Edited by
Vlassis Missos
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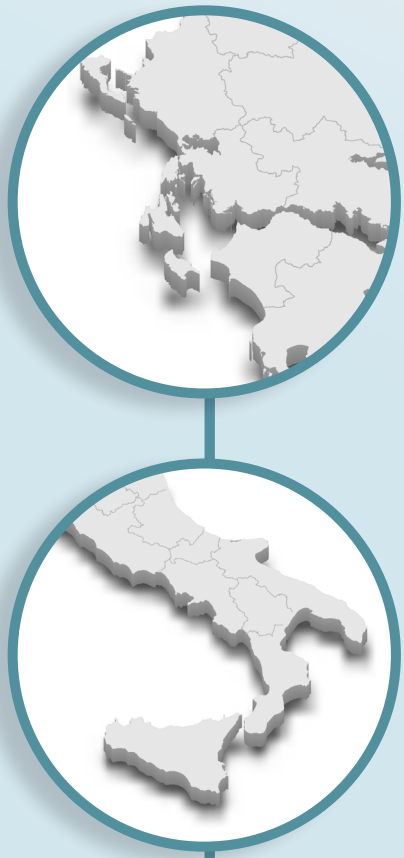
CENTRE OF PLANNING
AND ECONOMIC RESEARCH

Special Issues on Regional Entrepreneurship & Innovation Planning

Perspectives from Western Greece and Apulia



The Centre of Planning and Economic Research (KEPE) is the largest economics research institute in Greece. It focuses on applied research projects regarding the Greek economy, and provides technical advice to the Greek government and the country's regional authorities on economic and social policy issues.

The Regional Development Fund - Region of Western Greece, engages in activities that promote the development of Western Greece and manages the funds directed to the Region of Western Greece and its subregional and local authorities from the central government's public investment program, the European Committee, international organizations and other foreign bodies.

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Special Issues on Regional Entrepreneurship
& Innovation Planning:
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and Apulia

ISBN: 978-960-635-469-4

This volume was set in, printed, and bound by Pedion Publishers;
and published by the Regional Development Fund of the Region of Western Greece
and the Centre of Planning and Economic Research.
The editors were Vlassis Missos, Pródromos Prodromídis, and Ioanna Reziti.

Regional Development Fund
Region of Western Greece

Centre of Planning and
Economic Research (KEPE)

Special Issues on Regional Entrepreneurship & Innovation Planning: Perspectives from Western Greece and Apulia

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Vlassis Missos, Pródromos Prodromídis, Ioanna Reziti

Patras and Athens
2021

FOREWORD

Regional development is a major political issue. For all the regions across the EU, the challenge of enhancing prosperity, building a resilient economy and increasing living standards has become more acute than ever due to the contemporary threats like the long lasting COVID-19 pandemic and the current triple crisis: financial – climate – energy.

In our region, the geographical units that constitute Western Greece have a unique identity and at the same time different needs and sharp inequalities in the development prospects. All the above underline the fundamental issues of "What are the main policy interventions and instruments" for a holistic and progressive transition.

The present volume constitutes a high point in the fruitful cooperation of the Region of Western Greece –both separately and, lately, jointly– with the Centre of Planning & Economic Research and with Apulia Region on issues of regional development. Through the selection of works featured in the pages following, the volume demonstrates how evidence, statistics and analyses may help Western Greece and Apulia or regions across the EU, understand their current situation, calibrate their strategy, and consider and implement policy on entrepreneurship and innovation. It also describes individual interventions and issues that are both relevant and interesting to the analyst, the policy maker, and the local community.

It is our pleasure to share its content with all of the above and the wider community.

Nektarios Ath. Farmakis
Governor of the Region of Western Greece
and President of the Regional Development Fund

Region of Western Greece
December 2021

The Centre of Planning and Economic Research (KEPE) has a long-term commitment with the regional aspects of economic growth, as a necessary condition for promoting sustained employment, better living standards, and social welfare.

KEPE's focus on the Greek regions is part of its incessant effort to produce rigorous scientific studies that would induce social prosperity and better job opportunities to the population nation-wide.

With a view to the above, the current volume on regional policy and regional economic analysis constitutes a significant step forward and its conclusions may serve as a guide for consulting, planning, and implementing regional policies.

The readers have the opportunity to expand their knowledge on some of the most topical issues, such as that of the post-recession economic policy challenges, competitiveness and inequality, but also to assess the latest developments on some of the most classical ones, such that of the relation between agriculture and innovation and the way the public sector should intervene assisting the knowledge-augmenting capital to flourish.

Analyses such as those presented in the pages that follow, if properly used, may support the difficult role of regional policy makers, in their efforts to improve the lives in the regions and to enhance their productive potential for a better future.

Professor Panagiotis Liargovas
Scientific Director and
Chairman of the Board of Directors

Centre of Planning and
Economic Research (KEPE)
December 2021

PREFACE

The European Union's regional and interregional policy places the promotion of entrepreneurship and innovation (E&I) high in the agenda, anticipating that it may boost sustainable growth and social welfare. In this respect, the present volume delves into E&I issues that are important to Western Greece and Apulia (Puglia), by bringing together statistics, models, analyses, reviews, practical experiences, tools, and ideas, which, understandably, may be of interest or use to other parts of the world as well.

Situated on the eastern and western coasts of the European Union (EU)'s Adriatic & Ionian Macroregion, Western Greece and Apulia, respectively, have over the ages shared multilevel interactions, and recently joined forces in the framework of the 2014-2020 Greece-Italy Interreg Program to develop digital services and tools to enhance the business environment and related territorial development policy-planning.

The distinct experiences and needs, the common challenges, the exchange of ideas, the projects and cross-border cooperation of the regional administrations and of key agents in Apulia and Western Greece are, to considerable extent, captured or mentioned in the twelve original research or policy chapters that follow. These were organized and edited by the undersigned.

Chapter 1 provides a brief description of Western Greece on the basis of official domestic and EU statistics, drawing attention to the economic challenges faced by the region. It compares via indices Western Greece's production-and-well-being profile and development prospects to the respective profiles and prospects of the other EU regions (over two hundred territorial units) and finds that Western Greece shares a good number of production similarities with neighboring regions in Greece and Italy (including Apulia), as well as regions in Portugal, Romania, and other EU countries

Chapter 2 looks into the evolution of specific aspects of competitiveness at the regional level, focusing on Apulia and Western Greece via indices in order to advise on the improvement of the overall magnitude of competitiveness estimated for the two regions.

Chapter 3 uses EU data to econometrically estimate through alternative specifications the effects of income inequality, of research and development (R&D) ex-

penditure, of human capital, of sectoral, and of other possible explanatory variables on real regional per capita GDP in eighteen EU member-states. Thus, it advances understanding on the significance and role of the particular variables for policy implementation; and finds that a particular proxy for entrepreneurship does not function well.

Chapter 4 sketches out (a) the role of Apulia's ARTI (Regional Strategic Agency for Technology and Innovation) and (b) ARTI's web-based system of collecting and presenting socioeconomic and innovation indicators regarding the region; and Chapter 5 on the one hand proposes the use of additional indicators to help evidence-based regional policy making in Apulia on projects proposed by local businesses, and on the other hand engages in some exploratory econometric analyses to illustrate how the proposed data might be utilized.

Chapter 6 looks into things from a Western Greek perspective by describing (i) eleven electronic government-to-business services employed around the world (including one developed in Apulia), and (ii) an on-line system (platform) of collecting official macro-statistics, and micro-data obtained from local businesses and the general public for analyses to guide policy, further E&I, and improve the business climate in the region. Chapter 7 takes the next step and describes a platform that features (i) and (ii), developed to accommodate Western Greece and Apulia. In addition, whereas Chapter 1 showcases how a good number of collected macro-statistics may be used, Chapter 8 provides a number of exploratory econometric and algorithmic analyses based on the collected micro-data from Western Greece.

Chapters 9 and 10 focus on special funding issues. The former chapter describes the EU's funding instruments which are in place for supporting knowledge, research and innovation in the agriculture and forestry sector. The latter chapter describes raising funds via crowdfunding in Greece and the rest of the EU, with an emphasis on achieving – not private but rather – public goals, especially the promotion of innovation by the public sector.

Chapters 11 and 12 provide examples of how business ideas and pro-business policies might take hold in a place. The former describes an innovative business idea and some key-aspects that could be developed by a start-up in an olive-oil producing region, such us Western Greece and/or Apulia. The latter describes an innovation-development framework to help star-ups solve typical issues and grow.

