power, similar to other national institutions, namely, to (i) promote science, technology and
innovation policies in the country and with bilateral or multilateral world research networks and institutions, (ii) coordinate research institutions and strengthen links with enterprise networks, and (iii) speed up innovation and technological development to improve economy competitiveness.

A possible chart of organization of the NIS is in Figure 14. The creation of the Science and Technology Council possibly headed by the Chief Economist would assume the executive functions discussed above. There is also a need to strengthen the relations of S&T innovation with clusters of SMEs.

Figure 14

3. REGENERATING UNIVERSITIES AND LARGE LABORATORIES AND INTEGRATION WITH ENTERPRISE DEVELOPMENT

3.1. REGENERATING THE TERTIARY LEVEL (HIGHER AND VOCATIONAL) EDUCATION

The role of Tertiary Education is crucial for (i) preparing the scientific and technical capacities of future generations, and (ii) preparing the skills and qualifications of the labour force. Transmission of knowledge and training for the market place at the higher level are the two dual aims of Universities, Polytechnics and other specialized institutions of higher education from artistic to other cultural areas.

Starting with the first mandate of the system, the first point to make is the large expansion that occurred in the 1990s and up to now. From 4 public universities in the late 1960s,
Portugal expanded to 18 universities in the 2000s. The number of graduates more than doubled between 1995 and 2013: from 39 to 98 thousand per year. The tertiary attainment rates increased from 13 to 28% for the 25-34 years old, in the period 2000-2012, jumping from 50 to 70% of the OECD average: a remarkable increase despite the low initial levels of education. Within these aggregates, graduates from polytechnics expanded from 14 to 28 thousand in the same period.

There is a problem with the quality of the output. There are no international standardized tests for these graduates so it is difficult to measure objectively the knowledge and skills acquired. There are departments of international reputation in some areas, mainly in the three major cities, but a large number of graduates have neither the required qualifications for the job market with the diploma that they obtained, nor the general aptitude to adapt to a job offer of high qualification.

A second problem is with the Polytechnics. Although have been created to provide vocational training, the recent reforms have turned them into “second rate universities”. In the USA they are more like technological colleges as in Denmark and other European countries. The third problem is the quality of the curriculum, the qualification of teachers and the cursus taught in a number of universities is not up to present standards or required preparation of a student in a globalized world. This is a result of the explosion of doctorates that occurred in Portugal in the last 20 years. Finally, there is no autonomy of the universities, rigid salary structures across all public universities and not enough labour mobility and contestability among professorships. These problems are common to most of the European systems.

Several reforms have been undertaken like a national exam for university entry and numerus clausus fixed administratively. This has led to a stratification of universities according to the grade for entry and an obvious “rating” by the market for students. Although this was a very positive development to introduce competition among universities to get the best students, it was not followed by other reforms needed to make the system more efficient.

How do Portuguese universities rank in global rankings? In the Shangai technical universities rankings Portugal has 1 university in the top 300 (Lisbon), 1 in top 400 (porto) and 1 in top 500 (Coimbra). When normalized by population, Portugal ranks in the 22nd place among 40 countries with universities in the top 500 for 2014 (Figure 15). In the FT rankings of Business Schools in Europe, Catolica Business School ranked 23rd and Nova Business School 28th in 2014. The Lisbon MBA is ranked 36th by FT in the world.

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17 2 public (UNL, Lisboa), 4 Private (Catolica, UAL, Lusiada, Lusofona) in Lisbon, 1 Public in Coimbra, 1 Public and 3 Private (Catolica, Pessoa, Portucalense), and 7 regional public universities in Aveiro, Minho, Evora, Algarve, Tras-os-Montes, Azores and Madeira. These are the main universities, but overall, Portugal has 13 public universities and 15 public polytechnics. The private sector has 15 universities and more than 100 specialized schools.

Thus, both in terms of teaching excellence and research Portugal has good global level science and technology, medical, economics and business schools in Nova, Catolica, and public schools of Porto and Coimbra. However, other departments and most of private and regional schools are of at a distance, when considering both qualifications of teachers and grades of entry of students.

Despite progress in expanding tertiary education and the high level of reputation acquired by some departments, there is still a vast majority of the system that needs to improve its efficiency. The policies required are based on the notions of autonomy, evaluation and accountability, competition in obtaining resources, training for the market place and public-private partnerships.

The American university system is recognized as the most efficient at global level. It is founded in the following pillars\textsuperscript{19}: (i) relatively large salary scale, (ii) active inter-university market: departments with autonomy and financial resources to hire and retain academic talent, (iii) scholarships for research given by the National Science Foundation on a merit system and peer review, (iv) tenure system of professorships-researchers, after a probatory period of 6 to 9 years, following a rigorous and open selection process, (v) links between universities and industries, namely by the award of IPRs and consulting activities, (vi) important financial resources, public and private, with autonomy to administer them.

In Portugal, all public institutions are subject to a rigid salary scale and only recently, with the introduction of research grants and the possibility of consulting, some universities have been able to pay higher remunerations. Administrative autonomy is still

\textsuperscript{19} See Aghion et Cohen (2004), pg. 98.
Several studies carried out by Aghion and collaborators\textsuperscript{20} have shown empirically the main factors of success, measured e.g. by salary increases or patents, for an institution of tertiary education in the US or Europe. They show that autonomy and competition are positively related with output, that public universities produce better results when they compete with private universities and that recurring participation in merit-based competitions for research funding hones research capabilities.

Despite some progress, resource mobilization by public and mainly private sources remain one of the limiting factors for improving performance of universities. No European country comes close to mobilize the same resources to finance universities than USA (Figure 16). Denmark, Sweden, Norway, Netherlands and Finland are the ones closer. At tertiary level Portugal spends 74.8\% of EU average (and 35\% of USA), similar to Italy and Eastern European countries. One of the main problems in Portugal and most of Europe is the low level of financing of private sources. In Portugal only Catolica and Nova business schools attract a significant level of private resources. Tuition fees are extremely low and do not adequately translate the quality of education, or the expected increase in lifetime wage of students. Private universities do not receive also an adequate state subsidy and have much lower endowments than public schools, relying in higher tuitions.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{Figure16.png}
\caption{Financing of Tertiary Education: resources in Euros-PPP per student (2011)}
\end{figure}

\textit{Source: Eurostat}

Thus, the other traits of the American system are still lacking, mainly in terms of autonomy, the large salary scale financial resources to attract the best talent that usually stays in foreign universities. There is also a lack of an active inter-university labour market. Tenured faculty has low productivity and there is extremely low mobility of non-tenured faculty. Although the

\textsuperscript{20} See e.g. Aghion, P. et al. (2009).
number of publications has increased substantially in volume and per faculty, most of those are not in the journals of highest quality.

However, the Portuguese researchers have the lowest productivity in Europe, like the Bulgarians, when measured by the number of patents registered at EPO per researcher (Figure 17). One of the reasons may be the statistical definition of researcher that in Portugal covers all university academic staff, including part of the polytechnics. Figure 18 shows that Portugal has a number of researchers in universities, per capita, higher than Germany and Sweden, and if we include Large Laboratories, higher than the UK. The problem for Portugal is the low number of researchers in Enterprises. For a large number of academic staff these funds are considered as a complement of the wage. On average they represent a remuneration of about 3 thousand Euros per month, which even in PPP is only about 53% of the German remuneration.

Figure 17

**Productivity Researchers**

Source: Eurostat and author’s calculations

Figure 18

**Researchers per capita**
(per million pop)

- Enterprises
- Public labs and inst
- University
As we noted above, given the technological gap of the country, we estimate that about 70 to 80% of technological innovation has to take place by transfer/imitation, which is a more diffuse process than in leading countries where it can be concentrated on the core institutions of research on the frontier of technology.

Polytechnics produce about 34% of licenciados, according to the latest reform, should concentrate on short-cycle (2-years) vocational training. However, most of them have tried to emulate universities with disappointing results. There is a need to reform profoundly the system to make it more integrated with enterprise and to respond to local market industrial needs. In fact, the unemployment rate for tertiary graduates has increased in the last global and euro crisis and stands in 2015 at 10%, about 3 pp below the national average. But there has been an intensification of emigration of this class, which represents a drain in human capital.

Creating an environment in the Tertiary Education System geared to Innovation and Development

Two basic reforms are required to create an environment in Universities and Polytechnics: a more competitive environment and a reward system based on merit. More specifically, institutions of Science and Technology should create Offices of Transfer/Licence of Technology, as most of the US and UK, including some leading European Continental universities have already done (e.g. in Netherlands). Its aims would be (i) to facilitate the transfer to industry of technology from the university, in order to develop it into commercially viable products and services, and (ii) to be a contact point of industry to channel requests and funds from enterprises for research projects and to motivate inventors.

The Technology Licensing Office at MIT is responsible for identifying marketable technologies, managing the patenting and copyrighting of these technologies, finding licensees to develop the technologies, and negotiating licenses. In 2014, with a staff of 29 persons, (14 licensing professionals and 15 administrative and support personnel), it generated and income of 46 Million USD, mostly from patents, 102 new technology licenses and 20 option agreements. Twenty of these were to new start-up companies. It has 650 active technology licenses in house, of which over 100 are extant start-up companies (with equity in several dozen of them). The Office is also involved with student activities at MIT. These include participating in the judging of the MIT $50K Entrepreneurship Competition, lecturing on patents and licensing in a number of engineering, health science and technology, and Sloan School courses (undergraduate and graduate), and “open door coaching” for students thinking of starting a business, whether through an MIT license or not. Members of the Office are actively involved in disseminating technology transfer and entrepreneurship policies and practices to the University of Cambridge and other UK universities as part of the Cambridge-MIT Institute program.

I am grateful to Prof. Jose A. Girão for his ideas and experiences in this section. He launched an Office of Transfer of Technology at Nova.
These Offices could centralize institutions (universities and polytechnics) at regional level to have more critical mass, and coordinate with other national offices and foreign offices.

In order to foster entrepreneurship, there should be a course at undergraduate and graduate level, in all departments of business, science and technology, including lessons on business plans, how to make a start-up, IPRs and venture capital.

3.2. RESTRUCTURING AND REVITALIZATION OF MAJOR PUBLIC RESEARCH AND DEVELOPMENT CENTERS

We have already seen above that the problem in Portugal is the low level of financial and human resources allocated by Enterprises to R&D (Table 3), which in Portugal reach only 1.2 Billion Euros. In percent of GDP, with .68%, this represents less than half of the countries presented.

Table 3

<table>
<thead>
<tr>
<th>Expenditures in R&amp;D by Sector, 2012</th>
<th>Germany</th>
<th>Denmark</th>
<th>Sweden</th>
<th>UK</th>
<th>Portugal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In Millions Euros</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GERD</td>
<td>77,835</td>
<td>7,499</td>
<td>14,436</td>
<td>39,809</td>
<td>2,712</td>
</tr>
<tr>
<td>GBOARD</td>
<td>25,750</td>
<td>2,549</td>
<td>5,019</td>
<td>13,154</td>
<td>1,551</td>
</tr>
<tr>
<td>BERD</td>
<td>52,085</td>
<td>4,949</td>
<td>9,417</td>
<td>26,655</td>
<td>1,161</td>
</tr>
<tr>
<td>High-level Education (excl. teaching)</td>
<td>14,244</td>
<td>2,382</td>
<td>3,400</td>
<td>9,391</td>
<td>1,058</td>
</tr>
<tr>
<td>Project-based</td>
<td>4,558</td>
<td></td>
<td></td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Public laboratories and institutes</td>
<td>11,442</td>
<td>650</td>
<td>1,619</td>
<td>3,763</td>
<td>493</td>
</tr>
<tr>
<td>University linked</td>
<td></td>
<td></td>
<td></td>
<td>425</td>
<td></td>
</tr>
<tr>
<td>Non-University linked</td>
<td>11,377</td>
<td>611</td>
<td>1,567</td>
<td>2,967</td>
<td>190</td>
</tr>
<tr>
<td>Large labs</td>
<td>3,600</td>
<td></td>
<td>325</td>
<td>750</td>
<td>156</td>
</tr>
<tr>
<td>Private-public institutes</td>
<td>1,800</td>
<td>483</td>
<td>0</td>
<td>1,282</td>
<td>0</td>
</tr>
<tr>
<td>Other Public institutes</td>
<td>5,977</td>
<td>128</td>
<td>1,242</td>
<td>935</td>
<td>24</td>
</tr>
<tr>
<td>Non-Profit Organizations</td>
<td>65</td>
<td>39</td>
<td>52</td>
<td>796</td>
<td>46</td>
</tr>
<tr>
<td>Of which: health</td>
<td>8,951</td>
<td></td>
<td></td>
<td>2,762</td>
<td>31</td>
</tr>
<tr>
<td>Business R&amp;D</td>
<td>52,085</td>
<td>4,466</td>
<td>9,417</td>
<td>26,655</td>
<td>1,161</td>
</tr>
<tr>
<td>Multinationals and large corporations</td>
<td>43,751</td>
<td>3,697</td>
<td>9,830</td>
<td>24,875</td>
<td>987</td>
</tr>
<tr>
<td>Top 10</td>
<td>40,400</td>
<td>2,725</td>
<td>7,566</td>
<td>13,398</td>
<td>513</td>
</tr>
<tr>
<td>SMEs</td>
<td>6,250</td>
<td>769</td>
<td>1,780</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Memo: multinationals from abroad</td>
<td>447</td>
<td></td>
<td></td>
<td>13,594</td>
<td>81</td>
</tr>
</tbody>
</table>

However, we suspect that this number is an over-estimate because there is an incentive for firms to declare expenditures as R&D since they receive a tax credit.
Particularly low is the amount spent by multinationals with headquarters in foreign countries, problem linked to the low level of inward FDI that we will study further below. Figure 19 also shows the low level of R&D, in terms of GDP, performed by SMEs. Even large corporations perform a low level of R&D, when compared with Denmark, Sweden and Germany.

