



OECD Knowledge Triangle Project. Report on Greece

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This report has been prepared by National Documentation Centre (EKT) as part of an OECD-project organised by the Committee for Scientific and Technological Policy (CSTP) and the Working Group on Innovation and Technology Policy (TIP).

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Part I

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Part II

Data concerning Part II were provided by the institutions themselves, on the basis of a questionnaire template provided by OECD. To ensure an up-to-date and timely collaboration with the institutions, EKT established a direct line of communication with the selected institutions. In more detail, EKT collaborated with:

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Contents

Executive summary.....	3
Introduction.....	8

PART I: Overview of the KT in Greece

1. The knowledge triangle in Greece. The current state of play.....	13
2. The position of the higher education sector in the knowledge triangle.....	33
3. Funding research and higher education	41
4. The role of place-based policies in the KT	45
5. Evaluation of higher education and research	49

PART II: KT-related activities in selected HEIs

6. University of Crete.....	53
7. Athens University of Economics and Business.....	59
8. Aristotle University of Thessaloniki.....	69
References	80

Executive summary

The global financial crisis that began in September 2008 reached Greece in the form of a sovereign debt crisis. Since then, and due to the rapid deterioration of macroeconomic indicators, Greece has lost about 25% of its gross value added, official unemployment has reached 27%, while private consumption declined by almost 30%. Fiscal consolidation and radical broad reform policies have been initiated by the Greek state as a means of economic adjustment. These policies led to the significant reduction of the General Government deficit - from 15,2% of GDP in 2009 to 3,5% of GDP in 2014.

Despite horizontal cuts equally affecting institutional funding in Research & Development, the National Strategic Reference Framework (NSRF) during the 2011-2015 period compensated for these budgetary cuts and resulted in a slight increase in GERD. However, cross-country comparison throughout the years places Greece at the lower rank of R&D Intensity among EU member states, revealing a more permanent and structural character in this deficit than the crisis effects. While the State is the main actor in the area of research (being the main R&D performer and funder), the business sector underperforms in R&D activities. The Higher Education Sector accounts for a significant share in total GERD, i.e. 40%, one of the highest among EU. It is to be noted, that higher education has been more severely hit by the crisis given that funding in 2014 has been reduced by 40% when compared to 2009. The main institutions of HES are Universities -ISCED6, 7, 8- and technological educational institutes -ISCED6, 7- which are public entities. There are also private educational organisations which are part of the post-secondary educational system. Public professional academies or schools that deliver ISCED5 and 6-level diplomas are not R&D-active dealing mostly with education and training.

A finding of this analysis points to strong interactions between education and research. As in the case of Crete, where linkages have been developed between the University of Crete and the Foundation for Research & Technology (FORTH) allowing for human capital mobility and knowledge spillovers. Yet, it should be noted, that these interactions may take place not in a completely structured manner, given that close geographical proximity allows for a multitude of possible interfaces.

On the other hand, interactions between HEIs and business sector have a rather occasional and short term content. Data shows that the share of the R&D that is performed by higher education sector and is funded by business sector is one of the highest among EU countries. However, one should have in mind that very few companies have their own R&D departments and HEIs, as the main R&D performers in the country, are often the only solution, especially for basic research. Indeed, a high percentage of innovative enterprises do engage in cooperation of any type, especially with HEIs, where national performance reaches the EU-average. It is found in this report that the level of cooperation between the main R&D performer (HEIs) and the main potential R&D user (business sector) could be significantly improved. This is depicted in the low numbers of scientific co-publications in international journals, implying weak knowledge flows between public-private sectors. Congruent to this, is the career of PhD holders. HEIs stand as the main employer of this group, followed by the government and the business sector.

In order to enhance the blossoming of relationships between academia, research and business sector and the national innovation potential, the State, mainly through the General Secretariat for Research and Technology, is regularly launching a number of RDI programmes. These measures seek to enhance the interaction between the private and public sector (meaning, HEIs and public research centers) either by increasing the 'entrepreneurial contribution in the research effort', or by 'linking the RDI with the national productive nexus'.

In addition, significant policy initiatives have been undertaken or are under elaboration, contributing to national efforts to implement an alternative, sustainable knowledge-intensive growth model that will allow Greece to overcome recession. Specific measures regarding the research, technology and innovation sector aim to enhance the national scientific production, as well as cooperation between the main R&D performers in Greece, so as to achieve better interaction among them and greater exploitation of research results in the real economy and production.

Institutionally, tertiary education in Greece is supervised by the Ministry of Education, Research and Religious Affairs (MoERRA). While MoERRA determines operational matters such as recruitment, funding, students' enrolment, etc., higher education institutes are autonomous to a large extent in dealing with academic and managerial issues (e.g. structure). Concerning issues of funding, the severe reduction of the latter, to more than 45% has led HEIs towards seeking alternative, non-institutional –and probably non-public- funding. In this context, HEIs revised their strategies intending on broadening their activities, and overcoming past practices focusing on education and research, offering mostly theoretical and general-purpose knowledge. This shift has not been ubiquitous across all HEIs, as some HEIs or even specific faculties may be more “business-friendly” or facilitate linkages with the business sector than others, yet the dominant perception has not come in terms with HEIs' “third mission”, or the third dimension of the “knowledge triangle” scheme. Therefore, a set of related issues limiting the linkages between the academic and the business community should be overcome. For instance, in terms of substantial R&D networking, mobility, spin-offs, etc. In similar vein, HEIs' external evaluation committees have been arguing in favour of fostering closer ties between entrepreneurship to HEIs.

This report finds the issue of local embeddedness of HEIs multi-variate. Even in non-R&D intensive Regions, the degree of embeddedness into the social fabric is important, for example via the housing and infrastructural amenities. Furthermore, there is usually a high rate of students living in the specific Region that enroll in local HEIs, while HEIs cater for local societal challenges, as expressed by local authorities via requests for planning and consultative services. Furthermore, Regional Operational Programmes – managed by Regional authorities - finance RDI-related investment. This investment, in turn, has been requested by the local HEIs and research centers. Due to the smart specialisation strategy, which places emphasis in nurturing stronger ties of local embeddedness, this report finds that this interaction will probably increase in the near future.

For the purposes of this report, three universities (the University of Crete, UoC, the Athens University of Economics and Business, AUEB, and the Aristotle University of Thessaloniki, AUTh), were selected as case studies to examine their activities and strategies regarding the knowledge triangle. UoC is one of the largest regional universities, covering humanities, social sciences, S&T and medicine; AUEB is one of the oldest universities, with a strong tradition in the fields of Economics and Business, while AUTh is the largest university in Greece, including a wide range of faculties (hard sciences, humanities, engineering, etc.). R&D intensity (total R&D expenditures as % of total budget) in these HEIs range between 25% and 40%. In each HEI, the Research Secretariat (ELKE) is responsible for R&D management on project grants and contracts. As far as institutional initiatives supporting the knowledge triangle are concerned, NSRF 2007-2013 has funded the establishment of the *Innovation & Entrepreneurship Unit* (IEU-MOKE) in all three HEIs, aiming at integrating research, education and innovation. This should be achieved via seminars, presentations and mentoring on entrepreneurship, etc. The UoC has a long tradition of collaboration with FORTH, the regional public research center, enabling increased mobility and scientific interface. UoC participates in the Crete Innovation Initiative, the Science and Technology Park (STEP-C) incubator and has established strong links with the Regional authorities. AUEB stands as the first Greek HEI that introduced courses in entrepreneurship and implemented a strategy for “Innovation and Entrepreneurship” since

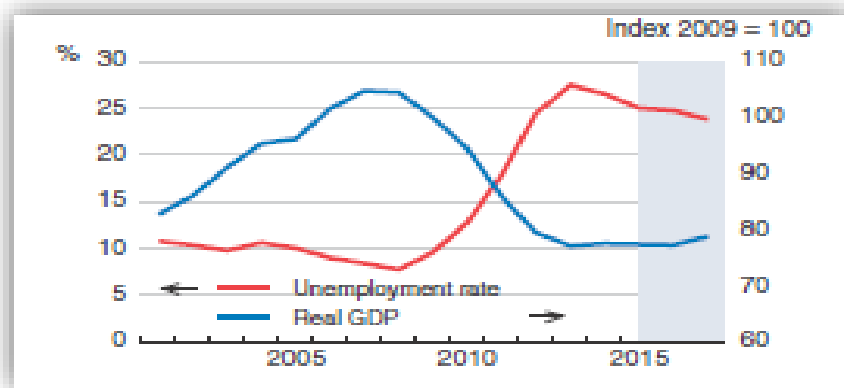
the early-2000s. Its main tool for supporting third missions is the *Athens Center of Entrepreneurship and Innovation (ACEin)*, the University's incubation center. AUTH is elaborating on an institutional strategy facilitating the transition from knowledge to innovation, in addition to having established strong links with the Regional authorities and participates in a pre-incubator establishment of the Municipality of Thessaloniki for entrepreneurship development (OK!Thess).

Introduction

Dimensions of macroeconomic performance of Greece

The global financial crisis that began in September 2008 reached Greece in the form of a sovereign debt crisis. Since then, the country has been experiencing a deterioration of macroeconomic indicators, thus making the country the single most hardly hit EU country. Over a seven-year period (2008-14), as shown in figure 1, Greece lost about twenty five per cent (25%) of its gross value added, official unemployment has reached twenty seven per cent (27%), while private consumption declined by almost thirty per cent (30%).

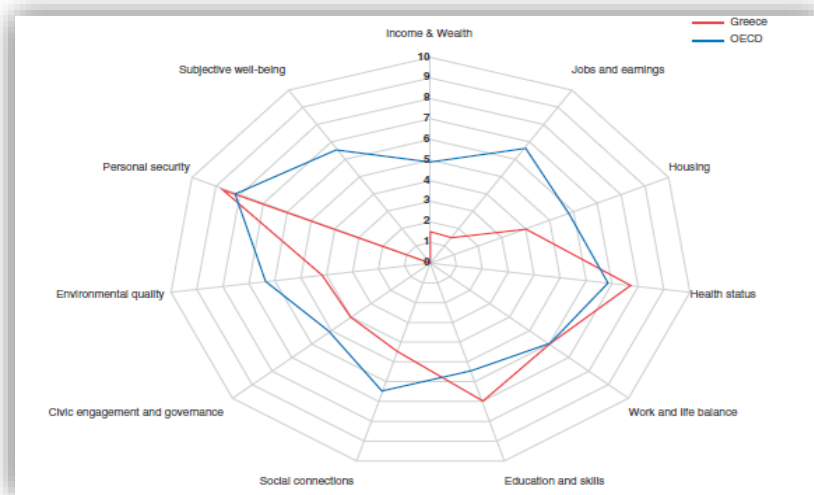
Figure 1: GDP and unemployment rate in Greece



source: OECD (2016)

These conditions illustrate the deterioration of Greek citizens' living standards in recent years, being now below the OECD-average in several relevant indicators-variables. According to the following figure, Greece follows the OECD-median in the areas of 'income & wealth', 'jobs and earnings' and 'housing'. The same pessimistic overtone can be observed in the productive potential of the economy, which has also been adversely affected during that period.

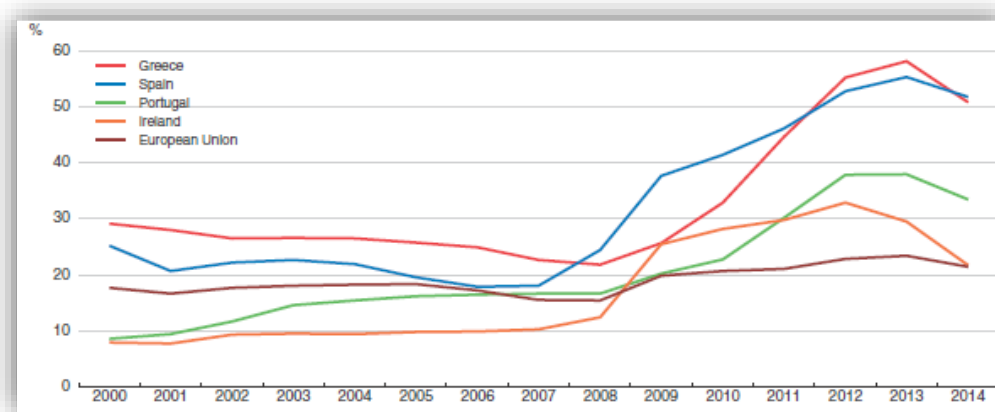
Figure 2: Well-being indicators in Greece and in OECD countries



source: OECD (2016)

However, the Greek State has engaged an ongoing economic adjustment that entailed fiscal consolidation and radical reform policies of broad scope, that contributed to the vast reduction of the General Government deficit, from 15,2% of GDP in 2009 to 3,5% of GDP in 2014. At the same time –though- public debt is among the highest in the world in relation to GDP. On the other hand, recession and weak demand and output losses have also undermined job creation dynamics. Thus, unemployment rate ranged within markedly high levels, with youth unemployment rate still affecting more than one half of the youth labor force (figure 3).

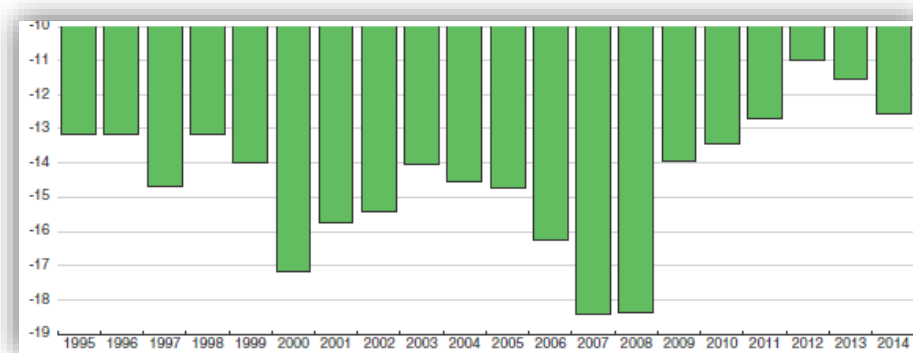
Figure 3: Youth unemployment in selected countries



source: OECD (2016)

As far as trade performance is concerned, Greece has relatively low exports and imports, given its rather small size and had a persistent trade deficit that is cut down during crisis (figure 4).

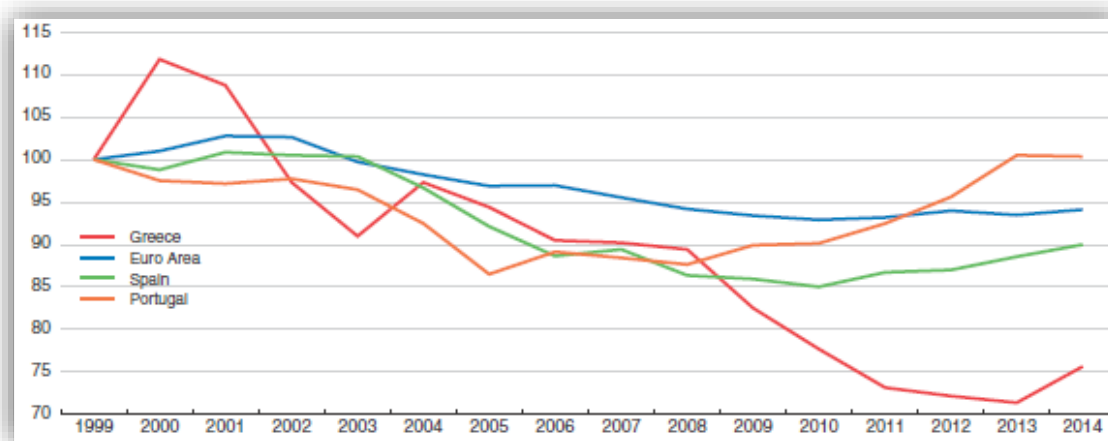
Figure 4: Trade balance, Greece (as % of GDP)



source: OECD (2016)

Nevertheless according to the Ministry of Finance (2015), the turn of focus towards a more extroversion-oriented economic model seems to have positive impact during crisis, even though a large portion of this export increase can be attributed to the sector of petrochemicals.

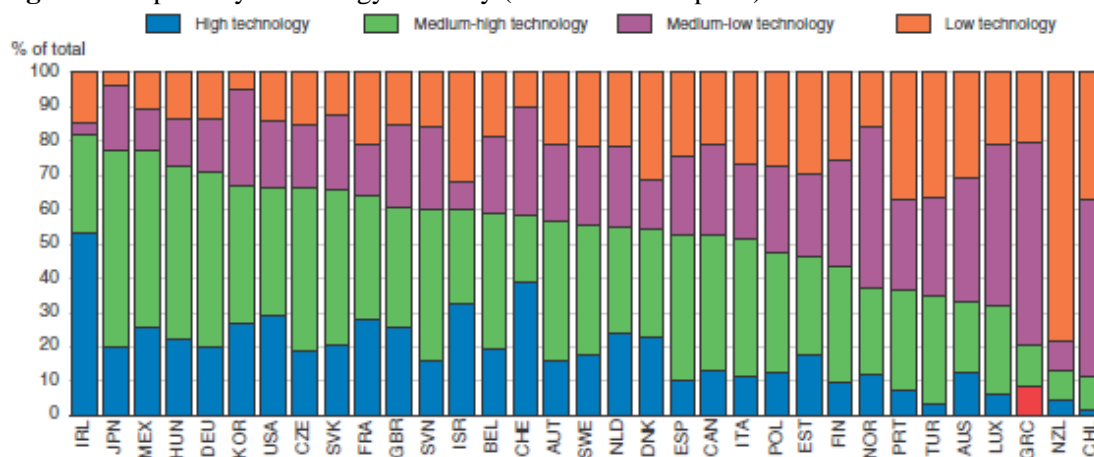
Figure 5: Export performance, Greece (index 1999=100)



source: OECD (2016)

As a matter of fact, the pattern of specialisation plays an important role in constraining Greek export performance (Athanasoglou et al. 2010). Greek exports are concentrated in low and medium low -technology products, while high and medium-high technology products, which have higher world market growth rates, constitute around 20% of total exports (figure 6). According to the OECD (2016), Greece is not well integrated into global value chains; and the weak specialisation of Greek exports and dominance of low-tech goods explains to a point the low integration in GVCs. One should have in mind, though, that the integration in GVCs enhances competitiveness by providing access to cheaper, more differentiated and better quality inputs (OECD 2013a).

Figure 6: Exports by technology intensity (as % of total exports)



source: OECD (2016)

Research, technology and innovation: current state of play in Greece

Despite Greece raising R&D funding during crisis, thanks to the National Strategic Reference Framework, compensating for the budgetary cuts on institutional funding since 2009, data on cross-country comparison shows that Greece is still placed at the lower rank among EU member states.

The State is the main actor in the area of research and tertiary education in Greece, while the business sector underperforms in R&D activities, when compared with other EU countries businesses. Funding from abroad, mainly from the EU (namely funds from Framework

Programme-FP) is important, providing 10% of the total R&D funds. In terms of regional allocation, three regions (Attiki, Kentriki Makedonia and Kriti) account for approx. 80% of total R&D spending.

Despite the designation of the national innovation system as rather weak-to-medium, certain elements of it do indicate above-average qualities. First among those is the potential of research human capital. If publications are a safe measure of the productive capability of the science base, then the domestic human capital, given the intertemporal low levels of R&D funding, manages to attain a robust publication-, citation- and impact-rate among EU and OECD countries. A second positive point of the domestic innovation system is the issue of participation in the European R&D projects. The country has managed to receive funds amounting to more than 1 billion €, a sum that surpasses many of the other member states.

As far as innovation performance is concerned, Greece is a moderate innovator member state, while data reveal an overall satisfactory state of Greece's innovative enterprises. More specifically, the performance is better when comparing organization/marketing innovative enterprises and worse when comparing product/process innovative enterprises. On a positive tone, Greek innovative enterprises rank the highest among EU countries for the acquisition of machinery, IT, software.

RTI-related policy initiatives in Greece

Significant policy initiatives have been undertaken or are under elaboration, contributing to national efforts to implement an alternative, sustainable knowledge-intensive growth model that will allow Greece to overcome recession that has hit national economy since 2010. Specific measures regarding the research, technology and innovation sector aim to enhance the national scientific production, as well as cooperation between the main R&D performers in Greece, namely HEIs and PRIs and the main potential user of research results, namely the business sector, so as to achieve better interaction among them and greater exploitation of research results in the real economy and production. An indicative presentation of these measures is the following:

- The new Law for Research and Innovation, among other issues, introduces the National Strategic Plan for Research and innovation as well as the Regional Councils for Research and Innovation. The new law also introduces simplification procedures for the management of Research and Innovation funds which also apply for the National Strategic Reference Framework (NSRF) Funds
- The planning of the National Roadmap for Research Infrastructures 2014-2020 has been completed. The primary objective is the priority development and upgrading of existing infrastructures, in order to enhance their use and their extroversion, competitive orientation, as well as their critical mass
- The national Smart specialization Strategy 2014-2020 has been approved by the European Commission, while thirteen (13) regional RIS3 strategies have also been finalized. The main objective is the productive restructuring of the country, on the basis of research, technological development and innovation. Smart Specialisation Strategy, a conditionality criterion laid down by the EU for ERDF financing in 2014-2020, introduced certain novelties in the way of selecting strategic issues and contributed definitely to the prioritization of the RTI sector in the national political agenda
- Innovation Platforms have been created around priority sectors (ICT, energy, environment, agrofood, culture-tourism-creative industries, transport, advanced materials, Life Sciences & Health - Medicines) bringing together all relevant stakeholders, in order to identify the main "activities" and "actions" to be addressed in the National RIS3 Strategy. The platforms implemented the "entrepreneurial discovery procedure", and will remain active until 2020

- As far as funding on RTI is concerned, i) the anticipated establishment of a Greek Innovation Fund -by the Ministry of Education, in cooperation with the European Investment Fund-, ii) the implementation of the National Strategic Reference Framework (the Operational Programme “Competitiveness, Entrepreneurship and Innovation” combined with other major initiatives such as the “Operational Programme for Human Resources Development, Education and Life-Long Learning) and iii) the forthcoming new Investment law are expected to raise further national GERD in the near future
- Given the fact that many policy measures adopted since 2010 deal with supporting innovation, the total volume of public support to business innovation is expected to further increase in the next period

The National Documentation Centre (EKT) -one of the main Research Development and Innovation (RDI) policy-supporting actors in Greece- aspires to contribute to these efforts through its activities and its ability to provide access to research results that may be used as channels of knowledge transfer between knowledge-intensive bodies from all sectors. EKT’s initial mission to record, document and disseminate the country’s scientific output has been extended in recent years to also monitor the input (both financial and human resources) that is invested on research and innovation activities. Since 2012, EKT is the competent authority to collect data and produce the national official statistics on RDI. Besides data collection that covers all sectors that perform RDI, EKT processes administration data for both benchmarking and validation purposes, making also tailor made requests to access RDI-related data, and providing main RDI data to National Statistical Authority (ELSTAT), Eurostat and OECD. In addition, EKT represents Greece in numerous Eurostat and OECD indicators-related meetings¹; publishes on a regular basis i) RDI metrics surveys and ii) bibliometric studies, using data from Scopus and Web of Science; participates in EuroCRIS initiative, contributing to the maintenance of the Common European Research Information Format (CERIF), promoting also open access activities; and is a long standing partner of the European Enterprise Network (EEN), a European initiative that seeks to enhance enterprises’ innovation activities.

This report presents the current state of play on the knowledge triangle in Greece and was carried out by the National Documentation Centre (EKT), as part of an OECD-project organised by the Committee for Scientific and Technological Policy (CSTP) and the Working Group on Innovation and Technology Policy (TIP). The structure of the report followed the relevant guidelines of the OECD, which specified also the mandate of the study. This report intends to analyse knowledge triangle policies and practices in Greece on the national level, using also case studies of specific higher education institutes, according to the template that was developed by the OECD.

¹ For instance, OECD NESTI group (working right now on the revision of Frascati Manual), OECD network for Statistics on the Career of Doctorate Holders (CDH); Eurostat Working Group on statistics on Science, Technology and Innovation, Eurostat Task Force on R&D Statistics and Eurostat Task Force on CIS statistics; DG Research consultations on Statistics and Indicators on Gender Equality in Science, Research and Innovation (SHE figures publications).

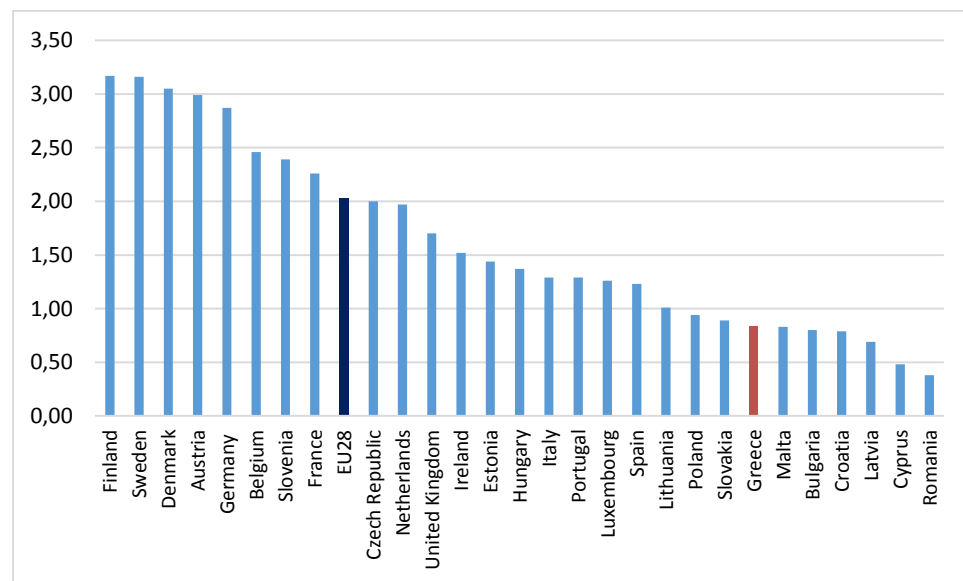
PART 1: Overview of the KT in Greece

1. The knowledge triangle in Greece. The current state of play

Overall R&D Performance

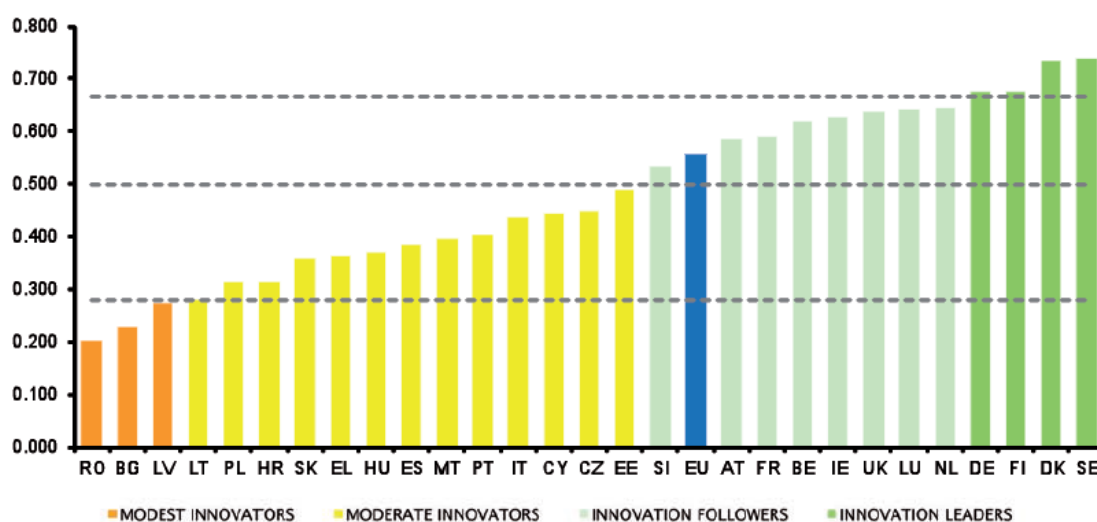
The European Commission has recognized the role and significance of knowledge creation and technological progress on economic growth, job creation and social progress, especially since the 2000s and the agreement for Lisbon Strategy and the “Europe 2020” project. In Greece, the economy and the local production system have experienced a significant growth period during that decade, which however has not resulted in a shift to a stable innovation or knowledge-intensive production model. The national innovation system is described as rather weak, for instance when R&D intensity is taken into account (figure 7), while according to the European Commission (2011, 2015b) Greece is a moderate innovator member state (figure 8). According to the latest data, available from the National Documentation Centre national survey on R&D statistics, R&D intensity in Greece has slightly increased from 0,66% in 2008 to 0,69% in 2012 and 0,84% of GDP in 2014. This however is partially due to the significant decrease of GDP since 2009.