Each chapter was evaluated by two reviewers. The editors express their appreciation to the latter for their useful comments and suggestions, which greatly contributed to the improvement of the volume. Namely, to (in alphabetical order): Panayiotis Alexakis (National & Kapodistrian University of Athens), Antony Calokerinos (National & Kapodistrian University of Athens), Helen Caraveli (Athens University of Economics & Business), Georgios Geronikolaou (Democritus University of

Thrace), Dimitrios Giannias (Hellenic Open University), Ioannis Halikias (Athens University of Economics & Business), Dimitris Kallioras (University of Thessaly), Chrysovalantis Malesios (Agricultural University of Athens), Christos Nikas (University of Macedonia), Lydia Papadimitriou (Liverpool John Moores University), Costas Passas (Centre of Planning & Economic Research), Giuseppe Pirlo (University of Bari), Nikolaos Philippas (University of Piraeus), Nikolaos Rodousakis (Centre of Planning & Economic Research), George Soklis (Centre of Planning & Economic Research), Konstantinos Themelis (Paris-Saclay University).

Vlassis Missos, Pródromos Prodromídis, Ioanna Reziti

CONTENTS

CHAPTER 1

POST-RECESSION ECONOMIC POLICY CHALLENGES FOR WESTERN GREECE: FRAGMENTATION, PRODUCTION, WELL-BEING, DEVELOPMENT PROSPECTS

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ABSTRACT | Western Greece is a geographically and functionally fragmented land, on the whole separated from the rest of Greece by mountains and bodies of water. Like the rest of Greece underwent a rather long (2008-16) economic recession. Normalizing and comparing recent (2016-19) regional statistics provided by Eurostat reveals that Western Greece is rather small in terms of population vis-à-vis the other 280 EU regions, and also features: (a) A large portion of people not being involved in the production process, relatively large portions being employed in the primary sector and the trade-transport-storage-accommodation-food service sector, while relatively small shares of the population are employed in the other sectors of the economy. (b) A high level of labor productivity in the arts-entertainment-recreation-other services sector, modest levels of labor productivity in the information-communication sector, the public administration-defense-compulsory social security-education-health-social work sector, and low or very low productivity in the other sectors. (c) A modest-to-high level of specialization, and, on average, the operation of very small businesses (by EU standards in terms of staff numbers) in all sectors. (d) Modest-to-high life expectancy and R&D spending, low ranking in terms of educated workers, highly educated people, jobs, per capita GDP, and disposable income, and a modest-to-unfavorable demographic composition: All in all, a difficult multivariate equation to solve.

1. INTRODUCTION

The chapter, written in 2020, studies the recent economic performance of Western Greece vis-à-vis the other 280 NUTS level II regions[1] of the European Union (EU)

[1] The *Nomenclature des Unités Territoriales Statistiques* (NUTS) is the three-tier hierarchical

via a common set of indices with the aim of contributing to the development of the region's economic policy. Hence, along with the works of Andreoni and Galmarini (2016), Herrero-Prieto et al. (2019), Pinar (2019) on regional well-being, Rizzi et. al. (2018) on regional resilience and sustainability, Parente (2019) on regional human development, as well as other works cited therein, also engaging in territorial comparisons via multiple indices, it is part of a growing literature on the study of subnational heterogeneity across the EU and the formulation of territorial policies.

Western Greece is in need of such a perspective. Classified as a less developed region of the EU, it comprises (a) the southwestern part of continental Greece (Aetolia and Akarnania, north of the long inlet forming the gulf of Corinth) and (b) the northwestern part of the Peloponnese peninsula (Achaea and Ilis, south of the gulf), where the principal urban center, the port of Patras, and the UNESCO world heritage site of Ancient Olympia, are located. It spans an area of 11.3 thousand km^2, split into two by the gulf of Corinth, further fragmented and separated by the rest of Greece by mountain-ranges,[2] rivers, lakes, a lagoon, other bodies of water, and a very jagged coastline, which prevent the formation of large markets, the achievement of economies of scale, and the diffusion of policy interventions. See Map 1. It is home to a

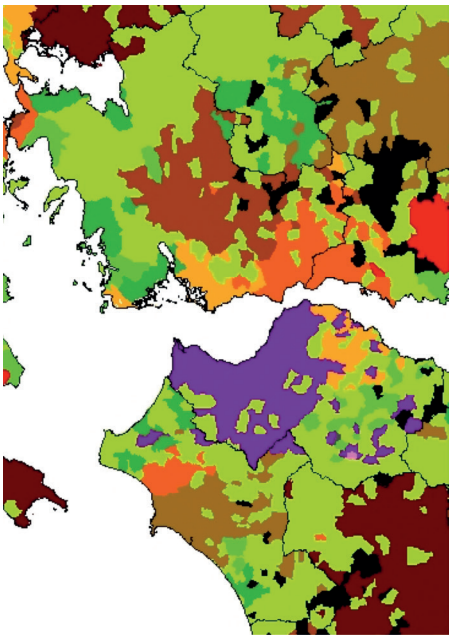
Map 1: The terrain and the land- and water-transportation network of Western Greece

Source: https://www.iliaoikonomia.gr/45087-html.

structure used in the EU to standardize territorial units. The current (2016-2020) population thresholds of NUTS I level range from 3 to 7 million, and of NUTS II from 0.8 to 3 million. However, as the case of Western Greece indicates, these guidelines are not applied rigidly.

[2] 44.2% of the area is situated at an elevation of over 800 meters (mountainous), another 30.5% is situated below 800 meters and features altitudinal differences of 300 meters or less (flat lowland), while the remaining 25.3% is below 800 meters and features rather large altitudinal differences (intermediate/hilly terrain).

Map 2: The functional areas of Western Greece and of neighboring areas based on the 15% in- and out-commuting ratio at the time of the 2011 Census



Groups of localities and isolated localities with a working population of:
≥ 100.0 thousand (linked to Athens)
50.0 – 99.999 thousand: Patras
linked to Ioannina
10.0 – 49.999 thousand
Agrinion (medium brown in the north),
Pirgos (light brown in the south)
(Other formations in shades of brown:
Arta, Karditsa, Lamia, Corinth,
Tripolis, Zakinthos)
5.0 – 9.999 thousand
Nafpaktos (orange in the center)
Amalias (orange in the south)
Messolongion (yellow in the center)
Aegion (yellow, west of Patras)
(Other formations in shades of orange,
red, yellow: Preveza Lefkas, Amfissa)
1.0 – 4.999 thousand
0.5 – 0.999 thousand
< 500

Source: Prodromídis (2018).

population of about 680 thousand people (2011 census),[3] who given the idiosyncratic terrain, infrastructure, broad production arrangements and resultant commuting patterns live in: (a) Seven functional areas in and around Patras, Agrinion, Pirgos, Nafpaktos, Messolongion, Aegion, Amalias, within which developments in the supply or demand of labor or the reduction of unemployment, the improvement of wages, and related socioeconomic phenomena and interventions may, to some or considerable extent, be diffused. (b) Three sets of areas primarily linked to Athens, Arta or Lefkas (beyond the region). (c) Many smaller, isolated communities situated predominantly north of Agrinion, in western Akarnania, in east Achaea, in north and in south Ilis. See Map 2.

[3] Of these, 5.9% are employed in the primary sector, 5.0% are employed in the secondary sector, 19.5% are employed in the tertiary sector, 8.1% are unemployed, and 61.6% are outside the labor market. The employed to non-employed population ratio is in line with those observed in neighboring Epiros, Thessaly, Central Greece, East & South Peloponnese, as well as in Apulia (Puglia), Basilicata, Calabria, Sicily (across the Adriatic).

Much like the rest of the country, the region declined economically during the recent eight-year-long recession;[4] and like the other twelve NUTS level II Greek regions, is headed by a governor and a council which possess very limited executive (no legislative) powers and rely on the central government for most of the funding. Under the circumstances, the regional authorities (the elected governor and council) assumed a practical strategy to coordinate local efforts, and support and promote entrepreneurship, innovation and economic development via (a) collaborations and (b) a combination of low budget approaches (either novel approaches or approaches already tried and tested in other places) (Prodromidis and Papaspirou, 2018).

As a consequence, identifying how the region is performing in key aspects compared to the other EU regions can be very instructive. So, a new set of indices, regarding Production, Well-being and Development prospects (PWD), consisting of twenty-two individual indices (elements) is prepared. These individual indices focus on:

- sectoral employment (ten indices: one for each production sector) and broader production features (three indices for overall labor specialization, productivity, and workers' education);
- well-being (four indices for disposable income, jobs,[5] people's education, life expectancy: all featuring in the works mentioned in the Introduction);
- development prospects (five indices for market size, demographic composition, R&D spending, GDP per capita and its rate of change);

across EU regions.[6]

[4] During 2008-16, per capita GDP decreased by 26.2%. In Greece it decreased by 24.8%, and in the EU it increased by 12.3%. During 2009-16, the number of unemployed increased 3.03 times. In Greece it increased 2.33 times, and in the EU it decreased by 3%.

[5] Even though it is people's leisure and not work that usually enters the individual's utility function, we lack non-work time-use measures at the regional level. If at a certain stage leisure (non-work time-use) is an inferior good so that the labor supply schedule may be positively sloped, and increased paid work involvement may reduce social exclusion (Giddens and Griffiths, 2006: 357), then it makes sense to include people's jobs as crucial for well-being, much like the OECD (2018) and other authors do.

