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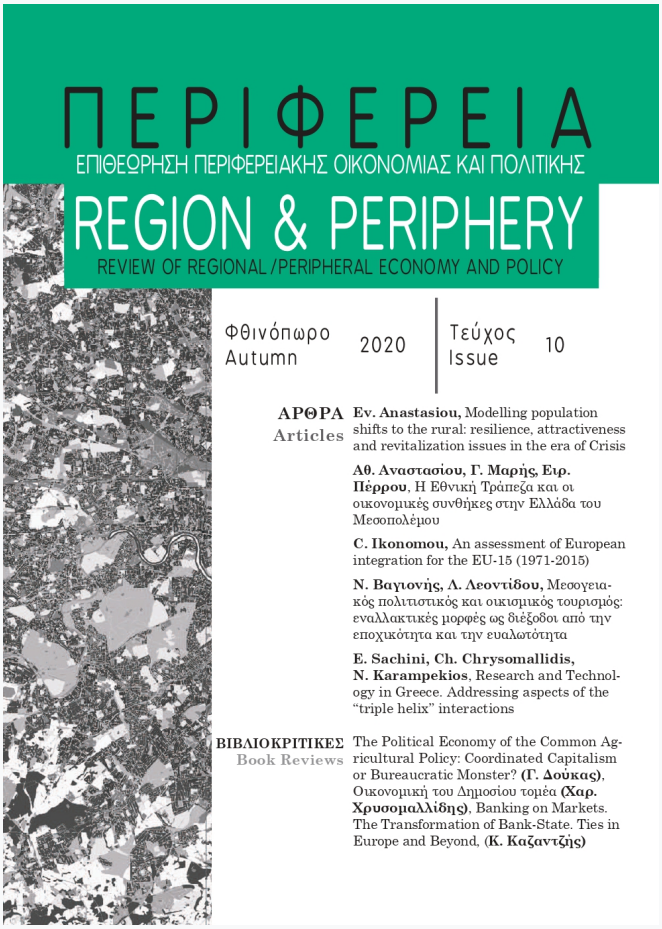

Research and Technology in Greece. Addressing aspects of the "triple helix" interactions

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Research and Technology in Greece. Addressing aspects of the "triple helix" interactions

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Abstract

The paper embraces a macro-view and elaborates on the synergies established between the main components of the triple helix scheme in Greece. The analysis focuses on the collaboration between the academia and the business world and the role the public sector is playing in the national research ecosystem, and, particularly, in motivating academia-business collaboration. The empirical evidence builds upon existing knowledge-intensive quantitative and qualitative indicators and data on the national research and innovation system. Findings give out a mixed signal - some aspects of this synergetic relationship, namely, copublications, can be improved while other aspects, such as innovative enterprises collaborating with the academia, indicate a growing collaboration pattern. On a wider level, this paper contributes to mapping of knowledge intensive synergies between academia, businesses and public administration, thus offering empirical level fi ndings at the national level.

KEY-WORDS: Research, Technology, Greece, Triple helix, Interactions, Business sector, Universities

Έρευνα & Τεχνολογία: Διαστάσεις του Τριπλού έλικα στην Ελλάδα

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Περίληψη

Το άρθρο εξετάζει μακροσκοπικά τις αλληπειδράσεις και τις συνέργειες που σημειώνονται μεταξύ των κύριων συνιστωσών του λεγόμενου τριπλού έλικα στο ελληνικό σύστημα έρευνας, αναδεικνύοντας βασικά τη συνεργασία μεταξύ του ακαδημαϊκού κόσμου και των επιχειρήσεων, παράλληλα με τον ρόλο του δημόσιου τομέα, ως διευκολυντή αυτού του είδους της συνεργασίας. Η ανάλυση βασίζεται σε σημαντικό βαθμό σε ποσοτικά και ποιοτικά στοιχεία και δείκτες. Η προσέγγιση αυτή συμβάλλει στη συζήτηση σχετικά με το συνεργατικό δυναμικό που παρατη-

ρείται μεταξύ των κύριων συστατικών μερών του τριπλού έλικα, στην προσπάθεια αναδιάρθρωσης του παραγωγικού και αναπτυξιακού μοντέλου της χώρας.
ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ: Έρευνα, Τεχνολογια, Ελλάδα, Τριπλός έλικας, Αλληλεπιδράσεις, Επιχειρήσεις, Πανεπιστήμια.