Figure 19

Source: Author’s calculations based on Erawatch

<table>
<thead>
<tr>
<th>Expenditures in R&amp;D by Sector</th>
<th>Germany</th>
<th>Denmark</th>
<th>Sweden</th>
<th>UK</th>
<th>Portugal</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERD</td>
<td>2.83</td>
<td>2.99</td>
<td>3.41</td>
<td>1.95</td>
<td>1.60</td>
</tr>
<tr>
<td>GBOARD</td>
<td>0.94</td>
<td>1.02</td>
<td>1.19</td>
<td>0.64</td>
<td>0.91</td>
</tr>
<tr>
<td>BERD</td>
<td>1.89</td>
<td>1.97</td>
<td>2.22</td>
<td>1.31</td>
<td>0.68</td>
</tr>
<tr>
<td>High-level Education</td>
<td>0.52</td>
<td>0.95</td>
<td>0.80</td>
<td>0.46</td>
<td>0.62</td>
</tr>
<tr>
<td>Project-based</td>
<td>0.17</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Public laboritories and institutes</td>
<td>0.42</td>
<td>0.26</td>
<td>0.38</td>
<td>0.18</td>
<td>0.29</td>
</tr>
<tr>
<td>University linked</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.25</td>
</tr>
<tr>
<td>Non-University linked</td>
<td>0.41</td>
<td>0.24</td>
<td>0.37</td>
<td>0.15</td>
<td>0.11</td>
</tr>
<tr>
<td>Large labs</td>
<td>0.13</td>
<td>0.00</td>
<td>0.08</td>
<td>0.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Private-public institutes</td>
<td>0.07</td>
<td>0.19</td>
<td>0.00</td>
<td>0.06</td>
<td>0.00</td>
</tr>
<tr>
<td>Other Public institutes</td>
<td>0.22</td>
<td>0.05</td>
<td>0.29</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>Non-Profit Organizations</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>Of which: health</td>
<td>0.33</td>
<td>0.00</td>
<td>0.00</td>
<td>0.14</td>
<td>0.02</td>
</tr>
<tr>
<td>Business R&amp;D</td>
<td>1.89</td>
<td>1.78</td>
<td>2.22</td>
<td>1.31</td>
<td>0.68</td>
</tr>
<tr>
<td>Multinationals and large corporation</td>
<td>1.59</td>
<td>1.47</td>
<td>2.32</td>
<td>1.22</td>
<td>0.58</td>
</tr>
<tr>
<td>Top 10</td>
<td>1.47</td>
<td>1.09</td>
<td>1.79</td>
<td>0.66</td>
<td>0.30</td>
</tr>
<tr>
<td>SMEs</td>
<td>0.23</td>
<td>0.31</td>
<td>0.00</td>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td>Memo: multinationals from abroad</td>
<td>0.00</td>
<td>0.18</td>
<td>0.00</td>
<td>0.67</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Source: Author’s estimates based on Erawatch
The UK have a large level of R&D performed by multinationals headquartered abroad, particularly in the pharma sector (dominated by AstraZeneca and GlaxoSmithKline).\footnote{Which is also the case of Ireland and the Central and Eastern European countries as seen above.}

Portugal has developed in the last twenty years a set of institutions in R&D, some of them world-class, and is already considered at an intermediate stage, within developed countries, in terms of science and technology indicators. However, a major problem is to translate those capabilities in improving the competitiveness and innovation in the country. Among those institutions there are: (A) Institutions dedicated to specialized research: (i) Laboratório Nacional de Engenharia e Geologia (LNEG), mainly dedicated to renewable energies and geology, (ii) Laboratório Nacional de Engenharia Civil (LNEC) dedicated to civil engineering, (iii) Laboratório Ibérico Internacional de Nanotecnologia. (B) Institutes and centres linked to Universities, like (v) INESC of IST, (vi) Centro Neurociência e Biologia Celular da FM-UC, etc.; and (C) R&D private institutions linked to foundations (vii) Fundação Champalimaud and the centre for biomedical sciences, (viii) Fundação Calouste Gulbenkian and the Instituto Gulbenkian de Ciência also for biomedical sciences.

To increase efficiency of R&D, namely in terms of its impact on the Portuguese productive economy, there is a need of improving its interaction with the enterprise world, fill-up major gaps in the National Innovation System and intensify networking at local, national and global levels.

The major problems are: (a) Most of the R&D is not specialized in areas were the competitive specialization of the Portuguese economy lies. There is a need to extend R&D to those areas like food and agro-industries including sea and fish industries, textiles, automotive, paper pulp and forestry; (b) There is a need to follow-up major world research in areas where new capabilities for the country offer opportunities like new materials, biotechnology and nanotechnology; (c) Need to clearly identify IPR for researchers and help them to commercialize research ideas, in public and private institutions, and give incentives for commercial oriented research; (d) Need to intensify links with enterprises mainly with manufacturing and agro-industrial clusters; (e) Need to create more bi-national or multi-national research projects and institutional cooperation; (f) Need to intensify links between university research with research pursued outside the universities and both with enterprises and other institutions, (g) Need to link with entrepreneurship programs and seed-capital to intensify innovative capabilities of the Portuguese economy. We will address these problems in the following paragraphs.

Creating R&D capabilities in areas where the economy has comparative advantages:

R&D activities in the most successful countries have been tied up with current or future/endogenous comparative advantage sectors. To determine priorities for the future the NIS has to engage in prospective exercises, like using the Delphi method. Currently, the sectors where the Portuguese economy has revealed comparative advantages and with substantial innovation capacity are pharmaceuticals, IT, agribusiness, forestry, cork and paper pulp, renewable energies and automotive, among others.
Follow-up major world R&D in areas of potential comparative advantages:

Almost all developed countries are currently pursuing research funded by the State in areas like biotechnology, nanotechnology, new materials, population aging, cancer and other medical conditions and energy efficiency and green technologies. Although Portugal cannot aspire to parallel all these areas, it needs to maintain the capability to absorb major breakthroughs in these areas and mainly be capable to internalize inventions and innovations that could apply to our endogenous technologies. In fact, catching-up countries like Portugal could waste a substantial amount of resources in replicating late and in worse conditions research that should be carried out more productively in the leading technological countries. Thus, research conducted in these areas needs to be closely coordinated with the leading centres.

Intensify links between applied research and enterprises:

It is never enough to emphasize the need to put more emphasis in applied research and in close links of research with enterprise needs to solve technological problems and improve quality of products and services. This is not to say that pure research is not necessary or should be considered an inferior task, but the problem is that Portugal is still a catching-up country in terms of technology. It would be less productive to try to emulate or to replicate what the leading centres are investigating, then to build on their results and pursue applied research that could translate in innovations for the Portuguese economy.

As Aghion, P. and others have stressed again and again the institutions required in innovation for a leading technological country are substantially different from a country that is still catching-up, and it would be detrimental for countries in different categories to imitate or replicate those institutions.

Establish more bi-national and multi-national cooperation among R&D institutions:

The BIRD program in Israel is a major example of successful cases. Under Mlavsky’s leadership, BIRD became a “matchmaker,” connecting small Israeli companies that focused on R&D and technology with larger U.S. companies that focused on product definition and marketing. To this end, Mlavsky hired a competent, business-oriented staff to better understand U.S. markets, while he built relationships with U.S. companies. These in-person efforts were later supplemented by the creation of a comprehensive database to track the relevant technological interests of U.S. multinational companies. BIRD concurrently recruited Israeli scientists, many of whom worked for U.S. multinationals, to return to Israel. These researchers were often lured back to Israel by the prospect of returning “home” to their families while taking advantage of the emerging economic opportunities.

Although the Israeli government provided no formal incentives for their return, many found the prospect of helping Israel prosper enticing. Faced with the prospect of losing many of their top researchers and a host of financial incentives, many large multinationals opened subsidiary R&D operations in Israel. Important to BIRD’s success was the generous financial incentives it disbursed as part of its matchmaking mission.
Backed by its founding endowment, BIRD funds up to 50% of the total cost of joint projects between Israeli and U.S. companies. Current grants range from $500,000 to $1 million for up to 35 projects, lasting 2 to 3 years, as well as 20 annual micro-projects of $100,000 each. Similar to OCS grants, BIRD funds these projects with guaranteed loans, repayable only if the project technologies are commercialized. Loan repayment takes the form of royalties: 5% of sales of the final product, up to a maximum of 150% of the original loan. BIRD funding is also closely leveraged with other government programs and goals; multinational Israeli subsidiaries are classified as Israeli firms and therefore not only allowed to take advantage of BIRD grants but also allowed to receive R&D funding from OCS.

BIRD also focused on building and developing the operational capacity of Israeli partner firms. Although Israeli companies typically had technical expertise, they often did not have the management, systems, or personnel capacity to work with large partner companies. BIRD played this “coaching” role by first hosting seminars on how to approach and cooperate with U.S. firms and by sponsoring numerous personnel exchanges and meetings. Furthermore, BIRD built a network of finance, technology, and management experts that could work with Israeli companies to help them understand the product development and marketing processes of large U.S. companies.

OCS and BIRD, headed by capable, ambitious leaders, served as powerful change agents in the Israeli economy. Most immediately noticeable were the increasing attention and presence of large multinational companies, primarily in the semiconductor industry, an area of evolving technological and manufacturing capability in Israel. Companies such as National Semiconductor, Digital Corporation, Motorola, IBM, Intel, and others had located R&D facilities there, a trend that continued as the global demand for IT products and services grew in the early 1980s. Furthermore, BIRD and OCS played an important role in the acceleration of Israel’s entrepreneurial culture; by 1992, 60% of Israeli companies listed on the New York Stock Exchange and 75% of those listed on the NASDAQ had been supported by BIRD.

Strengthen the IPRs of researchers to incentivize entrepreneurship

One of the major obstacles to university researchers is a clear definition of the ownership of their inventions, vis-à-vis the University. The US experience is a very successful case. The University and Small Business Patent Procedures Act, or Bayh-Dole Act (1980). This act gave universities, small businesses, and non-profit organizations title to intellectual property (IP) derived from federal research funding. While universities were allowed to own this IP, technology transfer rules and regulations differed among federal mission agencies. The Bayh-Dole Act harmonized these disparate guidelines and sought to foster relationships between the academic and the business communities.

Promote entrepreneurship linked to applied research and target Venture Capital initiatives:

The case of the Massachusetts Institute of Technology is one of the most relevant to encourage entrepreneurship linked to a university:
• Established in 1945, the MIT Technology Licensing Office (TLO) pioneered a strategy of leveraging MIT IP to form companies by taking equity in lieu of royalties, as we saw above. It assists MIT inventors in protecting technologies and in licensing those technologies to existing companies and start-ups. The TLO is a department of the University, reporting to the Vice President of Research, who in turn reports to the Provost. It has a research budget of $1.2 million. Inventors share one-third of royalties after deduction of a 15% administration fee and any unreimbursed patent expenses. MIT takes royalties or, as discussed above, takes a small percentage of equity in lieu of royalties. The MIT TLO is one of the most active and successful programs in the U.S, licensing 224 new companies in just the past 10 years.

• The MIT Enterprise Forum, created by alumni in the 1970s, builds connections between technology entrepreneurs and the communities in which they reside and produces extensive educational programming about entrepreneurship. The Forum currently has 24 chapters worldwide, including one in Russia as of June 2010.

• In the 1990s, the MIT Entrepreneurship Centre launched nearly 30 new courses across MIT on entrepreneurship and helped to create student entrepreneurship clubs. This effort has been credited with strengthening the network between students and nearby entrepreneurs and venture capitalists, ultimately leading to new company formation.

• In 2000, the Venture Mentoring Service was created to support any member of the MIT community who was considering launching a new venture. As of 2009, 88 companies had been formed through this service.