[6] Up until 2019 all regions operated under a converging (by and large, the same) legal, funding, export and competition policy framework. In 2020, the spread of the COVID-19 pandemic and the diverse responses of the member-states are bound to upset this pattern. In addition, from 2020 on, the forty-one regions forming the United Kingdom of Great Britain and Northern Ireland (UK) are expected to follow a separate path following the UK's withdrawal from the EU.

The rest of the chapter is organized as follows: Section 2 discusses the data. Section 3 describes the method used to prepare the indices. Section 4 provides the findings, and Section 5 supplies the conclusions.

2. THE DATA

The EU regional data employed hereinafter are published by Eurostat. The figures are collected and compiled regularly,[7] and measured in the same manner across all regions. Consequently, they are easy to compare and, indeed, are often used to guide policy decisions.[8] Most of the data used in the construction of the PWD Index run up to 2019, while some run up to 2018 (in three cases) or 2017 (in two cases). See Table 1. Apparently, it takes three years or more for some figures to be released. All series are quite complete, except for the R&D spending figures which date to 2017 and are available for 84% of all EU regions. The data provided are subject to revision. Some of those missing may be pending, while the rest may not be reported at all due to confidentiality concerns. For instance, they may involve very few, easy to identify, enterprises.

Additional aspects about labor productivity and the average business size in each sector (both of which are associated with crucial aspects about the structure and operation of businesses in every region) are considered on the basis of data dating to 2016 and 2017, respectively.[9] See Table 2. It draws attention to ten regional labor productivity indices (one for each sector) and twelve regional business size indices (one for each subsector of the secondary and tertiary sectors on which business statistics are usually collected). Most are quite complete, except for the productivity figures in real estate, which are available for 64% of all EU regions, and for the business size figures in the energy sector and the water provision and related activities sector, which are available for 83-84% of all regions.

3. THE METHOD

The Eurostat statistics are shaped into indices (modified into scores) based on an OECD (2018) approach that is also used by several analysts (e.g., Economou,

[7] A number of data that were or are solicited occasionally are not included in the Index.

[8] For instance, the GDP figures are used as criteria in the allocation of development and cohesion EU policy funding.

[9] A good number of other useful business statistics are not provided at the regional level.

Table 1: Index composition based on the most recent available data

	Variable (index)	Year	Observations	Description
WELL-BEING	1. Disposable income	2017	280 [a]	Net disposable income, purchasing power standard per inhabitant
	2. Jobs	2019	281	Employment (among people aged 15-64 years old (%),
		2019	279 [b]	Unemployment (among people aged 15-64 years old (%),
	3. People's education	2019	280 [c]	Population aged 25-64 years old with tertiary level education (%)
	4. Life expectancy	2018	278 [d]	Life expectancy of pop. < 1 year old
PRODUCTION	1. Distribution of employed people			Employment in each sector over the sum of all employed in each sector (%)
	a. Primary sector (agriculture-forestry-fishing)	2019	281	
	b. Secondary sector excluding construction	2019	281	
	c. Construction	2019	281	
	d. Trade, transport, accommodation etc.	2019	281	
	e. Information, communication	2019	281	
	f. Financial and insurance activities	2019	281	
	g. Real estate activities	2019	281	
	h. Professional-scientific-support services etc.	2019	281	
	i. Public administration, defense, education, health etc.	2019	281	
	j. Arts-entertainment-recreation, other services	2019	281	
	2. Specialization of those employed	2019	281	Coef. of specialization on the basis of sectoral employment (Schooler, 1960)
	3. Labor productivity	2018	281	Gross value added at basic prices over the sum of employed people (all sectors)
	4. Worker education	2019	281	Persons employed with upper secondary educ. or higher out of all employed (%)
DEVELOPEMENT PROSPECTS	1. Market size	2019	280 [e]	Population
	2. Demographic composition	2019	280 [e]	Pop. aged 15-29 years, Pop. aged 65 yrs. or over (among total population (%)
	3. R&D spending	2017	237 [f]	Intramural R&D expenditure in all sectors
	4. GDP per capita	2018	281	Euro per inhabitant
	5. Rate of change in per capital GDP	(based on the above)		Euro per inhabitant (annual % change)

Notes:
[a] Missing: Malta.
[b] Missing two regions: one from Finland, one from the UK.
[c] Missing one overseas region of France.
[d] Missing three overseas regions of France.
[e] Missing one region of the UK.
[f] Missing 44 regions: the 27 of France, the ten of Belgium, the three of the Rep. of Ireland, two from Sweden, and the two autonomous cities of Spain.

Source: Eurostat (May 2020), own calculations.

Table 2: Additional aspects regarding production

	Variable (index)	Year	Observations		
LABOR PRODUCTIVITY PER SECTOR	a. Primary sector (agriculture-forestry-fishing)	2016	256[a]	281	DISTRIBUTION OF EMPLOYED PEOPLE
	b. Secondary sector excluding construction	2016	277[b]	281	
	c. Construction	2016	279[c]	281	
	d. Trade, transportation, storage, accommodation, food service activities etc.	2016	269[d]	281	
	e. Information, communication	2016	250[e]	281	
	f. Financial and insurance activities	2016	264[f]	281	
	g. Real estate activities	2016	181[g]	281	
	h. Professional-scientific-support services etc.	2016	279[c]	281	
	i. Public admin., defense, educ., health etc.	2016	281	281	
	j. Arts-entertainment-recreation, other services	2016	279[c]	281	
BUSINESS SIZE IN TERMS OF EMPLOYED PEOPLE	a. Primary sector (N/A)				
	b. Mining and quarrying	2017	251[h]		
	Manufacturing	2017	272[i]		
	Electricity, gas, steam, air conditioning supply	2017	233[j]		
	Water supply, sewerage, waste management, remediation activities	2017	238[k]		
	c. Construction	2017	278[l]		
	d. Trade (wholesale and retail), repair of motor vehicles and motorcycles	2017	278[l]		
	Transportation, storage	2017	279[m]		
	Accommodation, food service activities	2017	278[n]		
	e. Information, communication	2017	277[o]		
	f. Financial and insurance activities (N/A)				
	g. Real estate activities	2017	280[p]		
	h. Professional-scientific-technical activities	2017	278[n]		
	Administrative-support service activities	2017	278[q]		
	i. Public adm., comp. soc. sec., defense, education, health, social work (N/A)				
	j. Arts-entertainment-recreation, other services (N/A)				

Notes:

Sectoral labor productivity definition as in overall labor productivity (see Table 1).

[a] Missing 25 regions: thirteen from the UK, four from Germany, two from Belgium, two overseas regions of France, the two autonomous cities of Spain, one from (each) Finland, Hungary.

[b] Missing four regions: the two autonomous cities of Spain, one from Finland, one oversea regions of France.

[c] Missing two regions: one from Finland, one overseas region of France.

[d] Missing twelve regions: six from Hungary, five from Bulgaria, one from Romania.

[e] Missing 31 regions: nine from Greece, four from (each) Poland, Portugal, three overseas regions of France, three from the UK, two from Italy, the two autonomous cities of Spain, one from (each) Austria, Finland, Germany, Romania.

[f] Missing seventeen regions: four from Greece, three from (each) Portugal and the UK, three overseas regions of France, the two autonomous cities of Spain, one from (each) Finland, Italy.

[g] Missing 100 regions: 22 from Germany, twelve from Greece, nine from the UK, eight form (each) Italy, Romania, seven from Hungary, five from (each) Bulgaria, Spain, Poland, four from (each) Austria, Portugal, four overseas regions of France, three from Belgium, one from (each) Denmark, Finland, Netherlands, the Rep. of Ireland.

[h] Missing 30 regions: nine from France, six from Poland, five from (each) Austria, Germany, three from Spain, two from Finland.

[i] Missing nine regions: four from Germany, three from France, two from Greece.

[j] Missing 48 regions: 34 from Germany, eight from France, two from (each) Denmark, Spain, one from (each) Malta, the Netherlands.

[k] Missing 43 regions: 34 from Germany (the same as above), five from France, two from Finland, one from (each) Malta, the Netherlands.

[l] Missing three regions from France.

[m] Missing two regions from France.

[n] Missing three regions from France.

[o] Missing four regions: three from France, one from the Netherlands.

[p] Missing an overseas region of France.

[q] Missing three regions: two from France, one from Greece.

Source: Eurostat (May 2020), own calculations

2018; Herrero-Prieto, 2019; Parente, 2019; Pinar, 2019). Indeed, the twenty-two constituent elements (indices) and scores of the regional PWD Index are provided in a decomposed form in Figure 1, in order to allow useful comparisons vis-à-vis the other EU regions. Likewise, the elements and scores regarding the additional aspects are provided in Figures 2 and 3.