1. Introduction

During the 2000s, the Greek economy experienced a buoyant growth period. It, however, was neither driven by innovation or knowledge-intensive production nor domestically stemming. Indeed, hesitance to fund risk-related activities has been pointed out as a trigger of the ensuing economic crisis that turned up as a fiscal crisis in the Greek case, in 2009. Reversing this trend, even within the crisis period (2013), a clear pattern of increasing Research, Development and Innovation (RDI) expenditures was observable from both from the private and public sector. Entering, thus, the post-crisis era (2017 onwards), Greece has been actively seeking a new growth model placing a premium on productive restructuring and initiatives for boosting investment. At the heart of the relevant policy discussions lies the improvement of competitiveness. Rather than viewed as an issue of lowering labour costs, it is a more complicated issue involving the improvement of the knowledge content of national production - a function of which is the increase of RDI spending (National Council for Research and Technology 2014). This, par consequence, speaks to the country's transformation into a knowledge-based economy. As a result, knowledge-intensive activities have been upgraded in the policy agenda by virtue of their impact on production restructuring and on investment boom that capitalise on the domestic RDI-relevant comparative advantages (e.g. human capital) (Hellenic Republic 2016). Conducive to these factors, has been the introduction of a national strategy for research and innovation, as part of the 2014-2020 smart specialization strategy (RIS3) in Greece, as well as the wider academic and policy debate on Higher Education Institutes (HEIs) and their role in the knowledge-intensive economy. This latter discussion fits well within HEIs' third mission in the context of the existing knowledge triangle approaches.

Within this framework, this paper aspires to contextualize the existing level of interaction between the higher education sector (HES) and the business/ enterprise sector (BES) concerning research activities. The geographical scope is Greece, while the argument of the paper will be highlighted by way of presenting and contextualising various, existing relevant indicators. Making use of these indicators, this paper takes a macro-view on the national-level and contributes in the mapping of the knowledge intensive synergies between the main actors of

the triple helix scheme in Greece. To do so, the role of the public administration, as the third axis of the triple helix construct, is taken into consideration. Indeed, the role of public administration has been highlighted within the triple helix theory (Galvao et al. 2019), a parameter prominent in the Greek case, as the role of the State is more pronounced in various aspects of the economic activity, including the research system. Analysis refers to the situation of the Greek research system and the relevant triple helix scheme, its characteristics and its evolution during the 2010s.

The structure of this piece is the following. Section two refers to the theoretical background and methodology followed. Section three deals with factual analysis, both in quantitative terms on synergies between HEIs and enterprises, and in relation to public administration and its role in the Greek research system. Section four discusses the findings and further analyzes certain aspects of the "Greek triple helix", followed by conclusions.

2. Theoretical background and methodology

Synergies between universities and research centres and the private sector has been consistently recognised as a hot issue in international literature regarding economic development and sustainable growth (Dasgupta and David 1994; Florida and Cohen 1999; Etzkowitz et al. 2000). According to cross-temporal evidence, enabling knowledge interaction and flows between HEIs with the private sector contributes to economic growth, productive transformation, applied research, technology transfer, etc. Both theoretically and empirically, this aspect of HEIs' operation is directly related to the promotion of the so-called "third" mission of universities (Gulbrandsen and Slipersaeter 2007).

Based on this, multiple theoretical and analytical schemes have been developed, such as the so-called "triple helix" theory, the knowledge triangle approach as well as more nuanced approaches, introducing extra components to the framework of interactions between university, industry and government, such as the civil society, media and the environment.

The underlying thesis has been the need to come forward with a hybridization of the age-old University, industry and Government activities to come up with new institutional and social formats for the production, transfer and application of knowledge. A common underlying feature of all these approaches has been the focus on the interaction of research, education and innovation (Phan and Siegel 2006; Rothaermel, Agung, and Jiang 2007; O'Shea, Chugh, and Allen 2008), and the issue of promoting and implementing the idea of the modern and "entrepreneurial university". A university, that is, able to re-invent itself and its operation by way of "stepping on two boats": that is holding steadfast in its

historical mission improving the wider dissemination of knowledge as well as delivering on various societal needs and market realities.