• In 2002, the Deshpande Centre for Technological Innovation was founded as part of MIT’s School of Engineering to provide research grants to faculty with commercially promising ideas. This initiative offers financial support to a university professor, rather than seed money to a business that has already produced a prototype of a product. This is being termed a “proof-of-concept centre,” as opposed to an incubator. Jaishree and Gururaj Deshpande donated $17.5 million to create the Centre. It has an annual budget of about $1.7 million, with $1.3 million for grants, $320,000 for administration and staff, and $80,000 for operational expenses. The Centre provides up to $250,000 per project through biannual rounds of grant proposals and two types of grants: Ignition Grants (up to $50,000) for exploratory experiments and proof of concept and Innovation Grants (up to $250,000) to fully develop the innovation. It has funded over 64 projects and awarded over $7 million in grants. There is an 18% approval rate of proposals. Spinoffs have acquired $88.7 million in private capital.

• MIT Media Lab. The MIT Media Lab is a department within MIT’s School of Architecture and Planning that was opened in 1985 by MIT Professor Nicholas Negroponte and the late Jerome Wiesner (former science advisor to President John F. Kennedy and former President of MIT). Based on the recognition of the increasing role of computing, publishing, and broadcasting in a quickly transforming communications industry, the Lab is devoted to multimedia projects on the cutting edge of technology research. It became well-known in the 1990s through a series of inventions in the fields of networks and the internet, and it currently has a bioscience-related focus on “human adaptability,” such as the treatment of dementia or mental illness, the development of technologies for monitoring health, and the development of smart
limbs for amputees. The Lab has significant industry funding and involvement. A diverse group of more than 60 corporate sponsors, not limited to any specific sectors, is responsible for the majority of the Lab’s annual budget. Most sponsors act as members of various thematic consortia, including Digital Life, Things That Think, and Consumer Electronics Lab. The Lab generates about 20 new patents every year.

3.2. R&D AND INTEGRATION WITH ENTERPRISE DEVELOPMENT AND TECHNOLOGICAL DIFFUSION: INDUSTRIAL REGIONAL CENTERS FOR EXCELLENCE IN TECHNOLOGY AND DESIGN

The aim of this program is to help to set-up, jointly with trade and industrial associations, a network of centres for excellence in technology, design and marketing for major industrial clusters in Portugal. The centres will be extensions for R&D of technical universities, with close cooperation with R&D of enterprises, and with networks of foreign R&D. Will be closely associated with enterprises of the respective sector, will be oriented for problem solving and to promote technological development and market penetration in new markets. Will be centres for innovation and inception of new design trends and marketing research. When appropriate the centres would be established as satellites of technical universities, on campus.

They respond to the need of major modernization efforts for industrial clusters, but either lack of knowledge or information, lack of financial and human resources, and lack of coordination efforts, has prevented these clusters to establish themselves as important players in the world markets.

Some candidates could be technological textiles, high-couture, specialized shoe industries, glass, china and tableware, automotive parts, furniture, specialized food industries, aeronautical industries, casts, electrical equipment, renewable energies.

The Technology and Design Centres will have a set of visiting specialists, scientists and artists working for periods of 1 to 6 months, on a rotating basis, recruited from a world basis. The management of the Centres will be conducted by three local industry persons (director, treasurer and administrative services responsible, on a voluntary basis), and a representative of a major Portuguese university chosen by a bidding process. The centres would have at a given time between 6 and 12 resident technical personnel. They should also invite local technicians from the industry to cooperate in the projects. The projects will be chosen at the beginning of a program year under the guidance of the management committee of the centre, the industrial association and a representative of the Ministry of Economy.

The financing could assume the following structure: investment in buildings, machinery, equipment and laboratories would be financed by Structural Funds. Salaries and other running costs of all personnel will be co-financed by the Ministry of Economy, industrial associations and participating enterprises. Each source would finance one-third.
Israel and Taiwan have some of the more interesting experiences:

**Israel**: The MAGNET program aims at solving common tech problems of SMEs, is overseen by the Office of the Chief Science. It is a precompetitive R&D program designed to solve common technology problems among small companies, better utilize academic R&D, and disseminate the results. MAGNET was established following a policy of horizontal neutrality, and it seeks proposals from industry, in consultation with academic researchers, for projects of up to 3 years in length to develop generic industrial technologies. When it was established, MAGNET initially covered a significant portion of the cost for the academic partner, up to 66%, with the industrial partner(s) covering the balance. Funds are provided as grants, and no repayment is needed. Resulting intellectual property is shared equally among members of the consortia and must also be made available to other Israeli companies at a “reasonable cost.”

Subsequent changes to the MAGNET program have resulted in increases in the partnership grant to research institutions; the program grants up to 90% of the cost of the overall project, with 10% covered by industry, depending on one of four chosen tracks. These include:

- **Consortia**. Based on the original MAGNET partnership, teams of industry and academic researchers conduct precompetitive R&D needed for the future development of advanced products. Projects may last 3 to 6 years.
- **Association**. These consortia help members of the same industrial sector understand and apply existing advanced technologies to advance their industry.
- **Magneton**. Magneton is a joint project between a single company and academic group. The purpose of the project is to test the feasibility of early-stage academic research and aid in its transfer to industry. Projects last up to 2 years with funding up to $800,000.
- **Nofar**. Nofar funds industry-relevant basic and applied research. The goal of the program is to advance or “prove” research to the point where industrial partners might make future investments. Projects last for 1 year and are funded up to $100,000 with a company paying 10% of the project costs.

Evolving policies and culture supported a growing trend in high-technology entrepreneurship, the most important of which may be the development of an Israeli VC industry in partnership with U.S. venture capitalists. Whereas Israel’s initial attempts at building a domestic VC industry failed (with Inbal), a better understanding of the U.S. VC market, related U.S. tax laws, and a program to attract U.S. VC expertise (with Yozma), the Israelis were very successful.

**Taiwan**: In 1979, the government created the Office of Science and Technology Policy within the Ministry of Economy. The purpose of the Office was to coordinate a broader technology development response to technological upgrading among small and medium-sized businesses by first understanding their technology needs and then through the funding of discrete R&D projects—typically through ITRI—in response. These Technology Development Projects (TDPs) were meant to reduce the risk of technology development while helping to improve performance of the small and medium enterprises (SME).
Upgrading was not just limited to ICT firms, however. For example, the Taiwanese bicycle assembly and component manufacturing industry was one of the first manufacturing industries in Taiwan. In the early 1980s ITRI formed the Bicycle Industry R&D Centre, created to help Taiwanese manufacturers produce increasingly value-added components. In 1987, the Materials Research Lab of ITRI helped Giant Manufacturing Company, one of the world’s leading producers of bicycles and an internationally recognized brand, develop a carbon fibre bicycle frame, and later (in 2000), an electric bicycle and high-end derailleur. While the most advanced components continue to be imported, these are typically only for the purpose of remaining competitive in the most advanced markets (such as the U.S. and Western Europe), but the majority of components for developing markets (such as China) are developed within Taiwan, often with ITRI’s assistance.

Value-chain R&D and technological transfer: It is important to conduct a value-chain analysis of R&D to identify missing links or stages that need further development and refining. In some of the areas it may be required to encourage technology transfer and in other areas to establish priorities in the national R&D projects.

Companies in Japan often have the practice of rotating engineers from the R&D department to the shop floor and back again (Hayashi, 1990) which not only gives them additional knowledge but also familiarizes them with other employees and their problems.

4. FINANCING INNOVATION: CAPITAL MARKETS DEVELOPMENT AND VENTURE CAPITAL

Financing innovation depends on the risk and if the object of financing is tangible or not (Table 4). Projects of R&D have high risk and they cannot be backed by collateral, so they should be financed by non-reimbursable subsidies.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>R&amp;D</th>
<th>Technological modernization</th>
<th>Investments</th>
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<tbody>
<tr>
<td>Intangibles</td>
<td>High risk</td>
<td>Medium risk</td>
<td>Lower risk</td>
</tr>
<tr>
<td>Tangibles</td>
<td>Intangibles</td>
<td>Tangibles</td>
<td>Investments in structures and machinery</td>
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<table>
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<tr>
<th>Activities</th>
<th>R&amp;D</th>
<th>Technological modernization</th>
<th>Investments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Development</td>
<td>Buying high technology equipment</td>
<td>Investments in structures and machinery</td>
<td></td>
</tr>
<tr>
<td>Product Innovation</td>
<td>Automation</td>
<td>Equipment for a new factory</td>
<td></td>
</tr>
<tr>
<td>Process Development</td>
<td>Management and technologies of quality control</td>
<td>Increase in production</td>
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However, projects that embody technological transfer in equipment or patents are less risky and can be easily collateralized, so they should be financed by loans.

Figure 20 also shows the product cycle financing of innovation with three separate phases: the seed capital and business angels covering start-ups, the second covering the development phase covered by mezzanine financing (VCs, M&A and Strategic Alliances) that could exit in IPOs and the final phase when the company is transformed into a public company.

![Figure 20: Product cycle financing](image)

The European countries with the highest levels of Private Equity (considering the origin of the investing company) relative to the size of the economy are UK, Denmark, Sweden, France and Finland (Figure 25). Portugal has a much lower ratio of investments in Private Equity as a percentage of GDP than the European total: .154% against .267% (data for 2013).

![Figure 25: All Private Equity - Investments as % of GDP - Industry statistics](image)
Considering the statistics of the target company, i.e. private equity invested in Portugal, the country has a lower share (0.194% of GDP) than the European average: 0.253%. The countries with largest activity are Denmark, United Kingdom, Norway, Finland, Netherlands, Luxembourg, France and Belgium (Figure 26).

![Figure 26](Image)

Considering only venture capital the three most active countries are Finland, Ireland and Sweden.

### 4.1. NETWORKING OF VENTURE CAPITAL INSTITUTIONS

The Venture Capital industry is totally globalized, and is constantly looking for business opportunities canvassing the world. The idea is to provide an informal setting for networking and information sharing, and a dynamic presentation and discussion of opportunities and financing in three fields: Information and Communication Technologies (ICT), clean tech and renewable energy, and life sciences, launching the seeds for enduring partnerships. The Networking Seminar for Venture Capital would bring together researchers, start-ups and entrepreneurs from Portugal and international VC networks (e.g. the European Venture Capital Network), to meet and present their business ideas and projects to venture capitalists (VCs) and business angels, in order to give the opportunity to develop their innovations and bring them to the market. The seminars will cover in succession the three segments of innovation and venture capital: (i) seed capital and start-ups, (ii) early growth, and (iii) growth capital.

The Networking Seminar on Venture Capital could become a periodic event with the purpose of exposing Portuguese start-ups and young entrepreneurs to potential sources of financing and partnerships with other start-ups and entrepreneurs of other countries, and in particular venture capitalists. The event could be sponsored by technological parks and Portuguese investment banks and venture capital funds, and could be also supported by the EIB, EBRD, IFC.

24 Networking is an intrinsic characteristic of the Venture Capital industry. See Hochberg et al. (2007).
and the European Commission and would count on the participation of academia and R&D centres, venture capitalists, investors and entrepreneurs.

4.2. CROWD FINANCING FOR VENTURE CAPITAL AND REGULAR COMPETITIONS FOR VENTURE CAPITAL INITIATIVES

Crowd financing is starting to raise funds in several developed financial markets. The objective of this initiative is to give the public the chance to invest in venture capital in the phase of growth companies, benefiting from tax incentives.

This initiative could transpose to Portugal models like the successful French program “Fonds Commun de Placement dans l’Innovation (FCPI)”. Set-up in France in 1998, has raised over 6 billion Euros, for an average investment of 6 000 Euros, and supported more than 1 000 enterprises. It allows the public to invest up to 13 000 Euros, and have an equivalent tax credit. These funds have been used mainly by medium and higher income taxpayers. By law, 60% of funds must be invested in small innovative firms. Research has shown that companies backed by FCPi funds grow their revenues quicker, file more patents, export more, and hire more staff than their rivals.

The subscriber has an upper limit of 13 000 Euros for tax deductibility or up to 6% of taxable income. The tax benefit requires a minimum of 5 years of investment. There is a minimum investment of 1 000 Euros. The revenues of the investments after this period are exempted from capital income tax, except for the minimum solidarity tax of 13%. The investor can choose one of the approved funds. The funds to be eligible for the system have to invest up to a minimum in start-ups or innovating firms that can only be quoted in special exchange markets (Alternext).

For each 100 million Euros of taxpayers investment, the approximate fiscal cost would be around 30 million. The advantage of the program is not only the financing of innovation and venture capital, but also to disseminate in the public the interest in investing in these types of firms.

4.3. CAPITAL MARKET DEVELOPMENT FOR SMES

To enlarge opportunities for SMEs to access capital markets, by creating an OTC market and a separate regulated SME market for prime SMEs, in order to be able to recapitalize and decrease reliance in banking funds.

Rationale: SMEs in Europe and in Portugal are heavily leveraged. The deleveraging of commercial banks has made it more difficult for SMEs to access the loans market. This project will open further opportunities for SMEs to access the commercial paper, bond and stocks market for non-regulated and regulated markets with simpler rules than the regular markets.