Since the Index's components are expressed in different units (euro, percentages, years etc.), they are rendered comparable via a Min-Max normalization procedure on the zero-to-ten scale. It goes as follows: Regions, *i*, with extreme values (outliers) below the 4th percentile and above the 96th percentile, are assigned scores of zero and ten, respectively; and all other regions are assigned a score $\hat{x}_i$ or $\check{x}_i$:

$$\hat{x}_i = \frac{x_i - \min(x)}{\max(x) - \min(x)} \times 10 \qquad (1)$$

$$\hat{x}_i = \frac{\max(x) - x_i}{\max(x) - \min(x)} \times 10 \qquad (2)$$

when higher or lower values, respectively, relate increased production, welfare or development prospects.

If a component (index) is based on two measures (e.g., the index regarding *Jobs* is based on both the employment and unemployment rates) the score is computed from the arithmetic mean of the normalized values of the two measures. Last but not least, in the case of the *Specialization of those employed,* the score is estimated via the Min-Max normalization of the regional coefficient of specialization (Schooler, 1960), i.e., the sum of positive sectoral $S_{k,i}$s:

$$S_{k,i} = \frac{\textit{Number of empl. people in sector k, country i}}{\textit{Number of empl. people in sector k across the EU}} - \frac{\textit{Number of empl. people in country i}}{\textit{Number of empl. people in the EU}} \qquad (3)$$

Figure 1: The Production, Well-being and Development prospects Index

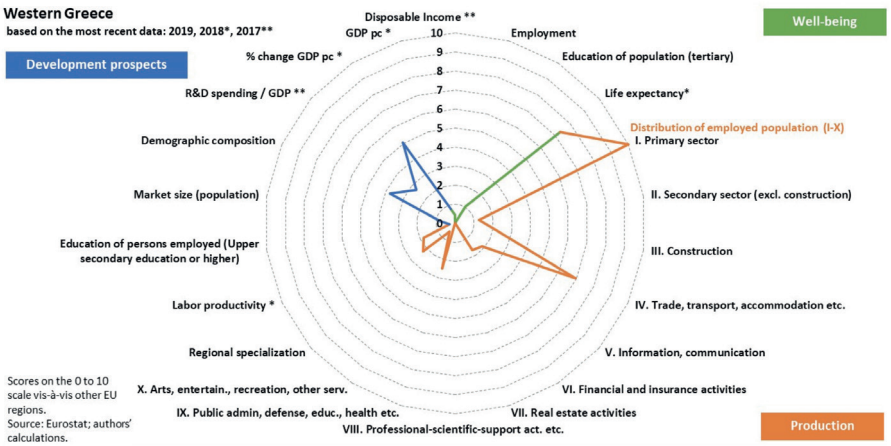
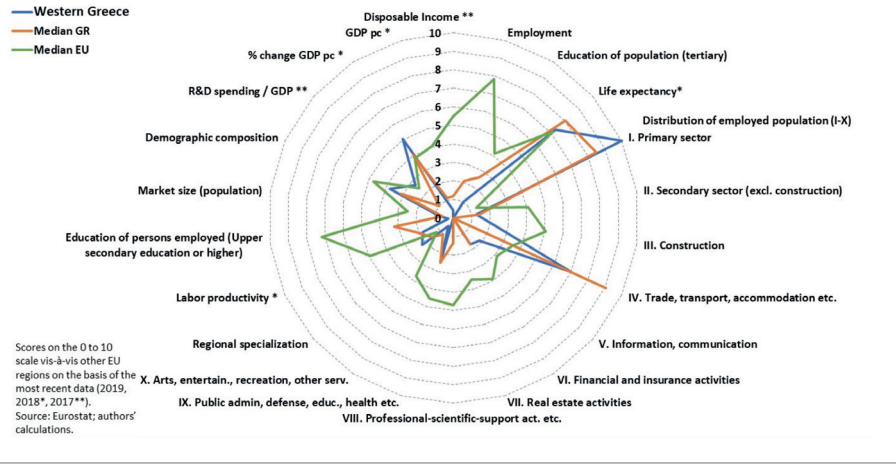


Figure 2: The Production, Well-being and Development prospects Index



4. THE REGION'S PERFORMANCE

According to Table 3 and Figures 1-2, Western Greece features:

- An exceptionally high allocation of people employed in the primary sector, a high allocation of people employed in the trade-transport-storage-accommo-

Table 3: Western Greece compared to the median Greek and median EU region based on the most recent available PWD scores, and the top EU region in each case

Elements (indices)	Western Greece	Median GR	Median EU	The top EU region
Well-being				
1. Disposable income (2017)	0.44 (264th)	1.17	5.47	Innert London-West (UK)
2. Access to jobs (2019)	0.00 (274th)	2.07	7.82	Åland Islands (FI), Praha encircled by Střední Čechy (CZ)
3. People's education (2019)	1.03 (250th)	2.63	4.15	Inner London – West (UK)
4. Life expectancy (2019)	7.29 (127th-133rd)	8.00	7.12	Madrid (ES)
Production				
1. Distribution of employed people (2019)				
a. Primary sector	10.00 (3rd)	8.50	1.37	Nord-Est (RO)
b. Secondary sector excluding construction	1.26 (250th)	1.43	4.08	Vest (RO)
c. Construction	2.09 (243rd)	0.00	5.04	Severoiztochen (BG)
d. Trade, transport, accommodation etc.	6.96 (36th)	9.09	3.55	South Aegean Islands (GR)
e. Information, communication	1.86 (221st)	0.00	3.11	Stockholm (SE)
f. Financial and insurance activities	1.68 (255th)	1.68	3.92	Inner London – West (UK)
g. Real estate activities	0.00 (180th-281st)	0.00	3.47	Algarve (PT)
h. Profession.-scient.-tech., admin. -support.	0.00 (276th)	1.37	4.71	Inner London – West (UK)
i. Public adm.-defense, educ.-health etc.	2.46 (214th)	2.51	4.54	Mayotte (FR)
j. Arts-entertainment-recreation, etc.	0.52 (258th)	1.05	3.74	Brussels (BE)
2. Specialization of those employed (2019)	2.23 (95th)	1.58	1.18	Île de France (FR)
3. Labor productivity (2018)	1.80 (223rd)	1.96	4.91	Inner London – West (UK)
4. Workers education (2019)	0.28 (268th)	3.24	7.18	Praha (CZ)
Development prospects				
1. Market size (2019)	0.79 (230th)	0.61	2.50	Île de France (FR)
2. Demographic composition (2019)	3.77 (188th)	3.13	4.73	Inner London – East (UK) Mayotte (FR)
3. R&D spending (2017)	2.68 (110th)	1.02	2.45	Braunschweig (DE)
4. GDP per capita (2018)	0.79 (244th)	1.12	4.05	Inner London – West (UK)
5. Rate of change in per capita GDP (2018)	5.06 (81st)	4.05	3.84	Severozapaden (BG)

Source: Eurostat (May 2020), own calculations.

dation-food service sector,[10] very low allocations of people employed in four sectors (namely, financial-insurance, real estate, professional-scientific-technical-administrative-support services, arts-entertainment-recreation-other services), low allocations of people employed in the other sectors, and for that is considered rather specialized.

- A very low ranking in terms of educated workers, a low ranking in terms of possessing a highly educated population, and a low ranking in terms of labor productivity.
- A modest-to-high life expectancy,[10] a modest-to-unfavorable demographic composition, and very low rank in terms of disposable income and jobs.
- Modest-to-high R&D spending, and a rather high per capita GDP rate ─commencing, though, from a rather low level of per capita GDP.

By contrast, the champion:

- In labor productivity is Inner London - West, also featuring the highest population share of educated residents, the highest workforce-share in financial-insurance activities and professional-scientific-technical-and-administrative-support services, and the highest GDP per capita and disposable income.
- In terms of demographics is Inner London - East (on account of its high share of people aged 15-29 years old), and the French region of Mayotte in the south Indian ocean (on account of its low share of people aged 65 years of older), also featuring the highest workforce share in public administration-defense-compulsory social security, education, health-social work.
- In labor specialization is the Île de France (where Paris is located), featuring also the largest population.
- In workers education and low unemployment is Praha.
- In high employment is Åland.
- In R&D spending is the city of Braunschweig.
- In life expectancy is Madrid.
- In terms of workforce share involved in primary sector activities is North-East Romania, in construction is North-East Bulgaria, in other secondary sector activities is West Romania, in trade-transport-storage-accommodation-food service activities is the South Aegean, in real estate activities is Algarve, in information-communication is Stockholm, in arts-entertainment-recreation, hosting extraterritorial organizations and bodies, and in other service activities is Brussels.

The sum of the absolute differences in the scores of the production elements, i.e,, the so-called *Manhattan distance* (OECD, 2018), reveals a number of regions with pro-

[10] Though below the regional median in Greece.