It is in this context, the current state-of-affairs concerning the Greek "version" of triple helix, particularly emphasizing on the HEIs-BES nexus, is the focus herein. Concerning methodology, this paper makes use of qualitative and quantitative data. On the former, relevant official (Eurostat and the National Documentation Centre (EKT)) indicators are presented and contextualised. Since 2012, EKT has been designated as the National Authority of the Hellenic Statistical System for European statistics on Research, Development and Innovation. Of special value is the fact that only since 2012, a comprehensive, regular time series of these statistical indicators has been made available - prior to that, the relevant indicators were either considered to be "estimates" or altogether missing. In addition, a range of other relevant indicators concerning the formal/informal HEIs - businesses collaboration in knowledge-intensive activities that are also collected by EKT by virtue of its role in the national innovation system, are also presented.

In more detail, variables that are made use of herein include data on R&D statistics on synergies for performing and funding R&D activities, entrepreneurial metrics on innovation based on results of the Community Innovation Surveys (CIS), metrics on recent public initiatives for supporting business/enterprise sector - higher education sector (BES-HES) cooperation for applying R&D projects, bibliometric analysis of co-authored publications. Also, qualitative data drawn from a recent field survey on HEIs' interactions as part of an OECD initiative on the knowledge triangle and evidence are also presented. These data refer to the manner in which public administration relates to the other two main actors of the "national triple helix". Where available, this paper makes use of cross-country indicators to make comparisons on an international (namely, European) scale.

The objective of the paper is to provide up-to-date data on the HEIs-businesses collaboration, thus shedding light on the existing situation of this interactive aspect of knowledge intensive activities in Greece. Also, the role of public administration is examined within the triple helix analytical framework, a parameter that becomes more critical in the Greek case, as the role of the State is important in various aspects of economic activity in the country (Pagoulatos 2018), including the research system. Therefore, this paper will also address significant bureaucratic instances of this interaction.

Last, provision of such indications can be "tied" to specific and actual comparative advantages and weaknesses of the national RDI system, as well as provide sign-posts on how to make the best out of its potential.

3. Factual analysis

Historically, one of the main "RDI stakeholders" in Greece has been the State. This center role has been taking place under many forms. For example, public universities and research centers have been, for the most part, prime performers of the national research production in terms of R&D spending or even as R&D personnel's employer. The State has diachronically -and at least until 2017- been the main funder of the national research ecosystem, either through the government sector or through the higher education sector, since all HEIs are public, according to the Greek Constitution. Also, the General Secretariat for Research and Technology (GSRT) has a critical role in establishing and operating the institutional framework for research and technology in Greece, inasmuch it has been the delegated agency for setting the national R&D policy and the R&D-related funding priorities within the National Strategic Reference Frameworks (NSRF) that Greece has been receiving EU Structural Funds. Despite these clear-cut state-centered parameters that would have enabled the public sector to pivot towards knowledge-intensive performance, this did not happen. One of the reasons for this inaction has been that the importance of RDI had been consistently downgraded and viewed as a low politics issue. That is, until the crisis was in full fledge. This was compounded with the relevant institutions perceiving their mandate in strict RDI-focused lenses and were unable to contextualize their mandate in a rhetoric that fed into the wider discussion of economic development.

On the policy level, turning away from this low politics loop was achieved (at least partially) with the appointment of a Deputy Minister for Research and Technology in 2015. It was in the 1980's that the RDI portfolio had fared so high in terms of political appointments. This, at least nominally, gave out a clear sign wishing to advance and upgrade this area of public policy in the national political agenda. Happily, the trend was not reversed by the 2019-elected new government, sustaining this high-profile position and indeed placing high on the political agenda the wider exploitation and commercialization issues.

In relation to the private sector, businesses' contribution and interest for R&D activities appeared to be rather low. For historical reasons, this can only be anecdotally sustained since the lack of cross-temporal official indicators prior to 2012 looms large. Additionally, domestic production depended mainly on technology and know-how transfer from abroad and did not capitalize on domestically produced knowledge. This has been characterized as one of the main weaknesses of the Greek research system. In the pro-crisis era and in hindsight, this was attributed to a problematic relationship between the scientific

community and business sector. This "disinterest" towards RDI was taken to mean a significantly low domestic demand for the research results by public universities, as businesses did not seek to increase their competitiveness through investments in knowledge and human capital, but through low production cost and illegitimate means, such as black market and tax evasion (Papagiannakis 2008). Moreover, quality, design, innovation and the level of specialization of products (goods and services) were not considered as the driving force for sales (Tsipouri and Papadakou 2005) while domestic enterprises tended to invest in activities of very low risk with high rates of return in the short-term. The tables, however, have begun to turn. Since 2017 the business sector seems to become the main R&D performer in Greece, for the first time, ever, according to official national R&D statistics, despite the fact that its share lags still behind the EU average (approximately 50% in Greece vs. more than 65-70% in EU28).