Figure 7: R&D intensity (GERD as % of GDP, 2014)



Source: Eurostat (*rd_e_gerdtot*)

Figure 8: EU member states' innovation performance



source: European Commission (2015b)

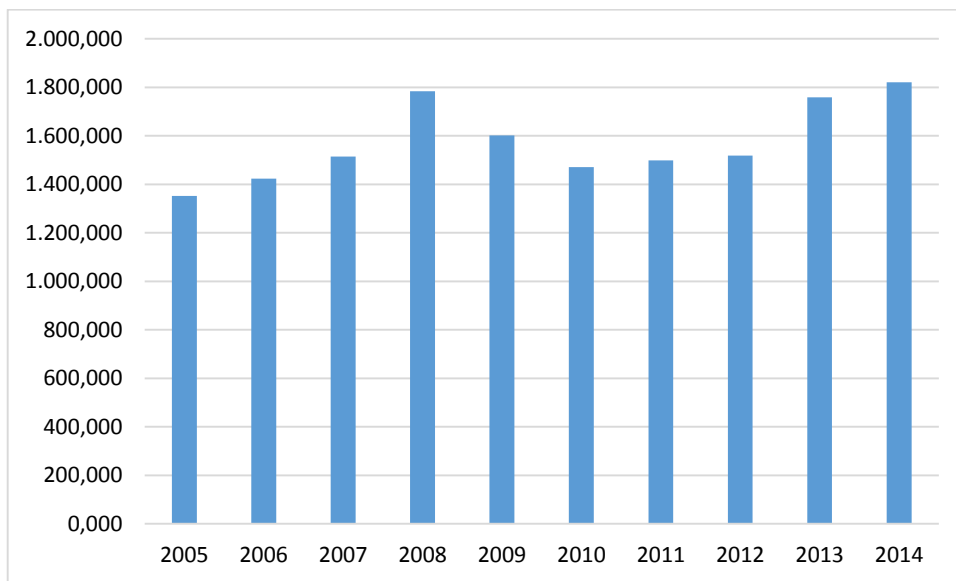
The overall R&D investment had grown significantly during the years 2000-2006, but this growth was offset by an even stronger growth of the GDP. Later on, the economic crisis caused the revision of the national R&D intensity target at 1.2% by 2020, a less ambitious target than the 3% set by the EU (European Commission 2014a). Thus, although gross expenditure on R&D increased after 2012, due to favorable conditions related to the National Strategic Reference Framework's² (NSRF) closing, R&D intensity in Greece remains the lowest in EU-15 and among the lowest in EU-28.

Economic crisis and the impact on research, education and entrepreneurship

In the context of the fiscal crisis, expenditures on research are among those public expenditures of the State's ordinary budget that were slashed in an effort to tackle central government's deficit. Thus, national R&D expenditure has been facing an additional challenge, namely to resist to significant horizontal, across the table, cuts (figure 9). However, the low national research and technology funding is not only related to the economic crisis. Instead, the country's relative position has slightly improved during the crisis, thanks to NSRF's high contribution to public research and technology funding during its closing years (2013-2015), compensating for the budgetary cuts of the last five years.

² The NSRF is related to EU's Structural Funds for Greece for the period 2007-2013.

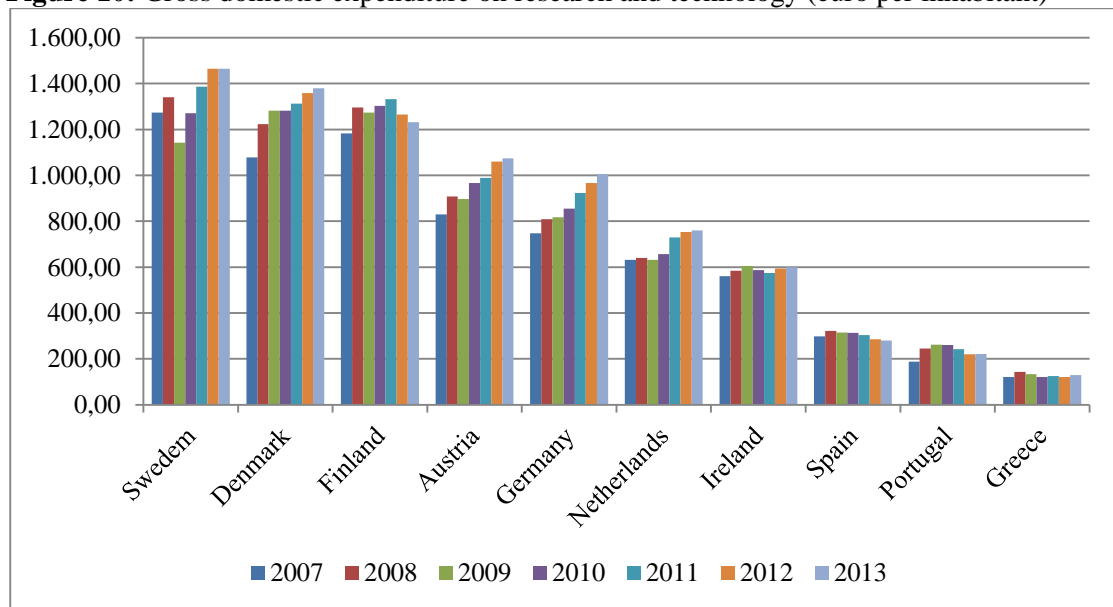
Figure 9: Gross expenditure on R&D in Greece (million PPS)



source: Eurostat (rd_e_gerdtot)

This slashing, though, ran against to other countries' counter-cyclic approach towards R&D spending, themselves also facing extreme deterioration of macro-economic conditions. Instead, they opted for fiscal protection even increase of public R&D funding (European Commission 2014b), as figure 10 illustrates.

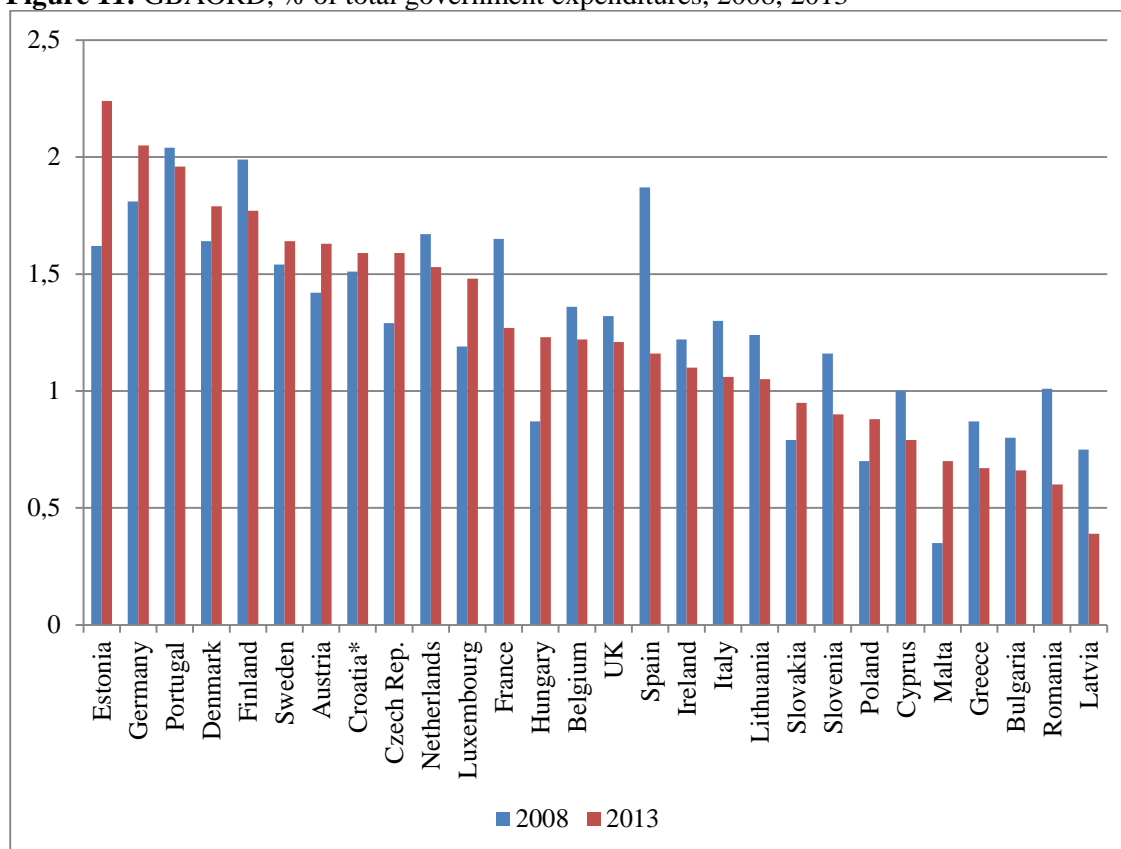
Figure 10: Gross domestic expenditure on research and technology (euro per inhabitant)



source: Eurostat (rd_e_gerdtot)

In terms of government budget appropriations or outlays for R&D (GBAORD), it is clear that reductions between 2008 and 2013 are to be seen not only in Greece, but also Latvia, Romania, Spain and France. Nevertheless, Greece had the extra task to deal with challenging fiscal adjustment and severe austerity measures.

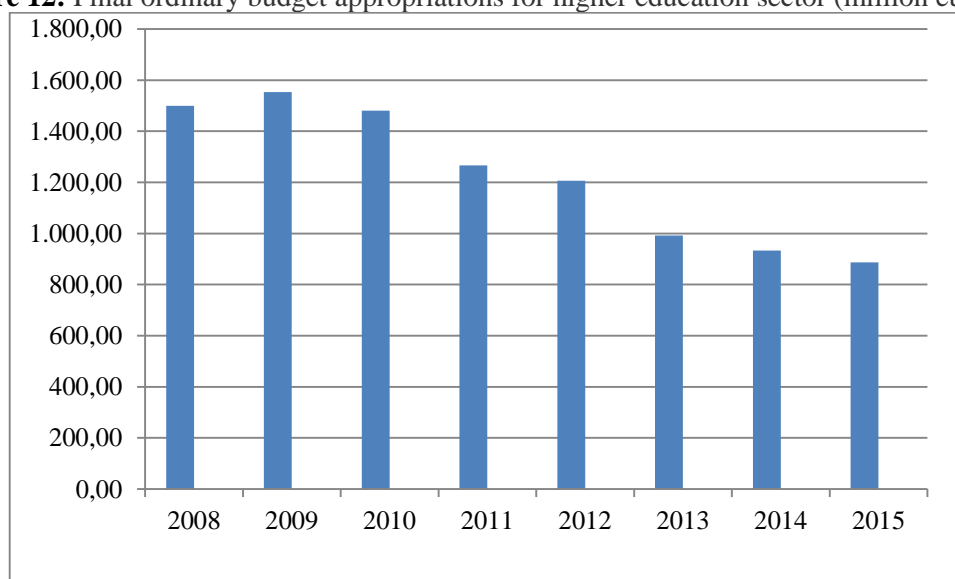
Figure 11: GBAORD, % of total government expenditures, 2008, 2013



source: Eurostat (gba_nabste)

As for the impact of the crisis on education, the higher education sector receives less than one quarter of the total budget for all levels of education, according to the budget of the Ministry of Education. In more detail, this share has fallen slightly from 24,8% in 2008 to 22,7% in 2015. However, the general trend is definitely negative for education expenditures as a whole and particularly for the higher education sector, as it is shown in figure 12.

Figure 12: Final ordinary budget appropriations for higher education sector (million euro)



source: Ministry of Finance

(http://www.mnec.gr/sites/default/files/financial_files/KENTRIKES%20YPHRESIES%202016.pdf accessed 03-12-2015)

Overall, the structure of the domestic private sector points to a lesser-degree of innovation potential given the number of enterprises activated in knowledge intensive activities. Greek enterprises active in high-technology manufacturing and knowledge-intensive high-technology services constitute 1,4% of the relevant total EU population (table 1).

Table 1: Percentage of high-tech enterprises in selected EU member states, 2013.

Belgium	3,3%
Czech Republic	3,8%
Denmark	1,7%
Germany	11,8%
Greece	1,4%
Spain	5,5%
France	14,6%
Italy	11,6%
Hungary	3,7%
Netherlands	9,2%
Austria	2,1%
Portugal	1,7%
Sweden	6,0%
United Kingdom	19,6%

Source: Eurostat (*htec_eco_ent2*)

This is equally indicated in analyzing the high-technology portion of Greek exports. In 2013, only 2,6% of total exports were of high-tech. This, in effect, placed Greece at the bottom among EU countries.

Table 2: High-tech trade (exports towards all countries of the world) as a percentage of total exports, 2013

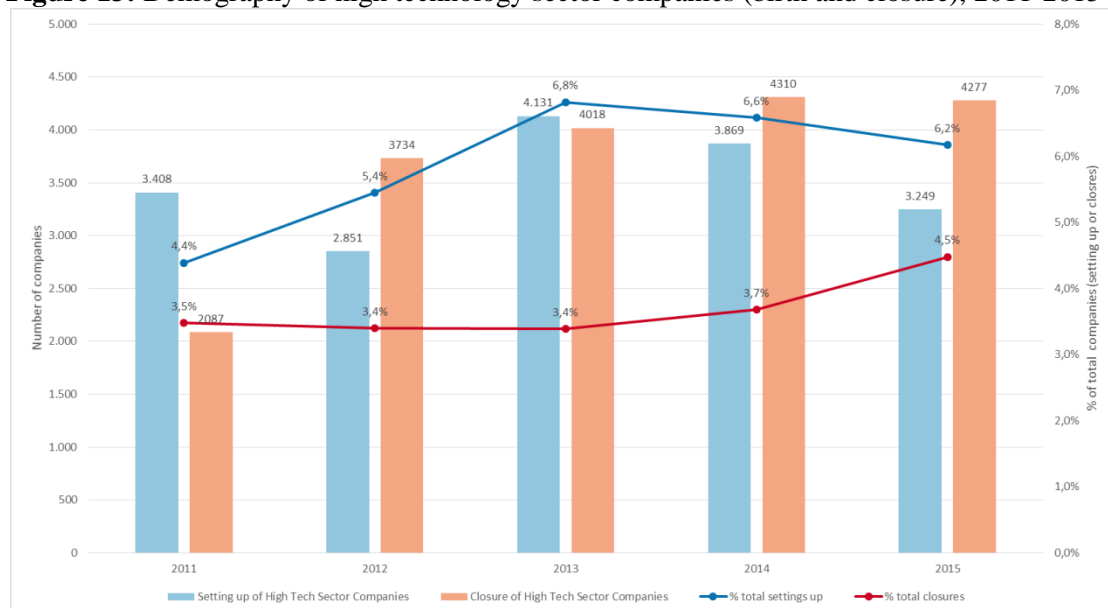
Austria	14,2%
Belgium	8,7%
Croatia	7,9%
Cyprus	18,1%
Czech Republic	15,1%
Denmark	9,3%
Estonia	15,0%
Finland	6,2%
France	20,4%
Germany	14,2%
Greece	2,6%
Hungary	16,3%
Ireland	19,7%
Italy	6,6%
Latvia	8,0%
Lithuania	5,8%
Luxembourg	22,2%
Malta	28,6%
Netherlands	17,7%
Poland	6,7%

Portugal	3,4%
Romania	5,6%
Slovakia	9,6%
Slovenia	5,5%
Spain	5,4%
Sweden	13,0%
United Kingdom	15,5%

Source: Eurostat (*htec_trd_tot4*)

The prolonged character of the economic crisis affected businesses both from the demand and supply side. The combination of the economic downturn and fiscal austerity are negatively influencing aggregate demand. In addition to this, the banking crisis has led to tougher credit conditions, essentially blocking easy access to capital. Firm demographics is an important indicator of the business environment as it is actually being perceived by aspiring as well as already active entrepreneurs given the latter commitment of resources and time allocation in such features. Making use of the latest and most comprehensive available data on companies' formation and closure in Greece in high technology sector, according to the NACE classification, 2011 appears to be the first and only year that birth of high tech companies exceeded the closure of similar entities. Up to 2013, the birth of high technology companies represented a growing portion of the total, while closures stood approximately the same, yet since then, births have been decreasing (from 6,8% in 2013 to 6,2% in 2015), and reversely, closures have been increasing at a higher rate for the same period (from 3,4% in 2013 to 4,5% in 2015).

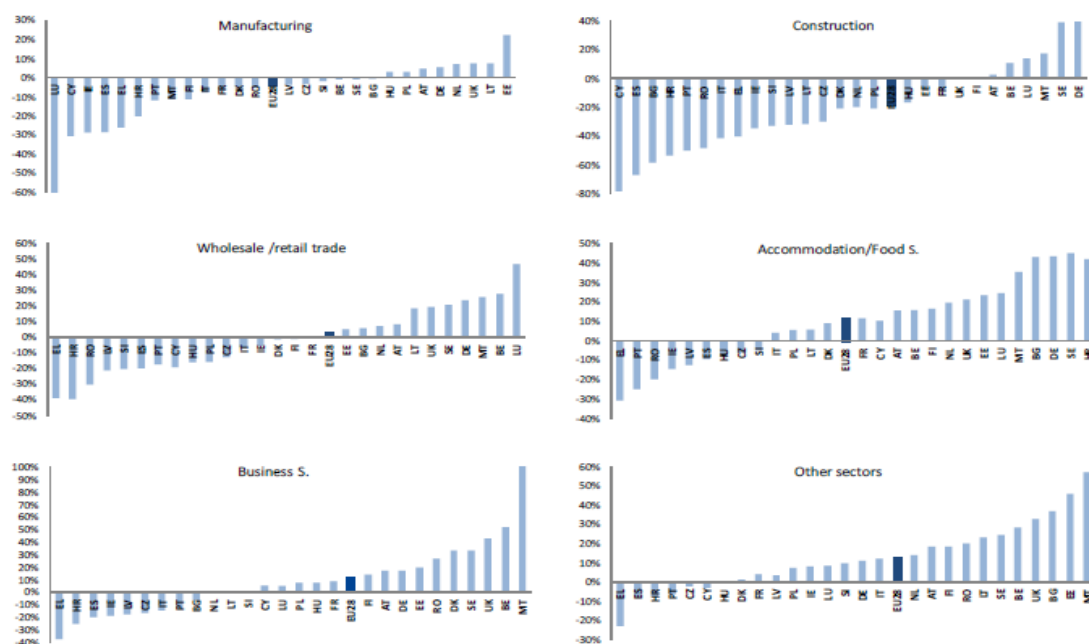
Figure 13: Demography of high technology sector companies (birth and closure), 2011-2015



Note: definition of high technology sector follows NACE classification, i.e. high technology manufacturing, NACE 21, 26, and, high technology knowledge intensive services, NACE 59-63, 72. source: National Documentation Center (unpublished data)

Making use of the latest available cross-country indicators and focusing on the SMEs, which form the backbone of the domestic economy, the country (together with Spain) is the only country among EU member states that records negative perspectives of the recovery or the recovery gap in all the key business aspects such as number of enterprises, value added and employment (figure 14). A similar image is portrayed, when examining the firms' employment growth/decrease from 2008 to 2014 in sectors of different technology and knowledge intensity.

Figure 14: Value added recovery of SMEs in various economic sectors (% change from 2008 to 2014)



Source: Muller et al. (2015)

The narrative of investing in RDI to overcome the crisis

Despite the designation of the national innovation system as rather weak-to-medium, certain elements of it do indicate above-average qualities. First among those is this issue of the research human capital. If publications are a safe measure of the productive capability of the science base, then the following table indicates that the domestic human capital, given the intertemporal low levels of R&D funding, manages to attain a robust publication-, citation- and impact-rate among EU and OECD countries (table 3). According to the European Commission (2015b), Greece is ranked 15th among the EU28 member states of the top 10% most heavily cited publications.

Table 3: Bibliometric Analysis of Greek Publications in International Scientific Journals-Scopus

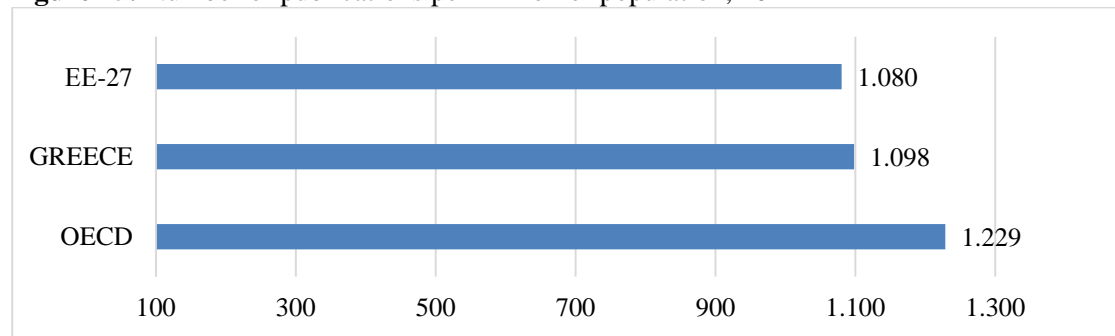
	2010	2012
PUBLICATIONS		
No. of publications	10.300	11.138
% of Greek publications among EU member states	2,40%	2,31%
% of Greek publications among OECD countries	1,12%	1,09%
CITATIONS	2006-2010	2008-2012
No. of citations	224.633	279.178
% of citations of Greek publications among EU member states	2,06%	2,20%
% of citations of Greek publications among OECD countries	0,94%	1,03%

IMPACT FACTOR	2006-2010	2008-2012
Impact factor (median of citations per publication)	4,51	5,23
Relative citation impact relative to EU member states	0,84	0,92
Relative citation impact relative to OECD countries	0,83	0,92

source: EKT (2015b)

A wide spread indicator of the output capacity of the science base concerns the capacity to publicize its research results in internationally acclaimed peer-reviewed journals. Examining, thus, the publication output of the domestic science base, the latter sustains a cross-temporal increase, managing to triple across a period of almost 15 years. More specifically, what started with 4.745 publications in 1998, it has reached 12.214 in 2012. Controlling for the number of publications in terms of the national population, the following table indicates that Greece has, just incrementally, surpassed the European countries' median, yet still lags behind of the OECD countries (figure 15).

Figure 15: Number of publications per million of population, 2012



source: EKT (2015b)

Another positive point of the domestic innovation system is the participation of Greek organisations in the European R&D projects. According to available data, Greece ranks 9th in terms of participation and 11th in terms of funding from the FP projects, among 28 EU member states³. Table 4 indicates the participation scores of the Greek innovation base in terms of the funds received in the latest European Framework Programme (FP7, 2007-2013). The country has managed to receive funds amounting to more than 1 billion €, a sum that surpasses many of the other member states. Partially attributed to the fact that the official national budget funds RDI activities only to a lesser degree/minimally, the domestic actors of the innovation system had to excel in their search for sources of funding from abroad. Signaling, mostly, features of research excellence, the manifestation of such capability to lure funds points to a capable and well-networked science and technology base. As a matter of fact, Greece holds the 8th position over time, in terms of participation, coordinating role in research projects and the power of its actors within the networks (centrality). In total, Greek organizations have participated in 4039 research projects (18,2% of all EU projects), with a total budget of 3200 million € (5,2% of the total budget) during the period 1984-2009, while some Greek institutions, mainly universities and research centers, have acquired an important role in these research networks (Protogerou et al. 2010).

3

http://metrics.ekt.gr/sites/metrics/files/%CE%95%CE%9A%CE%A4_FP7_EL_POSITION_report_el.pdf (accessed on 11 Febr. 2016)

Table 4: Funding of Greek entities from EU's FP7

	COOPERATION	CAPACITIES	PEOPLE	IDEAS	EURATOM	TOTAL
HIGHER EDUCATION SECTOR	283,15	45,26	37,33	22,38	0,64	388,76
GOVERNMENT SECTOR	224,06	56,17	39,47	30,30	0,64	350,64
BUSINESS SECTOR	185,08	47,72	9,96	-	-	242,76
PRIVATE NON PROFIT SECTOR	9,14	6,95	1,04	1,18	-	18,31
TOTAL	701,43	156,10	87,80	53,86	1,28	1.000,47

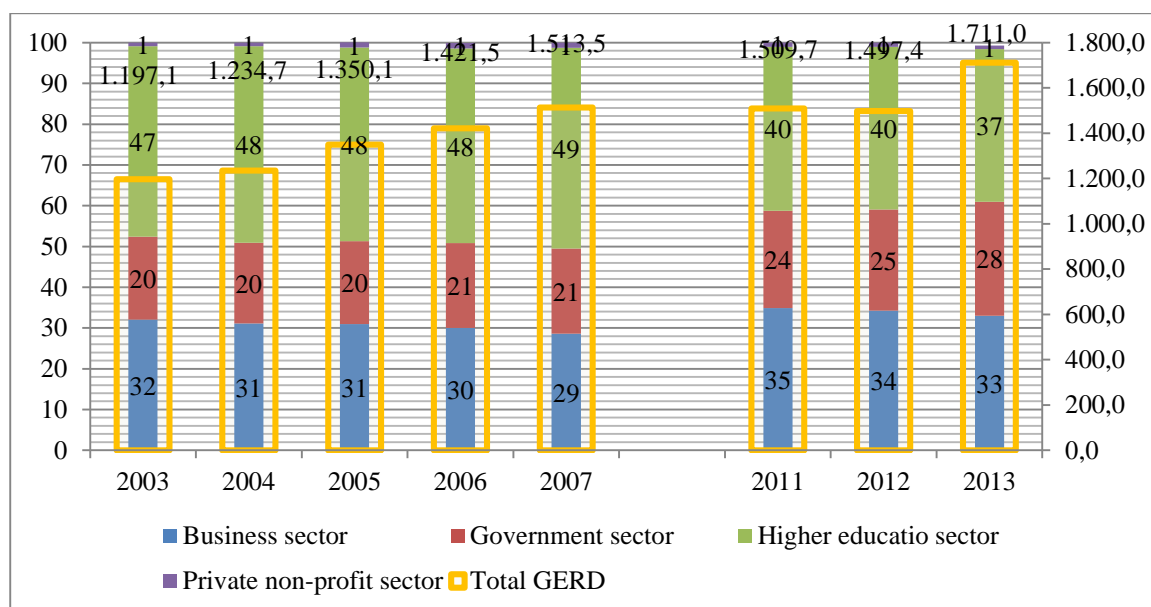
source: EKT (2015a)

In terms of human resources for research, Greece ranks below the EU average with 4,2 researchers (FTE) per thousand labor force (EU average: 6,3), but the number of researchers and new doctoral graduates per thousand population aged 25-34 have been growing at a faster rate than the EU average (over the period 2000-2008). This indicates that catching up was underway (during the time the crisis erupted), at the same time that the impact of internationally mobile Greek scientists seems to be significant, according to OECD (2013b). The above indicate that important elements of the domestic NSI are in place, and instead of employing a framework of analysis placing emphasis on the complete re-hauling of the system, one should focus on how to further upgrade and appropriately link these features (Herrmann and Kritikós 2013). Given the above, a knowledge-intensive growth pattern is possible and in this context, KT-relevant political initiatives are critical. In political terms, the appointment of a Deputy Minister for Research and Technology by the Greek government -for the first time since the 1980s- may be regarded as a breakthrough in RDI sector, giving a sign for the intentions to advance and upgrade this particular area of public policy in the national political agenda.

Synthesis of R&D and Innovation statistics

The State is the main actor in the area of research and tertiary education in Greece, as it is the main R&D performer and funder. At the same time, universities and technological educational institutes –constituting the major part of the higher education sector- are exclusively public, according to the Constitution. On the other hand, one persisting finding across time has been the under-investment of firms in R&D activities, leading to a situation, where the contribution of business sector in R&D funding, performance, as well as knowledge creation is significantly lower than most EU member states (Lyberaki 2008, Papagiannakis 2008).

Figure 16: GERD (million euro), GERD by sectors of performance in Greece (as percentage)



source: Mitsos et al. (forthcoming)

Resources from abroad, mainly from EU (namely funds from Framework Programme-FP) make a significant contribution to the national R&D activities. As the following two tables indicate, the portion of funds coming from abroad for R&D performed by both HES and GOV is significantly higher than the EU-average. In the Greek case, this funding is almost exclusively attributed to EU funds and is not FDI-type investments.