Table 4: Western Greece's similarity to other EU regions in terms of the PWD elements

	Similar regions in terms of the production indices (Manhattan distance in descending order)	The well-being scores of the four indices are				The development prospect scores of the five indices are				
		(Higher (+) or lower (−) than or equal (=) to W. Greece)								
		1	2	3	4	1	2	3	4	5
1	East Macedonia & West Thrace (GR)	+	+	+	−	−	−	−	−	−
2	Thessaly (GR)	+	+	+	+	+	−	−	+	−
3	Crete (GR)	+	+	+	+	−	+	+	+	−
4	East & South Peloponnese (GR)	+	+	+	+	−	−	−	+	−
5	Central Greece (GR)	+	+	+	+	−	−	−	+	−
6	West Macedonia (GR)	+	=	+	+	−	−	−	+	−
7	Central Macedonia (GR)	+	+	+	+	+	−	−	+	−
8	Extremadura (ES)	+	+	−	+	+	+	−	+	−
9	Alentejo (PT)	+	+	−	−	+	−	−	+	−
10	Epiros (GR)	+	+	+	+	−	−	+	−	−
11	North Aegean Islands (GR)	+	+	+	+	−	+	−	−	−
12	Calabria (IT)	+	=	+	+	+	+	−	+	−
14	Murcia (ES)	+	+	−	+	+	+	−	+	−
15	Centro (PT)	+	+	−	+	+	−	=	+	+
16	Severozapaden (BG)	=	+	+	−	+	−	−	−	+
17	Ionian Islands (GR)	+	+	+	−	−	−	−	+	−
18	Podlaskie (PL)	+	+	+	−	+	+	−	−	+
19	South Aegean Islands (GR)	+	+	+	+	−	+	−	+	−
20	Madeira (PT)	+	+	−	−	−	+	−	+	−
21	Açores (PT)	+	+	−	−	−	+	−	+	+
22	Dél-Alföld (HU)	+	+	+	−	+	+	−	−	+
23	Yuzhen tsentralen (BG)	=	+	+	−	+	−	−	−	+
24	Sicilia (IT)	+	=	+	+	+	+	−	+	−
25	Swietokrzyskie (PL)	+	+	+	−	+	+	−	−	+
26	Sud-Vest Oltenia (RO)	−	+	+	−	+	+	−	−	+
27	Molise (IT)	+	+	+	+	−	−	−	+	−
28	Puglia (IT)	+	+	+	+	+	−	−	+	−
29	Nord-Est (RO)	−	+	+	−	+	+	−	−	+
30	Vest (RO)	+	+	+	−	+	+	−	−	+
31	Sardegna (IT)	+	+	+	+	+	−	−	+	−

Source: Eurostat (May 2020), own calculations.

Table 5: Western Greece compared to the median Greek and median EU region based on the scores regarding the additional aspects of production

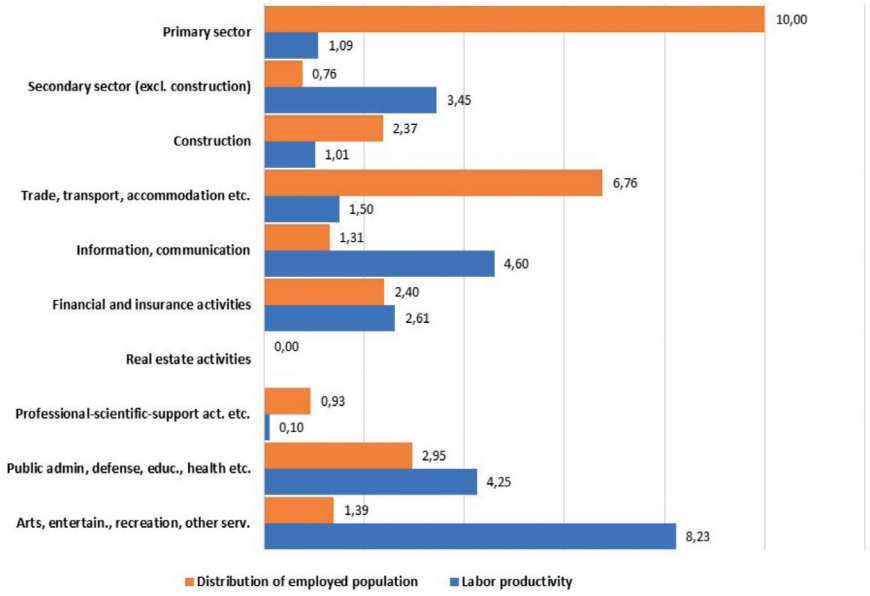
Elements (indices)	Western Greece	Median GR	Median EU
Labor productivity (2016)			
Primary sector	1.09 (211th)	0.98	3.24
Secondary sector excluding construction	3.45 (166th)	2.44	4.05
Construction	1.01 (245th)	1.59	4.92
Trade, transportation, accommodation etc.	1.50 (229th)	1.50	4.13
Information, communication	4.60 (75th)	3.31	3.21
Financial and insurance activities	2.61 (165th)	2.61	3.24
Real estate activities	NA	NA	2.85
Professional-scientific-support activities. etc.	0.10 (263rd)	0.40	3.79
Public administration, defense, education, health etc.	4.25 (203rd)	4.25	6.28
Arts-entertainment-recreation, other services	8.23 (34th)	5.67	5.10
Business size in terms of employed people (2017)			
Mining, quarrying	NA	0.01	1.11
Manufacturing	0.00 (217th)	0.07	2.79
Electricity, gas, steam, air conditioning supply	0.25 (207th)	0.29	1.79
Water supply, sewerage, waste management, remediation	0.37 (219th)	0.61	1.83
Construction	0.00 (272nd)	0.00	2.88
Trade (wholesale and retail), repair of motor vehicles etc.	0.00 (273rd)	0.00	2.64
Transportation, storage	0.00 (275th)	0.00	2.85
Accommodation, food service activities	0.55 (242nd)	0.68	2.60
Information, communication	0.56 (243rd)	0.60	2.97
Real estate activities	0.66 (232nd)	1.27	2.14
Professional, scientific, technical activities	0.55 (242nd)	0.55	1.94
Administrative and support service activities	0.05 (263rd)	0.09	3.41

Source: Eurostat (May 2020), own calculations.

duction profiles similar to that of Western Greece (see Table 4, the columns under the items 1, 2, etc. pertain to the respective well-being and development prospect indices):

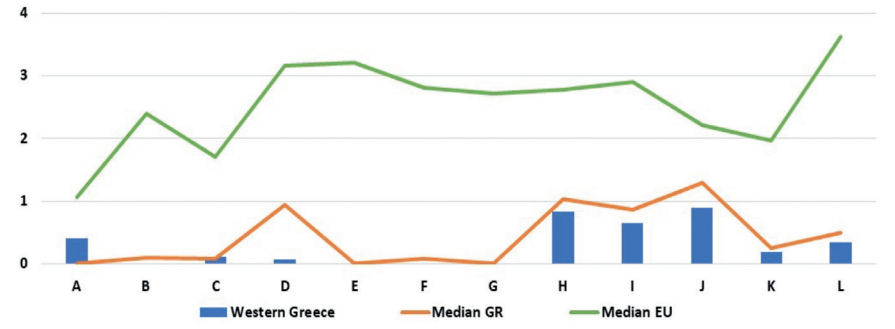
- Four of which, namely, Crete (in Greece), Calabria, Sicily (in Italy), Centro (in Portugal), are generally either on a par with or outperform Western Greece in nearly all well-being and development prospect dimensions. (The other regions feature fewer fields in which they perform better than or similar to Western Greece, marked with "+" and "=", respectively.)

Figure 3: Sectoral labor distribution and productivity in Western Greece, 2016



Source: Eurostat; authors' calculations.

Figure 4: Average business size in terms of staff numbers in Western Greece, Greece and the EU, 2017



Source: Eurostat; authors' calculations.

- Three of which, namely Dél-Alföld (in Hungary), Sardenia (in Italy), Murcia (in Spain), are among the more developed EU regions (in terms of GDP per capita) which outperform Western Greece in several well-being and development prospect dimensions as well.

Insofar as in several aspects they achieve more than Western Greece with quite similar production features as Western Greece, they may provide useful models that Western Greece policy makers and entrepreneurs may want to think about and emulate.

Turning to the additional aspects regarding the structure and operation of businesses which are based on the 2016-17 data (Table 5, Figures 3-4), reveals that Western Greece exhibited:

- Low levels of labor productivity in the primary sector (a sector that attracts a disproportionate large number of workers compared to other regions), in construction and in professional-scientific-technical-administrative-support services.
- High levels of labor productivity in arts-entertainment-recreation-other services, and modest-to-high levels of labor productivity in information-communication, both of which attract relatively few workers. So, it would seem that some rebalancing or shift in the sectoral orientation of the workforce from the low to the high productivity sectors ought to be considered.
- Reliance on much smaller business units (smaller in terms of staff numbers) compared to the other EU regions, especially in construction, in wholesale and retail trade and the repair of motor vehicles and motorcycles, in transportation-storage, and in administrative-support service activities.