3.1 Quantitative data on HEIs-BES synergies

Here, the most relevant and updated data on the various aspects of the HEIs-businesses collaboration in RDI-relevant activities are presented. Table 1 concerns the range of R&D collaboration between HEIs and businesses in R&D projects. When referring to R&D statistics on synergies for performing and funding R&D activities, data shows that the share of R&D that is performed by HEIs and is funded by the business sector is of highly relevant statistical information since it provides a percentile account of this kind of collaboration. Also, this indicator is estimated both as a percentage of the higher education expenditure on R&D (HERD) and of the gross expenditure on R&D (GERD) in order to compare the Greek performance to the average of EU. For the 2011-2018 period, Greek HERD (as a share of gross expenditure on R&D - GERD)) funded by the business sector exceeds the EU28 average (2015: GR: 2.9% vs EU: 1.5%, and 2017: 2.4% vs. 1.5%, respectively).

This finding can be also viewed in relation to the Greek HEIs expenditure on R&D funded by the business sector as a share of total HERD (Table 1), since Greece surpasses the EU average (2015: GR: 7.6% vs. EU: 6.4%, and 2017: 8.3% vs. 6.9%, respectively). The discrepancy, however, is not significant pointing to not an entirely different picture between Greece and the EU. As mentioned before, concerning HEIs expenditure on R&D funded by the business sector as a share of total GERD, the difference is more pronounced, given the fact that Greek HEIs have been diachronically the principal R&D performer in Greece.

Table 1. R&D Performed by Higher Education Sector and Funded by Business Enterprise Sector (as percentage of HERD and GERD)

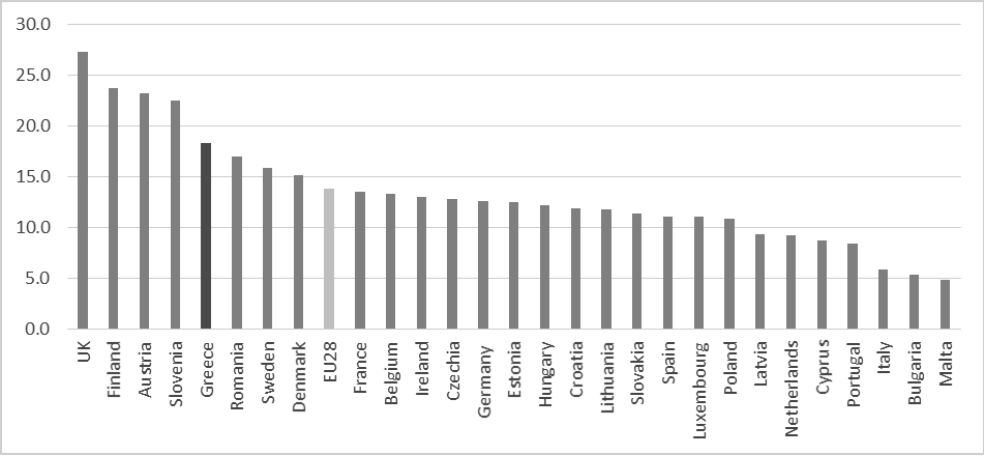
	2011		2012		2013		2014		2015		2016		2017		2018	
	as % of HERD	as % of GERD	as % of HERD	as % of GERD	as % of HERD	as % of GERD	as % of HERD	as % of GERD	as % of HERD	as % of GERD	as % of HERD	as % of GERD	as % of HERD	as% of GERD	as % of HERD	as% of GERD
EU28	6,5	1,5	6,4	1,5	6,4	1,5	6,4	1,5	6,4	1,5	6,5	1,5	6,9	1,5	:	:
Greece	9,0	3,6	7,9	3,1	5,5	2,0	6,0	2,2	7,6	2,9	7,3	2,3	8,3	2,4	8,5	2,4

Source: EKT, Eurostat, authors' calculation

Another indicator that provides evidence on the networking potential between HEIs and businesses can be derived from the CIS survey. In more detail, this indicator refers to innovative enterprises that establish collaborations for carrying out product and/or process innovation activities. Figure 1 refers to evidence from the latest CIS round (2014-2016), illustrating a cross European country comparison, according to which Greek enterprises indicate a higher than the EU average degree of engagement in cooperation with HEIs. Indeed, Greek firms fare in 5th place among EU countries.