Table 5: Total R&D Performed by Higher Education Sector and Funded from Abroad (as % of GERD)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EU28	1,11	1,14	1,24	1,18	1,28	1,38	1,59	1,70	1,95	:
Greece	:	10,10	:	:	:	:	:	6,13	6,43	5,31

source: Eurostat, authors' calculation

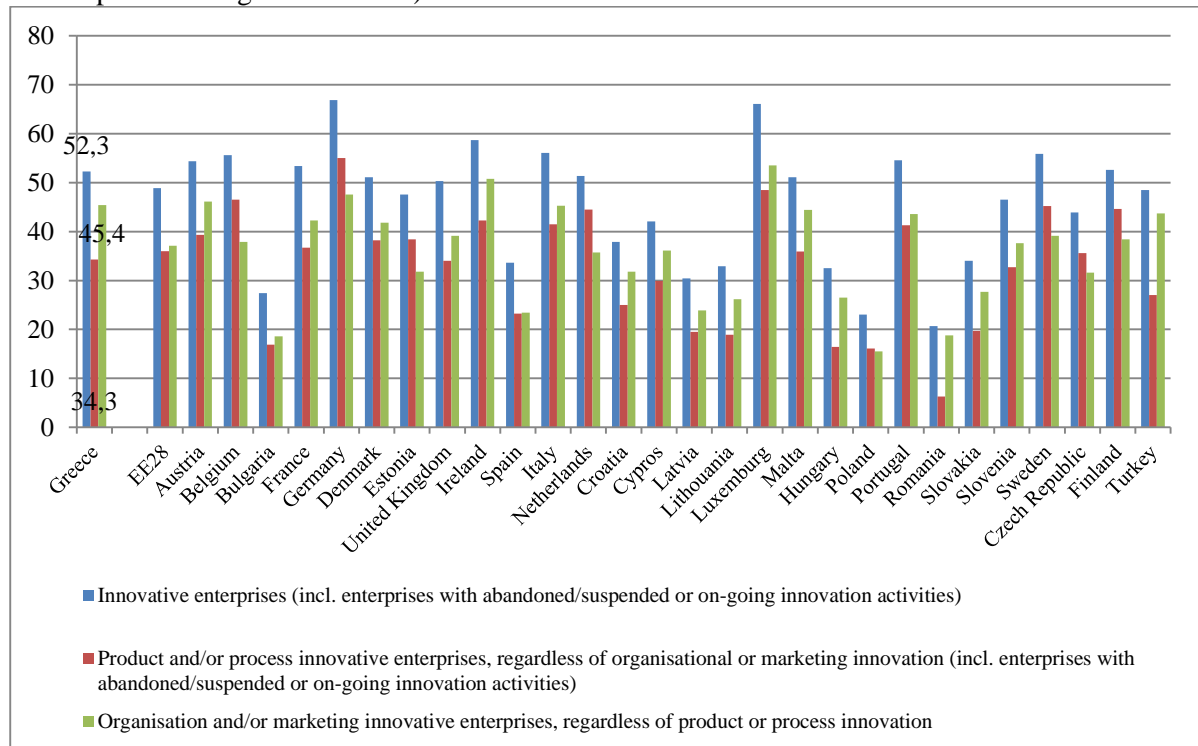
Table 6: Total R&D Performed by Government and Funded from Abroad (as % of GERD)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EU28	0,87	0,97	0,95	0,91	0,88	0,90	1,00	:	1,10	:
Greece	:	6,19	:	:	:	:	:	3,91	4,20	4,33

source: Eurostat, authors' calculation

Concerning innovation, the following figure indicates that while the percentage of Greek innovative enterprises is higher than the EU average, it is lower when compared to some other crisis-stricken countries such as Ireland, Portugal and Italy. In sum, this figure provides evidence of the overall satisfactory state of Greece's innovative enterprises, although the situation is worse when comparing product/process innovative enterprises and better when comparing organization/marketing innovative enterprises (figure 17).

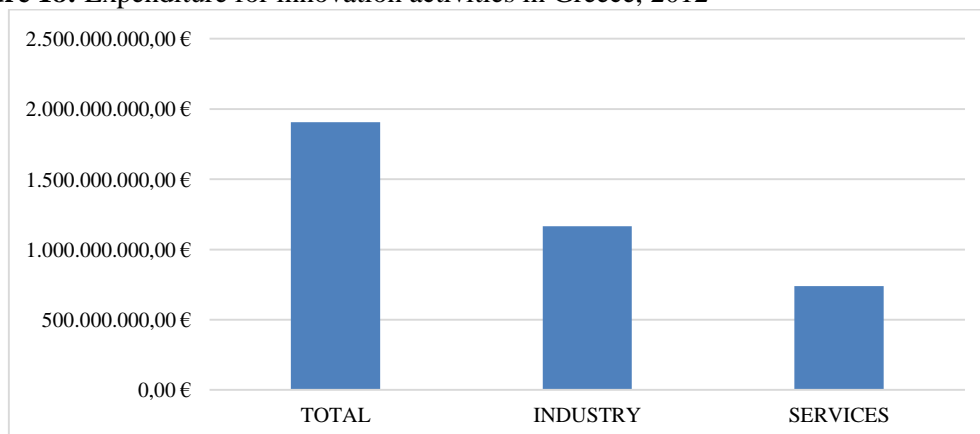
Figure 17: Innovative enterprises per type of innovation 2010-2012 (as % of total population of enterprises among EU countries)



source: Eurostat (inn_cis8_type)

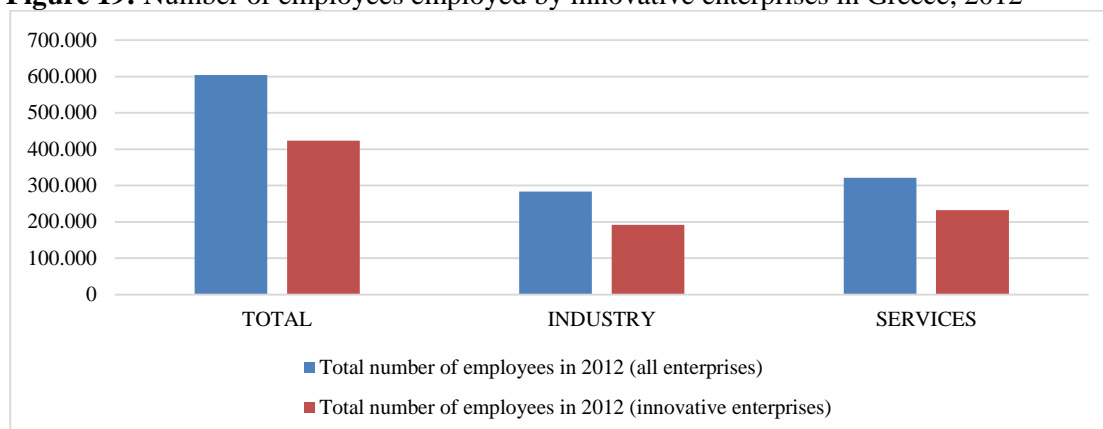
The following two diagrams present the expenditures and the number of employees employed by innovative enterprises in making use of the Community Innovation Survey (CIS) 2010-2012 data. Overall, enterprises spent almost 2 billion € for innovative activities, of which 1,2 billion refers to industry. Oppositely, while there is a proportionality of number of people employed by innovative enterprises, relative to the overall number of employees, it is the services that account for the majority of the people employed. Taken together, the above findings reflect the capital-intensive machinery-relevant product and process-type of innovation referring to industry, whereas the lesser portion of expenditure accounted for by services can be related to their less capital-intensive nature.

Figure 18: Expenditure for innovation activities in Greece, 2012



source: EKT (2015c)

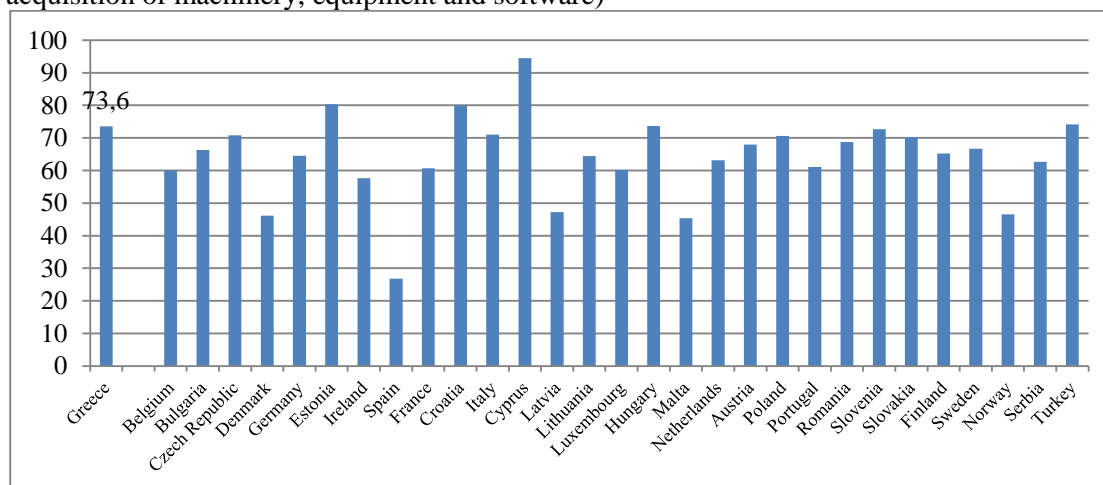
Figure 19: Number of employees employed by innovative enterprises in Greece, 2012



source: EKT (2015c)

On a positive tone, Greek innovative enterprises rank the highest among EU countries for the acquisition of machinery, IT, software. Public funding programs/schemes initiated by the Greek state for supporting industrial and commercial capacity (law 3299/2004 and 3908/2011 known as ‘*anaptyxiakos*’ law, ICT for Growth, and various SMEs initiatives, e.g. PEP for each national periphery) involved funding (up to 100%) of the acquisition of machinery, software, etc. have contributed significantly in this performance.

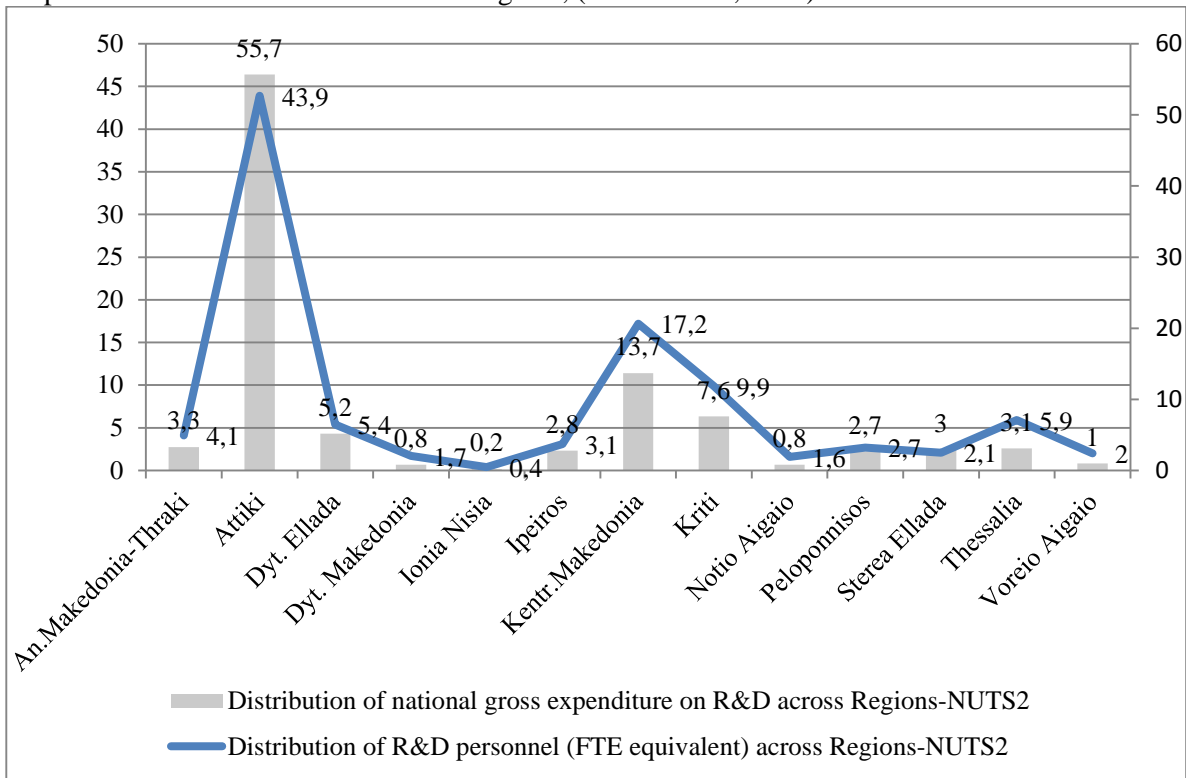
Figure 20: Acquisition of machinery 2010-2012 (% of innovative enterprises engaged in the acquisition of machinery, equipment and software)



source: Eurostat (inn_cis8_exp)

In terms of regional allocation of R&D, three regions (Attiki, Kentriki Makedonia, and Kriti) account for approx. 80% of total R&D spending (EKT 2015e). Research activity can be positively correlated to regions with agglomerations of research centres and universities (figure 21). Nevertheless, when R&D intensity and the regional GDP is taken into account, the Region of Kriti, hosting the University of Crete, the Technical University of Crete shows the highest research and technology intensity in Greece.

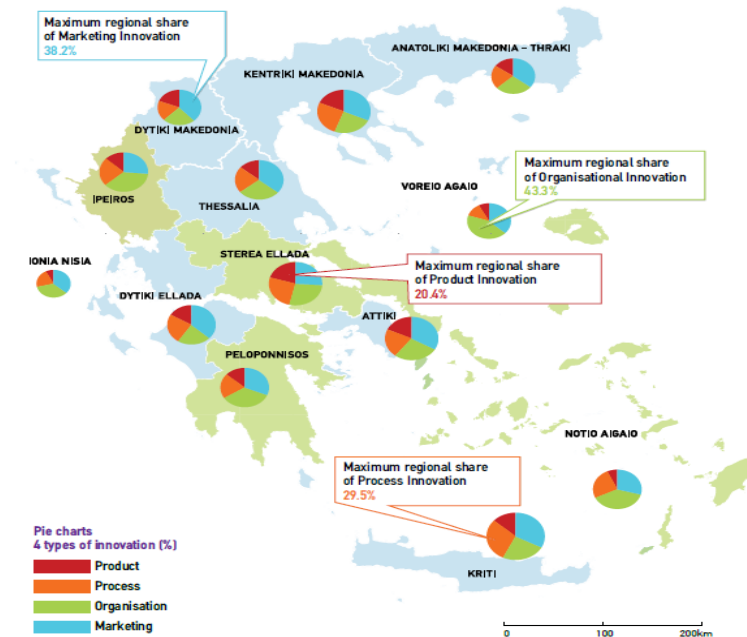
Figure 21: Distribution of gross expenditure on research and technology (GERD) and R&D personnel in Greece across NUTS2 Regions, (as % of total, 2013)



source: Eurostat (rd_e_gerdreg, rd_p_persreg) authors' calculation

Concerning the regional distribution of the four types of innovation activities of firms in Greece (Oslo manual), in most regions marketing innovation is the dominant type, while in the remaining regions it is the organization innovation that ranks first. It is to be noted that in every region, all four types of innovation are present yet with varying degrees.

Map 1: Distribution of innovation types of Greek enterprises per Greek regions, 2010-2012



source: EKT (2015c)

Focusing on the performance of Greek enterprises in the different types of innovation activities, it appears that the domestic enterprises indicate high performance concerning organizational and marketing innovation activities, significantly outperforming the relevant European community average. Conversely, their performance relative to product (products or services) and process innovation, that is those types of innovation referred to as technological innovation, are found to be lacking.

R&D performance and synergies between the main actors

The main actor carrying out research in Greece is the higher education sector, although its performance seems to decline in the last years, while the share of the business sector and mainly that of the government sector are growing. As for the linkages between the main RDI stakeholders, one may notice that the share of the R&D that is performed by higher education sector and is funded by business sector is one of the highest among EU countries. However, one should have in mind that HEIs in Greece are the main R&D performers, in contrast to what is the norm in other EU countries, where the business sector dominates R&D performance and funding.

Table 7: R&D Performed by Higher Education Sector and Funded by Business Enterprise Sector (as % of GERD)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EU28	1,42	1,46	1,50	1,57	1,58	1,55	1,56	1,55	1,52	:
Greece	:	4,23	:	:	:	:	:	3,60	3,15	2,77

source: Eurostat, own calculation

The following table exhibits evidence concerning the number of publications and number of citations received by institutional sector across two, overlapping time series (2006-2010 and 2008-2012). The higher education sector prevails diachronically in scientific publications due to its size in terms of human capital, its scientific operation and mandate (EKT 2014), while the low number achieved by Greek enterprises is an indicator of their low R&D activity.

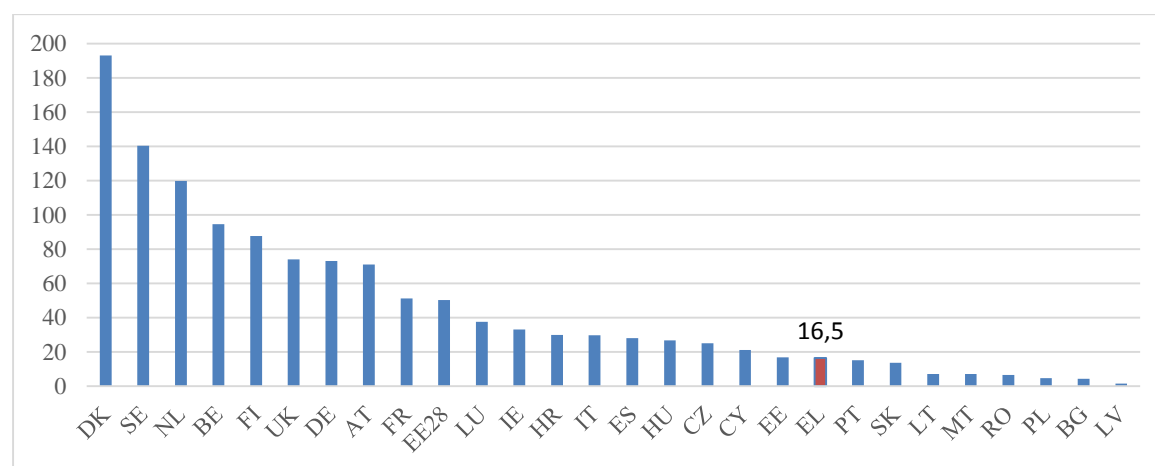
Table 8: Number of publications and citations in Greece, by sector of affiliation

	2006-2010		2008-2012	
	No. of Publications	No. of Citations	No. of Publications	No. of Citations
Public Hospitals	7.482	34.162	7.772	39.110
Enterprises	1.093	4.068	1.222	5.714
GSRT's Research Centers	6.694	44.164	7.219	54.817
Private non-Profit Institutions	538	2.762	599	3.319
Private Health Providers	1.390	11.298	1.457	10.931
Other Public Research Organisations	2.075	9.579	2.352	13.961
Other Public Organisations	406	1.574	403	1.725
Other Educational Institutions	631	2.052	772	3.158
Universities	44.310	222.113	47.510	271.529
Technical Educational Institutes	2.883	8.196	3.499	10.869

source: EKT (2015b)

Examining the combined research output of the academic in tandem with the private sector stand as an important measure of the established knowledge networks given that one such important output indicator, i.e. scientific co-publications in international journals, marks the revealed capacity of the two sectors to produce scientifically-relevant know-how of high quality. In figure 22, it is evident that the level of such public-private co-publications in Greece significantly lags the majority of EU countries, standing at three times less than the EU average pointing to weak public-private knowledge flows.

Figure 22: Public-private co-publications (per million of population)



Source: European Commission (2015b)

Turning our attention to the enterprises' synergies in undertaking R&D projects, enterprises have been increasingly setting their eyes in the European R&D projects as a potential source of financial assistance in conducting R&D activities, in addition to establishing research partnerships and networks given their international nature (Paier and Scherngell 2011). Evaluating, thus, aspects of the domestic knowledge triangle would entail exploring the institutional actors with which enterprises have established R&D partnerships. As the following table indicates, enterprises (BES) participate by themselves in almost half of the total FP7 projects a Greek BES presence is recorded in (42%). More than a quarter of enterprises (27%) have cooperated with an academic institution (HES), while almost 20% of BES participations are recorded with a government entity. A triad, though, as the climax of such a knowledge triangle found in a research project between entities of the private and the public sphere is found to be the case in only 7% of the cases.

Table 9: Participation of Greek businesses in FP7 projects (no. of projects per partnership)

Type of partnership	# projects
BES	363
BES-HES	230
BES-GOV	165
BES-GOV-HES	58
BES-OTH	9
BES-PNP	8
BES-GOV-OTH	4
BES-GOV-PNP	3
BES-GOV-HES-PNP	2
BES-HES-OTH	2

BES-HES-PNP	2
BES-GOV-HES-OTH	1
BES-OTH-PNP	1

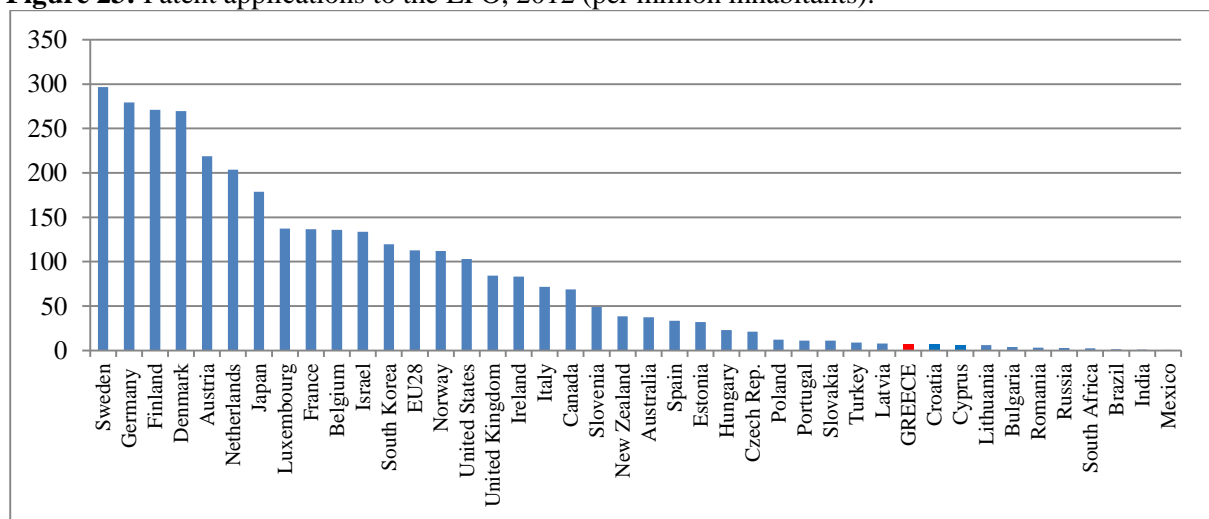
Source: E-corda. Date of extraction: November 2015

Note: it is possible that more than one institute per sector participates in each project (e.g. two businesses and three HES institutes participate in one project).

An additional indication of the innovation capability in terms of its output is patents and trademarks. Not without drawbacks (not applicable to every industrial field, a time lag component between invention-application-approval, etc.) patents are widely seen as a major indicator of knowledge intensive private sector's productive capability (Dietrich and Huggins 2007). Having these pitfalls in mind, trademark analysis is being used as a complimentary avenue to overcome the existing weaknesses of traditional measurement concepts focusing on patents (Gotsch and Hipp 2014). It is evident that the Greek private sector contributes only slightly in increasing the knowledge base of the EU, given that its percentage is 0,1% in terms of its patent applications across most recent years. This low percentage indicates the low yield in knowledge-intensive activities undertaken in terms of its institutional recognition. An equal underperformance is clear if the number of applications in community trademarks is taken into consideration, having an across time performance (2011-2015) between 0,6% and 1%.

As the following graph indicates, the country is lagging behind in terms of patent applications in the European Patent Office. For the year 2012, its total output has been well behind not only most European countries, but in fact in comparison with most OECD countries, having a rate of 7,3 patent applications per million inhabitants.

Figure 23: Patent applications to the EPO, 2012 (per million inhabitants).



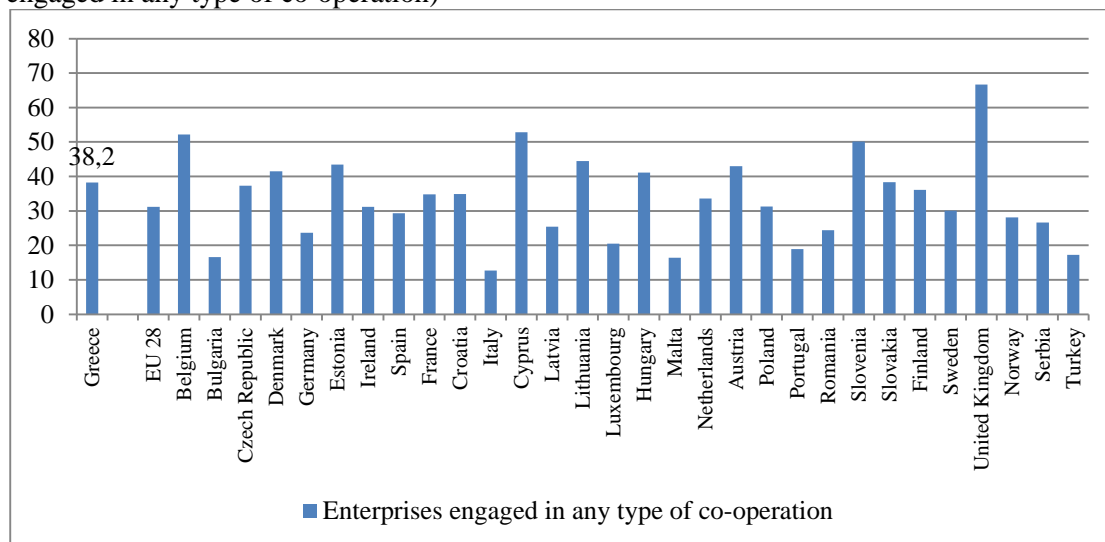
source: Eurostat (pat_ep_ntot)

As already noted, trademark-related data (designs and trademarks) relate to the launching of new products, they stand as (institutionally-recognized) steps taken towards diversifying them (the products) from the competition. As such, indicators based on trademarks usefully complement traditional indicators of innovative activities based on patents. Turning our eye on Greece's trademark-related output, the country follows not only top tier countries such as Germany and Sweden, but falls back in relation to most other countries.

An important indicator of the networking orientation of innovative enterprises deals with collaborations established for carrying out product and/or process innovation activities. The following figure illustrates a high percentage in relation to the innovative enterprises engaging in cooperation of any type. This is a strong point indicated by Greek enterprises since a number

of studies have shown that innovation is a ‘partnering game’ either up or down the product value chain. By employing such capital-intensive way to keep tuned with technological developments Greek enterprises manage to network with those innovation-savvy partners, either as contractors, or low-end manufacturers.