Parallel initiative: To create a special mutual fund that would function as a guarantor for the placements of these SMEs in the capital market.
4.4. STATE FINANCING: SETTING-UP A DEVELOPMENT BANK

Several EU countries have long standing State financial institutions to support either development goals, namely in the fields of R&D and SMEs, or external trade, notably the German KfW. Creation of a second-tier organization to promote productive investment in the country, reindustrialization and support exports, and to mobilize funds from foreign development banks and international capital markets. Ireland, Greece and Portugal have already created some kind of Institution for Growth in this regard, but which are still in its infancy. The Portuguese Development Bank (PDB) could have the participation in the capital of the Portuguese investment banks, other international development institutions like EIB, other national development banks like KfW, and a majority stake by the State. It should work at wholesale level and not compete in any form with retail investment and commercial banks and not have branches open to the public.

Source of funds: Public sources: Structural funds allocated to industrialization and investments in the private sector, EIB loans earmarked for investment projects, and loans from other development funds like KfW. Private sources: loans from foreign investment banks and obtained by selling securitized loans or issuing bonds in the capital markets.

Uses of funds: (i) Financing of large exports or international procurement projects that have difficulty in finding regular commercial or investment bank financing, (ii) financing of large productive private investment projects in cooperation with other national or foreign investment or commercial banks, (iii) supply lines of credit to SMEs disbursed through commercial banks for investment and working capital, (iv) buy securitized loans used for investment projects by commercial banks, (v) give a second-tier guarantee and provide additional maturity to productive private investment projects.

4.5. AN EUROPEAN-BASED INVESTMENT FUND

To create an international equity investment fund to invest in projects to stimulate growth of the private sector in Euro members in crisis, in the amount of 3-5 Billion Euros, funded by the European Commission, European Investment Bank, KfW and other development banks from EU countries, and large sovereign funds from Norway, Japan, Korea and Singapore, and in order to (i) assist and invest in major privatizations, (ii) participate in recapitalization and restructuring of major systemic corporations of the tradables sectors, (iii) participate in bank asset management corporations resulting from banking restructurings, and (iv) invest and capitalize in medium enterprises with large export potential through national equity funds jointly with national development banks and local private equity funds. The Fund could also have the participation of large private investment banks. The Fund would be set-up as an SPV with full and autonomous capacity. The Fund could be either (a) managed and operated as an off-balance sheet of a multilateral development bank or (b) as a new institution. The Fund would invest in new operations for up to 10 years and would wind-down operations in the next 5 to 7 years. A key for success is the Executive Board of the Fund that should comprise global experienced investment bankers with connections with global funds.

Reasons for creating a European Fund for Equity Investments
1. The countries of the Euro that experienced a severe economic and financial crisis are at a cross-roads and their capacity to recover depends crucially on restarting growth at a significant level. Economic growth is crucial for solving the serious social and unemployment problems and to grow out of the debt. The recovery of these countries is thus essential for finally resolving the Euro and EU crisis.

2. Despite the important structural reforms undertaken, economic growth depends on the dynamism of the private sector and having a vibrant entrepreneurial environment.

3. Private sector development requires availability of financing for profitable projects, entrepreneurial capacity and a business environment conducive to investment.

4. The crisis was accompanied by a substantial withdrawal of international and in particular European banks from the crisis countries leading to a reversal of financial integration in the EU. German banks have reduced their exposure to Portugal from 20% of its GDP to 11% between 2008 and 2012, and to Greece from 13 to 2%. French banks reduced their exposure from 13 to 8% in the case of Portugal and from 22 to 15% for Greece.\(^{25}\) Moreover, serious financial market fragmentation appeared in the form of spreads paid by enterprises with similar financial and economic structures in crisis countries versus core Euro countries.

5. The strong deleveraging of banks requires firms to find alternative modes of financing, in particular long-term stable financing. Moreover, given the deleveraging required by firms there is a need of equity financing.

6. These forms of non-banking financing can be tapped from major institutional investment funds at international level. However, these funds would only invest if the management of these funds has global reputation and the risk-return trade-off is favourable.

7. The crisis has been also accompanied by a deep fall in FDI from the core countries of the EU to the countries affected by the crisis. Greece experienced a fall of its FDI stock of about 20% in the last 3 years and Portugal is registering presently steep negative FDI flows. The reversal of these flows requires not only the rebalance of the macro disequilibria in the crisis countries but also a stable business environment with rebuilding of confidence, after the substantial regaining of competitiveness that has taken place.

8. The current problems of risk perception, that have led to herd effects, are serious market failures that cannot be solved by the private sector – in particular private equity and hedge funds – and need intervention by international public institutions to reverse the trends, as countries complete their macro adjustment programs.

9. There is also ample evidence that small and medium enterprises are the most financially constrained and may fail to have all conditions required for investment and exports.

10. For corporates and SMES to invest and grow in the global market, there is a need of stable sources of long-term financing and reliable partners in equity, which the Fund can provide and mobilize additional resources, providing the catalyst for further international private capital mobilization.

\(^{25}\) BIS statistics.
11. Finally, there is a strong need to strengthen corporate governance to support privatization and corporate restructuring and also the need to mobilize reliable international partners in value chains and strategic European and global industries.

Areas of intervention

Without precluding other areas of intervention, the Fund would assist in identification of projects and market opportunities, project preparation, equity finance, mobilize additional equity and debt financing, and mobilize strategic international partners. In particular, it would

(i) Assist and invest in major privatizations. Governments are usually assisted by large investment banks in these operations. The role of the Fund is to bring independent reliable expertise, grounded in European experience, and which financial involvement can bring strategic investors that need some comfort in their participation.

(ii) Participate in recapitalization and restructuring of major systemic corporations of the tradables sectors. This is an area where only private equity, hedge funds or major international consultants are involved. The Fund would bring a more reliable and trustworthy partner with a longer term perspective and should also bring strategic international partners.

(iii) Participate in bank asset management corporations resulting from banking restructurings. This is a crucial area for solving national financial crisis and requires very specific expertise that is not easily available in the private sector. It also may avoid distressed solutions that would be detrimental to taxpayers.

(iv) Invest and capitalize SMEs through national equity funds jointly with national development banks and local private equity funds. This is also a specialized area requiring specific skills and instruments to be efficient and have substantial impact.

Setting-up a Special Purpose Vehicle

The institution created for the Fund should be as light as possible and also be temporary. There is no need to create additional bureaucratic structures, but the Fund should have the capacity to operate and invest as an institution, and also offer the comfort required by the most important international funds. The solution is similar to the ESM, by setting-up an SPV and entrust its management and operation to the European institution best placed to manage and operate it, with a special vocation of investing and lending with the private sector.

Business Volume

The amount of Fund depends on the number of countries where it will operate and the areas where it will invest. Considering only the countries most affected by the crisis, the Fund could start with the amount of 3-5 Billion Euros.

Financing of the Fund

The Fund should have a core of official EU institutions participating in its funding to lend it credibility, and that could provide some type of risk reduction to other institutional investors.
These should include the European Commission and the European Investment Bank. The next tier of investors could be development banks from major EU countries like KfW and also development banks from crisis countries. The third tier would be large sovereign funds from Norway, Japan, Korea and Singapore, among others.

**Management and Operation**

The question of anchoring the Fund is crucial. Within the European institutions with long experience of financing bankable projects in the private sector and equity financing is the EBRD. EIB has a private equity fund but is very small, and is just a fund-of-funds dedicated mainly to venture capital, which is a different type of operation than the purpose of the proposed fund.

The Fund could be a SPV established as an off-balance sheet institution of EBRD, or IFC, or both. Its management would be entrusted to investment bankers with a large global experience. The operations of the Fund, in terms of project identification, preparation and appraisal could be entrusted to EBRD and IFC, which would charge the Fund for the services provided.

This arrangement would be compatible with the Statutes of EBRD that restrict its operation to its countries of operations. Since the services provided by EBRD are fully reimbursed there is also no competition of resources with the countries of operations: the Bank can hire additional resources for the operation of the Fund for the duration of its operations.

**5. FOSTERING ENTREPRENEURSHIP AND HUMAN CAPITAL**

**5.1. PROGRAM FOR APRENTICESHIPS AND VOCATIONAL TERTIARY EDUCATION**

Objective: To develop a system of apprenticeships and vocational training in a partnership between enterprises and the educational system for tertiary education and to improve qualifications of young employees in the industry and services sectors. The program would increase the employability of young workers, would improve the skills of enterprises and contribute to reduce youth unemployment.

Rational: The Portuguese labour force has one of the lowest levels of upper secondary and tertiary education in Europe, clearly below the Central and Eastern European countries with which is competing fiercely in some European markets. It is difficult to overcome this handicap in the EU and global competition without a strong effort to upgrade the general and technical qualifications of these workers.

Phasing: The program should start with a pilot in some districts (e.g. Lisbon, Porto, Setubal and Evora), subject to strict evaluation, and only then be progressively phased in. Subsidies for professional training should be transferred over time to this program.

Conditions for success: In order to be successful the program has to have very strong participation of the enterprises. Enterprises should be chosen by the local business administration based on competitive bidding and only under certain conditions, most
important having the disposition and capabilities to administer apprenticeships (e.g. having at least a qualified mentor for teaching the young worker). The program will be simultaneously axed in local vocational schools (e.g. politecnicos) that would administer the academic curriculum complementary to the enterprise training – in Germany the mix is 2 days of academic training plus 4 days of training.

Financing: Using QREN funds with strict control and setting-up a new specialized agency for the program as a partnership between business associations and the State. It should be subject to strict monitoring and evaluation in order to avoid the waste of the past training programs.

5.2. TECHNOLOGICAL PARKS INCUBATOR CENTERS AND UNIVERSITIES

To develop and strengthen a network of technological parks in the country, to create the synergies between innovative enterprises, research centres and universities. In particular, the program would (i) strengthen the management of the tech parks, (ii) create partnerships with foreign parks, (iii) create incubator centres in the most important parks, (iv) strengthen the links with regional tech universities.

There are already a number of important cases of technological parks in the country, with the most successful case being Tagus Park in Oeiras, or the recent case of Braga. There are also successful cases of incubators like the Instituto Pedro Nunes of Coimbra. The objective is to strengthen the existing parks increasing the number of participants, increasing the links with technical universities and strengthen their incubator capabilities (e.g. using the Google experience of London and Israel).

Financing and technical assistance to incubators could be provided by IAPMEI, IPN, and other regional institutions.
Box 2: Technological Parks and Incubator Programs

**Finland:** The INCUBATOR PROGRAM is a federally managed “jobs through entrepreneurship” project administered by the newly created Employment and Economic Development Centre (TE-Centre). Three-fifths of the total funding of EUR 2.15m came from various government ministries, with the remainder provided by the European Community. Instead of seeking unlimited growth, most companies started in incubators aim for a rather small size of 50 to 100 employees. This may be attributed to a culturally low tolerance for risk taking and a limited supply of VC. The Helsinki incubators provide business support services but do not subsidize rent. Specifically, through the partnership with the TE-Centre, services including testing of business ideas, search for co-partners, market development, management training, and international intelligence are offered to incubator companies. Frequently, companies move directly from incubators to science parks (discussed below), where they continue to receive at least some measure of institutional support. The Helsinki area incubators are sponsored by various educational institutions, city governments, and local organizations.

Finland created also a number of HIGH-TECH PARKS starting with Technopolis Oulu in 1982, 21 science parks had been built by 1999. Their purpose is to site the innovation infrastructure in the vicinity of academic scientific research. Today, Technopolis, a publically held company (HEX), manages technology centres not only in Oulu but also in Vantaa, Espoo, Lappeenranta, Jyvaskyla, and Tampere, providing business and development services to the resident companies. By developing and managing multiple parks, Technopolis is able to leverage its experience and bring best practices to benefit its clients, and is now exporting its expertise (e.g. to Saint Petersburg). Aviapolis combines innovative small and medium enterprises’ technologies to bigger companies and provides platforms for joint development, prototyping, testing, demonstrations and integrated product/service solutions. The business model is geared towards fast commercialization through a combination of in-house and sourced (bought and imported alike) technology development efforts. This improves ventures and their collaborators chances to reach quickly the proof of concept stage and move on to value system level, integrated business development.

**Taiwan:** Basic Law on Science and Technology in 1999, patterned after the U.S. Bayh-Dole Act of 1980 (The University and Small Business Patent Procedures Act, or Bayh-Dole Act (1980). This act gave universities, small businesses, and non-profit organizations title to intellectual property (IP) derived from federal research funding.). Previously, the NSC not only funded the majority of university research but also owned the IP. The Basic Law on Science and Technology reorganized the ownership and management of university IP. In 2001, MoEA also created a series of state-funded programs to further encourage technology transfer from universities, including technology transfer centres and incubators.