Seen across time, significant fluctuation can be observed. This fluctuation is observed when comparing the CIS 2014-2016 results to those of past series of the survey (for instance, in the 2012-2014 CIS round, the country is ranked in 20th place and in sixth place in the 2010-2012 survey) (National Documentation Centre 2017).

Figure 1. Share of enterprises engaged in product and/or process innovative activities in co-operation with HEIs, 2014-2016



Source: EKT, Eurostat, own calculation

A third data source on the level of collaboration between HEIs and the private sector is the R&D related public tenders and calls. Sachini et al. (2017) analysed the joint publicly funded R&D projects of GSRT. They conclude that the level of such collaboration is strongly related to the binding terms and conditions of the tenders and calls at hand. More specifically, only for those programmes, projects, etc. wherein collaboration between HEIs and the private sector was deemed as a formal requirement according to the rules for participation (i.e. obligatory), can a substantial collaboration pattern be observed. In all other cases of programmes, projects, etc. where the decision to collaborate or not is left up to the will of the participants (i.e. optional), the rate of collaboration is decidedly lower. Thus, it appears that these programmes insufficiently nurture the creation of innovation-targeted linkages (Table 2). This implies sub-optimal exploitation of research and knowledge production, as well as inadequate technology diffusion throughout the economic and social fabric.

Table 2. The range of Business-HEIs R&D collaboration in GSRT programmes, 2007-2013

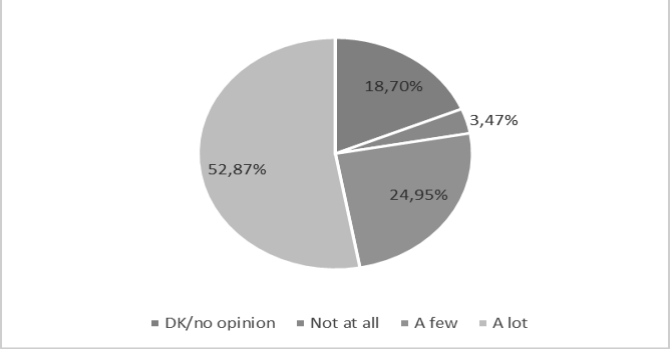
No.	Programme no.	Sectoral focus	Type of collaboration between HEIs/public research institutes (PRIs) and business collaboration	% of GSRT's programmes budget (*)
1.	22+	HEIs/PRIs	Non existent	25%
2.	10	HEIs/PRIs and businesses	Optionally	10%
3.	7	Businesses	Non existent	11%
4.	2	HEIs/PRIs and businesses	Obligatory	30%

(*) For the remaining % of GSRT R&D actions, no detailed data was available.

Source: Sachini et al. (2017)

An additional data source is data collected through other public financial interventions such as "Activities concerning Tertiary Education". This has been a flagship, national initiative that sought to upgrade the research potential of HEIs by way of funding the conduct of PhDs, post-doctoral research as well as the formation of research teams, funded by the 2014-2020 NSRF (Sachini, Karampekios, and Chrysomallidis 2020). A series of enterprise-friendly indicators can be derived. Specifically, when asked whether young scientists would collaborate in the future with firms in order to further exploit their current research idea/ project, approximately 70-80% of the beneficiaries responded that they would be willing to do so (Figure 2).

Figure 2. Potential R&D collaboration between young scientists and enterprises (as percentage of beneficiaries' responses)