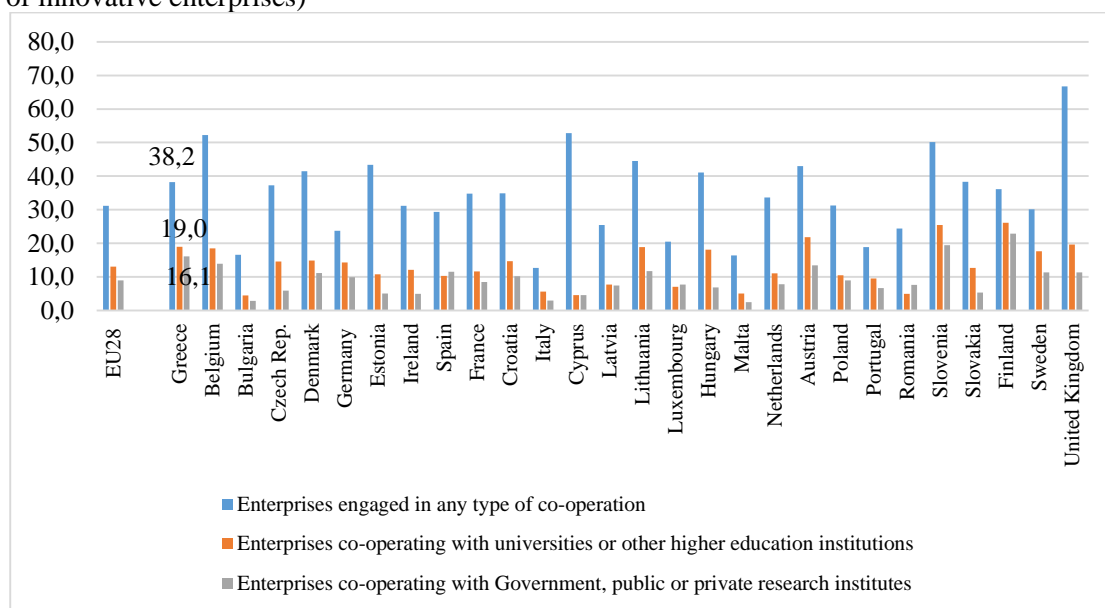
Figure 24: Co-operating innovative enterprises 2010-2012 (% of innovative enterprises engaged in any type of co-operation)



source: Eurostat (inn_cis8_coop)

A robust and direct indicator of the level of collaborations established between enterprises and HEIs-PRIs is presented in the following figure. On a cross European country comparison, as mentioned above, Greek enterprises indicate a higher than the EU average degree of engagement in any type of cooperation. The same, and more importantly in the context of this document, is the case of established cooperation with both public universities and the public research institutes, being the latter fundamental aspects of the domestic knowledge-creation system.

Figure 25: Cross country comparison of cooperating innovative enterprises 2010-2012 (as % of innovative enterprises)



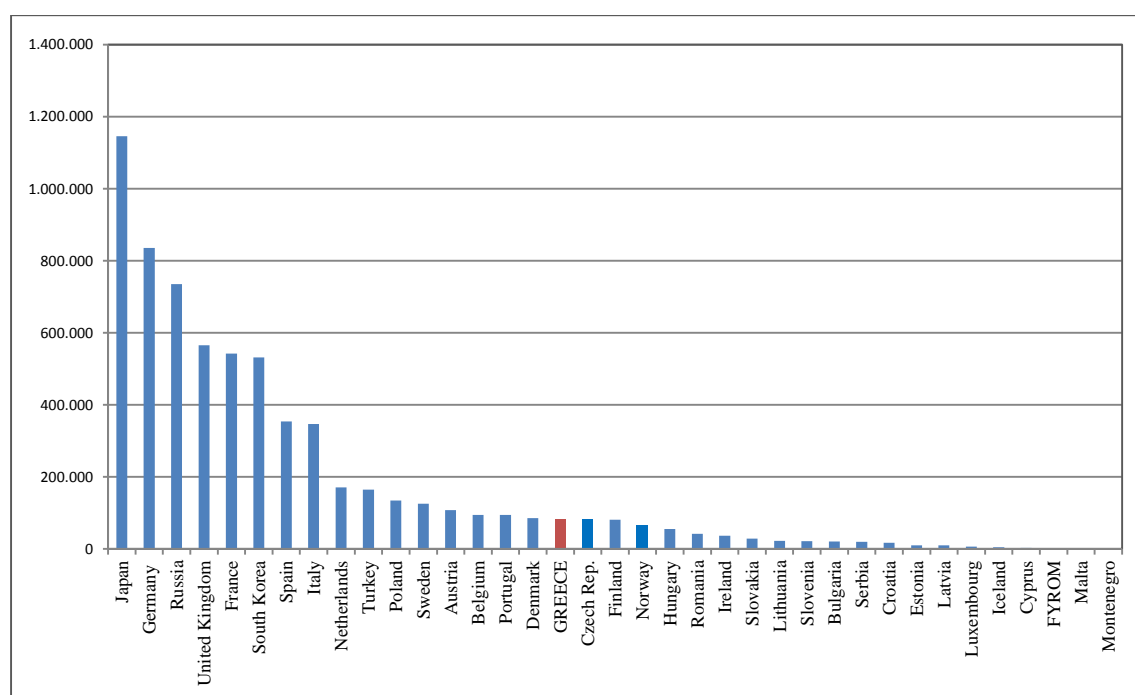
source: Eurostat (inn_cis8_coop)

The main actors and roles for research, education and innovation

Structurally, the General Secretariat for Research and Technology (GSRT) of the Ministry of Education is the competent authority for R&D policy, while the overarching authority (Ministry of Education) covers higher education sector as well. In 2009, it was decided to ‘transfer’ GSRT from the Ministry of Development to the Ministry of Education, in order to contribute to the ‘unification’ of the Greek RDI system, namely to bring closer HEIs and PRIs.

When trying to focus on the main actors for research, education and innovation, analysis on personnel and human capital is helpful, as a robust and sound indicator of the overall health of any knowledge-based economy. As such, the state of the Greek human capital in matters of R&D has been consistent with the range of previously pointed out indicators. For the year 2013 the total number of researchers has been 82.684, of which a third has been technicians and supporting staff, whereas the two thirds are the researchers. As the following graph indicates, performing a cross-country analysis, Greece does seem to lag behind in comparison with those countries that are considered to be highly developed, but not with most other developed countries. Indeed, if read in conjunction with data on R&D funding, this graph signals one of the strong points of the national innovation system, that is the high degree of highly-educated human capital, a necessary precondition for any sound and sustainable economic recovery.

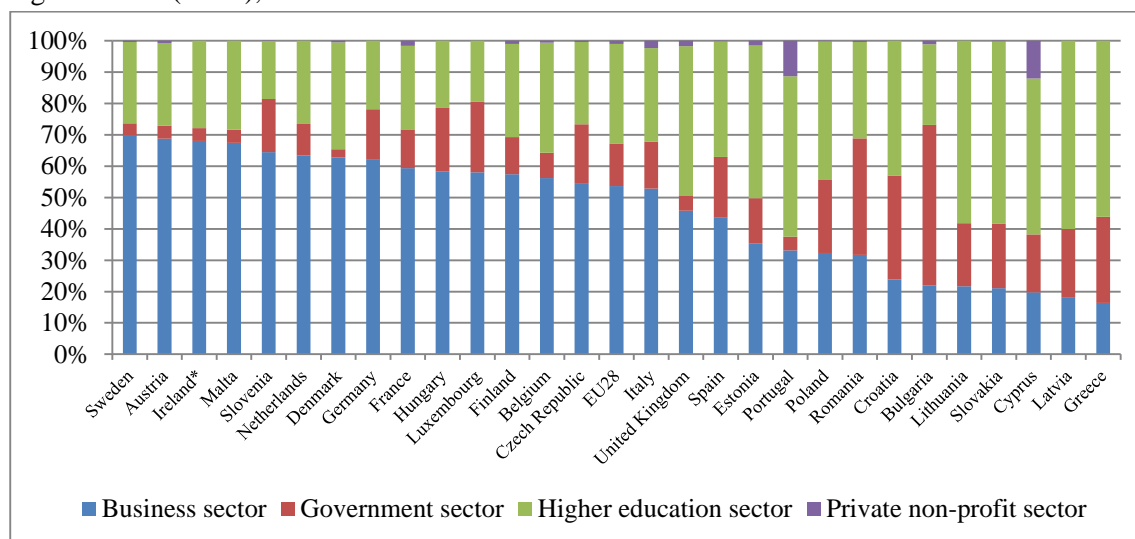
Figure 26: Total R&D personnel in all sectors of performance (HC), 2013



source: Eurostat (rd_p_persocc)

Concerning researchers, their share in total R&D personnel is higher in Greece than the EU average (69,3% and 63,5% respectively, in full-time equivalents). Performing a dissection of the typology of the researchers in relation to the sector of the performance, a reversed picture of the performing sector is clear in relation to most other countries emerges. That is, whereas the business sector is the employment locomotive for R&D personnel (e.g. in the EU28 business employs about 45% of total, reaching up to 70% in the case of Sweden), in Greece the private sector employs less than 20% of the respective human capital (figure 27). Reversely, the higher education sector is the main employer, as almost 70% of the total R&D workforce in Greece is employed in HEIs and PRIs.

Figure 27: Share of R&D personnel among different sectors of R&D performing organizations (FTEs), 2013



source: Eurostat (rd_p_persocc) - authors' calculation
* data 2012

Concerning the academic staff on higher education, the great majority is employed by the public sector, as most higher education institutes are public entities, according to the Constitution. At the same time, Greece records one of the lowest ratio of academic staff to total population in addition to the portion of academic staff over 50 years of age being quite high among EU member states.

The main channels of interactions

It is clear that interactions between education and research are strong, as a result of the identification of universities and technological educational institutes as the main R&D performer in Greece. On the other hand, interactions between them and public research centres are quite often, as in the case of Crete (linkages between the University of Crete and the Foundation for Research & Technology), yet they may have strong territorial aspects.

A new law for RDI was voted in 2014 (law 4310/2014), expecting to enhance networking; enable mobility of research human capital; support efficient and open utilization of research infrastructure; and facilitate the substantial unification of public research bodies, namely higher education institutes and research centers. In more detail, the law introduced patterns, such as: i) the establishment of common post-graduate modules, ii) the ability of researchers to apply for mobility in public sector, namely to universities, iii) initial steps towards conditionality in public research bodies' funding, taking into account parameters, such as networking, assessment etc., iv) the introduction of operational linkages, related to RDI, in all ministries, to avoid fragmentation in public RDI actions and to boost public demand for technology-intensive products, services and procedures.

Strengths and weaknesses of the relationships between research, education and innovation.

In the context of the current fiscal crisis, the country needs not only to face numerous and well known structural challenges for implementing successfully a different, knowledge-intensive

growth pattern, but needs to address a number of factors that have been amplified during crisis, namely brain-drain and the weakening administrative capacity, etc.

On the other hand, RDI sector seems to gain ground in terms of planning policy towards 2020, as a result of introducing smart specialization in the new programming period 2014-2020. More specifically, regional authorities and intermediate managing authorities have adopted the identification of key enabling technologies and entrepreneurial discovery as a means to sustain competitiveness and achieve modernisation of regional companies (GSRT 2015).

In this context, HEIs have an important contribution to the economic and social growth, as their collaboration with business enables knowledge flows and can create the ideal conditions for the promotion of new technology and innovation (Bektas and Tayauova 2014), factors that enhance firms' competitiveness and productivity. The limited participation and performance of business sector in RDI, implying the insufficient exploitation of research and knowledge production, need to be reversed. This imposes the strengthening of the relationships between the higher education sector -the main RDI performer in Greece- and the business sector -the main potential user of new knowledge- (Tsipouri and Papadakou 2005, Bartzokas 2007). Therefore, it is of major importance to promote good practices for leveraging business sector and HEIs and PRIs collaboration and strategic networking towards more sophisticated and knowledge-intensive production, deploying knowledge triangle potential.

In addition, establishing institutional links between the main actors, namely HEIs and PRIs, public administration/regions and business sector are prerequisites to improve knowledge transfer, while 'unification' of the Greek R&D system, namely the effort to bring closer HEIs and PRIs, has been a major goal of the Greek state. In this context, current discussion on the "knowledge triangle" that takes place on national and supranational level may be useful, trying to strengthen linkages between its main parts.

2. The position of the higher education sector in the knowledge triangle

The main types of tertiary education institutions

The main actors in tertiary education in Greece are universities (ISCED6, 7, 8) and technological educational institutes (ISCED6, 7). Both are strictly public entities, according to the Constitution, but there are also private educational organisations that are categorized as part of the post-secondary educational system. The latter are able to offer mainly undergraduate curricula (ISCED5, 6), in collaboration with universities and other educational institutes from abroad, according to national legislation that follows the relevant EU directives and regulations, linked to the EU internal market. In more detail, there are 22 universities (including Open University and International Hellenic University that delivers only ISCED7 degrees) and 14 technological educational institutes across the country, being the main R&D-active institutes of higher education. There are also public professional academies or schools that deliver ISCED5 and 6 diplomas on ecclesiastical education, merchant marine, military education, tourism and art, but these are not R&D-active institutes, as they deal mostly with education and training.

HEIs' degree of autonomy

Tertiary education in Greece is supervised by the Ministry of Education that is responsible for institutional funding, as well as for the institutional framework and the structure of HEIs' governance, within which and according to which HEIs operate. Thus, the Ministry of Education governs the operation of institutes in terms of recruitment, payroll, students' enrolment, etc. On the other hand, higher education institutes are autonomous in dealing with academic and managerial issues including their structure. According to the latest institutional settings introduced in 2011, 2012 and 2014, the Ministry has favoured a greater degree of autonomy for HEIs, as well as simplification of their operation and linkages with the State. One additional element in this discussion, directly related to the financial crisis in Greece, is the heavy reliance of HEIs on institutional funding from the Ministry. Given the fact that this was reduced almost to 50% one can understand the rate of cutbacks involved. This development, however, has led to a major change in HEIs' attitude towards seeking alternative, non-institutional –and probably non-public- funding, providing them greater autonomy the hard way.

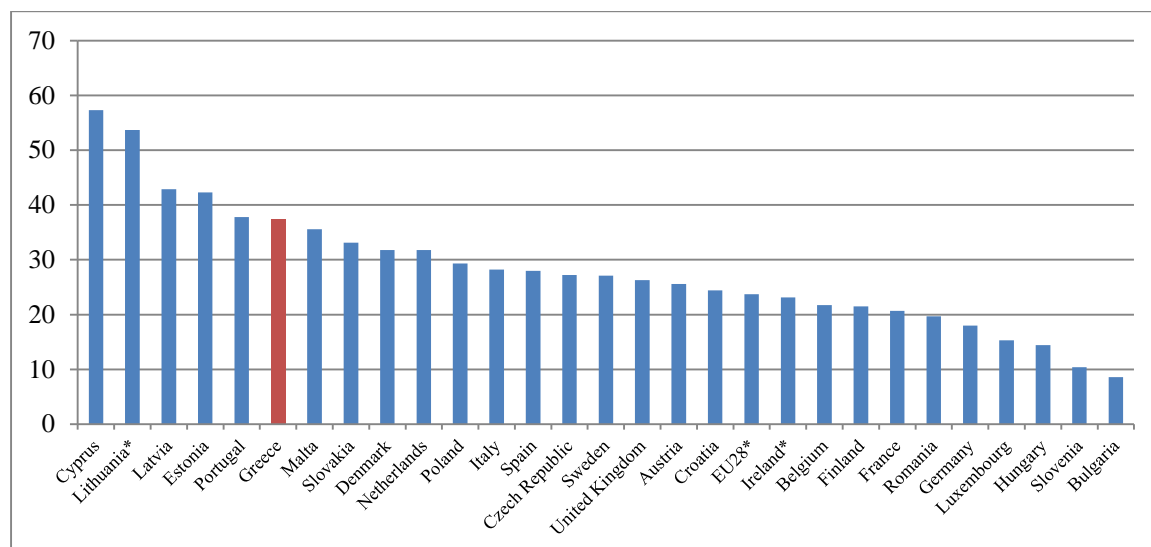
As far as private entities are concerned, they offer ISCED5 and 6 degrees only. In this case, their operation is regulated fundamentally by the Ministry of Education, as they are subject to certain criteria, but beyond that their operation is independent from the State. As a matter of fact, they rely substantially more to the norms that are defined by collaborative HEIs from abroad, giving them the right to deliver degrees of tertiary education, according to national law.

The positioning of HEIs with respect to research, education and innovation.

HEIs' positioning in research is high, as they conduct 37% of total GERD (in 2013)⁴, followed by the business sector (33%), the government sector (28%) and the private non-profit sector (1%). It is interesting that HEIs' share in total national R&D performance is one of the highest among EU28 member states, as figure 28 shows.

⁴ This share refers to the higher and post-secondary education sector as a whole. However, the major part of this share has to do with HEIs in the Greek case, namely universities and technological educational institutes.

Figure 28: Share of post-secondary and higher education sector in total GERD, in EU member states, 2013

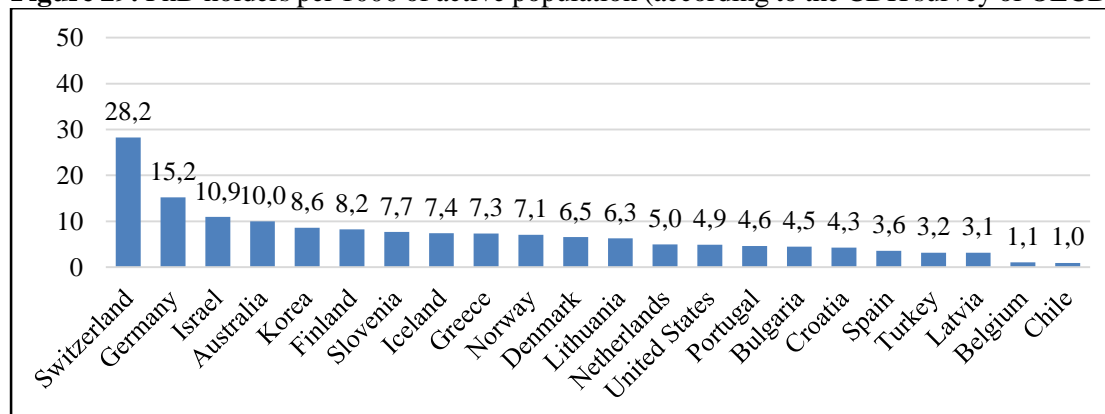


source: Eurostat (rd_e_gerdtot) - authors' calculation

* data 2012

A point of special attention in analyzing the domestic knowledge triangle is the issue of its human capital and the role that HEIs play in skills acquisition. In combining both research and education, namely providing studies at doctorate level (ISCED8), the contribution of Greek universities is significant and has been increasing since the mid-2000s, as the number of graduates at ISCED8 level is growing. The result is that Greece is placed among the first ten countries regarding the number of PhD holders per thousand active population in 2013 (figure 29).

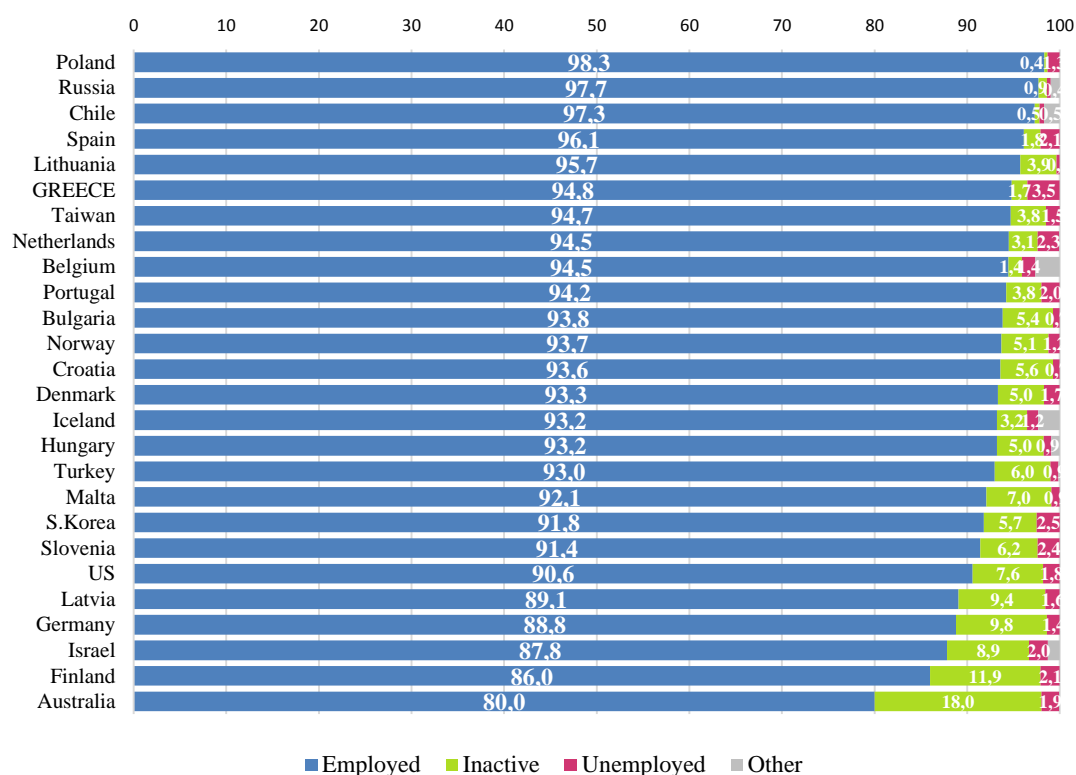
Figure 29: PhD holders per 1000 of active population (according to the CDH survey of OECD)



source: EKT (2015d)

Within this framework the contribution of universities in the real economy –amongst others, via the employment of PhD holders- is important, since employment rates are among the highest, according to the results of the CDH survey of OECD (figure 30). However, during the crisis the unemployment rates have raised dramatically (around 2% until 2007, 6% in 2009, 10% in 2012 and 13,5% in 2013), influencing national human potential in a negative way. This is especially true not only because of the de-learning procedures inescapably tied to any non-employed individual, but also because of the brain-drain outward flow. In turn, this means that there is plenty of underutilized human capital, of high scientific standards ready to be mobilized, when conditions are ripe.

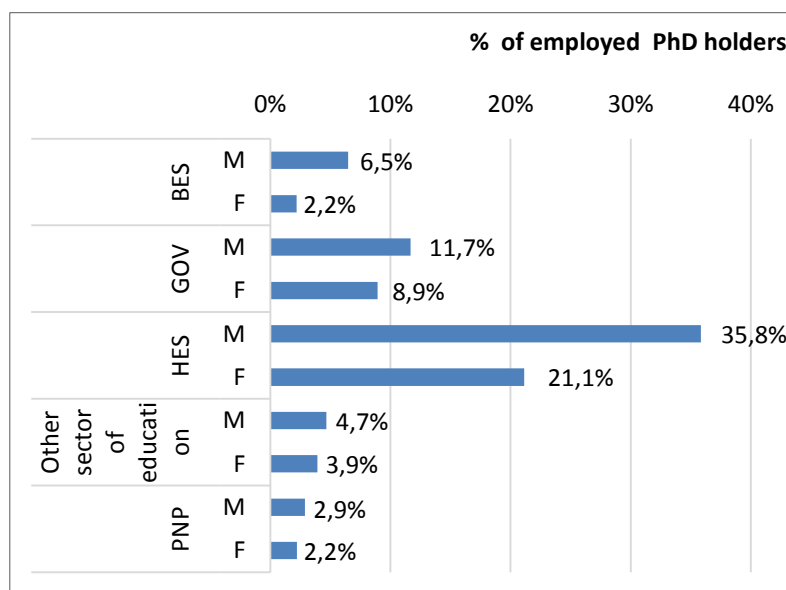
Figure 30: Share of PhD holders' employment condition (according to the CDH survey of OECD)



source: EKT (2015d)

HES sector stands as the main employer of PhD holders, a fact that is indicative for the productive pattern of Greece. The business sector comes only third -after the higher education sector and the government sector.

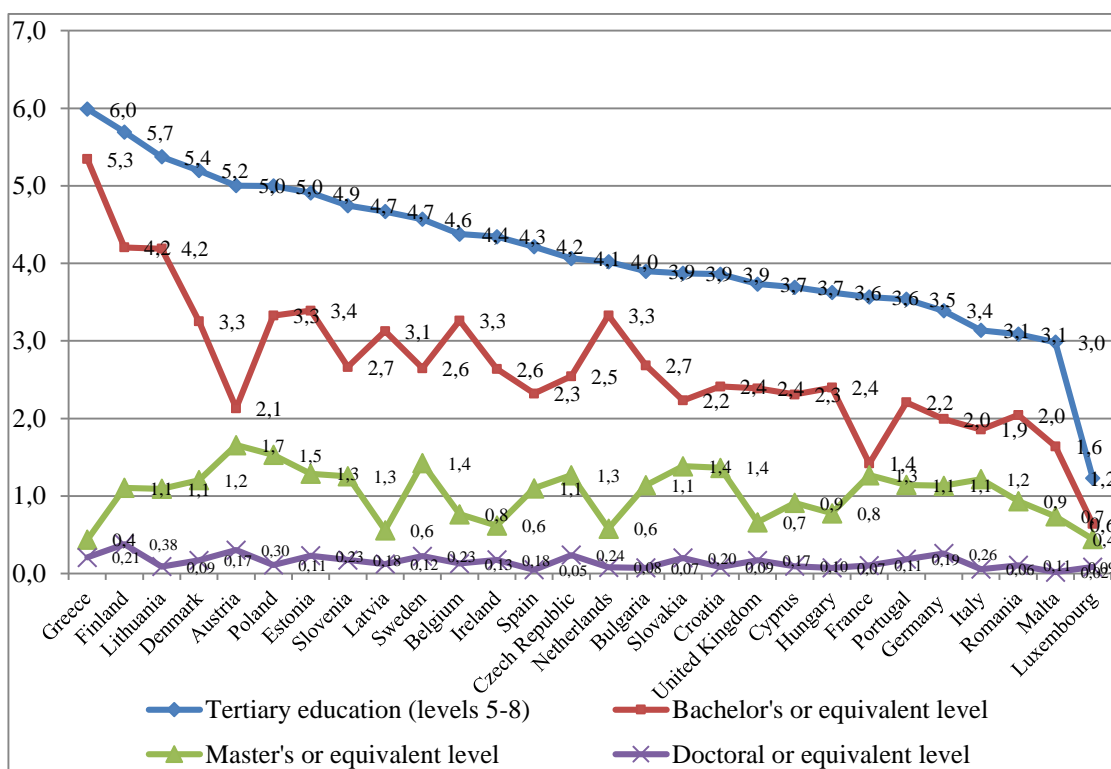
Figure 31: Employed or self-employed PhD holders by sector of employment, Greece (according to the CDH survey of OECD)



source: EKT (2015d)

On the other hand, as universities and technological educational institutes are the main actors in the higher education sector, data on students, academic staff etc. concerns actually HEIs' operation and activities⁵. A special notice should be made concerning the share of total students enrolled in tertiary education –namely on undergraduate, postgraduate and doctoral level-, which, in the case of Greece, tops international comparisons. The same is observed for undergraduate studies (ISCED6), whereas the relevant share on ISCED7 studies is the lowest among EU28 member states (figure 32).

Figure 32: Students enrolled in tertiary education by education level, 2013 (as share in total population)

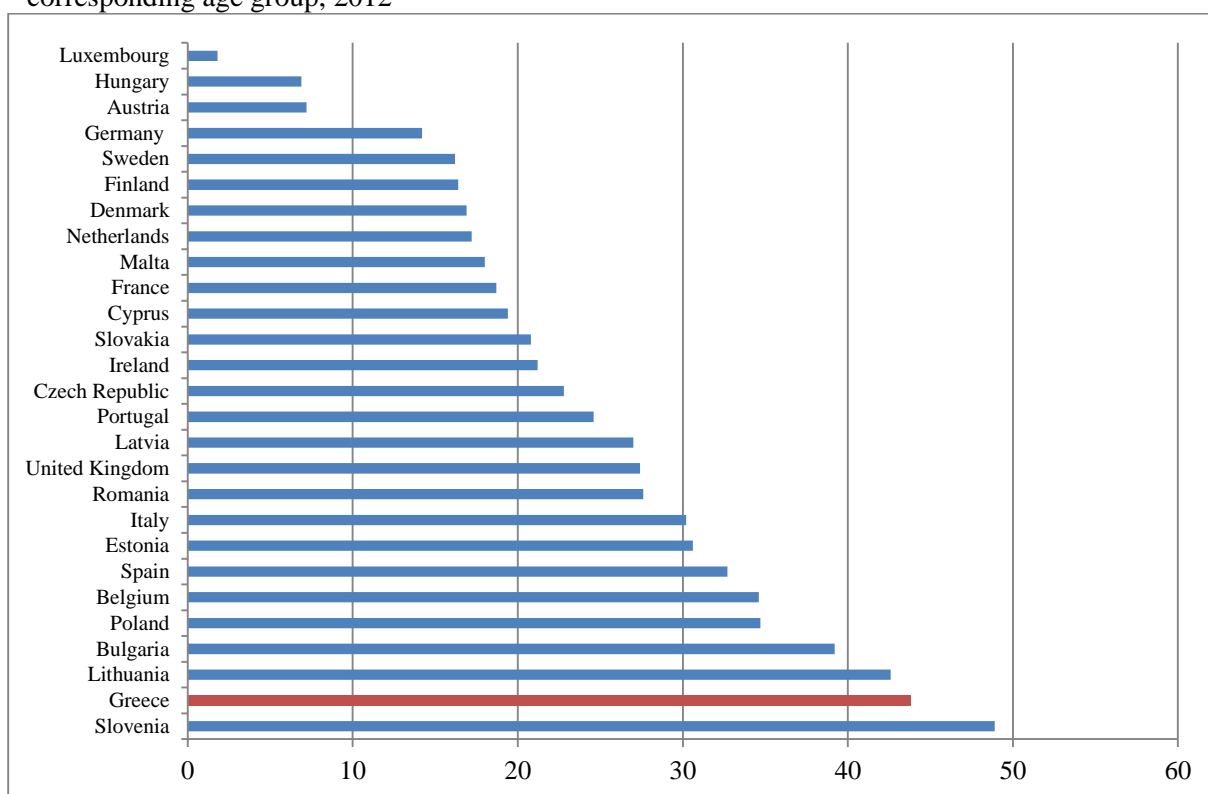


source: Eurostat (educ_uoe_enr103, demo_pjan) - authors' calculation

In this context, Greece achieves high national performance, when i) the share of under-, post- and doctoral students enrolled in the scientific fields of science, mathematics, computing, engineering, manufacturing and construction (the third highest rate in EU28, following only Finland and Germany) and ii) the entrants in undergraduate studies as a share of all persons of the corresponding age group (figure 33).