In 2001, MoIT also created the Themed Industrial Technology Innovative R&D Centre program, an effort to encourage universities to focus on research fundamental to advancing key Taiwanese industries. The program provides direction and follow-on funding to NSC-funded research projects or accepts proposals from university research teams for specific development projects. The program is also credited with a number of outputs, including 422 patents, 188 international licensing agreements, and 79 joint ventures with industry, as well as a rapid increase in industry-sponsored research. An example is the Systems on Chip program. The Systems on Chip program was established in collaboration with ITRI to focus university research on foundation research important for creating advanced processing systems on the micro- and nanoscales. To this end, the government has funding 85 new faculty positions in predefined subfields of specialization important to the Systems on Chip program.
6. INTEGRATION IN GLOBAL VALUE-CHAINS, INTERNATIONALIZATION AND ATTRACTING FDI

The technological capabilities of a given country are reflected in the type of exports. Thus, a country with a high level of efficient R&D will be reflected in a high level and intensity of high-technology exports. Figure 27 shows the high share of high-technology exports in total exports of Ireland, due to the presence of a large number of IT and pharma multinationals, although the share has fallen to half after the 2000s. Germany has a share close to 15%, Spain close to 7% and Portugal only 4%. The progress made by some Central and Eastern European countries is revealed by the case of the Czech Republic with a share close to Germany. Measured in absolute number (USD) Portugal exports the double of Greece and Ireland and Spain 10 times more than Portugal.

Figure 27A: Share of high-technology exports in total exports

Korea: At the regional level, the Technoparks in 16 regions have played an institutional role for implementation of the Government’s programs. The MKE supervises the Technoparks and allocates the necessary budget.

USA: Manufacturing Extension partnerships (MEP) is a network of not-for-profit centres funded by both states and the federal government to diffuse and implement manufacturing and other process technologies to small businesses. MEP centres are located in every state and have traditionally provided process improvement services—Lean, Six Sigma, Kaizen, and others—at a reduced cost, helping to reduce the operating expenses of small manufacturers. Recent MEP efforts have focused on improving product and service development among small firms.

Technological Parks and Incubator Programs (cont.)
But we could go further in the analysis and ask: what is the efficiency of R&D expenditures, measured by the success of the country in developing exports of high-intensive R&D exports? According to international institutions classification High-Technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Figure 28 plots High-Technology Exports versus R&D for EU countries.
and some developed economies. It shows Ireland, UK, France, Switzerland and Korea has the most successful countries in converting R&D into High-Tech exports. And the less successful are Finland, Slovenia, Spain and Portugal.

**Figure 28: High-Technology Exports versus R&D**

![Graph showing High-Technology Exports versus R&D](image)

Source: Author’s estimates based on World Bank data

We wanted to test what were the factors that could explain the share of High-Tech exports in total exports. One obvious factor is the level of GDP which captures factors like the high level of human capital and the level of technological development. The second factor, more related with the scientific knowledge effort would be the expenditures on R&D over GDP. And the third factor, as the experience of Ireland and Central and Eastern Europe shows, is the role of multinational enterprises. The following cross-section regression with data for 2013 shows the results:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1.293563</td>
<td>3.226114</td>
<td>0.400966</td>
<td>0.6913</td>
</tr>
<tr>
<td>R_D_2013</td>
<td>2.133444</td>
<td>1.578858</td>
<td>1.351257</td>
<td>0.1867</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>0.062721</td>
<td>0.025381</td>
<td>2.471152</td>
<td>0.0194</td>
</tr>
<tr>
<td>GDPPKICP2011</td>
<td>0.000168</td>
<td>0.000126</td>
<td>1.333003</td>
<td>0.1926</td>
</tr>
</tbody>
</table>


<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared</td>
<td>0.455621</td>
<td>Mean dependent var</td>
<td>14.66561</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.401183</td>
<td>S.D. dependent var</td>
<td>8.915839</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>6.899369</td>
<td>Akaike info criterion</td>
<td>6.810868</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>1428.039</td>
<td>Schwarz criterion</td>
<td>6.990440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-111.7848</td>
<td>Hannan-Quinn criter.</td>
<td>6.872107</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>8.369547</td>
<td>Durbin-Watson stat</td>
<td>1.821292</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob(F-statistic)</td>
<td>0.000342</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All the above factors are relevant and with the expected sign, with the ratio of the stock of inward FDI over GDP having the highest t-ratio, and R&D with a similar significance level as GDP per capita. It is also interesting to see the residuals for each country, which is a measure of inefficiency of R&D. The countries with the lowest levels of efficiency are Belgium (-12.7), Finland (-10.4), Portugal (-7.9), Slovenia (-7.6) and Spain (-6.7):

<table>
<thead>
<tr>
<th>Country</th>
<th>Filled</th>
<th>Actual</th>
<th>Residual</th>
<th>Residual Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>16.3299</td>
<td>12.9100</td>
<td>2.41906</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>16.7640</td>
<td>13.7155</td>
<td>3.04841</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>12.6912</td>
<td>11.4000</td>
<td>1.2912</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1.42476</td>
<td>9.6355</td>
<td>8.20873</td>
<td></td>
</tr>
<tr>
<td>Bulgaria</td>
<td>-3.43484</td>
<td>7.90064</td>
<td>11.3655</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>0.25952</td>
<td>14.0408</td>
<td>13.7813</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>19.0443</td>
<td>26.9555</td>
<td>7.92119</td>
<td></td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1.03765</td>
<td>14.7621</td>
<td>13.7244</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>-2.94431</td>
<td>14.2513</td>
<td>17.1955</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>-10.3948</td>
<td>7.21447</td>
<td>17.5093</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>11.2995</td>
<td>25.8860</td>
<td>14.5865</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>0.12884</td>
<td>16.0782</td>
<td>15.9494</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>-0.16344</td>
<td>7.53777</td>
<td>7.70121</td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>3.69621</td>
<td>16.3425</td>
<td>12.5663</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>-1.41109</td>
<td>22.4248</td>
<td>23.8359</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>-3.04732</td>
<td>7.25047</td>
<td>10.9061</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>1.98444</td>
<td>16.7843</td>
<td>14.7999</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>11.2188</td>
<td>27.0993</td>
<td>15.8806</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>0.17767</td>
<td>15.9248</td>
<td>6.74709</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>2.13669</td>
<td>20.4063</td>
<td>18.2696</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>1.83480</td>
<td>19.1199</td>
<td>17.2651</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>-1.91483</td>
<td>7.65660</td>
<td>9.77423</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>-7.94440</td>
<td>4.26343</td>
<td>12.2075</td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td>-2.03323</td>
<td>6.19562</td>
<td>7.75275</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>11.2805</td>
<td>46.9944</td>
<td>35.7139</td>
<td></td>
</tr>
<tr>
<td>Slovakia</td>
<td>-0.37376</td>
<td>10.3125</td>
<td>10.6863</td>
<td></td>
</tr>
<tr>
<td>Slovenia</td>
<td>-7.80033</td>
<td>6.21911</td>
<td>13.8194</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>-1.96270</td>
<td>5.46768</td>
<td>7.43036</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>-6.75294</td>
<td>7.68021</td>
<td>14.4188</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>-5.62936</td>
<td>13.9090</td>
<td>19.4999</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>3.18512</td>
<td>26.5454</td>
<td>23.3603</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>-5.44139</td>
<td>1.87799</td>
<td>7.31938</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1.71096</td>
<td>16.2662</td>
<td>14.5552</td>
<td></td>
</tr>
<tr>
<td>United States of America</td>
<td>0.30237</td>
<td>17.7558</td>
<td>17.4534</td>
<td></td>
</tr>
</tbody>
</table>
6.5. Attracting Foreign Direct Investment

Most of the case study locations of FDI show that successful policies should target a narrow number of sectors and/or niche activities/functions for FDI attraction, leveraging particular competitive advantages of their location (including national/regional innovation systems). A focus on cluster formation and sectoral ecosystem development driven by strong leadership was also strongly in evidence. The role of partners within the innovation system is a recurring theme, particularly in a sectoral ecosystem development context.

We have seen above that Multinationals make a big difference in the NIS, mainly in increasing the level of R&D within the enterprise sector. Thus, attracting multinationals with intensive levels of R&D is one of the most important policies for improving the NIS. Ireland is one of the most successful countries in Europe in attracting FDI, mainly from US firms that want to establish their operations in the EU market. There are presently about 1 thousand multinationals registered in Ireland employing about 250 thousand persons only directly. According to data for 2013 the top 20 multinationals in Ireland had a total turnover of 164 Billion Euros and employed 201 thousand workers (Table 5). In 2013 overseas companies exported 124.5 Billion Euros out of Ireland, almost 70% of Irish GDP. The success of Ireland in attracting FDI has been attributed to three main factors: availability of qualified personnel, low tax regime\(^{26}\) (corporate tax rate of 12.5% and tax credit for R&D of 25%) and English speaking culture. Obviously that two other factors are important: the hysteresis effect of agglomeration effects – once the first American multinationals located the others followed, and the diaspora of Irish in the US. The Industrial Development Agency (IDA) of Ireland has played an important role in attracting FDI and being a step-by-step partner to foreign investors.

\(^{26}\) “Double Irish” is an arrangement under which corporations are able to divert incomes out of Ireland into low tax regimes in places like Bermuda and the Cayman Islands. It is made possible by the fact that Irish tax laws allow two companies to be set up here side by side, with one of them resident here while the other one is resident in a tax haven. Funds can then be transferred from one to the other so that cash can be held free of US tax obligations in the offshore location. Apple has three subsidiaries based in Ireland which are not classed as resident in any country for tax purposes. US Senate investigators allege that the amount sheltered from tax in this fashion by Apple over the past four years is as much as $70 billion dollars.
Despite its large activity in Ireland, most of the R&D of these multinationals is carried out outside of Ireland. Even so, in 2012 these multinationals carried out an investment of 1.4 Billion Euros in 2012, about 70% of all enterprise R&D in Ireland. Even so, these numbers contrast with the Portuguese case. The R&D carried out by multinationals (Table 6) is just a fraction, with a total of about 100 Million Euros carried out in 2011 mainly by German firms in the areas of pharma and IT.
Box 3: The Irish Industrial Development Agency (IDA): the most successful agency in attracting FDI

In 2013 Ireland was ranked 10th in terms of FDI project inflows globally, ahead of countries such as Germany, Spain and the Netherlands. In pharmaceuticals, Ireland won a 10 percent share of projects to Europe, a 15 percent share of software and services projects and 14 percent of medical devices projects. In business and financial services Ireland was ranked at 6th and 7th in Europe with a 5 percent share of projects going to Europe.

Established in 1949, IDA is responsible to attract FDI into Ireland. IDA focus on attracting high value investment into Ireland such as R&D, European headquarters, advanced manufacturing and supply chain management activities. It is complemented by two other agencies. The promotion of Irish companies is the responsibility of Enterprise Ireland and policy and advisory matters are handled by Forfás. These agencies are responsible to the Minister for Jobs, Enterprise and Innovation in the Irish Government. IDA has a budget of about 155 Million Euros of which 88 are grants paid to enterprises, with staff costs of about 20. The agency has about 400 staff and 13 Board members. The following is the organization chart that is based on a dual structure, by industry and region.

It has offices in North America (New York, Boston, Chicago, Atlanta, Silicon Valley and Irvine), Brazil, Australia, China (Beijing, Shanghai, Shenzhen), Korea, Japan, India (Mumbai, Bangalore) and Singapore. The cost of job created by FDI over grants given by the Irish Government is around 13 thousand Euros:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost per Job (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>13,531</td>
</tr>
<tr>
<td>2001</td>
<td>13,527</td>
</tr>
<tr>
<td>2002</td>
<td>13,103</td>
</tr>
<tr>
<td>2003</td>
<td>14,450</td>
</tr>
<tr>
<td>2004</td>
<td>14,581</td>
</tr>
<tr>
<td>2005</td>
<td>14,516</td>
</tr>
<tr>
<td>2006</td>
<td>13,541</td>
</tr>
<tr>
<td>2007</td>
<td>12,608</td>
</tr>
</tbody>
</table>

Source: Forfás Annual Employment Survey 2013

Note: The cost per job sustained is calculated by taking into account IDA Ireland grant expenditure to all firms in the period of calculation. Only jobs created during and sustained to the end of each seven year period are credited in the calculations.
Box 3: IDA (cont.)

The following two tables show that about 70% of the FDI has origin in the USA and is concentrated in pharma, IT, medical instruments and supplies, metals and engineering. The largest sector is international and financial services (headquarters), including software.

<table>
<thead>
<tr>
<th>Origin of IDA Ireland Supported Companies 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
</tr>
<tr>
<td>United States</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>United Kingdom</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>Rest of Europe</td>
</tr>
<tr>
<td>Rest of World</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Source: Forfás Annual Employment Survey 2013
Note: *Includes full-time, part-time and temporary employees.

<table>
<thead>
<tr>
<th>Total Employment by Sector in IDA Ireland Supported Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td>Computer, Electronic &amp; Optical Equipment</td>
</tr>
<tr>
<td>Medical/Dental</td>
</tr>
<tr>
<td>Instruments &amp; Supplies</td>
</tr>
<tr>
<td>Metals &amp; Engineering</td>
</tr>
<tr>
<td>Miscellaneous Industry</td>
</tr>
<tr>
<td>International &amp; Financial Services (incl. Software)</td>
</tr>
</tbody>
</table>

Source: Forfás Annual Employment Survey 2013
Note: Includes part-time, temporary and short-term contract employees.