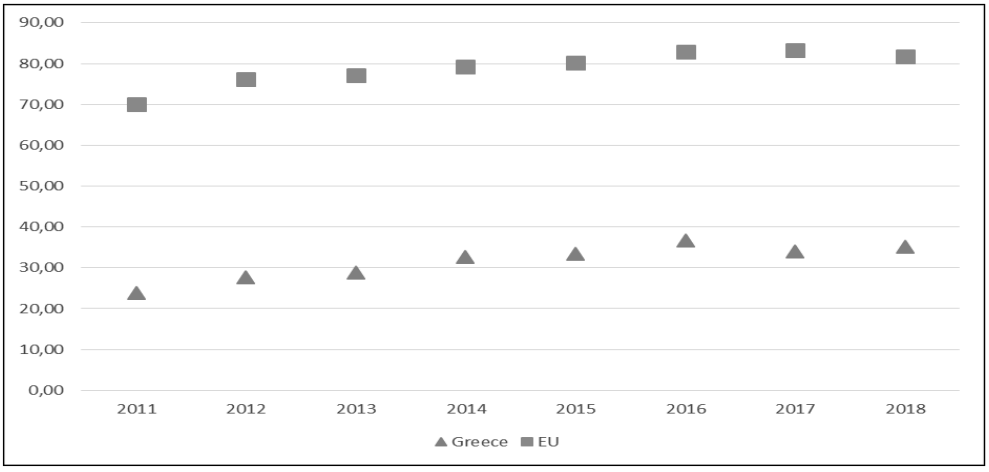


Source: (EKT 2019a, 2019b, 2019c), elaborated data

Bibliometric analysis is another data source upon which BES-HEIs interaction can be observed. Bibliometrics is the process of extracting measurable data through statistical analysis of published research studies and how the knowledge within a publication is used. Specific bibliometric indicators (university-industry co-publications) can be used as a proxy for examining the level of interaction between the academic community with the business world.

The following figure (Figure 3) presents the relevant European Innovation Scoreboard data for the period 2011-2018. Greece hovers around 31,5 for the entire period, reaching an all-time high value of 36,6 in 2016, whereas the EU average is 78,8, with an all-time high value of 83,3 in 2017. This indicates a case of significant lagging at the level of public-private co-publications in international journals in Greece in comparison with the majority of EU countries (Figure 3).

Figure 3. Greek and EU average, public-private co-publications (per million of population), 2011-2018



Source: European Commission (2019)

Furthermore, another data source refers to qualitative data, drawn from a recent field survey on HEIs' interactions within economy, as part of a 2016 OECD initiative on the knowledge triangle in its member states. Accordingly, an unforeseen effect of the economic crisis appears to be the renewed intention of HEIs and enterprises to co-participate in RDI-related synergies. This came as a result of the significant decrease of public funding for HEIs, which made academics realize the need to establish links with the private sector not only to obtain additional funds but also to increase the potential uptake and commercialization of their, basic and applied, knowledge. The private sector, similarly,

realized the need to collaborate with HEIs so as to tap into the potential of a growth-related, knowledge-intensive pool (Sachini et al. 2016).

3.2 Public administration in the "Greek version" of triple helix. The actors

Public administration and bureaucracy is a major component of the triple helix scheme, playing potentially a (significant) role in bringing closer academia and the business world in terms of funding, regulatory framework, cultivating enabling conditions for BES-HES collaboration, etc. This is based on the realization that public bureaucracy enables knowledge creation by way of planning, substitution, and orchestration (Acha and Martin 2011).

In Greece, there is a multiplicity of RDI-relevant public organizations. GSRT is the main competent authority for such matters by way of designing and implementing the national public policy on research and technology and coordinating the implementation of the national RDI policy. Additionally, other public actors at the national level are also engaged in RDI. For example, project calls that concern Research & Development (R&D) are planned and/or developed by the Managing Authorities responsible for the Operational Programme (OP) Development and OP Education. In addition, policies on human capital, environment and urban planning - policies that exert significant influence on RDI are formulated by the Managing Authorities of the relevant OPs.

Also, the establishment of Hellenic Foundation for Research and Innovation (HFRI) in 2016, a funding organization supporting R&D stands as the most recent institutional insertion in the domestic bureaucratic universe. HFRI was formed with the European Research Council as a role model, as according to HFRI's website "…it supports unrestricted research [….] and new researchers by providing scholarships for doctoral candidates, as well as research projects for post-doctoral students, researchers and faculty members". Indeed, according to the proclaimed objective, it seeks to fund projects with the sole criterion of scientific quality and excellence. Given that both HFRI and GSRT are supervised by the Minister for Research and Technology ensures, at least in principle, cross-institutional calibration and collaboration.

On the regional level and in relation to the coordination between central and regional authorities, despite past activities under different Community Support Frameworks (CSF) to introduce R&D-related funding activities, regional authorities exhibited limited capacity in planning and implementing RDI policies. Despite research and technology actions were included both in OPs and Regional OPs, Greek regions lacked the necessary administrative and managerial capabilities in R&D policy making. This can be attributed to low

technology intensity of regional production and innovative performance, lack of human resources, skills and relevant expertise in administration. As a result, collaboration between GSRT and regions has been inadequate in most cases (Reid et al. 2012). This pattern was replicated during the 2007-2013 NSRF pointing to a low level of horizontal co-ordination and a lack of a multilateral, longer-term and systematic consultation in the agenda-setting process between the Central State and the regional authorities. Additionally, the measures that were regionally implemented aimed at covering the needs of the existent academic and research institutes, mainly in terms of infrastructure, on a "bottom-up" basis that was convenient for the "insiders" (Bartzokas 2007). Additionally, they aimed at decentralizing existing infrastructures in those cases where regional HEIs were either established or expanded (Maroulis 2010).