⁵ Institutes of ecclesiastical education, merchant marine, military education, tourism and art are also included, being though a small share of total.

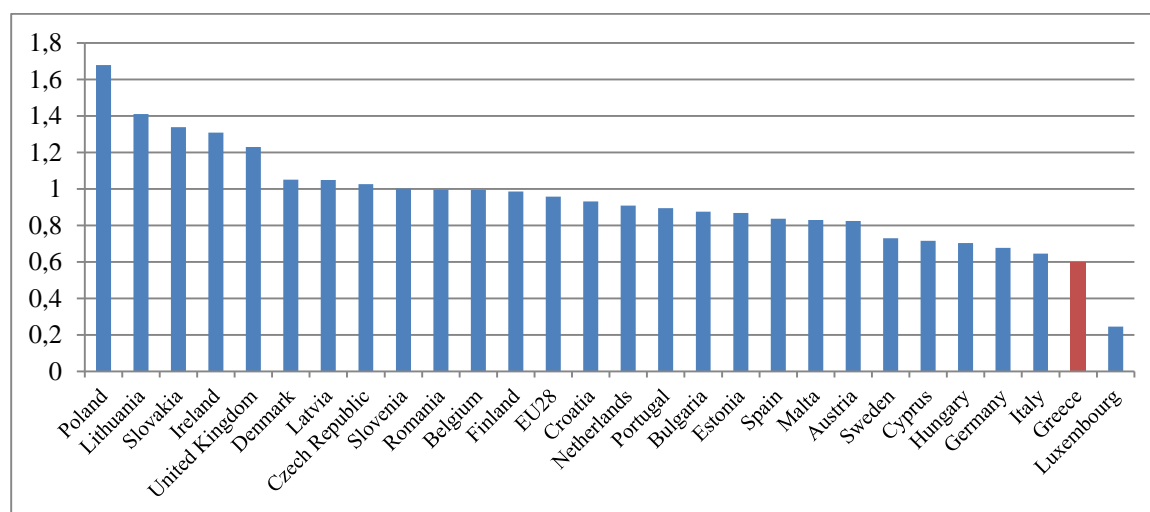
Figure 33: Entrants at theoretical starting age in ISCED level 5 - as % of all persons of the corresponding age group, 2012



source: Eurostat (*educ_iterp*)

The above, though, presents only half of the picture. In terms of graduation from HEIs Greece lies at the bottom rank of the relevant figure, among EU member states (figure 34). Associated with a number of well-known systemic problems, namely what is known as *not active students*, that is pupils enrolled in academic programs without going to classes or taking examination, thus lacking any incentive to graduate, has been inflating the number of entrants disproportionately.

Figure 34: Share of graduates from ISCED5-8 in total population, 2012



source: Eurostat (*educ_grad5, demo_pjan*) - authors' calculation

The same is also observed, when data on total graduates from higher education per thousand population is taken into account. This phenomenon implies a weakness of the Greek higher education system, as young people do access higher education institutes quite easily, but do not manage to complete their studies at all, or on time.

Employing a wider net, human capital refers not only on those with a tertiary education degree (according to the ISCED classification), but also those employed in science and technology. According to data on human resources in science and technology (HRST), compared to each country's overall population, Greece ranks 25th in EU28.

Open/close or strong/weak interactions between HEIs and the other KT-related sectors

For many years the main perception of the Greek population and the academic community about academic studies was that universities offer mostly theoretical and general knowledge without focusing on the practical aspect that will be applied on a business, at the same time that a wide proportion of graduates was either self-employed or was employed by the State and did not intend to deal with entrepreneurial activities. Thus, it is widely accepted that the limits between the academic and the business community should be minimized, for instance in terms of substantial R&D networking, mobility, spin-offs etc.

The analysis has shown so far that interactions of higher education institutes with other KT-related actors vary. More specifically, HEIs have the strongest relations with research centres regarding research collaboration in scientific fields of common interest, mobility of academic staff and students, etc. These interactions are structured on an *ad hoc* basis that rely on territorial parameters, mostly being the case in regions beyond the capital region of Attiki. In addition, research teams in HEIs have important linkages with international academic community, partly as a result of their strong participation in EU R&D projects.

As far as the enhancement of networking of HEIs (and public research organisations) with business is concerned, an important initiative was the creation of public technology intermediary organisations (university technology transfer offices, technological development centres / poles / clusters etc.) The main obstacle in these organisations was the cease of operations after the end of public funding. Thus, they have not been institutionalized into regularly contributing to research capabilities' enhancement and the raising business sector's funding.

NSRF 2007-2013 has funded the establishment of the Innovation & Entrepreneurship Unit (IEU-MOKE) in all HEIs, aiming at integrating research, education and innovation, for instance via seminars, presentations and mentoring on entrepreneurship, etc). Additional initiatives are taken by separate Universities and are illustrated in part II. Given the above, the definition of a clear, general rule is not easy, as some HEIs or even specific faculties may be more "friendly" or facilitate this kind of linkages.

The issue of the 'third-mission' of HEIs and the involvement of government

Following a perception that has been cultivated and embedded since the early 1980s, the Greek HEIs have mostly focusing on operating and working in education and research than the third mission. Evidence for this are the recruitment rules for academic staff, exclusively relying on academic criteria and performance, the low mobility of staff between HEIs and other sectors (mainly the business sector), or the governance modes of HEIs. The institutional reform of 2011 introduced a new governing body, the Board of HEIs, as a measure to open HEIs to society.

On the other hand, government policy since the mid-1980s promoted regional universities and technological educational institutes, broadening widely the interconnections of higher

education sector with local societies, while the enrollment in HEIs became gradually more tangible, as the system and the criteria for entering HEIs evolved. This can be argued to be one of the most explicit moves undertaken by the State to link the HEIs with the needs of the knowledge-user communities, the latter being active in agriculture, services, industry, etc. on a regional level.

The recent crisis, which led to the reduction of HEIs institutional funding, has made HEIs seek for other sources of funding. In this context, HEIs had to reconsider their strategies intending on broadening their activities, at the same time that the third mission seems to be more attractive to them, in order to broaden their funding sources.

Furthermore, the framework that is set for the Partnership Agreement between the European Commission and Greece in the programming period 2014-2020 and the relevant conditionality criteria for approving funding flows from the Structural Funds of EU that deals with smart specialization and entrepreneurial discovery is a significant element introduced in the national political agenda towards 2020. This is highly related to the knowledge triangle, as it prioritizes the third mission of HEIs, setting it in a more structured and organized way, and intending – amongst others- to leverage cooperation of HEIs and businesses at regional and national level (Foray et al. 2009). Following this practice, national policy for research, technology and innovation will focus on strengthening linkages between the main producers of new knowledge (HEIs and public research centers) and the potential users of it, namely the business sector.

Financial interventions from a KT perspective

In order to enhance the blossoming of relationships between academia, research and business sector and the national innovation potential, GSRT had been regularly launching a number of financial intervention measures. These measures explicitly sought to enhance the interaction between the private and public sector (meaning, HES) either by increasing the ‘entrepreneurial contribution in the research effort’, or by ‘linking the RDI with the national productive nexus’. Specifically, during the two most recent programmatic periods a number of major such financial intervention schemes were set up.

While the evaluation exercise for the above programmes is in its concluding phases (GSRT, 2016), it has revealed a number of strengths and weaknesses during the implementation and operational phases of these measures.

Concerning the Research Consortia for Technological Development intervention measure, participants noted that the gains exceeded the costs, and are to be found mainly in the then-created job positions for the highly educated, the formation of strategic partnerships between the consortia partners, the subsequent high quality scientific publications, as well the betterment of their public image.

Concerning PRAXI, 33 of the spin-offs created during the intervention measure are still operational, while 3 have been bought out by large companies. In addition, a number of these spin-offs have managed to secure follow-on funding. Yet, because of the rigid legislation, in addition to a lack of interest by the private sector, led the measure to underperform.

Concerning ELEFTHO, evidence points to less than half of the original incubators still in operational phase, a lack of data (demography and growth trajectory) concerns the firms that were incubated, as well as whether the incubators are financially sustainable in the long run.

Concerning PAVET and PAVET-NE, participating enterprises found the measure as helpful in concluding their RDI project at the time, while they value the measure as greatly beneficial in

helping them to employ human capital of high education, as well as towards know-how acquisition.

Concerning Clusters, Greek cluster policies were initiated during the second half of the 1990s as an attempt of the State to replicate industrial policies of other more advanced countries. All in all, while the results of the evaluation exercise are currently delivered to the issuing authority for further evaluation as to which financial intervention measures are to be re-issued in the upcoming programmatic period also taking into consideration the Regional Innovation Strategies, a recurring theme, yet with an alternating tone, is the issue of the links created between the academia and industry. While in some such financial measures a clear such link has been created with obvious benefits for both actors, it appears that this is the case only during the operation of the public financial measure. The moment this measure expires the link is either dissolved, or goes into some sort of a 'stand by' mode until a new such measure reappears, thus significantly curtailing any possible long term benefits spilling over to the wider society.

As far as GSRT's Co-operation project is concerned, this was one of the main funding tools to support RDI partnerships between the academia and business sector during the period 2007-2013. The range of its scope was quite wide, as it intended to make Greek firms more extrovert, increase employability of highly educated people, contribute to the development of new products and services, as well as serve societal challenges. However, the involvement of the business sector remained limited. A point of consideration related to the realisation that the knowledge supplied was mainly by HEIs and PRIs towards enterprises, yet without taking the latter's demand into account. On the other hand, these initiatives did not manage to leverage relevant foreign direct investment in Greece, nor did they include effective criteria for the exploitation plan of the funded project, nor were they planned in a way 'forcing' competitors to collaborate, thus achieving economies of scale, making the overall undertaking difficult (GSRT 2010).

Finally, concerning the Regional Innovation Poles, an important legacy has been identified, that is the creation of networks and the skills' acquisition process of the human capital, as well as the ability of the bureaucratic mechanisms in the Regions involved to manage and coordinate complex RDI intervention measures. Yet, the lack of a permanent infrastructure, as well as the incapacity to secure follow-on funding from neither public nor private funds stand as the major two handicaps decreasing substantially the long-term positive impact of this measure.

3. Funding research and higher education

Funding flows

Table 10⁶ gives the full picture of funding flows in R&D sector before and during the crisis. A cross temporal decrease of GERD spending (apart from years 2013 and 2014) is evident, coupled by a stable funding pattern by both BES and GOV. Funding from abroad has been increasing, while during recent years, it appears it has reached a plateau. Also, funding from NSRF –funding directly related to EU’s Structural Funds- has more than doubled since 2011.

Table 10: R&D Expenditure by source of funds in Greece, 2008 - 2014

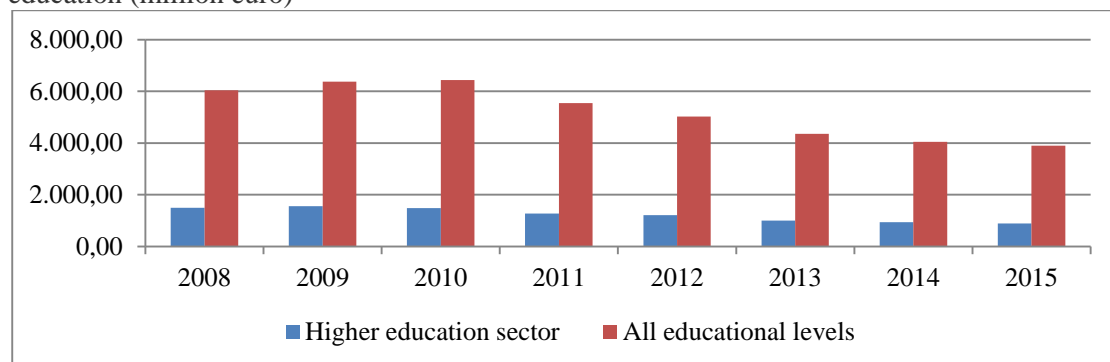
	2008 ^(e)	2009 ^(e)	2010 ^(e)	2011	2012	2013	2014
Businesses	468,3	497,5	494,0	455,5	414,8	443,9	444,3
Government	995,9	813,5	652,7	684,9	673,6	766,1	786,2
GOV: Ordinary Budget				504,4	481,2	411,3	400,9
GOV: NSRF				124,7	137,8	296,5	308,1
GOV: other source				55,7	54,6	58,3	77,2
Higher Education Sector	31,6	31,6	31,6	31,6	26,2	38,1	41,7
Private non-Profit Sector	13,9	13,9	13,9	13,9	12,1	12,6	12,9
Abroad	91,9	129,4	160,3	205,2	210,9	204,9	196,8
EU				165,2	164,6	167,4	155,7
Other sources from abroad				40,0	46,2	37,5	41,1
Total	1.601,57	1.485,94	1.352,52	1.391,20	1.337,60	1.465,70	1.481,8

source: EKT (<http://metrics.ekt.gr/el/statistika-etak/datatables>)

^(e)EKT estimations

As mentioned, the severity of the crisis affected education expenditures, as a whole and higher education sector, in particular (figure 35) by forcing Greek governments to cut the relevant public expenditures in a horizontal way, despite their growth impact and potential in the long-run. Moreover, it should be noticed that even though expenditures on research or education as a percentage of GDP may remain stable or even increase, this is the result of GDP’s fall to almost 30% from 2008 to 2015.

Figure 35: Final ordinary budget appropriations for higher education sector and all levels of education (million euro)



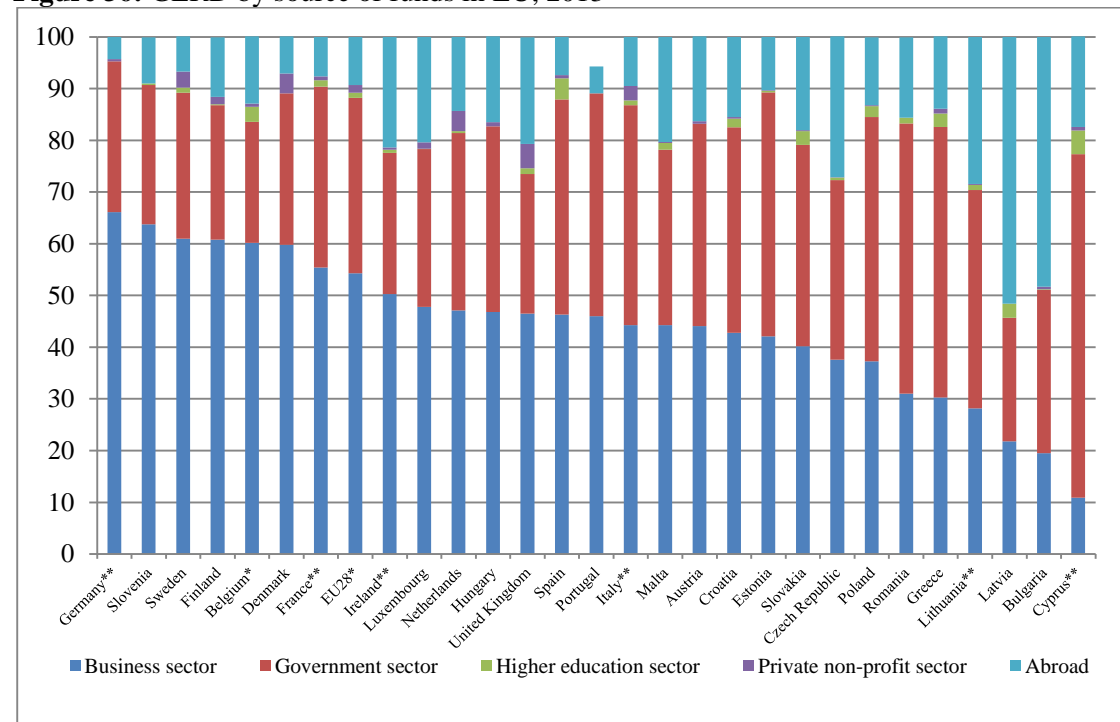
source: Ministry of Finance

⁶ Data on R&D have been not available in the period 2008-2010, therefore the National Documentation Centre has estimated relevant figures –aggregate data in some categories- retrospectively

The main funding sources for research and education

According to figure 36, R&D funding in Greece depends mostly by government that funds research that is performed in public sector (government sector and most of the higher education sector), achieving one of the highest shares among EU member states. On the contrary, R&D funding by the business sector in Greece is one of the lowest in EU. The main funder of R&D is the Ministry of Education (comprising also of GSRT).

Figure 36: GERD by source of funds in EU, 2013



source: Eurostat (*rd_e_gerdfund*) - authors' calculation

* data 2011

** data 2013

As mentioned above, the main R&D performer in Greece is HEIs and not the business sector, which is a telling difference to global trends. Therefore, it is meaningful to analyze the funding sources of R&D that is performed in this particular sector. Table 11 shows clearly that diachronically almost 75% of its R&D is funded by government, either as institutional funding (via ordinary budget) or as project funding (via NSRF). Funding from abroad is also significant for HEIs, at the same time that funding from the business sector, as well as its own resources for R&D are low (less than 5% as a share of GERD performed by HEIs).

Table 11: R&D Expenditure in the Higher Education Sector (HES) by source of funds, 2011 - 2014

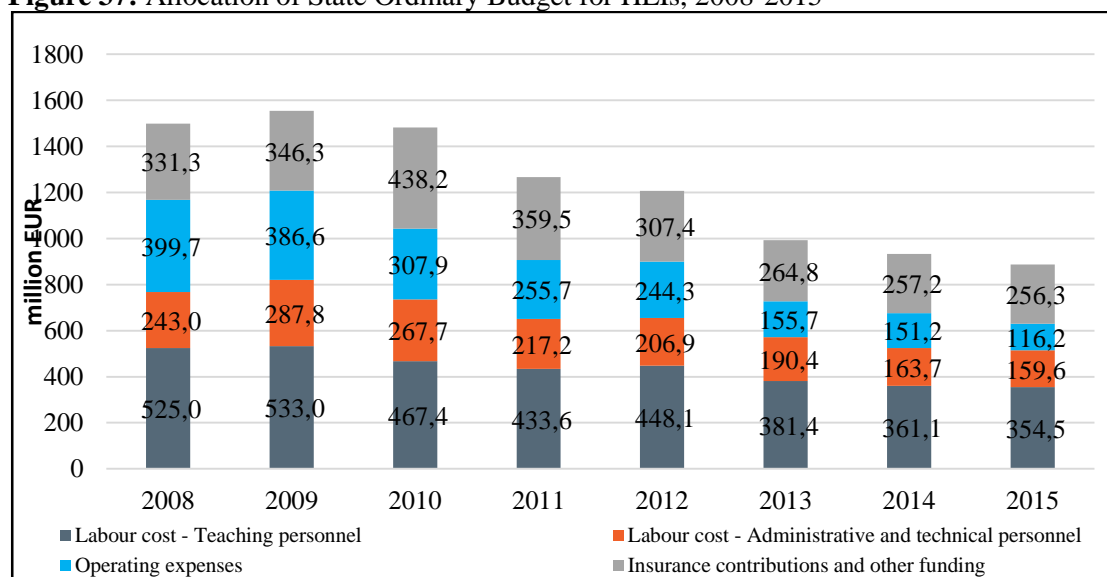
Source of funds	2011	2012	2013	2014
Businesses	50,1	42,1	30,0	33,0
Government	389,2	377,3	395,7	406,4
GOV: Ordinary Budget	340,9	321,2	253,1	251,6
GOV: NSRF	41,5	49,8	125,5	133,9

GOV: other source	6,7	6,3	17,1	21,0
Higher Education Sector	30,9	25,7	37,7	41,1
Private non-Profit Sector	4,1	3,2	3,8	3,9
Abroad	85,2	86,0	81,5	76,7
EU	77,3	78,1	74,6	68,8
Other sources from abroad	7,9	7,9	6,9	7,9
Total	559,5	534,3	548,6	561,1

source: EKT (<http://metrics.ekt.gr/el/statistika-etak/datatables>)

In qualitative terms, the main funding source in higher education is the State that is financing HEIs via either institutional funding or project funding. Due to missing analytical quantitative data on the funding mix in higher education, it is interesting to examine the evolution of budget appropriations allocated to HEIs. Figure 37 reveals an overall decrease of more than 40% (or 612,5 million EUR) between 2008 and 2015. Budget cuts have been more severe in years 2011 (budget has been reduced by 15% between 2010 and 2011) and 2013 (18% decrease between 2012 and 2013). The cost category mostly hit by the ordinary budget cuts was the ‘Operating costs’ category (71% decrease between 2008 and 2015). On the other hand, budget allocated to cover labour costs has been reduced by one third. Provisions for 2016 are not promising. A further reduction by 7,5% in the total budget allocated to HEIs has been ear marked in 2016 state budget.

Figure 37: Allocation of State Ordinary Budget for HEIs, 2008-2015



source: Ministry of Education, Research and Religious Affairs and Ministry of Finance

Evidently the government/state budget is the main funding instrument for research and education. State budget comprises of (a) the Ordinary Budget, the revenues of which come mainly from taxation, and is intended mainly for the funding of institutes of the public sector (including universities, public research centers as well as research institutions located abroad – e.g. CERN), (b) the Investment Budget, comprising of other government revenues as well as EU support (European Development Fund, European Social Fund, Cohesion Fund), which is allocated to public and private institutes in the form of projects and programmes, (c) a budget annexed to the general budget, that is actually adjacent to the government budget, and is mainly used for project funding in agriculture.

The case of performance based funding

On the whole, the State is the main funder of research and education in Greece. In more detail, institutional funding for HEIs and most PRIs comes from the Ministry of Education, either directly or via GSRT of the Ministry of Education for the case of those PRIs that are supervised by GSRT.

The introduction of a performance-based funding mechanism, in parallel to the existing ones, replacing partly institutional funding was announced in the past, as an intention of the Ministry of Education and GSRT, in order to improve efficiency and serve accountability, related to public funding. So far, no particular initiative has been taken, but one may assume –especially during crisis and as public expenditure becomes scarce- that this approach is still on track and under elaboration. As performance based funding is missing, there are no knowledge triangle-related criteria, too, but it may be taken for granted that if this funding mode becomes operational, criteria involving all three dimensions of the triangle will be taken into account.

4. The role of place-based policies in the KT

The location of HEIs / PRIs and local embeddedness

Taken together, the geographically allocated placement of the Greek science base found in HEIs and PRIs and the appreciation of the regional character of innovation point to a need for a renewed understanding of the innovation process on a sub-national level via identifying, mapping and taking stock of the links between the regional knowledge triangle actors (educating & research actors: HEIs, research actors: PRIs, innovation actors: business sector). By way of this approach, certain aspects of the innovation system will also be highlighted.

As already mentioned in section 2, 22 universities (including the Open University and International Hellenic University that delivers only ISCED7 degrees) and 14 technological educational institutes operate in Greece, being the main R&D-active institutes. More specifically, most Greek Regions have one university, one technical educational institute and some research institutes, as parts of public research centres. This is not the case for the most R&D-active Regions in Greece (the capital Region of Attiki, Kentriki Makedonia, Kriti and Dytiki Ellada), where most of the HEIs and PRIs are located (table 12). Greece is highly centralised in terms of R&D performance, with public sector (mainly HEIs) mostly responsible for the R&D performed.

Table 12: Location of Universities, Technological Educational Institutes and Public Research Centers in Greece

Region of:	Number of Universities	Number of Technological Educational Institutes	Number of Public Research Centers / Parts of other PRIs
Anatoliki Makedonia Thraki	1	1	0/2
Kentriki Makedonia	3	2	1/1
Dytiki Makedonia	1	1	0/1
Thessalia	1	1	0/2
Ipeiros	1	1	0/2
Ionia Nisia	1	1	0/1
Dytiki Ellada	2	1	0/3
Stereia Ellada	0	1	0/1
Peloponnisos	1	1	0/2
Voreio Aigaio		0	0/0
Notio Aigaio	1	0	0/0
Kriti	2	1	1/3
Attiki	8	3	16/0

The range of HEIs' local embeddedness varies, but in the most cases it is rather significant. While not R&D-related, especially in those Regions that are non-R&D intensive, the level of embeddedness into the social fabric is important, for example via the housing and infrastructural amenities required for catering for students. Furthermore, there is usually high rate of domestic students' enrollment in local HEIs, as their academic structure and curricula may be related to some extent to local productive activities and needs, and on the other hand HEIs cover local societal challenges, as they are expressed by local authorities, mainly in planning and consultative services. Indicative for this has been the case of planning smart specialisation at regional level, where stakeholders from research community and academia have addressed right from the beginning its technological and R&D-related perspective, contributing not only in public consultation process, but also in the formation of regional strategies.

Level of cooperation between Regional authorities and HEIs

In terms of RDI governance, and especially funding, regions fit one pattern, being dependent upon government budget and Structural Funds. Regions' involvement with research and technology has to do usually with the administrative management of the Regional Operational Programmes (ROP) projects that are the main funding instruments for RDI at regional level. Each Region may include (some) RDI activities in its ROP, according to the emphasis that it lays on knowledge-intensive sectors and its R&D performance capacity. In this context, ROPs finance mainly RDI-related investment requested by local HEIs, research centers etc. It is to be noted that this investment deals mostly with infrastructures. Thus, there are significant funding flows between local HEIs and local authorities. This is not so clear in the case of the capital region of Attiki, due to its size and the complexity of activities. This particular Region represents almost half of total national performance in various areas, such as domestic product, population, RDI, number of universities etc. making a regionally based analysis rather difficult. Nevertheless, this relationship reflects the policy strategies and funding that brings HEIs and Regional authorities closer, as there has been no other embedded and clear expression in institutional terms so far.

As of recently, two major institutional innovations were introduced in regional governance, related to RDI policy: i) Law 4310/2014 for RDI carries provisions for the establishment of Regional RDI Councils in each of the thirteen Greek Regions. The aim is to leverage RDI policy's regional aspect, favoring the involvement of Regions in RDI planning and implementation, and ii) the decision of the Central government to nominate regional authorities to prepare their own RDI-related smart specialization strategies, in order to enhance the salience of their comparative advantages towards a knowledge-intensive direction. However, these policy norms have not been implemented fully so far, so the success or the efficiency of these new political layers remains to be seen.

Past place-based knowledge intensive policies

Some of the most important aspects of regional RDI policy in Greece in previous programming periods included Regional Innovation Poles (C. Macedonia, W. Macedonia, Thessaly, Crete, W. Greece), as well as Clusters. As for the latter, it can be divided largely in two phases. The first was more industrial-oriented in the sense of making an effort to enhance established industries. As such technology intensity was not a major factor. Such examples would include a policy initiative by the General Secretariat for Energy based on a large-scale study "The Future of Greek Industry" during 1994-1997, followed by the call 'Promoting Industrial SMEs networking (clustering)' as well as the call "Strengthening Environmental Networks" both in 2003. In 2005, an attempt to build clusters on the already successful businesses of the Greek sectors of tourism and hospitality led to the "Promotion of Networking in Tourism SMEs (clustering)".