The reasons pointed out to attract FDI to Ireland are: (i) labour costs of 28.4 Euros per hour below some of the more developed countries in the EU, (ii) labour productivity 48% above EU27 average, (iii) the only English speaking country in the Eurozone, (iv) youngest population in Europe with the 9th ranked educational system globally, (v) corporate tax rate of 12.5% with 72 double-taxation treaties, (vi) one of the best infrastructures in Europe, and (vii) Dublin one of the cheapest cities particularly in office space in Europe.

The strategy of IDA for 2015-2020 is based on reinforcing past success, allocating more resources and efforts to China and India, recognizing that the new emerging industrial powers will be the source of FDI growth in the future and can benefit from Ireland’s position in the EU. It also gives more emphasis to industry, to transferring more R&D of multinationals to Ireland, and evolving new technologies and business areas like internet of things, big data, security biometrics, smart ageing, portable services, sharing economy and financial technology.

According to the strategy “the Government will intensify its efforts to nurture and develop those areas that will genuinely differentiate Ireland’s offering, and specifically:

1. **Talent:** Ireland as an internationally competitive location for talent attraction and growth.
2. **Place-making:** to create competitive, dynamic and globally connected city regions as attractors of investment, and position Dublin as the leading European hotbed for start-ups, fast growing firms and talent.
3. **Connected world leading research:** Ireland recognised as one of the most enterprise aligned science, technology & innovation systems in the world, renowned for excellence in research, connecting and collaborating with enterprise, delivering sustainable economic impact, and attracting investment and exceptional talent.”

IDA, Policy Statement on Foreign Direct Investment in Ireland, July 2014.
Portugal has a similar institution to IDA (Box 3), AICEP (Trade and Investment Agency), however its scope is much larger: encouraging the best foreign companies to invest in Portugal and contribute to the success of Portuguese companies abroad in their internationalization processes or export activities. In 2013 it had 473 staff and a budget of 33 Million Euros, with representatives in the 4 continents. While with different mandates, AICEP performance is much lower than IDA in capturing FDI: on average in 2009-2012 Ireland captured 27.3 while Portugal captured 6.3 Billion Euros of FDI, per year. A possible recommendation is to have dedicated teams for FDI with more resources and with a streamlined network, strategically defined.

To promote investment of the more developed countries in the EU in the program/peripheral countries that have suffered a large drop in FDI from those countries and need a push in the process of technological progress. The program would be limited to 5 years, renewable once, in order to limit the distorting effects in the internal market. The program would give tax exemption from profit tax both in the host and origin countries in the first 5 years and a reduction of 50% of the tax due in the next 5 years. It would be restricted to manufacturing investments.

Portugal is experiencing a deep crisis with large drop in investment, after the output stagnated for a decade and half. It has lost competitiveness and large outflows of FDI in the last 15 years. Portugal is the country most affected by the enlargement of the EU to the Central and Eastern Europe, and has lost large number of firms due to the liberalization of trade by the EU. It cannot devalue to regain competitiveness in the short to medium term, and a deflation is and will cause large pain in terms of job losses and resource transfers to other sectors and abroad. To mitigate those impacts, and superior to giving loans, assistance to the country should be in terms of investment and private sector flows to the country, that prove to be sustainable. To solve the above problems the proposed fiscal incentives, shared by host and originator countries, would promote FDI in the country. There were precedents in this type of state aid in the past when the Commission allowed large grants and subsidies to investment in Auto Europa in the late 1980s and early 1990s. There are also countries, like Ireland that have kept a low profit tax rate that have given an incentive to FDI for more than 3 decades.

**Why the state aid:** In order to satisfy the criteria for state aid, this should be (i) temporary, (ii) the objective cannot be achieved by other means less distortionary, and (iii) there is a positive balance of the benefit cost analysis. All these conditions seem to be satisfied: (i) its duration is limited to 10 years, (ii) there are hardly any other measures to give incentives to FDI, given that all reforms for labour and product market liberalization have been done, and (iii) the benefit in terms of synergies created, technological transfer and job creation may be achieved by choosing projects with a large benefit balance.

### 6.2. Trade financing for small and medium enterprises

With the cut-off of Portuguese banks from foreign private flows, SMEs have experienced major difficulties in accessing trade finance, either because foreign correspondent banks do not accept guarantees of Portuguese banks, or the commissions and margins required are too

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high. Trade finance is fundamental for maintaining and expanding foreign trade and exports. The objective of this program is to reduce the costs and ensure trade finance to Portuguese SMEs by using a major international finance institution (EIB) in order to provide those guarantees, when they are not available or are too costly to SMEs. The program could also provide pre-financing, up to 1 million Euros, or 50% of the value of the transaction, in transactions of export.

**How will it function:** The EIB will allocate a given amount to finance trade in Portugal (e.g. 500 million Euros), and will implement the program through a list of commercial banks with accreditation with the EIB.

**Who benefits:** All SMEs with a turnover up to 500 million Euros requiring trade finance for exports and imports. The guarantee would kick-in when the SME is refused financing with a genuine transaction or the correspondent bank does not accept the guarantee, so it complements private banking only.

**How to implement:** The system could be quickly implemented by using commercial banks. In order to reach larger segments of SMEs medium and small banks need to participate in the program. EBRD that pioneered trade finance could help in setting up the system at EIB and also finance trade finance in its countries of operations.

6.3. **Creation of trade companies as aggregators of exports for SMEs**

The objective of this program would be to create several trade companies that could be aggregators of exports of goods and services, in order to overcome the fixed costs for SMEs in entering foreign markets and the small number of products in each series of production. Trading companies would be particularly important in agribusiness. Studies by Brugel have shown that to start exports and be successful firms have to be of a minimum dimension, and one of the main reasons why the SMEs of Germany are more successful when compared with Spain or Italy is because they are larger, growth faster and are more innovative. Japan and Korea overcome the smallness of their enterprises in the 1960s thru the 1980s with the important role of trading companies. These companies could also play an important role in negotiating supply deals with networks in foreign markets that are also important in reaching a larger market in foreign countries (e.g. chain of supermarkets).

Incentives for the creation of trading companies could be a more favourable tax regime, direct support from AICEP in kind and in subsidies and technical assistance from similar companies in Asian countries (“twining”). Its creation may be speed up by sponsoring by CGD or some other commercial public institution.

6.4. **Business Assistance and Cooperation (BAC) programs: twining of entrepreneurs of more advanced and less advanced economies**

The Business Assistance and Cooperation (BAC) program for Portugal would mobilize very experienced small and medium entrepreneurs, consultants and specialists of more developed countries in the EU to give technical assistance and training to SMEs in Portugal for development and internationalization. It has a triple aim (i) facilitate the process of
cooperation between entrepreneurs of the more developed EU regions and the least
developed areas, (ii) to assist the development and modernization of Portuguese small and
medium enterprises with great potential, and (iii) facilitate the process of restructuring of the
Portuguese industry that is experiencing a deep crisis.

The BAC program will be demand driven and will target around 100 SMEs per year and will be
financed by a special EU structural funds. The BAC program would mobilize entrepreneurs,
managers and specialists with large and deep knowledge and experience in a specific industry
to provide technical assistance to a selected number of SMEs in Portugal that have already
established themselves in the sector, in order to make a leap in productivity and quality of
production, to internationalize or to expand exports.

The rationale for this program is quite simple. The Portuguese economy is experiencing a deep
crisis and productivity has stagnated in about a decade and half – the largest spell in
stagnation of any EU country. Since the country cannot devalue its currency, because is a
member of the Euro, an increase in competitiveness can only come through an increase in
productivity. More important than loans, solidarity by the more developed countries should be
in the form of investment and transferring of knowledge. Central to the restructuring process
is entrepreneurship and management of Portuguese enterprises. Small and medium
enterprises are the backbone of the Portuguese economy, representing about 85% of value
added, 80% of employment and about 70% of exports. The role of SMEs in giving a bust to
productivity, reduce unemployment and res

tore growth is crucial.

Who may supply assistance: Entrepreneurs, managers and specialists of the (a) highest
developed regions in the EU, (b) of Portuguese ascent scattered around the world, and (iii)
Portuguese especially in retirement, highly experienced in a specific industry (20 or more years
of experience)

Who should receive assistance: SMEs would present their candidacy through the local offices
of the Trade associations or Ministry of Economy. Based on a recommendation of the regional
offices, a central Committee will select a set of 100 SMEs, based in the following criteria: (i)
number of employees between 50 and 500 employees, (ii) turnover of at least 10 million
Euros, (iii) entrepreneur willingness to receive technical assistance and with manifest
capabilities for the development of the enterprise, (iv) participate with co-financing in the
project at 10%, and provision of local transport and translation services, if required, (v)
convincing business story for development and/or internationalization of the SME.

Additional aid to the SME: In addition to the technical assistance, the SME under the BAC
program could receive financing from a fund for financing recapitalization or working capital,
based on the business plan developed by the project coordinator. Additional assistance could
be provided to penetrate in external markets, either by help to participate in international fairs
or in information provided by AICEP and other market official or entrepreneurial organizations.

Budget: Each assistance project with a SME will have a project coordinator and will use about 3
to 5 specialists that will be required in the project throughout the 3 year duration of the
project. The average project per SME will use about 12 men-months equivalent, scattered
through the project, following the implementation of the program draw-up by the project
coordinator. Following other international technical assistance programs the standard remuneration of the specialists is 400 Euros per day, giving a total of 140 thousand Euros, with an additional 40 thousand for travel and subsistence. Per project the cost is 180 thousand. The annual program is 1.8 million Euros. After 3 years, the program will cost 5.4 million Euros. Considering an overhead of 600 thousand, the total cost is around 6 million Euros.

The BAC program could be financed by the EU structural funds.

**Organization and management of the program:** The program would be implemented in participating countries (Germany, France, Netherlands, Finland, Sweden, Denmark, UK, Austria) by their respective Ministries of Economy and Cooperation Agencies. At the Portuguese Ministry of Economy there would be a team of 8 persons for the central coordination of the program, plus a team of 3 persons per region (5 regions). These regional teams would have the support of the delegation of the Associação Industrial Portuguesa or local Câmara de Comércio.
7. ENHANCING COMPETITIVENESS AND PRODUCTIVITY ACROSS THE ECONOMY: TECHNOLOGICAL UPGRADING AND DIFFUSION (INDUSTRIAL EXTENSION)

The successful case of Ireland in attracting Foreign Direct Investment and enhancing competitiveness shows the need to pursue three interrelated policies: (i) create a talent powerhouse by a vigorous policy of technical and vocational education, (ii) smart and vibrant cities that attract scientists and enterprises in a cluster of universities, laboratories and research places, and service and financial centres, and (iii) closely connected and inserted in world networks of knowledge and commerce and embodied in anode of the value-chains of a global economy.

According to the Doing Business Rankings of the World Bank (Figure 29) that measures some of the relevant indicators, Portugal is placed in an intermediate position close to Netherlands and ahead of France, Poland and Spain. But when compared with Ireland is still quite far from having an environment conducive to doing business. This is an area where the country has to work in improving its human capital, management abilities, rule of law and contract enforcement as well as improving its policy capabilities.

Figure 29: World Bank Doing Business Rankings

The level of technological sophistication is closely related with the level of high-technology exports of the country. Figure 30 shows the 9 countries that in 1990 represented 80% of the world trade of High-tech exports. In the course of the 1990s they lost about 13 p.p. but by 2013 they had regained the 70% mark. However, there was a profound change in the structure of these countries: China went from a negligible share to 27 pp in 2013. The countries with the
The largest loss in market shares were the USA (-17) and Japan (-13) and UK (-7). Both Korea and Singapore gained between 2 and 3 pp the same amounts that Germany and France lost.

**Figure 30: World market shares of High-Tech Exports**

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### 7.1. Horizontal and Vertical Policies to enhance Productivity

It is quite well known that horizontal policies across all sectors without targeting a specific sector or region are less distortionary than targeted policies. The other important advantage is that they are less risky because resources may be wasted when concentrated in unsuccessful industries or regions, and they do not create “white elephants” that may require indefinite support and state aid. Current EU state aid rules also limit substantially targeted state aid because they may distort competition in the single market.

Vertical policies single out a particular sector and cover the whole supply chain. They are also quite risky because the sector chosen may not turn out to be the right one. However, they may be justified when the sector has clearly demonstrated comparative advantage like the Portuguese tourism sector, addressed below.

### 7.2. Speed-up enterprise restructuring and closing down inefficient firms

There were recent reforms in the insolvency code and also a program was launched to help restructuring enterprises. However, the real impact in terms of number and value of firms that have been restructured has been quite low. The aim of the program is to combine a new package for enterprise restructuring and recovery to try to accelerate the process and make it more effective. The package comprises: (i) deep reform of the corps of insolvency fiscal agents to avoid corruption and improve management capabilities, (ii) set-up a cooperative solution...
with the fiscal and social security institutions, (iii) complement the new management of the firm with credit and technical assistance to improve the chances of success.