Closely associated is the realization that in the absence of a solid national RDI programme guaranteeing regular state funding, the RIS3 priorities and ex-ante conditionalities that have been part of EU's cohesion policy were not as much the result of an internal demand-focused process but rather introduced exogenously. This may partially explain why the concept was not fully understood by policy-makers and regional stakeholders. It was only in July 2015 that GSRT finalized and published the "National RDI Strategy for Smart Specialization".

Beyond the regional versus national dichotomy, another important issue refers to the extent to which the domestic research system depends financially on EU's research initiatives and policies. Patchy domestic funding has forced Greek researchers to focus on EU R&D calls as a prime funding source. This made the country's dependence on EU even more intense (Maroulis and Mikroglou 2011), far exceeding the typical framework of Europeanisation (Chrysomallidis and Maravegias 2011). The realization that the overall direction of RDI policy is initiated at the EU-level is probably a mixed blessing (Collins and Pontikakis 2006) inasmuch paneuropean priorities are stretched to fit domestic idiosyncrasies. Addressing this policy consideration would greatly enable the domestic institutional arrangement to support thematic priorities according to national or regional comparative advantages and priorities. This shortcoming, however, relates to the "free meal" effect (Tsipouri and Papadakou 2005), arguing that as long as funding is, by and large, external, it does not require any special effort from administrative stakeholders.

4. Analyzing aspects of the "Greek triple helix scheme"

The evidence put forward indicates that the quality and leverage of the academia-enterprises nexus is rather mixed regarding research and

innovation-related activities. A subsequent point of discussion would necessarily involve means to enhance the blossoming of such a relationship.

One such solution involves the availability of financial resources stemming from the Ordinary Budget and from EU's Structural Funds. Towards this, public authorities have launched a number of financial intervention measures aiming at enhancing the national innovation potential, in terms of joint research calls addressed to both academia and the business world. These measures explicitly sought to enhance the interaction between the private and public sector either by increasing the "entrepreneurial contribution in the research effort", or by "linking the RDI with the national productive nexus" (e.g. "Cooperation" Programme, PAVET, etc.).

On a more theoretical level, the mixed quality and leverage of the academia-enterprises nexus can be attributed to the overarching perception held by both the Greek population and the academic community, at large. This being the case that university degrees mostly offer theoretical and general knowledge without focusing on the practical aspect that will be applied on a business. Additionally, a large portion of those graduates were employed by the State, thus they did not intend to engage in entrepreneurial activities. While anecdotal, this perception has been mainstream since the early 1980s. The recent economic crisis in Greece led to the reduction of HEIs institutional funding, forcing HEIs to seek for alternative sources of funding. The tight fiscal crisis conditions had direct effects on HEIs' actions and behavior, creating a new context (Sachini et al. 2016). Thus, HEIs had to reconsider their funding options. It is fair to say that the same process was initiated by the private sector. Putting a premium on knowledge and innovation meant to start flirting with the prime producer of these commodities - the tertiary sector.

Indeed, the broadly accepted view about the problematic relationship between academic community and the business sector is not fully validated from recent data. For example, data on R&D synergies reveal a rather satisfactory level of cross-sectoral collaboration when examining R&D performed by HEIs and funded by enterprises. This is so despite that when referring to the high level of Greek performance in the R&D conducted by HEIs and funded by the business sector (as a percentage of GERD), one should consider that HEIs have persistently been the main R&D performer. This remains at odds with EU and international cases, even though as of recently, firms have been significantly boosting their R&D spending. Overall, and in line with some aspects of the triple helix approach that lay emphasis on interaction between HEIs and businesses (Cervantes, Ajmone Marsan, and Paunov 2016; Ritzen 2018), the domestic business sector has been making inroads towards increasing their R&D performance. Similarly, HEIs approach towards the private sector has been, by

and large, accommodating, indicating a potential path towards a growing and more effective exploitation of knowledge production.