Following the recognition that the knowledge economy requires constant interaction of innovation actors, and the focus on an international level was on supporting technological specialisations and concentrations, GSRT initiated technology intensive-focused cluster attempts. Following deliberations with interested parties, the sector of microelectronics received increased interest from policy makers given a large number of promising Greek-based high-tech industries as well as a sound science base. This led to the Hellenic Technology Clusters Initiative (HTCI) established in 2006, and soon renamed as Corallia⁷.

⁷ For example, the technology cluster of microelectronics (mi-Cluster) has been initiated in 2006, has been financed with approx. 40 million Euros, and is currently entering its third developmental stage. Strongly export-oriented, the cluster is home to a number of knowledge-intensive companies with significant growth potential. The endeavor has prompted the relevant government authorities (GSRT) to

The initiative of establishing Regional Innovation Poles that was also mentioned above (see section on past means of policy to enable cooperation between the business sector, HEIs and PRIs), which started in mid-2003 and involved five regional innovation pole projects underpinned by the necessity of fostering partnerships between research institutions and businesses of the same region, to focus on one or two themes per region, to launch technological platforms. Their goal was to boost innovation and innovative activities in specific regions, according to their sectoral, productive specialisation and their comparative advantages. Although the concept had been innovative, the results were lower than anticipated due to the limited local mobilization and the difficulties in selecting thematic priorities, while there were no provisions for the poles' future operation and knowledge and experience dissemination (GSRT 2010).

A second similar action was the founding of the Thessaloniki Innovation Zone. Focusing on developing innovation and high-tech activities in one geographical region, where a high concentration of universities, research laboratories, technology parks, incubators and businesses is found the assumption went that this concentration would lead to the creation of a critical mass of companies and clusters.

Regional authorities have to further move towards a strong interface with possible innovation actors, especially from the business sector. Regions' involvement has been –until now- not substantial in facilitating the connection and knowledge/technology transfer between research performers and domestic business.

Smart specialisation towards 2020. The significance of RIS3

The introduction of smart specialisation strategy is definitely a critical juncture in RDI policy-making, as this practice presupposes the collaboration between the national and the sub-national level. The country, being a member of the European Union, approaches issues relating to its innovation system via (also) European priorities. In the current programmatic period emphasis is given to understanding and enhancing the regional innovation systems. It is in these delineated regions that the concept of the knowledge triangle bears most impact given that in most cases the downstream and upstream aspects innovation output tends to be geographically-bound.

More specifically, smart specialization practice that is integrated in the new Partnership Agreement between European Commission and Greece for the programming period 2014-2020 deals with the idea that public investments for RDI should be more focused on regional knowledge strengths, to leverage these specific assets with a view of transforming productive structures towards higher value-added activities. This strategy, for the first time implemented in Greece, aims at addressing the 'regional innovation paradox', namely the problem that those regions most in need to lift up their RDI potential are also those that pay less attention to innovation as a factor for regional growth, and experience more difficulties in absorbing European Funds dedicated to this goal.

GSRT initiated a process of selecting thematic areas or dynamic sectors that would contribute to growth perspective, namely environment, energy, agriculture, health, ICT, logistics, tourism, materials. Then, it tried to analyze and specialize further these areas, in collaboration with business and academia, in order to find knowledge-intensive activities that are related to RDI, operating the so-called sectoral "innovation platforms". In effect, GSRT designated critical research fields and means of policy, introducing them in the new National Strategy for RDI and

copy this public intervention scheme in the fields of space (si-cluster), gaming (gi-cluster), and health (bionian cluster) (see GSRT, 2016).

Smart Specialization (published in summer 2015), taking into account outcomes of regional strategies, too. As far as regions are concerned, they engaged a relevant bottom-up consultation process with stakeholders, in order to prepare their Regional Smart Specialization Strategies, focusing on identification and exploitation of their comparative advantages, on a way that would support innovation, and would focus on investment that would contribute to local economies' transformation towards more sophisticated patterns that involve business sector and favor entrepreneurial discovery, mixing bottom-up with top-down practices. Thus, a main challenge for the forthcoming RDI policy and measures is to initiate and develop a learning process that would involve regions to discover promising research and innovation domains, with the collaboration of entrepreneurial actors and other regional intermediaries.

5. Evaluation of higher education and research

Present evaluation mechanisms and indicators applied

The Hellenic Quality Assurance and Accreditation Agency (HQA) and GSRT are institutionally responsible for the evaluation mechanisms in the area of higher education – regarding HEIs- and research –regarding PRIs- respectively. Although evaluation in PRIs has been an embedded procedure for more than 15 years, the situation has been different in higher education, where evaluation tradition is definitely shorter, being actually introduced in the Greek system, as a result of Greece's participation in the European Higher Education Area. The direct outcome of these initiatives was the establishment of HQA only in 2006, a state-independent authority that establishes accreditation programs and quality assurance procedures. On the other hand, there is no specific organisation or body being competent for the evaluation of all national research institutes. GSRT has introduced a regular, more or less every 5 five years, evaluation cycle for those research centres that are supervised by the GSRT. The last cycle of evaluation of the research centres supervised by the GSRT was completed in 2013.

Beyond the evaluation of HEIs and PRIs by internal and external evaluators on a faculty- and/or institutional-base, there is also the need for evaluating research that is undertaken in the country; examined in parallel with the ability to finance research in competitive terms, so as to serve scientific excellence. The objective of a solid and embedded system of evaluation and assessment activities is to ensure that previous initiatives, measures and programmes have achieved the desired effects and have contributed to policy's efficiency. Ideally, the evaluation results are used to re-design a programme, a policy instrument, or the ingredients in the innovation policy mix. The existence and operation of such mechanisms gives also the ability to policy-makers to adapt and improve past policy tools. In general, *ex post* evaluation of programmes and funding schemes were introduced in the late 1980s by GSRT on an *ad hoc* basis and the evaluators were usually selected after public bids. Since 1997, *ex post* evaluations have been implemented for a number of research programmes. On the other hand, after the integration of systematic evaluation into the Operational Programmes, there is a formal *ex ante* and on-going evaluation for the OP as a whole, as part of the measures supporting RDI.

Evaluation practices and KT-related activities

The institutional evaluation of HEIs follows international standards and norms, both by external and internal evaluators. The basic structure of the evaluation process refers to: i) the curricula, ii) teaching activities, iii) research activities, iv) other services, v) strategic planning and vi) conclusions and recommendations. HEIs are asked to provide general information (history and numeric data), data on governance, strategic development, financial planning, data on available infrastructures, informational systems and buildings, academic performance of the staff (teaching, publications), curricula, public access etc. More direct information on the third mission of HEIs is requested, when research activities are analysed, mainly in relevance to technology transfer results and visibility in society, especially when the examined faculty/scientific field favors interaction with production and real economy. In addition, evaluators and committees of evaluation –mainly external ones- highlight often the need for brining business and entrepreneurship closer to HEIs, their faculties and their students. These cases are to be found mostly in questions/fields, such proposed initiatives, recommendations, or even weaknesses of the existing operation.

PRIs' evaluation takes into account the following parameters: personnel (number and type), financial data (expenditures and revenues), information on facilities and equipment, scientific

outcome (publications, patents etc.), and other scientific and technological achievements. The latter includes data on initiatives taken by researchers for the exploitation of research results and knowhow, and initiatives taken for the establishment of spin-offs. Evaluators appeal – amongst others- to compare the Greek context to the relevant international standards in each field, to mention opportunities and threats and to make recommendations. They evaluate the institute according to its image and its academic reputation, as well as its performance regarding quality, productivity and vitality, highlighting also the relevance of complete research activities to dissemination and implementation of knowledge, linking the latter directly with PRI's relations and openness to society.

As far as the impact of policy measures and the RDI relevant programmes concerning the dimensions of the knowledge triangle has been analyzed so far in an indirect way.

According to the Ministry of Development and the preparation of the Operational Programme for Development, Entrepreneurship and Innovation –that includes the greater part of RDI project funding for the 2014-2020 programming period- a new monitoring mechanism, directly linked to smart specialisation implementation, has been scheduled to operate. In this case, the funding authority should have the ability to monitor and evaluate means of policy or funding tools, beyond the usual quantitative rules that apply generally in the case of Structural Funds. Therefore, it is critical to combine qualitative parameters, as well, following peer review practice, and using concrete methodology and assessment logic. More specifically, the evaluation systems referring to smart specialisation should rest on an agreed definition of its “success”, being at the same time rather dynamic. Therefore, monitoring and evaluation mechanisms need to be well-integrated into the policy cycle in view of adjusting the policy mix over time (Nauwelaers et al. 2014). In this context, GSRT and the Ministry of Development have set specific indicators for assessing the implementation of smart specialization practice at national level, while Regions have selected their own relevant indicators for monitoring the progress of their own strategies that are directly linked to RIS3.

PART II

KT-related activities in selected HEIs

Methodological note

Concerning the case selection of the institutions presented hereafter, the following should be mentioned. Selection of the case studies took into consideration issues of geographical dispersion, number of schools within the institution, and the pro-business character of the institution. More explicitly, University of Crete (UoC) was selected upon the fact that it is located afar from the major cities in Greece. In addition, this selection was informed on the basis of the university's close geographical proximity to a regional, high-class, research institute (Foundation for Research and Technology – Hellas), as well as the University General Hospital. This would allow for mapping of the linkages developed on a regional and cross-disciplinary level. The Aristotle University of Thessaloniki (AUn) was selected upon one specific characteristic. That is being the largest University in Greece, comprising of 11 Faculties organized into 41 Schools. This in effect would allow for an understanding of the knowledge-triangle characteristics across the widest possible variety of thematic and sectorial environments. The Athens University of Economics and Business (AUEB) given its explicit pro-market and pro-business orientation stands as a case in point that has taken the most steps towards establishing linkages with the private sector as well as nurturing students in developing innovation-relevant skills. Relations between the two pylons of the knowledge triangle (universities and the private sector) and a strong focus on innovation both in theory and practice informed this case selection.

Data concerning Part II were provided by the institutions themselves, on the basis of a particular questionnaire, prepared by the EKT, and following upon the lines of the structure of OECD's KT project. To ensure an up-to-date and timely collaboration with the institutions, EKT established a direct line of communication with the selected institutions. In more detail the EKT collaborated with: the Rector of the University of Crete Prof. O. Zoras, Vice-Rector Prof. T. Filalithis and C. Codrington, who provided information on the UoC, with the Rector of the Athens University of Economics and Business Prof. E. Giakoumakis, Prof. T. Apostolopoulos, V. Mantzios and E. Chatzopoulou for data on the AUEB and with the Rector of the Aristotle University of Thessaloniki Prof. P. Mitkas, Vice-Rector Prof. N. Varkaselis and A. Tzaneraki, who prepared the answers for the case of the AUn. The final editing and refinement of part II was made by the authors of the KT report on Greece.

Universities' mission as defined by statute is 'to generate and transmit knowledge through research and teaching, to prepare students for its application on a professional level, and to cultivate the arts and culture' (N.4009/2011, s.4). Thus, as far as institutional policy or strategies supporting the KT are concerned (question 7), all Greek HEIs possess homogeneous characteristics in terms of state defined constitution, line-item budgets, staff status as civil servants. While, in principle, there is scope for institutional policy/strategy implemented at the university level, this is by definition limited.

On the other hand, the main characteristics of the governance and leadership of the HEIs, and their KT-related aspects (question 9) are the same for all HEIs. More particularly, the institution of University Councils was introduced with the N4009/2011 law on HEI governance (note subsequent and pending revisions) to act as a 'second chamber' to the Senate. According to the Law, the Council's responsibilities are the following: Development of the Institution's strategy, Supervision and control of the University's function, Participation in the development of the framework for the Institution governance, Involvement in decisions related to Academic and

Student Affairs, Approval of the Annual Financial Reports and Budgets of the Institution, Supervision of the University Property Development and Management Company and of the Special Account for Research Funds, Set up of the quality assurance system of the university. The recruitment/selection processes are detailed in laws and regulations for the University's Council members, the Rector, Deans, Heads of Department. The Rector participates in the Council meetings without voting right. Universities' leadership, including those with professional experience in other sectors, is assessed primarily in terms of their academic performance and administrative capabilities. As it stands, the Rector, Deans and Heads of Department are internally recruited. The internal members are elected by all the professors of the institution, with a single ballot, using taxonomic voting system (noting the election preference beside the name of preferred candidate in series of consecutive integers). For external members, an open call is published. The setting of high level qualifications for the election of an external member was taken as a step to inspire wider recognition in science, in literature or the arts. The candidate should possess high qualifications and at least a diploma from a national institute or a recognized foreign higher education institution. This does not hold for subjects or disciplines of exceptional and undoubted specificity, for which it is not possible for someone to possess one. The Chairman and the external members of the board are elected individually from the previously elected internal members, with the process of open ballot and a required majority of four fifths of all the internal members to get elected. To be elected as Rector, the candidate is expected to be a Full Professor of domestic or foreign University, having Greek nationality and excellent knowledge of the Greek language, recognized prestige and significant administrative experience. The Rector is elected for four years by an electorate consisting of the professors of the university. The Rector appoints, to assist his work, Full Professors or Associate Professors of the University as Deputy Rectors, and delegates to them specific responsibilities, by ruling approved by the Council. The ruling that appoints the Deputy Rectors determines the order in which they substitute the Rector. The number of the Deputy Rectors is specified in the Internal Regulation and Organizational Chart of each University. Moreover, the Senate is composed of: 1) the Rector, the Vice Rectors, the Deans of Faculties and Heads of Schools, 2) one representative of the teaching assistants/ tutors/ research fellows, 3) one student representative of each Faculty, 4) one representative of the Special Teaching Fellows (S.T.F.), 5) one representative of the Administrative Personnel, 6) one representative of the Special Administrative-Technical Personnel (S.A.T.P.), and 7) two representatives of the postgraduate students and Special Postgraduate Scholars (S.P.S). Thus, in most HEIs there are no particular organizations for promoting KT activities. However, one activity that is funded by the Structural Funds, according to a relevant call of the Ministry of Education, is the establishment of University's Innovation and Entrepreneurship Unit (MOKE) in all HEIs. Primary aim of these Units is to promote innovative thinking and the entrepreneurial mindset to students and recent graduates, as well as to support the idea of entrepreneurship, as a career choice, supporting its pursuit and creating –ideally- pre-incubation conditions through the provision of training, support and networking of young entrepreneurial initiatives in their early stages of development.

Horizontal rules are also the case for human resource policies and KT-related activities in the Greek HEIs (question 15), as the recruitment/selection processes for faculty and other staff are detailed in national laws and regulations (Law 4009/2011, articles 16,18). The rest of Part II presents the cases of the selected HEIs, providing answers to the relevant questions that had been set by the OECD for the purposes of the KT project.

6. Key characteristics

The University of Crete (UoC) is a public HEI, established in 1973. Currently, approximately 14.000 undergraduate and 2.000 graduate students study through the Faculties of Philosophy, Education, Social Science, Sciences & Technology, and Medicine. Each of the University's 16 Departments offers an undergraduate programme with a wide range of core and elective courses leading to specializations within each discipline. Bachelor degrees require 4 years of study, and the Medical Degree follows a 6-year programme. Postgraduate studies and research training at all levels benefit from inter-disciplinary collaborations between Departments, with the Research Institutes (RI) of the Foundation for Research and Technology – Hellas (FORTH), with the University General Hospital, etc.

Research activity at UoC is organized along the lines of the Divisions within each Department. It follows the classic 'bottom up' academic model of research driven by the interests of the UoC's scholars and scientists. In parallel, research & research training benefit from close collaboration with the FORTH Research Institutes, notably those based in Crete. Around 100 of the UoC's faculty members have dual affiliations with the FORTH RIs in the domains of Electronic Structure and Laser, Molecular Biology and Biotechnology, Computer Science, Applied & Computational Mathematics, and Mediterranean Studies. Clinical research is undertaken in the affiliated University General Hospital. Other collaborations are realized with the Institute of Marine Biology, Biotechnology and Aquaculture (IMBCC) and with a wide range of national and international partners.

R&D expenditure analysis shows that 35% of the University's core budget is dedicated for R&D purpose. University's core budget covers operational expenses, capital expenditure, and salaries and thus, 35% of these types of expenditures are R&D-related. In addition to this, 67-75% of total expenditure made for projects managed by the Research Secretariat (ELKE) are R&D-related. Over the 5-year period of 2010-2014, ELKE managed project grants and contracts with an annual mean income of more than 15,7m €. During the same period, the annual average growth rate was 11,5%. Grant and contract income for R&D purposes typically accounts for about 70-80% of ELKE annual income, out of which, financial inflows attributed from publicly-funded competitive calls, primarily EC and national, was on average more than 9.3m € p.a. (mean 2010-14).

7. Institutional policy or strategies supporting the KT

As a rather newly established HEI, UoC recruited/attracted both established and young Greek researchers professionally employed in the diaspora. To facilitate research in identified key domains, the strategy adopted in the 1980s was to promote and support the formation of autonomous research institutes. The RIs of FORTH in Crete, the origins of the Marine Biology RI (IMBCC), as well as joint initiatives such as the Skinakas Observatory (Max Planck, FORTH & UoC) are few such institutes. Inauguration of the University General Hospital in 1989 also marked a critical springboard in terms of availability of clinical research and teaching.

The UoC prides itself as a research-intensive HEI characterized by research-led teaching. Research activity within the Divisions and Centres of the University's Departments is 'bottom-up', based on the initiatives of scholars and scientists in developing their own curiosity-driven or practice-based projects or working in collaboration with other research groups. The UoC at an institutional level strives to support the research and educational initiatives of its members. Knowledge diffusion /technology transfer has been occurring independently alongside since the UoC was founded (i.e. not institutionally controlled/ centrally managed).

According to the recent Institutional Self-Evaluation report to the Hellenic Quality Assurance & Accreditation Agency (HQA), the main points to support KT /third mission are -amongst others- the following:

- a) promote knowledge transfer beneficial to the socio-economic and cultural environment
- b) improve the communication and community understanding of the UoC's research activities
- c) strengthen interdepartmental, interdisciplinary curricula collaborations
- d) strengthen and develop partnerships with other PRIs and enterprises (public, NGO, private) for student internships
- e) promote inter-sectoral interaction/bridge-building e.g. through on-campus forums and events with other PRIs and enterprises for transferrable skills training and career development
- f) further cooperate with Regional Authorities in developing and implementing regional development strategies in areas where the University has expertise
- g) further cooperate with Regional Authorities in developing adult education programmes
- h) develop support for environmental policy in the public and private sector for the management of hazardous waste, municipal solid waste, energy, water and recycling.

Curricula are influenced by what can be termed 'default strategy' of an outward looking academic culture, with faculty seeking novel ways of creating, utilizing/delivering knowledge as well as exploring new inter-disciplinary alliances and partnerships. Some examples are:

- internships/work experience and accredited professional training are elements common to many of the University's degree programmes
- interdisciplinary Masters programmes within the University, involving external partners
- partnerships in doctoral training networks and ITNs (European Molecular Imaging Doctorate Schools Network - EMIDS)
- participation in curriculum development partnerships such as ERASMUS Intensive Programmes, specific CD projects
- MOOCs being developed and offered by some Departments; etc.

Specific initiatives, goals and/or benchmarks that are included in the current institutional policy or strategies to support: i) entrepreneurship and ii) local impacts are the following:

- Recent revision (2014-2015) of several Postgraduate Studies (e.g. "Isolation and Synthesis of Natural Products with Biological Activity", "Molecular Biology and Plant Biotechnology", "Sciences and Environmental Engineering») focuses on high-level training experts (theory and technology) in new, modern and rapidly developing interdisciplinary fields. Also the development of innovative products, techniques and environment-friendly services, as well as the promotion of entrepreneurship.
- Transnational Master programme "Technology, Innovation Management and Entrepreneurship -TIME MBE" focuses on the constantly internationally changing business environment, the use of technological opportunities to promote entrepreneurship
- Involvement in the recent place-based strategic initiatives related to RIS3
- Participation in the Crete Innovation Initiative (CrInI network of regional PRIs).

The examples given above are initiatives approved by the University Senate and adopted as institutional policy and practice. In the case of minor/major changes in institutional strategy, goals, benchmarks, etc., this should take into consideration the variations within and between arts, humanities and social sciences (AHSS) disciplines and science, technology, engineering and mathematics (STEM) disciplines.

8. The main sources of funding

The funding sources are: a) Public – state funding for salaries, operational costs and capital expenditure (infrastructure), b) Endowments and income from UoC properties (Property Management Services PMC) and c) External grants & contracts managed by the Research Secretariat (ELKE). In more detail, public funding of the core budget including salaries is the primary funding source for the University. Third party (external) grants & contracts logged by ELKE constituted on average 34,5% of the overall institutional income in 2010-14. External revenues managed by the PMS add another 1,5% on average. It is noted that the decrease of the core public funding because of the austerity measures, from 54,2m € in 2010 to 36,6m € in 2014, led to the increase (of the significance) of external funding. External R&D funding – managed by ELKE- amounted to more than 50% of total R&D expenditure for 2013 and 2014. Concerning public-private funding, grants/contracts funded by private enterprises constitute on average (2010-14) 18,5% of all third party income. In total, privately funded grants/contracts taken together with revenues managed by the PMS amounted to 4m € p.a. (2010-14), an amount less than 10% of total revenues.

9. Characteristics of the governance and leadership of the institution. KT-related aspects

In UoC, the Council comprises of 7 senior faculty members and 6 external members (all academics in foreign universities, distinguished for their contributions to the sciences, arts or literature). The Council has wide-ranging governance responsibilities which include strategic planning for the development of the University at all levels - local, national, European and international. The Council also reviews the recommendations of the Senate and the Rector on a range of governance and policy issues, including the University's internal regulations and quality assurance procedures, as well as approving the financial accounts and ensuring that the University is functioning in compliance with state law.

The impact of changes in governance mode on the UoC's linkages to society and the real economy are not readily discernible to date. This is due in part to the transitional phase and short lead-in time, so that much of the Council's work to date is at the preparatory /proposals stage. For example, the UoC Council established working group committees in the following thematic areas: Economic issues (University finances & budget); External, Social and Economic Engagement; Educational and Academic Affairs and Fund Raising; University Organization and Internal Regulations; Management (financial) of Master Programmes with Tuition Fees. The composition of the committees together with associated reports and recommendations are available on-line⁸. Beyond that, there is no particular organization and leadership for promoting KT activities (or integrating research, education and innovation) in the institution and no particular organizational resources devoted to implement greater KT linkages (such as designated staff, special units, special funding).

10. The role of local/regional partnerships for HEIs

Community ties/place-based partnerships are expressed mainly via strong place-based partnerships that exist with i) other PRIs in Crete & the University General Hospital, ii) Regional Authorities, iii) enterprises (hosting student interns or research collaborations). More specifically, the University is involved in the recent place-based strategic initiatives related to RIS3 as well as the Crete Innovation Initiative (CrInI network of regional PRIs). Historically, KT capacity building in the 1970s-1980s was the result of symbiosis between UoC and government initiatives as well as the then nascent regional PRIs (realized with significant support from Structural Funds). Subsequent initiatives have been due to collaborations between

⁸ <http://council.dev.edu.uoc.gr/legislation/Committees>

researchers. Similarly, enterprise partnerships have been initiated by UoC staff, with research and service contracts providing a significant source of external revenues.

11. Programs, initiatives or centres that explicitly aim to integrate research, education and innovation

Some examples of relevant programmes, initiatives and centres of UoC are the following: Natural History Museum Centre affiliated to the Biology Department, Skinakas Observatory Joint FORTH-UoC Astrophysics facility, Atmospheric Monitoring Station (Foinokalia) of the Environmental & Analytical Chemistry Division, Archaeology and geoscience collaborations (Lesvos excavations; Eleftherna archeological site & museum), Center for Research & Studies in Humanities, Social Sciences & Pedagogics. Moreover, there are similar examples supported by FP7 Capacities (RegPot) funding⁹. Although, the university does not take any measures to minimize the trade-offs between education, research, innovation, the above mentioned activities are related to societal challenges, such as environment¹⁰, ageing¹¹, health¹², clean energy¹³ and agriculture¹⁴. As mentioned above, UoC participates also in the CrInI (Crete Innovation Initiative), an initiative for the development of the knowledge economy of Crete based on a solid and lasting cooperation of Universities, Research Organizations and the business community. The aim is to create a vibrant entrepreneurial ecosystem investing in and capitalizing on the accumulated knowledge, human assets and infrastructures.

12. Partnerships with private and public users in research, education and innovation

UoC has established multiple partnerships with other HEIs, RIs, public bodies, NGOs and private and corporate enterprises. Aggregate data for grants & contracts logged with ELKE for the 5-year period 2009-13 are indicative of partnership networks (see following table 13).

Table 13: Number of projects with income by external funding source, 2009-13

⁹ Applied Mathematics: Archimedes Centre for Modeling, Analysis and Computation (ACMAC), Physics: Crete Centre for Quantum Complexity & Nanotechnology, Medicine School -Basic Sciences: TransPot (Translational Potential) to enhance technological capacity in Regenerative Medicine and Genomics

¹⁰ i) Natural History Museum, ii) Environmental and Analytical Chemical Division

¹¹ Medical & bio-medical research programmes

¹² i) REA cohort study on effects of in-utero environmental exposures on childhood development, ii) Isolation of biologically active natural substances from plants and herbs of Crete and further use in food and pharmaceuticals

¹³ i) Production of bio-hydrogen from photosynthetic algae and cyan-bacteria, ii) New materials for storage of hydrogen produced from renewable energy sources, iii) Advanced porous materials for storing methane

¹⁴ i) Innovative analytical techniques for various local products, ii) Isolation of biologically active natural products from plants and herbs of Crete and further use in food and pharmaceuticals, iii) Analytical technologies for fast and in-situ detection of plant diseases

Funding Source	No. projects	Aggregate Income (€)
European Union	134	20.183.795
Other public international	49	1.564.234
Private Enterprises	336	16.038.218
Public Corporations	4	696.849
Structural Funds 2007-2013 (National/EC)	222	21.213.719
Public Investment Programme (National/EC)	29	445.395
Other Public Funds (regional & local authorities)	93	4.087.097
NGOs	9	274.087
HEIs	3	1.088.323
Miscellaneous	29	1.416.934
total:	908	67.008.650

Concerning private enterprise/industry cooperation, the largest single category is clinical trials/studies undertaken by Medical School research groups through contracts with approx. 60 pharmaceutical companies. As far as spin-offs are concerned, UoC is currently collating data on the enterprise and innovation track record of academic staff. Data on licenses, patents, and spin-offs is not recorded centrally and there is also limited alumni tracking to date. With very few exceptions, UoC does not fund IP actions and does not impose disclosure obligations on staff concerning research results that may be patentable. While the potential net gains/losses in institutional revenues related to a lack of IP protection are debatable, there is evidence that the use and commercialization of research results/discoveries at the UoC has been occurring independently, with specific examples of spin-off companies¹⁵, products – services¹⁶ and successful start-ups¹⁷.

13. Participation in innovation ecosystems

UoC is part of a *de facto* regional cluster of PRIs that has been built up over the last 30 years including: the Institutes of the Foundation for Research and Technology-Hellas (FORTH) in Heraklion-Crete, the Institute of Marine Biology, Biotechnology & Aquaculture, and the University General Hospital, as well as other HEIs in the region – the Technical University, the Technological Educational Institute, and the Mediterranean Agronomic Institute of Chania. Furthermore, UoC participates in the CrInI Network formalizing the collaboration with a view to smart specialization and regional development.

14. Support of entrepreneurship activities among staff and students

Support of entrepreneurship activities among staff and students is achieved in the UoC, via collaboration with FORTH & associated access to FORTH PRAXI-Help Forward, which is the national link in the Enterprise Europe Network and STEP-C science park (incubator facilities+). Moreover, the *University's Innovation and Entrepreneurship Unit (MOKE)* organizes elective courses on innovation and entrepreneurship for students in the third or fourth year of study. In

¹⁵ Bionature E.A (biomedical R&D), Gnosis Data Analysis (AI, machine learning & bioinformatics), Modern Amphiaraiia.

¹⁶ Critical Information System (CRITIS)– electronic information management system for intensive care units, Public Opinion Research Unit (PoPRuN), Modified ETDRS visual acuity chart.