With the crisis there have been a record number of bankruptcies. A large part of these firms were in sectors without competitive advantages or that simply responded to the distorted resource allocation and incentives that prevailed in the 1995-2010 period. However, a significant part could be restructured or recovered and it is quite a waste of resources and painful in terms of unemployment, so it is one of the most important supply side programs to improve productivity in those firms. There were some important constraints for the success of some reforms recently implemented, and that need further deepening and follow-up to produce full impact in the economy. Two cases in point are the insolvency code that is supposed to facilitate the process of liquidation and restructuring. However, one of the major problems is the scarcity of good managers to create and implement the recovery plans. The system has been plagued with corruption and widespread inefficiencies. The second problem is that there is a need for a full cooperation of all creditors, including tax and social security authorities to make the process work. Moreover, the banks have sometimes used a short-term approach of maximizing liquidity recovery, without a medium and long-term perspective.

Component 1: Creation of a small team of highly professional and honest insolvency managers that could handle a first set of projects, and use them as a demonstration factor for other insolvency managers. Simultaneously, there should be an intensive training program for these managers, given by 2 leading universities. A third sub-component would be the “cleaning-up” of the system of corrupt officials. A fourth sub-component should be setting-up a monitoring system for performance assessment of all insolvency managers with a “carrot-stick” approach—firing the most incompetent.

Component 2: Improving the judicial system, by (a) prosecuting some entrepreneurs and managers that led their firms to bankruptcy with fraudulent methods and use them as a demonstration effect; (b) prosecuting some high-profile corrupt insolvency officials, (c) training program for judges of insolvency cases, and nomination of specialists to assist courts, in order to identify fraudulent cases.

Component 3: Improving the process of decision by assisting creditors’ assemblies to determine the best course of future actions, and creation of specialized unities in the banks to analyse these cases, as well as in the fiscal and social security departments. Submit the business plans to scrutiny of independent consultants.

Component 4: Business plans need to be realistic and competently defined. They should also be proposed and discussed as a package comprising: (i) appropriate financing, (ii) technical assistance, and (iii) concrete and dated investment and other restructuring measures, in order to make the process effective and efficient.

7.3. Revitalizing and up-scaling the tourism sector

To revitalize and upgrade the touristic activities of the country, by (i) creating anchors and synergies for upgrading the quality and the value-chain of tourism, (ii) recreate the roots of touristic activities based on the geographic, cultural, historical, gastronomic and climacteric
unique conditions of the country, (iii) segment tourism policies by type of demand, exploiting the demand characteristics of each type of tourism (cultural and artistic, sports, religious, summer-beach and summer-interior/mountains, sea-centred tourism, island centred tourism, agro-tourism, etc.), (iv) create clusters of services and activities geared to supply those types of segmented demand, (v) fill-in the backward (e.g. agribusiness) and forward (e.g. leisure activities) value-chain of tourist demand, (vi)

Tourism activities are undoubtedly the single most important comparative advantage of Portugal. We have excellent climacteric conditions compared with North Europe, with a mild climate and sunny summer; the geographic conditions with a long shore-line and may be the best beaches in Europe; an excellent historical and architectural patrimony; an ancient European culture with friendly populations; unique gastronomic wealth; and diverse geographical and even climacteric sub-regions from the mountains of Gerez, the valley of the Douro river, the central mountains, the planes of the Alentejo, and the beautiful coastline from Lisbon to Algarve. And the unique islands of Madeira and Azores. However, maximizing value creation requires an integrated approach of all value-chain, deepen and improve the quality of all our competitive advantages (e.g. the gastronomic quality of our restaurants and the development of high quality foods), exploit the characteristics of each tourism segment (the approach required to develop religious tourism is completely different from beach-summer tourism).

Components:

A. Cultural and historical tourism: preservation of our heritage of monuments, palaces, castles, churches and monasteries, mansions and in general urban centres. Development of several poles of historic sites: (e.g. Cabo Espichel, close to Lisbon, was a major centre of peregrine activity in the 16-17th centuries, with some of the best scenic capabilities, but remains in ruins, the Arrabida mountain is also one of the most scenic mountains close to Lisbon, or the coast from Setubal to Fonte da Telha, that remains one of the least developed regions, with large potential, which would benefit from some sparse touristic poles, while preserving the unique environment). And these examples could be multiplied by hundreds around the country.

B. Artistic tourism: creating a major artistic event to anchor artistic tourism, like an opera and/or classical festival (e.g. baroque music and opera), but needs a critical mass and marketing to make it a world event)

C. Sports: continue to exploit certain types of sports from golf to fishing, football, tennis tournaments.

D. Religious: Although the Fatima events are already quite well-known worldwide, there are a number of other religious sites that are worth further development, sometimes linked to local festivals (romarias) (e.g. Braga (Bom Jesus), Cabo Espichel(linked to the sea and fisherman)).

E. Summer-beach and summer-interior/mountains: create more urban centres in the Coast Vicentina and other cost-lines, preserving the environment and with high architectural standards, preserving local architectures.
F. **Sea-centred tourism:** We need to exploit our heritage of the discoveries and fishing activities by creating a museum-in-the-sea with replicas of caravelas and bacalhoeiros (probably in Lisbon or Algarve, linked to Sagres).

G. **Island centred tourism:** although tourism in Madeira is already at the highest world level standards, Azores has a lot of potential but needs some attraction points to develop its unique scenic wonders and its unspoiled environment.

H. **Agro-tourism:** there is a need to develop further this type of tourism based on our rich agricultural communities, like in Minho, Beira-Litoral and Interior and Alentejo, Ribatejo or even Algarve (using the grape picking-wineries, olive picking, cherry flowering, horse rearing, etc.).

**Regional planning:** A priority is to map the main poles around the country with touristic activities centred on the segments described above. Then, a set of regional and local tourism development plans should be drawn-up, closely linked to the historical patrimony and cultural potential of each region of Portugal.

**Development and implementation of regional/cluster plans:** The central government would then choose every year a set of multi-year tourist development plans, among those presented and in an open competition, endowed each regional plan with a fund that would be co-financed by European funds, central government and regional/local governments, local businesses, contributions in kind or others from local populations and emigrants. A commission should be nominated to carry out the plan with participation of some local government officials, but supervised by a supervisory council of local representatives with wide participation. Instead of distributing widely the resources it is important to concentrate in certain clusters, with sufficient resources to have a substantial regional impact, and then use those poles as a demonstration effect.

7.4. **Small and Medium Enterprises: re-inventing Industrial Extension Services**

According to a survey of the ECB the problems that constraint most SMEs in Portugal are

**Figure 31:** SMEs survey: What is the factor that most constrains activity?
related with marketing and competition, followed by regulation. These are similar to Spanish firms, but contrast with financing problems in Greece and cost of labour in Italy. We are going to address policies that could contribute to improve innovation among SMEs.

**Support for research and development of small and medium enterprises**

**Objective**: To support the technological development of innovative small and medium enterprises, and more specifically: (i) stimulate innovation of SMEs, (ii) make SMEs participate in the R&D effort, (iii) integrate SMEs in the R&D networks of the country and EU.

**Rationale**: SMEs are the backbone of industry in Germany, USA or Italy, and they represent a large part of the manufacturing in Portugal. SMEs have been a major source of innovation in countries like the US or Taiwan. Thus, no Program for Innovation can avail itself of reaching out for their support and development.

**USA Experience**

The Small Business Innovation Research (SBIR) program was enacted in 1982 by Congress, which passed the Small Business Innovation Development Act. Is an R&D funding program that helps small businesses to commercialize technology. Small Business Investment Companies (SBICs) were launched in 1958, by the Small Business Investment Act. They facilitate the flow of capital through the economy to small entrepreneurial businesses in order to stimulate the U.S. economy. They were instrumental in the development of Silicon Valley.

The SBIR program specifically to (1) stimulate technological innovation, (2) use small business to meet federal research and development needs, (3) foster and encourage participation by minority and disadvantaged persons in technological innovation, and (4) increase private sector commercialization of innovations derived from federal R&D. The SBIR program sought to meet these goals by mandating that agencies with R&D budgets over $100 million set aside 0.2% of their funds for the program. Subsequent reauthorizations of the program have increased this percentage incrementally to 2.5% of agency extramural research budgets. Eleven mission agencies currently participate in the SBIR program, including the Department of Defence, National Institutes of Health, Department of Energy, National Aeronautics and Space Administration.

SBIR grants are awarded in two competitive phases. Depending on the specific mission agency, phase I grants are for as much as $100,000 for 6 months, while phase II grants are for as much as $750,000 for 2 years. Agencies can seek waivers from the Small Business Administration—which coordinates and oversees policy among the agencies—to increase award size. While recent congressionally mandated reviews of the program suggested a number of improvements to the program, including an increase in award size and continued agency flexibility, findings indicate that the program is a critical component in the U.S. innovation system and important for meeting mission agency needs.

Small businesses may deduct capital R&D expenditures as current business expenses. It may deduct R&D expenditures in the tax year or can amortize expenditures over a period of more than sixty days. R&D must be performed in the country to be eligible for tax incentives, which are sales-based in that a firm can claim a tax credit whenever its R&D expenditures constitute a higher percentage of sales than in the year the base was fixed. Additionally, most states have
their own R&D tax relief. Contributions to endowments would normally be classified as gifts and subject to up to 100% deduction.

**Taiwan Experience:** SBIR Program. Fashioned after its U.S. namesake, the SBIR program is designed to strengthen the R&D capabilities and competitiveness of small and medium-sized businesses in Taiwan. Created in 1999, the program has competitively funded more than 3,000 SME R&D projects and is credited with stimulating more than NT$12.1 billion in industry R&D investments. Like its U.S. counterpart, SBIR disburses funds in two phases. Phase I awards up to NT$1 million ($30,000 USD) for up to 6 months to explore the technical merit or feasibility of a specific technology. Phase II is an R&D phase in which companies are competitively awarded up to NT$5 million ($310,000 USD) to further develop a technology. However, unlike the U.S. program, the program differs in the fact that companies can apply for a phase II award without having applied for a phase I award, and all SBIR funds must be matched by the awardees.

The financing could be provided by EU funds, by allocating a small percentage (1%) of EU funds managed by agencies of all ministries.

**Business support services for start-ups: centres for concept stores and young designer experimentation and development**

A major need of start-ups is to have support in business areas like marketing, project management, or simply legal and technical advice in the areas where they operate. The aim of this program is to establish in the incubator and/or regional R&D centres a small group supplying those services, on demand, as well as to provide mentors and matching entrepreneurs that could give support and advice. Similarly, the government could provide some commercial space for, on a limited time basis, designers and start-ups could expose their products or services to consumers and market suppliers.

**Management training program for small and medium enterprises**

The aim of the Management Training Program (MTP) for SMEs is to provide training at regional level, tailored for the specific needs and characteristics of SMEs, directed at improving their management, financial, marketing and production techniques. It would be implemented by executive and extension services of the best business schools of Portugal.

**How it will function:** Short and targeted training actions, tailored to SMEs in all regions of the country. These actions would comprise: (i) seminars and short courses in management, marketing, financial management, accounting and market development, (ii) On-the-job training given to a small number of participants targeted to problem-solving of that group. All the teaching is based on case studies, with specific cases of EU and Portuguese SMEs.

**Rationale:** Need to improve level of quality of management and to open new horizons of technological and marketing levels for the Portuguese SMEs.
Who may supply assistance: Contracts between Ministry of Economy and best business schools of the country or abroad. Submit the program to competitive bidding by different components and regions. Submit to a permanent evaluation of results.

Who should receive assistance: SMEs between 50 and 500 employees, selected by a committee of regional representatives of business organizations and Ministry of Economy, based on submission of candidacies. Priority given for export and import substitution manufacturing and support for manufacturing.

Additional aid to SMEs: Competitions with projects for funding by special lines. Prizes for best SMEs improvements.

Budget: There would be 40 seminars and short refreshing courses in the different regions of the country plus 100 actions of on-the-job training in medium enterprises. Total estimated cost: 500 thousand Euros.

Financing: Special line of financing under the structural funds.

Organization and implementation of the program: The management of the program will be outsourced to a top university, under an annual contract and competitive bidding.