5. CONCLUSIONS

Western Greece is a less developed region of the EU. As a geographically and functionally divided land, it ought to benefit from attempts likely to reduce fragmentation (such as road-, rail-, bridge-, toll-, pro e-commerce- and telework- projects), so that production and transportation may be facilitated, costs reduced, and public spending and other interventions reach more people and places.

The region's production model ought to be reviewed. Labor productivity in the primary sector, where a considerable number of people are involved, ought to improve (whether by introducing new capital, technology and techniques, improving human capital, and/or by moving up the value chain) so that output and wealth in the region may increase. And in the other end of the economy (the highly productive arts-entertainment-recreation and information-communication sectors) the number of workers ought to increase, so that more people may produce more

output and generate wealth. This may be achieved by attracting people working in other sectors and/or by attracting non-participants. Perhaps the same ought to take place in the relatively understaffed sectors (e.g., the real estate and professional-scientific-technical-administrative-support services) so that the regional economy may turn to their expertise, and function better.

Simplifying the process of commencing and conducting a business, improving the entrepreneurial ecosystem, facilitating the creation and use of digital and other job-matching services, in all likelihood will accommodate this agenda. The educational level of both workers and of the broader public ought to be brought up, towards the EU average, to ensure the region's competitiveness. The exposure of workers to business-related training, whether in person or long distance, may be easy to carry out and serve as a substitute to some extent.

The analysis shows that Western Greece has to cover considerable distance in several areas. It also identifies a number of EU regions with similar production features that generally outperform Western Greece in well-being and development prospects. These regions may provide useful models that policy makers and entrepreneurs in Western Greece may want to think about and emulate. To the extent the relative position of Western Greece in a good number of areas with respect to the other EU regions has been mapped, it is easy and useful to monitor the progress, and evaluate the performance on an annual basis.

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CHAPTER 2

COMPARATIVE ANALYSIS AND EVALUATION OF THE COMPETITIVENESS OF THE REGIONS OF APULIA AND WESTERN GREECE

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ABSTRACT | The European Commission publishes every three years the Regional Competitiveness Index (RCI). On October 7th, 2019 the last (4th) edition was published. This chapter takes into consideration all 4 editions of the RCI, namely, the 2010, 2013, 2016 and, 2019 editions with the purpose to present the evolution of the competitiveness of the two regions of this project, specifically, the regions of Apulia (Puglia), Italy and Western Greece (Dytiki Ellada), Greece. Particular attention is given to the components of competitiveness as they are described in the editions of RCI. The goal of the chapter is to identify aspects of competitiveness that the two regions need to improve in order to boost their overall competitiveness and, as a result, the wellbeing of their citizens.

1. INTRODUCTION

The concept of competitiveness beyond the strict microeconomic level (*i.e.:* firm and industry level) is haunted by Krugman's aphorism "*competitiveness is a meaningless word when applied to national economies. And the obsession with competitiveness is both wrong and dangerous.*" (1994, p: 44). At the time the discussion was mostly on the national level, but we can presume that Krugman's criticism includes the regional level which is closer to the national than the firm level. The above criticism from such a renowned economist led to more elaborated and refined definitions of the concept of competitiveness at both the national and regional levels.

The European Commission (EC) defines competitiveness in terms of productivity, high standards of living and high employment rates (European Commission, 1998). More recently, the EC has characterized competitiveness as a "*key determinant of growth and jobs in Europe*" and it refers explicitly to a variety of factors, such as a) access to markets and resources (*e.g.*: finance, energy, raw materials,

skilled labour), b) quality and efficiency of public administration as well as good infrastructure and, c) innovation and sustainable production (EC, 2018).

After many years of well-established literature on competitiveness and productivity the EC realized that an index of regional competitiveness was necessary to address socioeconomic issues at the regional level. It was understood that national level competitiveness could not offer the so much needed fine-tuned information to policy makers at the regional level. In 2010, the EC introduced the new Regional Competitiveness Index (RCI) which is the only inclusive measure for regional competitiveness in the EU.

In the following sections the chapter discusses the theory, the method and the data for the construction of the RCI, presents the results of the four editions of the index (2010, 2013, 2016 and 2019) while focusing on the regions of Western Greece, Greece, and Apulia, Italy. For the rest of this chapter the names Dytiki Ellada and Puglia are used following the NUTS2 appellations. The goal is to use the index to compare the two regions both between each other and with the other regions in each country, namely, Greece and Italy, respectively. By doing so the chapter concludes with specific policy measures and reforms that may help the two regions improve their competitiveness and, consequently, productivity, citizen wellbeing and standards of living.

2. CONCEPTUAL FRAMEWORK

The relation between competitiveness, productivity and wellbeing has long been established in the literature (Chymis, 2019). According to the World Economic Forum, national competitiveness is the "*set of institutions, policies and factors that determine the level of productivity of a country*" (WEF, 2015, p.4). In the 2018 edition of *the Global Competitiveness Report*, the WEF provides some empirical evidence of the relation between competitiveness and productivity (WEF, 2018, p.43-45, Box 3).

While firm-level competitiveness is uncontested, the concept of national or even regional competitiveness has attracted some criticism, the most famous by Krugman (1994) mentioned above. However, the concept of competitiveness is very important for nations and regions. As Meyer-Stamer argue: "*We can define (systemic) competitiveness of a territory as the ability of a location or region to generate high and rising incomes and improve livelihoods of the people living there.*" (Meyer-Stamer 2008, p.7 as quoted in Annoni & Kozovska, 2010, p.2). Moreover, regional (and national) competitiveness is not a zero-sum game as is often argued for the firm-level competitiveness (Krugman, 1996) but it can be a positive sum game (Martin et. al., 2006).

Dijkstra, et al. (2011) have proposed the following definition for regional competitiveness: "*Regional competitiveness is the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work.*" This is the definition RCI authors follow. It is a definition that combines and integrates the perspective of firms and residents. This is very important given the problem of out-migration many less-developed European regions face, particularly Greek regions.

Regions with relatively high RCI (i.e., more competitive regions feature positive net migration while regions with very low competitiveness feature negative net migration (Annoni et al., 2017). People simply leave less competitive (and less prosperous) regions and move to more competitive (more prosperous) regions. In the case of Greece, during the crisis, hundreds of thousands of Greeks migrated to more competitive and prosperous European countries. This is very important because, historically, Greek regions suffer from out-migration to the capital region, Attiki. The phenomenon can be explained by the large difference in competitiveness and prosperity between the capital region and the rest of the Greek regions since 1950s.

The relation between competitiveness and prosperity requires the presentation of the relative per capita GDP of the regions under consideration. Tables 1 and 2 show the evolution of the purchasing power parity (PPP) adjusted relative GDP per capita of Greek (Table 1) and Italian (Table 2) regions, expressed as a percentage of

Table 1: GDP per capita PPS[1] (% of the EU average -100) of the 13 Greek regions.

		2009	2011	2014	2016	2017	2018*
	Greece	94	80	72	68	67	69
EL30	Attiki	124	107	99	92	91	93
EL41	Voreio Aigaio	76	63	57	50	48	47
EL42	Notio Aigaio	114	89	80	73	72	74
EL43	Kriti	85	69	63	57	57	59
EL51	Anatoliki Makedonia-Thraki	70	57	50	46	46	48
EL52	Kentriki Makedonia	76	62	56	53	53	54
EL53	Ditiki Makedonia	86	80	66	59	59	59
EL54	Ireiros	65	55	51	48	48	49
EL61	Thessalia	72	56	55	52	52	53
EL62	Ionia Nisia	81	75	67	62	62	63
EL63	**Dytiki Ellada**	**66**	**59**	**54**	**49**	**49**	**50**
EL65	Peloponnisos	76	65	58	55	56	57
EL64	Sterea Ellada	87	72	61	60	62	63

Source: Eurostat, different years.

* Eurostat does not include the UK regions in the calculation for 2018 (produced in 2020, when the UK withdrew from the EU).

[1.] The Purchasing Power Standard is used by Eurostat and is calculated by dividing the GDP in current prices and national currency by the respective Purchasing Power Parity (PPP).

Table 2: GDP per capita PPS (% of the EU average -100) of the 21 Italian regions.