¹⁷ Virtual Trip Ltd (founded 2000); NovelTech (founded 2005); OpenIT (founded 2008).

parallel, seminars and workshops on IPR and enterprise skills training are organized in Departments, as part of particular research /educational programmes. Although, innovation/third-mission/commercialization practices' impact on instructional practices at the University is not mapped to date, these activities do indicate a positive –but not uniform- spill-over effect.

15. Human resource policies and KT-related activities

The University's commitments to the HRS4R process link in with the principles of open, transparent and merit-based recruitment. All UoC positions are, for example, publicized through the EURAXESS Jobs portal. HRS4R supports the evaluation of broader competencies related to inter sectoral mobility and entrepreneurial activities in recruitment and promotion procedures. However, evidence is not readily available on the extent to which this is impacting on custom and practice whereby researchers and academic staff, including those with professional experience in other sectors, are assessed primarily in terms of their academic performance, research management and administrative capabilities. Moreover, there are no incentives (financial, etc.) for staff to engage in KT-related activities.

16. Do assessment and evaluation policies and practices support KT activities?

Systematic quality assurance procedures have been developed and implemented according to legal framework for QA in higher education institutions (N.3374/2205 and N.4009/2001) and are supervised and coordinated by the Hellenic Quality Assurance and Accreditation Agency. According to the relevant law and regulation, each department has a QA group (OMEA), which works together with the University QA Committee (MODIP) to meet the requirements for periodic internal and external evaluations. Evaluation practices encompass KT-relevant measures, as these are embedded in the QA criteria for the thematic areas evaluated: curriculum, teaching, research, strategy for academic development, relations with social, cultural and productive bodies, and administrative services and infrastructure.

Research & knowledge transfer metrics include: i) publications & citations; ii) external funding for R&D; iii) licenses, patents, spin-offs (partial). Metrics for Educational KPIs include student intake, graduation and completion rates. Evaluation procedures are common to all disciplines but the assessment and evaluation of metrics are inherently qualitative and discipline specific.

17. Results achieved by current KT initiatives

The UoC does not monitor results achieved by the initiatives taken to improve KT linkages and minimize trade-offs between the three KT missions, but one can argue that CrInI and regional RIS3 are the primary developments aimed at stimulating/improving KT-related linkages. On the other hand, though, concepts of the 'entrepreneurial university' associated with 'the KT vision' are being debated and disputed, with noted tensions between IPR and open access/ 'privatization' of the science commons. The process of developing the UoC's new strategic plan and associated targets is expected to formalize positions on the knowledge transfer and commercialization issues associated with the KT and impact accordingly on academic practices (research and educational) as well as the support services.

6. Key characteristics

Founded in 1920, the Athens University of Economics and Business (AUEB) is a public university, having a strong tradition in the general fields of Economics and Business. From 1999 onwards, AUEB has expanded its areas of expertise in the fields of Marketing and Communication, Informatics and Statistics. As a result, the University currently has eight Departments, namely International & European Economic Studies, Economics, Management Science & Technology, Business Administration, Accounting & Finance, Marketing & Communication, Informatics and Statistics.

Each department offers an Undergraduate, several Master's (currently, AUEB offers 33 full-time and part-time Master Programs) and a Doctoral program. Combining two of its main mandates, AUEB focuses on the organization of high-class Doctoral Studies in order to upend its research quality. Furthermore, several faculty members have established AUEB's 28 Research Laboratories. The Research Laboratories have been operating with the aim to conduct forefront research, to carry out applied research within the European framework, conduct public- or privately-funded projects, and collaborate with national and international research partners.

7. Institutional policy or strategies supporting the KT

In addition to delivering high quality under-graduate and post-graduate education in its areas of expertise, in recent years, AUEB has undertaken several initiatives to become a center of excellence for basic as well as applied research, for innovative educational practices, as well as for promoting and supporting youth entrepreneurship and innovation. In matters of research, AUEB provides funding from own sources to the faculty-members and post-graduate researchers so as to conduct high-quality basic research (this funding program was initiated in 2009 with an annual budget of 250.000€ per annum, while for the academic years 2014-2015 and 2015-2016 the budget reached 272.000€). In matters of education, this is accomplished through the delivery of educational courses on entrepreneurship through innovative and interactive methods such as simulation programs, experiential learning and mentoring sessions. So far, these programs have been addressed at under- and post-graduate students, while at the end of each academic year a Youth Entrepreneurship Summer Program takes place for high-school students.

Moreover, AUEB actively promotes the on-going strive for innovation by its academic community members. To this end, the University i) coordinates the international student competition on digital entrepreneurship, innovation and e-business, called “e-innovation”, ii) has introduced a specific course on product design and iii) has introduced a stream on Product Design to its Entrepreneurial Idea Competition, which is run annually by its Innovation and Entrepreneurship Unit. AUEB has also undertaken several initiatives to bridge research, education and innovation, by encouraging not only the commercialization of its research results, so that more innovative products and/or services find their way to the market, but also by encouraging collaboration with the industry, both at an institutional (e.g collaboration with OTE telecom company) and at individual level (renowned managers and entrepreneurs as invited speakers in courses or as mentors for the University’s entrepreneurship initiatives), so as to conduct applied research in response to industry needs.

Although a particular institutional strategy has not been established for supporting KT, several AUEB initiatives undertaken the past few years demonstrate the actualization of the main KT concepts and objectives, such as: a) the delivery of applied research, through the systematic

development of close collaboration with large and small firms¹⁸, b) the support in commercializing research results, in an effort to turn out innovative products and services through the implementation of the “Exploitation of Research Results at AUEB” initiative funded by the Municipality of Athens. This has led to the establishment of the Athens Center for Entrepreneurship and Innovation (ACEin) (see below).

On the other hand, due to the specific disciplines that AUEB serves and the active involvement of its academic community in KT activities, there are numerous KT-relevant instances in Undergraduate and Masters programs up to Doctoral programs. AUEB is the first University in Greece that introduced courses on entrepreneurship in its undergraduate studies programs in 2003. As of today, hundreds of students attend yearly relevant courses with modern active learning educational methods, such as case studies, simulation business games, business plan competitions, etc. Since 2013, in the Department of Management Science and Technology there is a specialization on “E-Business, Innovation and Entrepreneurship” offered at undergraduate level. Furthermore, some Departments (e.g. DMST and Informatics) have introduced courses aiming to promote the innovation and creativity of their students through innovative product-design lessons. Additionally, AUEB is the only University in Greece, which offers a specialization on "Innovation and Entrepreneurship" in its MBA International Program offered in English since 2007.

Another pioneering initiative of AUEB is the introduction of project-based innovation seminars, such as the one specialized in retail industry, called “Retail Innovation” seminar. During this program, executives from the Greek retail ecosystem (representatives from fast moving consumer goods companies, cash and carry chains, food retailers, etc.) address industry-specific problems and work collaboratively towards introducing innovative solutions.

AUEB has also integrated in its vision and mission a strategic plan for supporting the financial, economic and entrepreneurial ecosystem of Greece through various initiatives. Based on the AUEB's experience in entrepreneurship and relevant best practices from foreign Universities, an integrated strategy regarding "Innovation and Entrepreneurship" has been formed. The main pillars of this strategy concern:

- The education on entrepreneurship in all the University's graduate and undergraduate studies' programs, with modern educational methods;
- The systematic promotion of entrepreneurship in Greece through competitions, specialized seminars, support and development of new entrepreneurs with specialized services, mentoring, etc.;
- The promotion of innovative research (doctorates, research projects, etc.) and the subsequent valorization of research results;
- The establishment of technology transfer structures in collaboration with foreign centers of excellence and organizations with innovative technological products/services;
- The development of collaborations with the wider Greek entrepreneurship and innovation ecosystem for the establishment of economies of scale, complementarities, and multiplication of results.
- The wide collaboration with the international entrepreneurship community and establishment of strong ties with other Universities and Entrepreneurship Support Centers at European and global level

¹⁸ Supply chain projects with Barilla Italy, Physical and electronic retailing shop re-arrangement based on customer insights and shopper missions, computer aided maintenance with Augmented Reality technologies at CERN etc.

Figure 38: AUEB initiatives towards entrepreneurship and innovation management



Since the majority of disciplines that AUEB serves are business-related social sciences, knowledge produced from these disciplines is transferred in the established industry, mainly, through private consulting projects that faculty and researchers undertake with public and private sector. However, this is not the norm, as the rest of activities described above utilize a mix of disciplines in both engineering and social sciences that transfer knowledge and mobilize innovation through other forms. Without a doubt, the most relevant initiatives from the aforementioned have been undertaken in the field of Information and Communication Technologies (ICT) and innovation management.

8. The main sources of funding

Regarding education, salaries of the University's permanent faculty members are covered by the Ministry of Education. Thus, AUEB does not consider salaries as a budget category handled by it. R&D funding comes from a variety of sources, such as the EU, GSRT, the Ministry of Development, the Ministry of Education, other Ministries and public bodies as well as the private sector. All funding is handled through the AUEB-ELKE. During the period 2014-2015, ELKE budget reached about 12 million €, of which more than 60% was originated from the EU, 24% from Greek public sources and the remaining 15% from Greek private sources. Overall, R&D funding represents approx. 25% of AUEB's total budget (the latter includes total public funding for operational expenditures and salaries, as well as ELKE).

AUEB has established three University structures to manage funding streams, namely the AUEB budget office, the AUEB ELKE, and the Company for exploitation and management of AUEB property. *AUEB budget office* handles the institutional funding allocated annually from the Ministry of Education. This budget is used for operational costs. *AUEB ELKE* handles funding streams coming from research projects (National, European, privately or publicly funded). AUEB ELKE is also responsible for exploiting private funds with regards to research. *The Company for exploitation and management of AUEB property* is a private legal entity entirely owned by the AUEB founded in 1993 and is in charge of handling the budget of revenues from extracurricular educational activities, such as special organized seminars, educational programs, post graduate studies, etc.

9. Characteristics of the governance and leadership of the institution. KT-related aspects

The academic board of AUEB consists of fifteen members. Out of the nine internal, eight are AUEB professors or associate professors and one is a representative of the students. Concerning the external members, all six are former or active executives from leading companies or non-profit organizations, with international exposure, as well as academics with sound credential affiliated with a highly ranked national or an international academic institution. The Rector can participate, if need be, in the board without voting right, safeguarding the independent nature of the board. The Rector, Vice Rectors and Deans are responsible to administer the institution and implement the strategy agreed by the board.

The new governing mode has promoted the international outlook of AEUB as well as its links with the industry and society. For example, AUEB managed to attract and recruit international faculty members. The university implemented numerous bilateral agreements with foreign universities focusing mainly in the exchange of students, faculty and researchers. In addition, AUEB signed -between the 2011-2015 period- MoUs and agreements with several Universities¹⁹, as well as unilateral agreements with CERN and LSE in the field of technology exploitation and development of youth entrepreneurship, respectively.

Last, but not least, an important KT-related activity of the AUEB was its participation in an initiative funded by the Municipality of Athens entitled “Exploitation of Research Results at AUEB”, which led to the establishment of the Athens Center for Entrepreneurship and Innovation, the University’s incubation center.

10. The role of local/regional partnerships for HEIs

The AUEB has developed ties with domestic, local and foreign industries. The majority of the implemented initiatives are initiated independently, acquiring on a later phase institutional support. By initiating and executing various developing projects, AUEB manages to attract sponsorships and funding for research purposes. In more detail, the AUEB has developed several national and international partnerships with key actors. These partnerships can be classified to the following categories, according to their main aim:

- a. Funding of applied research (i. Strategic partnership with OTE Group, the largest telecommunications provider in the Greek market, ii.–Traineeship programs based on applied research provided through the Internship office of the AUEB funded exclusively by companies, iii. Strategic research projects with Procter & Gamble Innovation Center Hellas)
- b. Commercialization of research results (i. CERN: Collaboration within the framework of an EU-funded project for the commercialization of research results, ii. NTUA & the Agricultural University of Athens: Collaboration for the creation of multi-disciplinary entrepreneurial teams to foster the creation of more innovative entrepreneurial initiatives)
- c. Greek entrepreneurship ecosystem (i. National Bank of Greece iBank competition: Provision of seed funding and mentors, ii. Endeavor: Nation-wide surveys on youth entrepreneurship, strategic collaboration on supporting entrepreneurial activities, iii. Stavros Niarchos Foundation: Provision of joint collaboration on supporting youth entrepreneurship and research commercialization activities, iv. Orange Grove of the Dutch Embassy in Athens: Collaboration in training and support actions for new ventures etc.).
- d. Delivery of market-driven innovations - IDEA Program (i. Athens International Airport: Organization of a competition for innovative solutions that will provide useful services to travelers and improve the operation of the airport, ii. Interamerican: talented individuals

¹⁹ Capital University of Economics and Business (CUEB), Indian Institute of Management Raipur, University of Quebec a Montreal, Soongsil University of Seoul, Nanyang Business School, NTU Singapore, University of Illinois at Urbana-Champaign, Business School and Texas Technical University

formed a team in order to build a solution tailor made for the problems of the company, as they were described by company executives)

A major place-based activity of AUEB is the *Athens Center of Entrepreneurship and Innovation (ACEin)*, the University's incubation center. ACEin is hosted in a newly renovated collaborative space²⁰, to support researchers and potential entrepreneurs in developing innovative services/ business models and their successful development and promotion. Following the practices of similar Centers in leading Universities in Western Europe, ACEin aims towards: i) the valorization of innovative research results from AUEB and its collaborating research centers from other parts of Greece, ii) the support and promotion of sustainable youth entrepreneurship through education, specialized consulting services, continuous mentoring, networking, necessary infrastructures, etc., iii) the transfer of new technologies and services (within and outside Greece) for training purposes and their innovative application/utilization, iv) the offering of integrated education programs (at all levels) on innovation and entrepreneurship through modern techniques of "active" learning and e-learning, v) the implementation of research projects on innovation and entrepreneurship and vi) the collaboration with other organizations for joint actions, economies of scale and dissemination of results.

ACEin puts significant effort in supporting students pursuing either undergraduate studies and executive master's or doctoral degrees, who wish to turn their innovative entrepreneurial ideas or scientific research results into a sustainable business model and subsequent start-up company. The Center offers more than just physical resources. The basic pillars of the key strategy concern Education, Motivation and Mentoring, Consulting Services, as well as Networking. Some notable statistics regarding the first year of operation include: the Center actively supported more than 70 entrepreneurial teams consisting of 180 potential entrepreneurs and more than 60 experts/mentors. As a matter of fact, through ACEin, incubated spin-offs and startups get valuable supportive services that help them bring into reality their innovative idea or complex technology. Indicative consulting services are business planning, marketing, accounting and legal issues.

Furthermore, AUEB deals also -through ACEin- with initiatives that focus on bringing innovative ideas into established companies so as to address existing problems. This is the IDEA program (idea.aueb.gr) that has been tested through two pilot projects with the Athens International Airport "El. Venizelos" and the insurance company Interamerican. During this program, business executives familiarize the academic ecosystem about the challenges and problems they face during their daily operations incentivizing talented students and individuals to team up with subject matter experts and researchers in order to provide solutions. In turn, the solution or part of it is then acquired from the companies involved. Building on this, the pharmaceutical company MSD funded a completely new stream in the MBA international postgraduate program dedicated to entrepreneurship. Young leaders/ entrepreneurs during their fully-funded MBA studies were challenged to plan and establish innovative companies in the field of Health and Pharma. Three of the most prominent results were acquired to be incorporated into the MSD's product portfolio.

²⁰ As mentioned above, the initial phase of operation of ACEin has been funded by the Project ATHINA of the Municipality of Athens

11. Programs, initiatives or centres that explicitly aim to integrate research, education and innovation

Beyond the ACEin initiative, two more structures aim to integrate research, education and innovation: *AUEB's Unit for Innovation and Entrepreneurship (MOKE)* aims to instill business spirit and skills in students and to support entrepreneurial ventures in their early stages. To this end, MOKE links theory and practice by inviting businesspeople to share their experiences and advise students on business ideas. MOKE also supports courses on entrepreneurship by organizing presentations in new fields of business in conjunction with instructors, as well as by offering contemporary materials and tools for teaching and personal development. Four years after its establishment, MOKE has invited more than 20 speakers for in-class presentations and more than 40 speakers, some of whom foreigners, for workshops and seminars. MOKE has also brought together student teams with more than 60 mentors. It has developed, in conjunction with researchers and teaching staff, a series of case studies, entrepreneurial issues and business plan models.

AUEB's Career Office was founded in 1992 and was the first such Office to operate within a Greek University. Its central objective has been to provide guidance and assistance to AUEB students and recent graduates (of all undergraduate and postgraduate programs) in decisions related to their future employment and career path.

The supporting initiatives described above have not a specific societal challenge that fall into, as the underlying initiatives have a broader perspective. Thus, initiatives address contemporary societal problems that Greece encounters, such as youth unemployment, industry development, brain drain, skillful people underutilization. Through the innovation management activities described, knowledge is leveraged.

Furthermore, AUEB has introduced several procedures to deal with the KT, such as: i) the introduction of innovative, interactive methods for the delivery of entrepreneurial training (e.g. a simulation software and on-line platform where students can acquaint themselves with the decision-making process, a simulation of the first stages in the establishment of a new venture through experiential learning, a training on how to develop the financial part of a business plan through a computer-aided tool, Entrepreneurship Bootcamps, where individuals or teams with an entrepreneurial idea participate in a two-days training and mentoring program, in order to acquire knowledge and receive feedback on their idea from experienced managers and entrepreneurs), ii) the introduction of innovative networking events (e.g. The Match and Develop a Start-up networking events, The Start-up Career Day).

12. Partnerships with private and public users in research, education and innovation

AUEB has developed public/private partnerships²¹ and has participated in EU or other funded projects. During 2007-2013, AUEB participated in 77 EU-funded projects, of which in 25, as coordinator (total AUEB budget: 18.298.500,89€). In addition, AUEB participated in state-funded projects (total number of projects: 153 of which in 118 AUEB acted as the coordinator; total AUEB Budget: 16.741.503,62€), as well as in private-funded projects (total number of projects: 241 in 197 of which AUEB acted as the coordinator; total AUEB Budget: 5.105.118,32€).

²¹ During the period 2014 - 2016, the AUEB has formed partnerships with several international public and private organizations within the framework of EU-funded projects (University College Cork, Software Improvement Group B.V., City University London, Università Degli Studi Di Trento, European Dynamics Belgium SA, ECOLE Polytechnique Federale De Lausanne, Universitàet Bern, Università Degli Studi Di Camerin, Intrasoft International SA, Universidad de Murcia, Executive Agency for Small and Medium-Sized Enterprises (EASME), CISE – Centro per l'Innovazione e lo Sviluppo Economico).

The partnerships formed by AUEB during 2014 - 2016 within the framework of EU-funded projects fall under into the following categories: i) ICT: 7 projects with 161 partners (Universities, private companies and municipalities), ii) International Investment & Trade: 2 projects with 12 partners (Universities and Research Centers), iii) Education: 1 project with 9 partners (Universities and private companies), iv) Supply Chain: 1 project with 10 partners, (Universities and private companies), v) Technology: 1 project with 8 partners (Universities and private companies), vi) Entrepreneurship: 1 project with 6 partners (Universities). Of the above (i), (ii) and (iii) encompass research and education, whereas categories (iv), (v) and (vi) encompass innovation and entrepreneurship.

On the other hand, although AUEB has been active during the previous decade into supporting entrepreneurial activities of its students and academic community, it did not establish any procedure to systematically register the entrepreneurial achievements of its alumni. This only took place two months ago when the Unit of Entrepreneurship and Innovation in association with ACEin came up with a process to register this type of information.

13. Participation in innovation ecosystems

AUEB, through its units and laboratories participates in a number of KT-related communities, both national and international. For instance, ACEin that was presented above, is part of an incubators network, coordinated by the Municipality of Athens, called “Diktyo”. Through this network AUEB is active in the local startups ecosystem, providing educational and skills building programs. Furthermore, the AUEB participates in many professional and industry associations, through its faculty members. Such an example is the participation of ELTRUN lab at Effective Consumer Response Hellas (ECR Hellas), the Greek leg of the European association for retailing. Another KT-related practice is the participation of faculty in the boards of professional associations, such as the Greek leg of Free/Open Source Software (FOSS).

14. Support of entrepreneurship activities among staff and students

Research and education are crucial elements of the entrepreneurship actions and programs that are delivered by the AUEB to promote and support the entrepreneurial mindset among its students and staff. Particularly, many of the actors involved in the design and delivery of entrepreneurship programs are also conducting research on entrepreneurship and innovation, at a doctorate and post-doctorate level, while the supervisors, who are faculty members, are teaching Innovation and Entrepreneurship. This allows for the delivery of cutting-edge entrepreneurship programs that take into account all the recent developments in the field of entrepreneurship, as well as for the real-life examples to feed into the entrepreneurial research.

The importance placed on innovation/third mission/commercialization practices is reflected in several of the University's practices such as the introduction of a course on entrepreneurship in almost all of the University's Departments, as well as the provision of a Major in Innovation and Entrepreneurship within the framework of the international MBA provided by the Department of Management Science and Technology. Moreover, indicative initiatives and actions of the AUEB to support innovation and entrepreneurship over the last ten years are the following:

- AUEB is the first University in Greece that introduced courses on entrepreneurship in its undergraduate studies programs back in 2003, while today hundreds of students every year attend relevant courses with modern active learning educational methods, such as case studies, simulation business games, business plan competitions etc. Since 2013, in the

Department of Management Science and Technology there is an undergraduate specialization on “E-Business, Innovation and Entrepreneurship”.

- AUEB has been a pioneer in the establishment of Innovation and Entrepreneurship Units (MOKE) in the Greek Universities. For its relevant activities, AUEB received the “National Champion” award in the “Promoting the Entrepreneurial Spirit” category of the European Promotion Award 2013.
- For eight consecutive years, AUEB organizes and runs the most successful University competition on "Digital Innovation and Entrepreneurship" (in collaboration with 16 other Universities in Greece and Cyprus). Winners of the competition have successfully continued with their entrepreneurial activity
- AUEB is the only University in Greece which offers as part of its post-graduate studies (the MBA International Programme is offered in English) a specialization on "Innovation and Entrepreneurship" since 2007.
- Several times per year, ACEin organizes a two-day “Entrepreneurship Bootcamp” where 10 young groups (mainly AUEB alumni) with innovative business ideas collaborate with experts and mentors to further develop their business model and identify critical success factors. Moreover, ACEin organizes various “Match & Develop” events to help the formation or expansion of entrepreneurial teams with new team members.
- Focus on high-school students. Each year a Greek Competition on Youth Digital Entrepreneurship and a Youth Entrepreneurship Summer School (YES) are organised.
- Thinkbiz is the first entrepreneurship association for students. It was founded in 2012 by undergraduate student of AUEB, with support from University and has already attracted interested students from all the Greek Educational Institutes.
- International collaborations with top-ranking Universities and Research Centers for the creation and exchange of know-how and the transferring of structures on innovation and technology, the development of youth digital entrepreneurship, the organization of Entrepreneurial Bootcamps etc. As part of the EU-XCEL project, AUEB has supported the formation of European teams on tech entrepreneurship through startup scrums and virtual incubation services towards a European Challenge final.
- Active participation in initiatives for the promotion of innovation and entrepreneurship in Greece such as the "Greece Innovates" initiative of the Hellenic Federation of Enterprises and Eurobank, the Orange Grove organized by the Dutch Embassy, the Competition iBank of the National Bank of Greece, the EGG accelerators etc.

15. Human resource policies and KT-related activities

Although the importance of promoting research and innovation to society through various activities and initiatives is understandable and its impact highly valued for the majority of the academic ecosystem, there is no particular policy or examined factor in the recruiting process. Criteria deal mainly with the output of academic research. However, each Department may judge on this perspective in a different manner. Currently, the University does not make use of any financial or other incentives to motivate its staff to engage in KT-related activities. Yet, the importance placed on KT-related activities is delivered by its on-going commitment and funding of basic research, conducted by its faculty members and researchers.

16. Do assessment and evaluation policies and practices support KT activities?

Within the AUEB there are several policies and reporting practices, dealing actually with the knowledge triangle. Internal assessments for services related to Research, Innovation and Education take place yearly as part of the quality control system of each unit but also as a

holistic approach of Quality Assurance Practices applied in the AUEB. AUEB's Unit of Quality Assurance (MODIP) ensures that University strategy is aligned and compliant with the pertinent national and European benchmarks.

On the other hand, AUEB is the first Greek University to obtain in 2012 a distinction of excellence according to the globally recognized quality model called the European Foundation of Quality Management (EFQM) excellence Model. The Model is provided by EFQM and AUEB was the first public university ever to receive such a distinction of "Excellence". MODIP has also accreditations from United Nations Global Compact and PRME - Principles for Responsible Management Education for its commitment to quality management education.

In addition, AUEB was chosen in 2014 by the European Union through the Eurydice network as a model university for entrepreneurship and employability. The representatives of the European Commission, specializing in Higher Education issues, recorded AUEB's best practices in matters of entrepreneurship, employability and internships. The above depict the strong commitment of AUEB to act within the core of Knowledge Triangle.

The AUEB has three different schools (School of Business, School of Economics and School of Information, Sciences and Technology) and all disciplines share typically the same processes and procedures for cross-institutional activities and evaluation practices. Through the extensive Assessment processes, weakness and room for improvement are identified, based on global standards and benchmarks, so that the AUEB will implement control activities and remain competitive.

17. Results achieved by current KT initiatives

The University does not have a systematic way of monitoring the results achieved by the initiatives taken to improve KT linkages and minimize trade-offs between the three KT missions. During the AUEB's Innovation and Entrepreneurship Unit's 5 years of operation, more than 150 teams with entrepreneurial ideas received entrepreneurial training and feedback on their idea through their participation in AUEB's Annual Entrepreneurial Idea Competition, while during the ACEin's operation (18 months) more than 95 teams received specialized services and mentoring as they transformed their entrepreneurial idea into a start-up. In accomplishing their role, both units have established close collaborations with a) faculty members specializing in entrepreneurship and innovation, and with b) experienced managers and successful entrepreneurs communicating their experiences.

Introduction of KT perspectives on education could have positive impact both on students and on their development as professionals. Based on qualitative and quantitative analysis of gathered data on alumni satisfaction and achievements, it is evident that they gained entrepreneurial skills valued by enterprises, and obtained a more positive attitude towards entrepreneurship, innovation and growth development through research and product development methodologies.

Overall, KT sheds some light in the important parameter of measurable impact of innovation in society. Thus, Research steering committee should be established within universities, responsible for authorizing PhD research topics and maintain a predefined quota between basic and applied research. This committee could also be part of a PhD consortium, or commercialization module, were the PhD research proposal will be assessed not only based on the established criteria of uniqueness, innovativeness and relative scientific impact, but also based on some KPIs on the level of applicability, the time to market and commercial maturity of the forthcoming research output.

Furthermore, there is a need for a broader strategy of research commercialization in Greece. Apart from the pertinent legislation and government policies that need to be in place in order to set a clearer base for the Research Centers and Universities to function, it is the researchers'

mindset that need to shift in a more commercialization-friendly or entrepreneurial-friendly manner. There is a need to regional or national TTOs that will build on acquired know-how and best practices in order to foster the transfer of research outputs into new industries, markets and countries. All the aforementioned practices and the KT notion could lead in a mindset shift among academics and governments so that they include KPI indicators into their analysis. For example, a pertinent criterion could be the amount of EU research funds that were attracted by an academic individual.

6. Key characteristics

The Aristotle University of Thessaloniki (AUTH) is a public, comprehensive University, founded in 1925. It is currently the largest University in Greece, comprising of 11 Faculties organized into 41 Schools. The eleven faculties are the following: Faculty of Theology, Faculty of Philosophy, Faculty of Sciences, Faculty of Law, Faculty of Economics and Political Science, Faculty of Engineering, Faculty of Fine Arts, Faculty of Education, Faculty of Health Sciences, Faculty of Agriculture, Forestry and Natural Environment, Faculty of Physical Education and Sports Sciences.

Amongst others, the following education and research units operate under the supervision of AUTH: Experimental Schools (primary and secondary education), The Institute of Modern Greek Studies, The School of Modern Greek Language, The Center for Foreign Languages Teaching, The Centre for Byzantine Research, The Telloglion Foundation of Art and Museum, The University Clinics of the School of Medicine, The Clinics of the Faculty of Veterinary Medicine, The Animal Breeding and Treatment Station, The University Farm, The Seismologic Station, Biological Applications Centre. Furthermore, great emphasis is given on archaeological research in order to promote the Greek cultural heritage; for that reason the University sponsors and manages more than 20 excavation sites, where academic staff and researchers from the School of History and Archaeology carry out research, with the participation of undergraduate and postgraduate students.