**Rethinking Extension Services for SMEs**

Technology and innovation advisory services are services to provide information, technical assistance, consulting, mentoring, and other services to support enterprises in adopting and deploying new technologies and in commercialising innovations. Examples include the: Manufacturing Advisory Service (England), the Manufacturing Extension Partnership (USA), and the Industrial Research Assistance Program (Canada). Technology and innovation advisory services are also provided by technology centres and other business assistance programmes. Such services are typically targeted at small and medium-sized enterprises. A defining capability of technology and innovation advisory services is the offer of expert one-on-one guidance to individual companies through extension staff, field offices, or dispersed technology centres. The available studies generally find that technology and innovation advisory services provide positive benefits for participating firms. The types of benefits achieved include reductions in costs, improved quality, reduced waste and improved environmental performance, higher productivity, and new product development and innovation. Net benefits achieved are typically relatively modest, but commensurate with the relatively small amounts of public funding usually invested. They have been leveraged with partnerships in several countries.
Box 3: The Manufacturing Extension Partnership (MEP)

The Manufacturing Extension Partnership (MEP) was created in the USA in 1988 to improve the competitiveness of firms in order to “disseminate technical information”. In response to the Japanese threat to US manufacturing, MEP helped SMEs to improve quality on a continuous base, by adopting methods of lean manufacturing, ISO certification and technological improvements. With the rapid rise of low-cost manufacturing, especially in China, MEP now offers growth-related services, focusing on enhancing the innovative capacity of small manufacturers. In addition, MEP has increased its partnerships in federal and state initiatives, served as bridge to technology sources, with cost-sharing with firms, designed to advance the competitiveness of U.S. manufacturing, expanding MEP’s impact beyond individual firms to entire industry supply chains, manufacturing communities, and innovation ecosystems. It has helped to develop new products and customers, expand into global markets, adopt new technology and reshore production. Since 1988, MEP has worked with nearly 76,000 manufacturers, leading to $79 billion in sales and $12.8 billion in cost savings, and it has helped create more than 636,000 jobs.

MEP is a public-private partnership, designed from inception as a cost-share program. Federal appropriations pay one-third, with the balance for each centre funded by state / local governments and/or private entities, plus client fees. At the local level, MEP centres partner with 2800 service providers – with expertise in workforce, technical tools related to the shop floor and IT, and manufacturing and business processes – to deliver additional support to manufacturers. Centres also collaborate with state leaders and regional stakeholders such as universities, community colleges, and area economic development organizations to leverage investments, research, and activities that help grow manufacturing companies and jobs. And increasingly centres serve as an invaluable partner in support of government initiatives launched to strengthen U.S. manufacturing, serving as a bridge between the manufacturing community and collaboration partners. Specifically, centres:

- **Educate** local and regional partners on small and medium sized manufacturer needs and drivers of behaviour.
- **Provide outreach** to manufacturers by connecting them to other programs and services offered by partner organizations.
- **Connect the gap** between technology developers / R&D organizations and manufacturers: finding firms that are interested in a particular technology, as well as informing tech developers of manufacturer’s technology needs.
- **Support** workforce development programs.
In support of federal initiatives such as those related to advanced manufacturing, technology transfer, supply chain, and sustainability, local MEP centres are involved in regional consortia, providing ground-level support. Some examples are:

- **AMTech (Advanced Manufacturing Technology Consortia)** - Supports industry-driven collaborations that address high-priority research challenges impeding the growth of advanced manufacturing in the U.S.
- **NNMI (National Network for Manufacturing Innovation)** - Local consortia will leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.
- **AMJIIAC (Advanced Manufacturing Jobs and Innovation Accelerator Challenge)** - Supports advanced manufacturing clusters that will help revitalize U.S. manufacturing and spur job creation.
- **M-TAC (Manufacturing Technology Acceleration Centers)** - A program goal is for MEP centres to efficiently connect researchers, scientists, and engineers with SMEs and to serve as coordination points within key supply chains.
- **E3 (Economy, Energy and Environment)** - Coordinated federal and local technical assistance initiative that is designed to improve production and profitability through reduced energy usage and environmental impact.
- **IMCP (Investing in Manufacturing Communities Partnerships)** - A competition launched in 2013 by the Obama administration, IMCP encourages communities to develop a comprehensive economic development strategy. MEP centres in the 12 communities involved in this initiative are providing supply chain support.

Through partnerships, MEP supports multi-agency initiatives that encourage reshoring:

- **Make it in America Challenge** - The MIIA program is a partnership between NIST/MEP, the Department of Labour, and the Economic Development Administration. Also, local MEP centres are collaborating with regional partners.
- **Buy America/ Buy American** - Federal agencies partner with MEP in its Supplier Scouting program to find American suppliers for their procurement needs.

Increasing exports is a priority at every level of government. MEP’s successful program is built on a partnership with several export assistance organizations:

- **ExporTech** - Export assistance program jointly offered by MEP and the U.S. Commercial Service, ExporTech connects SME participants with experts from FedEx, District Export Councils, State Trade Economic and Development groups, the Export-Import Bank, and the Small Business Administration.

MEP centres collaborate with their state governments on numerous initiatives to grow manufacturing and manufacturing jobs.

MEP is partnering to serve non-traditional segments such as the Maker Movement (artisan-scale manufacturing often spurred by innovative technologies such as additive manufacturing) and collaborating with start-up initiatives like FuzeHub in NY.
The Portuguese Institute for Support to Small and Medium Enterprises and Innovation (IAPMEI) was created in 1984. The objectives inscribed in its charter are all the objectives described in this section however it is far from reaching those objectives. It has a budget of 54 Million Euros and with a staff of 230 technical personnel. According to data for 2014 it helped in the preparation of 50 investment projects, subsidized 170 start-ups, gave scholarships to 850 young entrepreneurs, contributed to the training of 364 SMEs and helped 1000 enterprises in the process of technology and knowledge transfer. Furthermore it helped in the recovery of 8 enterprises and made the analysis of candidacies for the requests of investment incentives. As we can see not only has small resources as its impact on the universe of 250 thousand enterprises is a drop in the ocean to have any significant impact. There is also a problem with several functions that should be performed by entrepreneur’s associations and not by civil servants, like the analysis of investment projects of SMEs.

The coverage of manufacturing extension services is much higher in the US and Canada then in Latin America, as Figure 32 illustrates. The coverage in Portugal is about 3 to 4%, comparable to Latin America.

8. CLUSTERS AND INFRASTRUCTURE: COORDINATION, CLUSTERS AND DEVELOPMENT POLES

8.1. Infrastructure: global platforms and logistics

The NIS needs to be supported by an appropriate and developed infrastructure, in particular physical infrastructures (i) information and communication infrastructure (optical fibre and broad band networks), (ii) transport system, with easy connections to the major urban and R&D centres, and depositories of knowledge: books and major scientific journals.

8.2. Inner city reconstruction and revitalization program
Substantial amounts of investment have to be dedicated to urban infrastructures in order to build the cities of the future. One of the priorities is to restore and redevelop the inner cities of Portugal, starting with Lisbon and Oporto, in a program of reconstruction of real estate with multiple and integrated purposes of residential, commercial, cultural and state purposes, as well as revitalize the centres to attract tourism and revitalize its local economies.

Some quarters of our cities have fallen in a state of dilapidation, with buildings falling into disrepair, attracting marginal and low value activities, ultimately giving a postcard to our populations and the world of a disinherit society in deep crisis. Situations of inner city crisis have been experienced in several developed countries like in Washington DC, New York and Baltimore, to just cite a few. Successful programs of reconstruction and revitalization have been carried out in the 1980s and 1990s. We have to learn from these experiences and undertake policies to urgently correct the situation.

The benefits of these policies far outweigh the costs. Revitalizing and reconstructing our inner cities, in particular the two major ones, has an impact on: (i) cultural and social consciousness of the Portuguese, including their sense of belonging to the history of this great country, (ii) multiplier effect on the regional and national economy, (iii) attracting tourism and FDI to the country. There is no worst impression to a foreign investor or tourist when they take with them the impression of a dilapidated and crumbling inner city.

Pre-conditions for success: (i) A Committee with appropriate executive power to implement policies staffed with highly qualified specialists, (ii) legal instruments to enable the implementation of the program, (iii) some major individual projects that would be the anchor(s) of the program, (iv) mobilization of the local communities to undertake the program, (v) minimum financial resources. The program may require well defined exemptions in terms of real estate laws and have special tax treatments. It is also important to have a medium to long term program.

Conditions for success: (i) There has to be a critical mass for generating the required renewal, (ii) The program should be community based and mobilize all social players, (iii) It requires an integrated approach in terms of productive activities, residential, administrative, cultural and leisure activities, (iv) It should preserve strictly its historical architecture and heritage, (v) Empowerment of a single authority with executive powers on the intervention area with required legal capabilities, (vi) There is a need for relocation of residents and businesses that do not have the capacity to pay the high rents of a prime space in the area of intervention, which requires complex negotiations and solutions on a case by case. Previous success cases: The Program and Fund for Reconstruction of Chiado can be considered a success story after the major fire that destroyed that part of the downtown Lisbon. An initial fund was set-up with monies from the central government, municipalities and EC, as well as donations from several sources. The fund was administered by the Banco de Portugal, and gave subsidies to interest rates. A committee with distinguished architects and urban planners was set-up, and the mayor of Lisbon gave it a major priority in his policy agenda. Another important program has been the reconstruction of old buildings in danger of destruction but without financial means by the owners to save them. However, the program has been largely underfunded. Another
problem is that some major and central buildings have been plagued by problems of inheritances.

**Financial resources:** Substantial financial resources need to be mobilized under public-private partnerships to undertake these projects. Past governments have poured billions of euros in urban projects like the Expo 1998 and major infrastructures, without any regard for the priorities of maintaining a healthy and beautiful capital, preserving its historical value. Besides the revitalization of their economies, that would make a major contribution to the regional and national economies, there are major externalities in terms of tourism and even the “proud of being Portuguese”. The Jeremie Funds from EIB could be complemented with other sources.

### 8.3. Clustering and modern urban centres

National Innovation Systems are mapped into the national territory, and the obvious question to ask is if they are located in coordination with the clusters and networks that represent the most dynamic activity in the country. The need to create clusters of Universities, Laboratories and Enterprises in the manufacturing or services sectors derives from the complementarities generated. These stem from the economies of scale, economies of scope and different types of externalities that generate agglomeration economies. The regional articulation of primary, secondary and tertiary R&D centres with the economic activity is of the utmost importance. The creation of a network of technological and design centres of excellence linked with industries or services is part of the regional planning.
8. CONCLUSIONS: SEQUENCING AND COMPLEMENTARITIES

Innovation is a fundamental and encompassing process that extends largely from R&D (only about 10-15% of total innovation) and includes the process of accumulation of intangible capital at enterprise level. It contributes 20-30% to Total Productivity growth in developed economies. As the case of Korea shows in order for an intermediate-level country to develop it has to continuously upgrade its technology. And recent research has also shown that as the country reduces the technological gap the creative and “software” parts of infrastructure become more and more important. Given the position of Portugal we estimate that about 25 to 35% of innovation has to come from creation and close following of leading technology and the majority has to come from technological upgrading and imitation of top technologies, obviously adapted to the local capabilities. However, it should be printed at the front of all programs that innovation is carried out by firms and the state is just the enabler and incentivizer.

There have been significant improvements in the centres for generating knowledge in Portugal. There was a large expansion of universities and state financed R&D is now close to EU averages. However, its impact on the technological capacity of the Portuguese economy is rather limited. Portuguese researchers are among the least productive in terms of patents in Europe, and the ratio of high-tech exports over R&D is also among the lowest. How to improve the capacity for generating knowledge into improvements in the technological capacity of the country? This is the main question that needs to be addressed in the next decade in order to bring the country closer to the EU average and stop the degrading of its performance relative to its European partners.

First, starting with Universities, further reforms have to be implemented to increase research productivity and make the human capital generated a contributing factor to economic and technological development. Make universities more autonomous and competitive, change the financing system to reward outputs – performance in market outcomes – and give priority to applied research with commercial use. Strengthen the links between universities, laboratories and industry. Second, Reform laboratories and integrate them with universities and industry. One avenue is to privatize them and transform them into Private-Public Partnerships like the reforms in the UK. They also need to be revitalized and reoriented to support the strategy of industrial competitiveness of the country.

Third, decentralize some of the laboratories and harness efforts of several programs of IAPMEI and Ministries of Science and Technology, including regional universities and polytechnics to set up a network of Design and Technological Centres dedicated to the main industrial and service sectors and integrated in regional clusters. These could constitute the core of the technological upgrading of the enterprise structure.

Forth, create environments and systems conducive to start new enterprises incorporating new technologies. This requires financing start-ups and other forms of Venture Capital, campus for incubators and technological parks endowed with appropriate infrastructures.

Fifth, policies to increase R&D and innovation at enterprise level have to go hand in hand with policies to attract multinationals into the country. Our research has uncovered a strong
relationship between high-tech exports and enterprise R&D with FDI inward investment. Policies to attract FDI have to address questions of business environment, availability of talent, taxes and having scientific vibrant and culturally attractive urban centres, as the case of Ireland shows.

This brings us to the sixth policy that is related with building clusters of learning-research-industry and services that are not only leading cities that attract students, scientists and technicians but have also the logistics and networks to fully integrate them into the world economy. Portugal has the natural and human resources that could become such beacons of science and technology but needs to make a large effort in transforming them into world-class centres.
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