		2009	2011	2014	2016	2017	2018*
	Italy	104	102	96	97	96	97
ITC1	Piemonte	111	110	100	103	102	104
ITC2	Valle d'Aosta	133	132	133	122	119	128
ITC3	Liguria	111	106	104	108	107	106
ITC4	Lombardia	133	132	126	128	128	128
ITH1	Prov. Autonoma di Bolzano	148	147	144	149	143	156
ITH2	Prov. Autonoma di Trento	125	122	123	122	122	126
ITH3	Veneto	120	118	108	111	112	110
ITH4	Friuli-Venezia Giulia	116	116	101	106	104	103
ITH5	Emilia-Romana	127	125	117	121	119	120
ITI1	Toscana	114	110	104	105	103	104
ITI2	Umbria	96	93	87	84	83	84
ITI3	Marche	105	102	92	93	91	94
ITI4	Lazio	121	117	114	110	111	111
ITF1	Abruzzo	86	87	84	84	83	85
ITF2	Molise	84	78	75	70	67	69
ITF3	Campania	67	63	61	64	62	61
ITF4	**Puglia**	**69**	**67**	**63**	**62**	**62**	**63**
ITF5	Basilicata	75	71	69	72	71	74
ITF6	Calabria	68	64	59	59	58	56
ITG1	Sicilia	68	65	62	60	59	59
ITG2	Sardegna	80	77	72	71	69	70

Source: Eurostat, different years.
* Eurostat does not include the UK regions in the calculation for 2018, as it is produced in 2020 when the UK has left the EU.

the European Union (EU) average. The effects of the economic crisis are evident in the case of Greece. Most of the regions suffer an initial severe deterioration of the relative GDP per capita due to the economic crisis. However, while some regions, mostly Italian, stabilize or even start to move upwards after 2014, quite a few (mostly Greek) continue the downward trend. 2018 is the last year with available data. It should be noted that the EU average is calculated based on all EU regions (268). From 2018 on the United Kingdom is excluded from the calculations (Eurostat, 2020). Given that the UK's relatively prosperous regions were slightly above the EU average (100%), the new EU average (100%) in 2018 is slightly underestimated compared to previous years. This means that part of the increase of the relative GDP per capita of the Greek and Italian regions is due to the exclusion of the UK regions.

The ranking of the Greek regions follows the numeric order of the code name

of each region. The ranking of the Italian regions follows the order of a previous numeric code name. The reason is that the previous codes which were assigned followed the north-south pattern of Italy and the differences between the two halves are evident in Table 2. Puglia as well as Dytiki Ellada are among the poorest regions in Italy and Greece respectively. Puglia is almost constantly at the 18th place among 21 regions in Italy in terms of GDP per capita. In a similar pattern Dytiki Ellada stands usually at the 12th place just above Ipeiros, the poorest Greek region. It should be noted here that this picture of the less developed Greek regions (that is, all regions but the capital region) as well as Italy's south persists despite the continuous and significant EU aid and support during the past decades.

3. METHOD AND DATA

The RCI was introduced in 2010 as the major regional competitiveness measure of the EU (Annoni & Kozovska, 2010). It is published every three years. Methodologically it is based on the Global Competitiveness Index (GCI) published every year by the WEF. It uses eleven (11) out of twelve (12) pillars of the GCI, namely, Institutions, Infrastructure, Macroeconomic stability, Health, Basic education, Higher education and lifelong learning, Labour market efficiency, Market size, Technological readiness, Business sophistication, and Innovation. These eleven pillars are categorized in three sub-indexes measuring three dimensions: Basic dimension, Efficiency dimension and, Innovation dimension. Basic includes the first five pillars, namely, Institutions, Infrastructure, Macroeconomic stability, Health, and Basic education. Efficiency includes the next three, that is, Higher education and lifelong learning, Labour market efficiency, and Market size, while Innovation includes the last three, namely Technological readiness, Business sophistication, and Innovation (Annoni & Dijkstra, 2010; 2019).

RCI also follows GCI in the way it ascribes weighs on the pillars based on the level of development of each region. The level of development is measured by the GDP per capita and had initially three stages, High, if the region's GDP is above the EU average (i.e.: 100%), Intermediate, if it is between 75% and 100%, and Medium if it is less than 75%. RCI editions of 2016 and 2019 increased the number of development stages from three to five: Stage 1: <50%, Stage 2: 50%-75%, Stage 3: 75%-90%, Stage 4: 90%-110%, and Stage 5: >110% for a more nuanced analysis. Based on the stage of development, RCI weighs differently the three sub-indexes to calculate the final index, the RCI. The general rule is that the more developed a region is, the more weight is put on Innovation dimension (stage 1 gets 0.15 while stage 5 gets 0.30) and, respectively, less weight on the Basic dimension (stage 1 gets 0.35 while

stage 5 gets 0.20). The efficiency dimension is not affected and always receives a weight of 0.5. Regions can switch stages of development, between different RCI editions, based on the change of their relative GDP. For example, Notio Aigaio has moved from stage 5 (high) in the 2010 edition to stage 2 in the 2019 edition. Western Greece and Puglia have remained to the same stage 2 in all RCI editions, although Western Greece is very close to shift to stage 1. It should be noted that in 2019 the GCI modified its method abolishing the weighting based on the development stage.

Each of the eleven pillars is measured by a series of indicators. It is true that some of these indicators are by their nature measured at the national level. In some cases, the whole pillar is measured at the national level, such as in Macroeconomic stability and Basic education which cannot vary significantly (if at all) at a subnational level. Moreover, some other pillars such as Institutions and Technological readiness are not measured in the NUTS2 level in some countries. For example, in the case of Greece and some other countries these two pillars are measured at the NUTS1 level. Consequently, the same score is applied for a group of regions, thus, information for specific regions is missing.

The total number of indicators in the eleven pillars is around 74. Every year there are some improvements in terms of either the inclusion of indicators not available in earlier editions, or the substitution of indicators that are proved to be not a good fit for the specific regional characteristic the RCI tries to measure. Even though it takes place in limited number, the constant change of indicators puts a difficulty in directly comparing all RCI editions. The reason is that sometimes the significant change in the score of some pillars is due to the use of different indicators rather than a real change in the characteristics of the regions. In the following sections there will be a short reference to the specific indicators of the pillars. For more information on these indicators and, generally, on the method and data the RCI uses, as well as its shortcomings, the reader can go to the RCI webpage. Note that data of each RCI edition refer to 2-3 years earlier. UK regions are included in all four RCI indexes.

4. COMPETITIVENESS OF DYTIKI ELLADA AND PUGLIA

4.1 Overall competitiveness

In this section the general RCI score and ranking as well as each pillar score and ranking are presented for the regions of Greece and Italy in order to be able to put in perspective the regions of Dytiki Ellada and Puglia. Tables 3 and 4 present the general index (score and rank) of every region in Greece (Table 3) and Italy (Table 4) according to the four RCI editions (2010, 2013, 2016, 2019). The total number of regions is 268 in 2010, 262 in 2013, 263 in 2016 and 268 in 2019 due to break-

Table 3: RCI scores and ranking of the Greek regions

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score	2019 rank
Gr30	Attiki	-0.152	154	-0.366	174	-0.564	193	-0.40	180
Gr41	Voreio Aigaio	-1.511	266	-1.264	243	-1.296	249	-1.61	268
Gr42	Notio Aigaio	-1.376	260	-1.376	257	-1.253	244	-1.39	259
Gr43	Kriti	-1.135	242	-1.201	240	-1.317	250	-1.26	250
Gr51	Anatoliki Makedonia-Thraki	-1.178	247	-1.371	256	-1.490	261	-1.45	265
Gr52	Kentriki Makedonia	-0.783	224	-1.114	238	-1.179	242	-1.06	239
Gr53	Dytiki Makedonia	-1.233	252	-1.403	258	-1.327	252	-1.44	263
Gr54	Ipeiros	-1.311	258	-1.265	244	-1.289	248	-1.29	251
Gr61	Thessalia	-1.026	238	-1.275	245	-1.284	247	-1.31	252
Gr62	Ionia Nisia	-1.465	263	-1.309	249	-1.364	256	-1.33	256
Gr63	**Dytiki Ellada**	**-1.103**	**240**	**-1.317**	**250**	**-1.410**	**257**	**-1.43**	**262**
Gr64	Sterea Ellada	-1.115	241	-1.417	260	-1.446	258	-1.32	254
Gr65	Peloponnisos	-1.172	245	-1.337	253	-1.443	258	-1.37	258

Source: RCI 2010, 2013, 2016, 2019.