AUTH has more than 70.000 undergraduate and postgraduate (Master's and Doctoral level) students, of whom approx. 4.000 are international students. AUTH has almost 2.000 members of Academic Staff and 1.015 members of supporting staff. Academic Staff has both teaching and research duties and must hold a doctoral-level degree. All 41 Schools offer Postgraduate Programs at the MSc and PhD level. Among the 85 MSc programs, 8 are co-organized with foreign Universities, while in 11 Programs courses are taught in English. Furthermore, AUTH has signed 27 Agreements (Protocols) for offering joint PhD programs with foreign Universities.

External researchers participating in the research projects exceed significantly the number of the university members. The above leads to the conclusion that the AUTH might be the biggest employer of highly educated personnel in the area of Southeast Europe. In addition, the distribution of the collaborators in the research projects provides strong evidence that the AUTH has established collaborating links with the private sector, as almost 45% of the total research budget is dedicated to collaboration with companies and other organizations, while the rest 56% to collaboration with other universities and research centers.

The following table provides an overview of the R&D activity of AUTH as summarized by U-Multirank for the year 2015. R&D intensity of the total university funding is approx. 25%, (more than 65% of ELKE funding). The overall university research productivity is high with 7.659 publications (as reported in the web of science), while the citation rate is high, too. The R&D intensity of the total university funding is 44%, classifying AUTH in the first group regarding HEIs' R&D intensity. However, AUTH is lagging behind in activities relating to knowledge transfer, as observed in the same table, falling under third tier ranking.

Table 14: Research performance of the AUTH, 2015

	Score	Rank group
Research		
Citation rate	0,89	3
Research publications (absolute numbers)	7.659	1
Research publications (size normalised)	0,103	4

Top cited publications (% of total publications)	8,44%	3
Interdisciplinary publications (% of total publications)	9,67%	3
Knowledge Transfer		
Co-publications with industrial partners (% of total publications)	3,24%	3
Income from private sources (per fte academic staff)	8.230	3
Patents awarded (absolute numbers)	8	4
Patents awarded (size normalised)	0,11	4
Spin-offs	1,4	4
Publications cited in patents	0,94%	4
Income from continuous professional development (% of total income)	0,08%	4

7. Institutional policy or strategies supporting the KT

AUTH is restructuring and updating the academic organization, in order to accommodate for the new technological developments and current challenges, taking into account relevant national restraints. As to the KT, AUTH is considered one of the most important research hubs in SE Europe (e.g. in terms of participation in the European Union Framework Programs since 1985). At the same time, the considerable number of its publications places the AUTH at a relatively high ranking position worldwide, especially in scientific areas related to innovation.

The fundamental issue for the Aristotle University is that until recently no mechanism had been developed to facilitate the transition from knowledge to innovation. There are many reasons for this delay, such as the lack of innovation and entrepreneurial culture, ideological preconceptions etc. Promoting innovation and entrepreneurship is expected to significantly improve the university budget and the local and national economy given the links that will be grown out of collaborating with the private sector. Towards this, the AUTH has established the Technology Transfer Office (TTO) and the Innovation & Entrepreneurship Unit (IEU-MOKE).

In order to promote the development of entrepreneurial culture amongst students and researchers, AUTH aims to implement the following actions: i) strengthening the Innovation and Entrepreneurship Unit (MOKE) for the acquisition of knowledge and skills and the networking with business, ii) strengthening the Technology Transfer Office in order to implement actions for researchers and academic staff, enabling market oriented research and promoting research outcomes/ partnerships to/with the market (change attitudes, map scientific results, stablish relationships with the industry and facilitate the filling of patents and the creations of spin-off companies) and iii) collaborating with regional stakeholders for the promotion of the city of Thessaloniki as a pole of innovation and entrepreneurship. These policies have already been included in the strategic plan 2015-2020.

On the other hand, AUTH has not implemented, so far, any mechanism to monitor the impact of the KT institutional strategy on curricula. However, since KT constitutes one of the missions of AUTH, as it is clearly stated in its strategic plan 2015-2020, this monitoring is expected to take place by the Quality Assurance Unit (MODIP), which has recently started taking measures towards this direction. Besides, the Senate has established a special committee for the Postgraduate programs; one of its roles is the evaluation of the curricula of the master programs. The monitoring of the curricula regarding the KT is expected to be part of the future evaluation.

The dissemination of research results is expected to enable AUTH to play the leading role in the local, regional and even national economy since knowledge creation is the key competitive advantage. This goal will be achieved through the:

- Strengthening of the Technology Transfer Office in terms of manpower (currently, TTO employs two people). The policy for the commercial exploitation of the research results through licensing and spin-offs is under review.
- Systematic presentation of research results in foreign languages
- Establishment of an organizational environment that fosters the exploitation of the research results
- Collaboration with other local partners for the creation of pre-incubators and incubators

Moreover, the design and implementation of actions supporting interdisciplinary teams should be sought after. Therefore, the strategic plan 2015-20 includes: the Development of the Centre for Interdisciplinary Research and Innovation, the Development of excellence research centers, the Establishment of postdoctoral fellowships, the Support of international research collaboration and the Support of teams for the preparation of research proposals in the fields of humanities and social sciences.

8. The main sources of funding

According to table 15, the main funding sources of the AUTH are the State (institutional funding) and the revenues from research (services) provided to the private and public sector. Institutional funding covers staff salaries (teaching and administrative) and part of the operating expenses. This financing has declined severely since 2009, as AUTH experienced a reduction of nearly 50%. On the other hand, while the revenues from research (services) increased significantly in the same period, yet this was not adequate to cover the reduction of institutional funding. The revenues from research cover the salaries of more than 3.000 young researchers and the administrative cost of ELKE, while ELKE covers part of the operating expenses of the AUTH. As a matter of fact, the areas of health-food and environment-energy have contributed more than half of the total research revenues in the period 2010-2014. Materials, process and the ICT follow suit indicating areas of a relatively strong competitive advantage.

Table 15: The Aristotle University of Thessaloniki Budget (in thousand €)

	2009	2010	2011	2012	2013	2014	2015
State Funding	196.313	166.692	155.307	155.409	126.073	117.870	106.941
Research Revenues	36.610	29.308	43.392	50.097	53.119	46.366	49.232
University Camping							380
Company for the exploitation AUTH's assets	489	362	222	3.194	2.163	1.981	1.963
Total Revenues	233.413	196.364	198.923	208.701	181.356	166.218	158.517
Program Of Public Investment	12.630	11.437	22.345	16.428	14.306	1.430	2.083

AUTH is the owner of a private company exploiting its real and financial assets. During the last years the company has followed an expansionary path with its revenues increasing from almost 500.000 € to almost 2.000.000 €.

9. Characteristics of the governance and leadership of the institution. KT-related aspects

In the period 2012-2016, the Council exclusively consists of academics: Eight internal professors and associate professors and six professors from foreign universities. Professor Richard Hunter (University of Cambridge) is the President of the Council. However, the Council's role to improve the HEI's linkages to the local and regional economy and society has not been as thorough as ought to be. This inefficiency might be attributed to the internal and external objections to the establishment of the Council that prevented the normalization of the administrative process in the AUTH.

On the other hand, there is no any particular organizational unit established to promote KT activities (or integrating research, education and innovation). The whole process, according to the law, is delegated at the level of Faculties and Schools. However, implementation of the strategic plan 2015-20 is expected to influence the promotion of KT activities given their intertwined nature.

While there is no Unit responsible for implementing KT linkages, there are Units working closely and are complementary and mutually supportive towards the achievement of the goals of the Institution, such as:

The Quality Assurance Unit (QAU/MODIP) is -according to the Law- responsible for the development of the policy, the strategy and the procedures necessary for the continuous improvement of the quality of the work and services of the institution, as well as for the support of the external evaluation procedures and accreditation of the programs of studies and of the internal quality assurance system of the institution, in accordance with the principles and guidelines of the HQA (Hellenic Quality Assurance & Accreditation Agency in Higher Education).

The Technology Transfer Office (TTO) is part of ELKE and its scope is to facilitate and promote the exploitation of research results. TTO provides information and support services to the research community for Technology transfer agreements, establishment of spin-off companies, networking and promotion between researchers and enterprises, protection and management of intellectual property rights (IPRs), exploitation of the research results.

The Employment and Career Structure (ECS) is an umbrella organization which coordinates the actions of the *Career Services Office (CSO)*, *the Innovation and Entrepreneurship Unit (IEU-MOKE)* and the *Internships Office* in order to facilitate the transition of graduate students towards the labour market, the creation of new business as well as further studies.

As a matter of fact, the policies, practices and procedures adopted by the Units mentioned above, and the relevant services provided are all innovative not only for the members of the AUTH, but also for the Greek tertiary education system, as well. Especially as far as the IT systems are concerned, it is noteworthy that they are all in house developed, while the ResCom –that will be presented in section 16.3- the project management software of the Research Committee (ELKE), is used in 20 Higher Education Institutions (HEIs) in Greece, while 5 HEIs have already expressed their interested in MODIP's QMS. Thus, the new practices are effectively incorporated in all the existing academic and administrative units, resulting in the provision of high quality services.

10. The role of local/regional partnerships for HEIs

AUTH has developed a network of links with other organizations at local, regional and national level. Through these links the university preserves its significant role in the economic development as well as the cultural and research advancement of the country. These linkages between AUTH and these organizations are realized through cooperation agreements and

memoranda of understanding. Furthermore, collaborations have also been established at Faculty or School level. AUTH is also an active partner in the following partnerships and actions:

1. Region of Central Macedonia (RCM): participation in the preparation of the RIS3 strategy, cooperation in the establishment and operation of the Agro-Food Partnership of RCM
2. Municipality of Thessaloniki (participation in the Development Partnership "Culture - Development - Employment", participation in a project aiming at the development of local employment, collaboration in pre-incubator establishment for entrepreneurship development).

AUTH collaborates with associations and enterprises focusing on research and development related to innovative products and services and employment promotion. Examples, for the period 2010-2014, would include the Greek International Business Association (SEVE), Federation of Industries of Northern Greece (FING), Association of Information Technology Companies of Northern Greece (SEPVE), the Hellenic Fashion Industry Association (SEPEE).

The above mentioned initiatives were not the result of any government, top-down incentive, but were arranged in accordance to AUTH's internal strategy. These collaborations have a very positive impact on the university's budget, since almost a third of ELKE funds come from the private sector.

11. Programs, initiatives or centres that explicitly aim to integrate research, education and innovation

As mentioned above, AUTH lays emphasis on the support of interdisciplinary research and collaboration. For that reason, AUTH established in 2014 the Centre for Interdisciplinary Research and Innovation (KEDEK), a new interdisciplinary cooperative structure. The widely applied concept of collaborative and interdisciplinary research in solving research problems is the fundamental idea behind KEDEK, aspiring to foster collaboration between diverse disciplines and research fields, as well as the involvement of different actors, and to create the conditions for the implementation of the innovative results in the economy and society.

Furthermore, in the Framework Program "Education and Lifelong Learning" (NSRF 2007-2013), AUTH –and all other Greek HEIs- has implemented actions promoting the entrepreneurial culture to its student body enhancing their career options. The objective of the *Innovation and Entrepreneurship Unit (MOKE) of AUTH* –that was already presented- was to cultivate and reinforce students' positive attitudes towards innovative entrepreneurship initiatives, enhance their entrepreneurial knowledge and skills, and bring them in contact with the entrepreneurial world. On the other hand, though, the university does not have a specific policy to minimize the trade-offs between education, research, innovation²².

In terms of societal challenges, AUTH has contributed through education and research – amongst others- to the understanding of environmental issues and continuously improves the teaching and research work in this direction. The integration of sustainability and environmental awareness in every aspect of university life constitutes one of its main objectives. In this context, the strategic plan 2015-20 adopts policies of integrating environmental management objectives that aim at the energy saving in the public area; encouraging the increasing use of renewable energy sources; reducing air pollution and emissions related to climate change; the sustainable mobility and improved accessibility; encouraging and disseminating the organic farming and traditional forms of cultivation. Thus, the strategic plan 2015-20 adopts policies of integrating environmental management objectives. On the whole,

²² According to the legislation, the teaching staff is obliged to teach at least 3 courses per year, for at least 6-8 hours per week. Even though this obligation does not eliminate this trade off, it is a measure of protection of the education process.

AUTH and its members have always been significant contributors to the local, regional and national cultural development. They participate in the governing bodies of Cultural institutions of the city, are members of Boards of Directors of Scientific and Cultural Associations and Clubs and accept invitations for conducting lectures, seminars, courses etc.

12. Partnerships with private and public users in research, education and innovation

AUTH has formed research networks with other European universities and research centers, submitting tenders and undertaking multi-part Framework Programme projects since the 1980s. During recent years, specific National Strategy Reference Framework initiatives (such as “INTERREG”, “European Territorial Cooperation Programs” and “Bilateral Research and Technology Co-operation”) have been funding co-operations between different countries and AUTH has participated in many such projects. AUTH participated also in research groups running projects, funded by national or EU sources. Focusing on the 2007-2013 period, AUTH was involved in various projects funded by the FP7, in addition to previously initiated ones.

Table 16: AUTH’s participation in projects

AUTH Role	Number of projects	AUTH Budget
Partner	674	109.793.236
Coordinator	136	35.601.364
Subcontractor	11	428.311
Total	821	145.822.912

The research areas of these projects are shown in the following table.

Table 17: Participation of the AUTH in projects, according to different research areas

Research Area	Number of projects	AUTH Budget
1. Health - Food	124	21.063.702
2. Informatics and Telecommunications	141	26.855.175
3. Spatial Development	64	9.429.984
4. Environment - Energy	289	42.575.165
5. Materials - Processes	117	20.404.156
6. Socioeconomic Research	42	5.671.923
7. Culture	44	19.822.804
Total	821	145.822.912

AUTH has over the years established also a number of spin-off companies, of which four are in operation. *EXOTHERMIA SA* is a spin-off company of AUTH, established in 2007 by members and researchers of the Laboratory of Applied Thermodynamics (LAT), the company's primary activity is the development and application of software tools for automotive after-treatment systems simulations. The software products are based on the 20-years long experimental and simulation experience of LAT, obtained in close collaboration with major after-treatment system suppliers and automotive OEMs. *EMISIA SA* is a spin-off company, established in 2008 by members and researchers of LAT. The company specializes in the areas of emission inventoring, emission modelling, and impact assessment studies of environmental policies. *PLiN Nanotechnologies SA* is a spin-off company, established in 2015, specializing in the

fabrication and characterization of tailored metal and oxide nanoparticles. *ACTA SA* is a spin-off company which has based its operations on the quality and high standards of certification services.

13. Participation in innovation ecosystems

AUTH participates in the KT-related innovation regional communities. Examples would include Alexander Innovation Zone, Thessaloniki International Fair (HELEXPO), the Center for Research and Technology Hellas (CERTH), University of Macedonia, Alexander Technological Educational Institute of Thessaloniki, International Hellenic University, the Olympic Museum and Organization of Thessaloniki Film Festival.

In addition, it participates in the open innovation ecosystem “OK!Thess”, where the Municipality of Thessaloniki, the AUTH and 11 other stakeholders participate. The cornerstone of this alliance is the creation of a pre-incubator which will host early startups and social enterprises. Services that will be provided are: training, start-up coaching, mentoring, events (invited speakers, validation events, boot camps – demo days), networking with angel investors and VCs.

Last but not least, the AUTH participates at the annual regional conference “Technology Forum” along with the Centre for Research & Technology Hellas (CERTH), the University of Macedonia (UoM), the Federation of Industries of Northern Greece (FING), the International Hellenic University (IHU), the Association of Information Technology Companies of Northern Greece (SEPVE) under the auspices of the Region of Central Macedonia (RCM), the General Secretariat for Research & Technology (GSRT), the Enterprise Greece (EG), the Thessaloniki Municipality and the Alexander Technological Educational Institute of Thessaloniki (ATEIT), join forces to organize the Technology Forum.

14. Support of entrepreneurship activities among staff and students

Beyond the TTO and the MOKE that were mentioned above, the Aristotle University supports and promotes entrepreneurship via *Career Services Office (CSO)*. Its main goal has been to bridge the gap between studies and employment. In this context, self-employment and entrepreneurial endeavors of graduates were supported by start-up and business development counseling, intuitive workshops on entrepreneurship (White Belt & Black Belt in entrepreneurship) based on the lean start-up and customer development methodologies, networking with local and national stakeholders (chambers of commerce, development agencies, angel and VC investors, entrepreneurs etc), holding creative events in entrepreneurship.

Entities, such as the TTO, the MOKE, the CSO, etc. are related to research and education. In more detail, TTO serves as the focal point for researchers regarding the business potential of their research results; potential business partners find support on IPR protection and the creation of spin-off companies. Moreover, TTO serves private and public sector bodies and companies interested in working with the university on research and technology transfer. In developing these activities the TTO applies an "open door" policy. Businesses interested in working with AUTH, for the exploitation of research results, tend to work with the executives of the Office for the identification of areas of mutual interest and are informed for the available portfolio of discoveries / inventions / research results.

AUTH finances and supports researchers through the TTO and the Legal Support Office of ELKE, in order to safeguard their IPR applicable of industrial exploitation. AUTH has a total

of 44 patents and 1 Industrial Design²³. Since 2010, AUTH has exploited research results through technology transfer agreements and licensing. In particular, the University has granted 10 licenses to 22 companies. AUTH is involved in industrial research at regional, national and European level, accounting approximately 14% of the total turnover of ELKE. The industrial research at national level involves collaborative projects with SMEs for the improvement, certification of established or newly invented products and services; at international level the industrial partnerships include collaborations with large companies and R&D institutions.

On the other hand, the MOKE of AUTH supports the curriculum of 19 Schools with courses on entrepreneurship and innovation, providing students introduction to the basic concepts of Innovation and Entrepreneurship, training in the preparation of business plans, participation in open actions (entrepreneurship meetings, workshops, visits to innovative enterprises, conferences), thus stimulating their entrepreneurial activities.

The CSO of AUTH supports all senior undergraduate and graduate students of AUTH with counseling sessions and series of intuitive workshops, aspiring at developing creative thinking and a problem-solution attitude while at the same time they are provided with structured methodologies in order to map and bootstrap their entrepreneurial ideas.

The aforementioned practices had a twofold impact on instructional practices at AUTH. Specifically, the curriculum of 19 Schools was enriched with the course “innovation and entrepreneurship” and new enhanced curriculums (market-driven) were introduced due to the extroversion of specific researchers and laboratories.

An indicative portfolio of entrepreneurial initiatives developed in the AUTH is the following:

- The Physical Metallurgy Laboratory (PML) at the School of Mechanical Engineering is involved in several research areas, covering the material science technology.
- Members of PML have recently founded PLiN Nanotechnology SA, a research driven spin-off, specializing in the fabrication and characterization of tailored metal and metal oxide nanoparticles (NPs).
- A unified solution for cognitive and physical health for senior citizens. Long Lasting Memories (LLM) is a project that has implemented an integrated ICT platform which combines state-of-the-art cognitive exercises with physical activity in the framework of an advanced ambient assisted living environment, while respecting ethical and legal boundaries.
- BIO2CHP offers to agro-food industries with organic waste a power generator at the size of a container, that converts their own waste into energy (electricity and heat/cooling) for their own needs, on site.
- Regenerative medicine is an emerging scientific discipline encompassing the latest achievements in the fields of basic sciences (Biology, Biotechnology, Material Science, Nanotechnology, Engineering and others) aiming towards the production of new therapies for a multitude of medical/dental conditions. Regenerative medicine exploits the potential out of tissue and cell handling and manipulation to provide solutions for tissue repair and regeneration. A well-developed EU and consequently National legislative framework provides directives and regulations and sets the standards for quality and safety for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells. The milestone of these regulations is the GMP (Good Manufacturing Practices) compliance, and a tuned “Tissue and Cell Establishment” abiding to this legal framework.
- The Lab of Physiology of the Medical School jointly with the lab of Fixed Prosthesis and Implant Prosthodontics of the Dental School the REMEDIC project, aiming towards the creation of an accredited tissue and cell establishment.

²³ 25 Patents at national level, through the Industrial Property Organization (OBI), 9 Patents at European level, through the European Patent Office (EPO), 1 Industrial Design at European level, through the European Patent Office (EPO), 10 International patents, through PCT filing or extension of European or national patents.

- The Lab for Thin Films-Nanobiomaterials, Nanosystems & Nanometrology (LTFN) is an internationally acknowledged specialist in Organic Electronics - OEs (OPVs, OLEDs, OTFTs, biosensors, etc.), Thin Films & Nanomaterials Technology, vacuum, printing (roll-to-roll, inkjet), OVPD & CVD Pilot Lines, Nanometrology, in-line optical sensing & Nanomedicine.

15. Human resource policies and KT-related activities

The hiring and promotion process of the academic staff abides to the provisions of the Law. Moreover, each Faculty and School sets the academic criteria for promotion (these criteria are also applied in the recruitment process). These criteria include the research and teaching performance and the administrative contribution to the Faculty. However, research is ranked higher than teaching and administration. AUTH in the framework of strategic plan 2015-2020 aims at the advancement of quality both in research and education. One of the proposed policies seeks further integration of research into the educational process. Therefore, it is expected that the integrated KT will play a more significant role in the future promotion process. Apart from granting of sabbatical and scientific conferences participation, extra laboratory infrastructures, rewards and facilities to Academic Staff, there are so far no other specific policies to support and promote KT-related activities.

16. Do assessment and evaluation policies and practices support KT activities?

The Strategic Plan of AUTH for 2015-2020 identifies Institutional Strategies, which are subdivided to quantifiable and time-specific Strategic Goals. Among those, the goals/policies which are related to KT activities, are: 1) Academic Development Strategy, 2) Research Strategy, 3) Internationalization Strategy and 4) Societal Strategy. AUTH emphasizes the Societal Strategy, which is considered to be directly related to the KT, intending to leverage the research outcomes through industrial relations, commercialization and higher returns of outcome back to society.

On the other hand, AUTH has determined its quality policy –since 2011- as follows: Continuous improvement of the quality of procedures and services, Continuous improvement of the quality of working and living conditions, Transparency, Enhance and promote the work conducted at the AUTH to the society, the Government and to the international scientific community.

The Quality Assurance Unit (QAU/MODIP) is responsible for the development of the policy, the strategy and the procedures necessary for the continuous improvement of the quality of the work and services of the institution, as well as for the support of the external evaluation procedures and accreditation of the programs of studies and of the internal quality assurance system of the institution, in accordance with the principles and guidelines of the HQA.

A specific tool, related to quality assurance was the initiative of AUTH to gather all published research work of the members of its academic personnel, so as to be able to assess the efficiency at all levels (personal/School/Faculty/Institution). MODIP has taken several measures to mobilize the members of the University to register their research work in the Institutional Repository of Scientific Publications (IKEE) of the Central Library. IKEE comprises of scientific papers, such as articles in journals and conferences, books, art and multimedia work, studies, etc. as well as unpublished (“grey”) literature, such as doctoral dissertations, master theses, and diploma theses.

Overall, AUTH’s quality policy has resulted in very close cooperation between MODIP, ELKE and the IT Center. MODIP, has strived for the interconnection of QMS to existing IT systems, such as the Students’ Care applications of IT, the University Directory Service (PYKA) and the central AUTH user authentication mechanism of IT, the applications of Central Administration (Personnel Management, Economic Affairs & Supplies, Educational Programs), the

Institutional Repository of Scientific Publications (IKEE) of the Central Library and ELKE's Charter for Researchers.

Thus, suitable conditions have been created for:

1. Reliability testing, homogenization and synchronization of the primary data related to quality (between different systems and applications).
2. Upgrading of the applications, when they do not provide the necessary data associated to quality.
3. Improving the existing administrative procedures and creating new ones, when and if considered required for the registration of the necessary data associated to quality.
4. The production of a large variety of reports assisting the administration to monitor and assess the results at all levels of activity of the University as well as to assess the actions and the measures taken towards the achievement of its goals.

Moreover, AUTH-ELKE evaluates practices that encompass KT through the ISO 9001 standard, while it conducts reports in compliance to the five (5) year strategic plan. Goals and processes are evaluated and optimized annually, with the assistance of two software programs, developed in-house, ResCom²⁴ and WorkMan²⁵. The results and the measures of the evaluation in the fields of KT are assessed through various quantitative and qualitative indicators and processes which are monitored by MODIP, ELKE (regarding research projects) and the IT Center. Concerning research and innovation, these measures relate with the research activity of the institution and the commercialization of research outcomes.

Regarding the first category, the measurement is conducted through quantitative metrics, retrieved from ResCom (Total budget of state funding / EU / other sources, Budget generated from the collaboration with other universities / research centers / enterprises and other organizations / per country, Number of active faculty members per year, Number of external collaborators per year, Total budget given for scholarships (PhD and post-PhD researchers), Number of events hosted at the research dissemination center of RC (KEDEA)). Regarding the commercialization of research outcomes, ELKE uses quantitative metrics retrieved from ResCom (Number of new patents & management/promotion of the existing, Number of spin-off companies, Number of licensing and other agreements with the industry, Total turnover of the RC from industrial research, Networking with business associations and other partners at regional and national level, Mapping and promotion of the services provided by the laboratories of the university).

The core evaluation practices and procedures applied by MODIP apply to all disciplines, in order to extract the necessary quality indicators and statistics which apply to all the scientific fields. Despite that, MODIP and ELKE acknowledge that the internationally accepted scientific evaluation practices are common worldwide and a degree of variation can be attributed only because of the different disciplines/fields of science. The AUTH is aligned with the international evaluation standards that are valid for each discipline. MODIP, though, seeks to highlight the work conducted in all scientific fields and especially to the ones that are not so easily evaluated such as Humanities and Arts and has taken the necessary measures to facilitate the members of those Schools in various ways.

²⁴ *ResCom* is a project management software which assists the implementation and monitoring of the whole project life cycle: proposal – approval of project – deliverable production. Moreover, it provides information about the research activity of AUTH and knowledge transfer to other agencies. Finally, it includes a data processing tool for the formation of the ELKE's research policy.

²⁵ *WorkMan* is an application for the support and monitoring of the QAS of RC. Moreover, it facilitates the internal communication of the staff and provides information for the HR management.

17. Results achieved by current KT initiatives

ELKE has been nominated 45 patents (National, European and International), 10 licenses for 22 companies, 4 spin-offs companies, as well as 14,13% of the total turnover of ELKE in industrial research. Data on patents per school, industrial research, cooperation with foreign partners (per country and per type of organization), partnerships with different categories of research entities, external collaborators etc. are available.

During the last 5 years ELKE launched or assisted in the operation of many KT activities. For example, in 2012 ELKE hired a professional for the organization and operation of the Technology Transfer Office (TTO) and a business consultant (since September 2015) to facilitate the commercialization of research outcomes. During this period, TTO initiated many actions to raise the awareness of the researchers (internal marketing) and the market (external marketing) about opportunities for collaboration. One such action is the clustering of various laboratories under thematic disciplines in order to promote holistic and interdisciplinary services to the market.

The impact of KT is evident among students and within the education process. A significant number of students are involved in market-oriented projects²⁶. In the coming years, it is estimated that the KT vision will bring the following changes to the University: *Firstly*, in terms of behaviors, norms and practices: the MOKE and the TTO towards creating a friendlier environment to creative ideas, university-business collaboration and the establishment of start-up and spin-off companies. It is expected that in time the revenues generated from industrial research and royalties will permit young researchers to work in the AUTH (so as to decrease the brain drain) and produce internationally competitive research. *Secondly*, it is expected that the curriculum of some graduate programs will be adjusted towards the market needs and more interdisciplinary research/solutions will be produced to address market and societal challenges. *Finally*, the implementation of AUTH's Strategic Plan (2015-2020) and the necessary participation of all stakeholders will certainly bring changes towards more planned, better documented practices.

²⁶ Smart Eyes (device for people with disabilities), Sign2Talk (device for people with disabilities), Symbiosis (Alzheimer's support application), ART Formula and ART electric, Prognosis (Parkinson's Disease diagnosis/ support application; 1st price at the competition "Microsoft Imagine Cup 2015").

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