Establishing substantial links between the main actors, namely HEIs and public research institutes (PRIs), pubic 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, is a major objective. This was not always the case, as interactions took place in a rather unstructured manner, given that close geographical proximity allowed for a multitude of possible interfaces, such as interpersonal relationships, having sometimes strong territorial aspects, mainly due to the absence of suitable regulation and institutions that would enable institutional and sustainable connections of this kind (Sachini et al. 2016). This non-structured, interpersonal manner grew out of the lack of a clear-cut, domestic institutional framework that set the collaborative rules. In recent years, i) the establishment of common post-graduate modules, ii) the ability of researchers to apply for mobility in public sector, namely to universities, iii) the 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, across all ministries, to avoid fragmentation in public RDI actions and to boost public demand for technology-intensive products, services and procedures, stand as public actions that may entice further collaboration.

In relation to the public administration, GSRT recognized a number of shortages in its policy-making ability. These shortcomings involved the lack of a standing R&D national strategy, the need to establish cross-departmental collaboration (including) regional authorities to improve R&D governance, as well as fragmentation in R&D policy-making (General Secretariat for Research and Technology 2012). Since then, steps correcting these shortcomings have been taken. Stop-gap measures, in addition to the institutionalization of high-profile position of Minister for Research and Technology since 2015, as well as the introduction of smart specialization strategy and the implementation of a RIS3-relevant policy practice imply that the previously set problematic RDI context may have started to change (Reid et al. 2012; Technopolis Group 2012).

For such a change to be complete, one should take notice of a range of other issues required at the "micro" level. For example, GSRT's officials should further immerse themselves in strategic policy planning, such as tracing research priorities and drawing a complete public RDI policy in a systematic nor sporadic manner in addition to their every-day-policy and administrative activity (Chrysomallidis, Tsakanikas, and Giotopoulos 2014). In addition, according to Reid et al. (2012) the existing "operation culture" at both national and regional level needs

to take into account the conclusions, recommendations and results of research activity and studies in policy planning.

Also at the "micro" level, stands the issue of implementing the smart specialisation in Greece. Here the danger is that the policy measures meet criteria in a rather typical manner, satisfying ex ante conditionalities. However, this may conceal that the substantial impact of these initiatives remains under question, as most (regional) authorities involved have proved to be ill-prepared for planning and implementing a technology-intensive strategy. As Boden et al. describe it "(t)he evolution of the entrepreneurial discovery process … was influenced by the ongoing RIS3 approval process and administration, as well as by the serious political and economic uncertainty of Greece in 2015" (2016, 6). According to McCann and Ortega-Argilés (2015), this is the case for the less developed EU regions, but it is even more likely, due to political tradition and past practice in the Greek case.

5. Conclusions

This paper employed a macro-view and made use of a variety of existing indications (both quantitative and qualitative) detailing the existing level of interaction in Greece between universities and the business sector. This was conducted taking into account the theoretical framework of triple helix. Also, the existing bureaucratic format as an enabler between the triple helix's main components was examined.

This empirical-laden, descriptive-oriented paper contributes into the policy discussion concerning the synergetic potential between the major actors of the triple helix in Greece and the need to support knowledge-intensive activities as a means to re-structure the productive and growth model in the country.

The approach built upon factual analysis and indicated that the existent level of this kind of synergies brings to the fore a more complex picture compared to the broadly accepted view that there is major lack of HEIs-business collaboration in the Greek research and innovation system. Data and trends send out a mixed signal. While some aspects of this relationship (namely, co-publications) should be assessed carefully, other aspects (innovative enterprises collaborating with HEIs) indicate a clear and growing collaboration pattern. Correcting the former and enhancing the latter constitute steps which are especially important in the post-crisis era, where a new growth model and productive restructuring towards a knowledge-intensive pattern is a prerequisite for sustainable growth.

On the other hand, the issue of collaboration arrangements and its sustainability beyond the scope of specific programmes or projects, as in the case of

GSRT calls in the 2007-2013 programming period, is a point worth further considering. In addition, building robust linkages and synergies between HEIs and BES is a crucial parameter, for which institutional consistency and clear-cut legal arrangements, in terms of, e.g. the exploitation of research results. On this, bringing to the fore successful collaboration schemes and analyzing the manner in which this has already been made possible so as to replicate it is a case for future research. While HEIs have an important role to play in respect to economic and social growth, full potential can only be accomplished with enacting collaborative arrangements with the private sector. EKT, as the national statistical agency on R&D, aims to shed more light on this particular subject producing relevant indicators that would enable more comprehensive analysis.

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