Table 4: RCI scores and rankings of the Italian regions

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score	2019 rank
Itc1	Piemonte	-0.084	149	-0.198	152	-0.274	163	-0.24	167
Itc2	Valle d'Aosta	-0674	212	-0.436	178	-0.442	177	-0.55	200
Itc3	Liguria	-0.255	170	-0.165	146	-0.314	167	-0.30	172
Itc4	Lombardia	0.211	95	0.013	128	-0.047	143	-0.07	145
Ith1	Prov. Autonoma di Bolzano	-0.478	191	-0.356	173	-0.261	160	-0.35	176
Ith2	Prov. Autonoma di Trento	-0.413	184	-0.162	145	-0.178	153	-0.14	155
Ith3	Veneto	-0.067	146	-0.255	158	-0.322	169	-0.26	168
Ith4	Friuli-Venezia Giulia	-0.275	172	-0.219	157	-0.268	162	-0.28	169
Ith5	Emilia-Romagna	0.060	121	-0.090	141	-0.222	157	-0.18	162
Iti1	Toscana	-0.154	155	-0.269	160	-0.376	172	-0.32	173
Iti2	Umbria	-0.370	181	-0.335	167	-0.421	175	-0.44	184
Iti3	Marche	-0.362	180	-0.419	177	-0.463	180	-0.49	188
Iti4	Lazio	0.006	133	-0.125	143	-0.202	156	-0.18	163
Itf1	Abruzzo	-0.451	189	-0.516	187	-0.610	198	-0.69	213
Itf2	Molise	-0.788	225	-0.640	201	-0.673	209	-0.70	215
Itf3	Campania	-0.530	199	-0.764	217	-0.918	228	-0.91	232
Itf4	**Puglia**	**-0.668**	**211**	**-0.880**	**232**	**-0.983**	**233**	**-1.00**	**235**
Itf5	Basilicata	-0.918	235	-0.850	227	-0.853	226	-0.91	231
Itf6	Calabria	-0.772	222	-0.905	233	-1.055	235	-1.11	244
Itg1	Sicilia	-0.676	213	-0.961	235	-1.081	237	-1.09	241
Itg2	Sardegna	-0.915	234	-0.807	222	-0.920	228	-0.97	234

Source: RCI 2010, 2013, 2016, 2019.

ups or mergers for the RCI needs. The scores are the z-scores (-2.5 to 2.5) which sets the EU average at zero. Regions above average competitiveness receive positive scores and regions below average receive negative score. The 2019 edition uses two decimals for the score while the previous editions use three.

The regions of Dytiki Ellada and Puglia seem to lose competitiveness relatively to the other regions in their countries. However, Dytiki Ellada lost competitiveness much faster than Puglia. Specifically, it ranked 4th out of the 13 Greek regions in 2010, 8th in 2013 and 10th in 2016 and 2019. In a similar but less severe track, Puglia was 15th out of 21 regions in 2010, and 19th for the rest of the other three editions. This is certainly not good news for Puglia and, especially, for Dytiki Ellada which seem to be among the less competitive regions in their countries. Comparing Puglia and Dytiki Ellada, it is obvious that Puglia stands at a better place in terms of competitiveness as well as GDP per capita (Tables 1 and 2).

It is interesting to note that in Italy, like in Germany and the Netherlands, the capital region (Lazio) is not the most competitive. Lombardia is traditionally the most competitive region. Greece belongs to the group of countries (Slovakia, Bulgaria, France) that the capital is by far the most competitive. In the rest of the EU countries differences in competitiveness between the capital region and adjacent to the capital regions are not so large (Annoni & Dijkstra, 2019).

In the following sub-sections, the nine pillars of the RCI are presented. Two pillars, Macroeconomic stability and Basic education are not presented as the information available is at the national level. Note that RCI 2019 does not provide pillar by pillar rankings. The indicators described below are those included in the last, 2019 edition. In many pillars, indicators have changed significantly between editions.

4.2 Pillar by Pillar competitiveness

Institutions

The included indicators in the pillar Institutions are mostly national level indicators except corruption, quality of accountability and impartiality which are measured at regional level, specifically, at the NUTS2 level in Italy and NUTS1 level in Greece. The first RCI edition in 2010 provided information on Institutions only at the national level. Consequently Tables 5 and 6 do not include 2010. In the 2013 edition the RCI included many more indicators from the GCI such as property rights, intellectual property protection, efficiency of legal framework, transparency of government policymaking, business costs of crime and violence, organized crime, reliability of police services. However, these indicators are at the national level. More information on each pillar indicators can be found at the RCI four editions.

Table 5: Greece: Competitiveness pillar Institutions

NUTS code	NUTS name	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.88	222	-1.43	243	-1.35
Gr41	Voreio Aigaio	-1.11	233	-1.24	228	-1.47
Gr42	Notio Aigaio	-1.11	233	-1.24	228	-1.47
Gr43	Kriti	-1.11	233	-1.24	228	-1.47
Gr51	An.Makedonia-Thraki	-1.35	241	-1.36	233	-1.59
Gr52	Kentriki Makedonia	-1.35	241	-1.36	233	-1.59
Gr53	Dytiki Makedonia	-1.35	241	-1.36	233	-1.59
Gr54	Ipeiros	-1.11	228	-1.39	238	-1.59
Gr61	Thessalia	-1.35	241	-1.36	233	-1.36
Gr62	Ionia Nisia	-1.11	228	-1.39	238	-1.36
Gr63	**Dytiki Ellada**	**-1.11**	**228**	**-1.39**	**238**	**-1.36**
Gr64	Sterea Ellada	-1.11	228	-1.39	238	-1.36
Gr65	Peloponnisos	-1.11	228	-1.39	238	-1.36

Source: RCI, 2013, 2016, 2019.

Table 6: Italy: Competitiveness pillar Institutions

NUTS code	NUTS name	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	-0.70	206	-1.13	225	-1.28
Itc2	Valle d'Aosta	-0.40	180	-0.53	186	-1.03
Itc3	Liguria	-0.87	221	-1.22	227	-1.30
Itc4	Lombardia	-0.87	225	-1.08	223	-0.94
Ith1	Bolzano	-0.94	177	-0.37	168	-0.88
Ith2	Trento	-0.44	181	-0.35	167	-0.88
Ith3	Veneto	-0.87	220	-0.92	209	-0.92
Ith4	Friuli-Ven. Giulia	-0.57	187	-0.66	199	-0.94
Ith5	Emilia-Romagna	-0.84	219	-0.93	210	-0.92
Iti1	Toscana	-0.91	224	-1.08	221	-1.11
Iti2	Umbria	-0.73	209	-1.06	219	-1.43
Iti3	Marche	-0.83	217	-1.08	221	-1.37
Iti4	Lazio	-1.21	238	-1.53	247	-1.44
Itf1	Abruzzo	-1.04	226	-1.33	232	-1.65
Itf2	Molise	-1.19	236	-1.60	251	-1.27
Itf3	Campania	-1.69	254	-1.86	260	-1.61

NUTS code	NUTS name	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itf4	**Puglia**	**-1.41**	**247**	**-1.57**	**249**	**-1.45**
Itf5	Basilicata	-1.20	237	-1.49	245	-1.50
Itf6	Calabria	-1.62	252	-1.61	252	-1.75
Itg1	Sicilia	-1.45	249	-1.56	248	-1.45
Itg2	Sardegna	-1.07	227	-1.43	243	-1.29

Source: RCI, 2013, 2016, 2019.

Dytiki Ellada is slightly better than Puglia regarding institutions but both regions as well as all Greek regions and most Italian ones need significant improvements.

Infrastructure

This pillar is composed by just three indicators: population accessible by roads, by railway, and number of passenger flights (accessible within 90' drive). In the 2013 edition it also included ferry networks which was discarded in later editions.

Table 7: Greece: Competitiveness pillar Infrastructure

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.13	162	-0.32	111	-0.51	145	0.25
Gr41	Voreio Aigaio	-3.52	261	-1.32	255	-1.38	255	-0.88
Gr42	Notio Aigaio	-3.36	259	-1.26	247	-1.46	258	-0.97
Gr43	Kriti	-3.15	254	-1.10	228	-1.24	238	-1.23
Gr51	An.Makedonia-Thraki	-1.23	232	-1.25	244	-1.30	249	-1.54
Gr52	Kentriki Makedonia	-0.64	212	-0.96	197	-1.01	203	-0.84
Gr53	Dytiki Makedonia	-1.72	243	-1.22	239	-1.27	243	-1.60
Gr54	Ipeiros	-3.16	255	-1.29	251	-1.35	252	-1.77
Gr61	Thessalia	-1.23	233	-1.25	245	-1.18	227	-1.31
Gr62	Ionia Nisia	-3.44	260	-1.27	248	-1.36	253	-1.03
Gr63	**Dytiki Ellada**	**-1.22**	**231**	**-1.30**	**252**	**-1.36**	**253**	**-1.54**
Gr64	Sterea Ellada	-0.24	175	-0.91	188	-1.04	210	-1.03
Gr65	Peloponnisos	-0.44	193	-1.02	206	-1.10	218	-0.97

Source: RCI 2010, 2013, 2016, 2019.

Table 8: Italy: Competitiveness pillar Infrastructure

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	0.43	73	0.28	70	47.70	82	0.44
Itc2	Valle d'Aosta	0.43	74	-0.20	103	31.22	136	-0.82
Itc3	Liguria	0.38	81	0.02	90	38.65	112	0.20
Itc4	Lombardia	0.23	109	0.78	44	53.62	69	0.17
Ith1	Bolzano	-0.06	149	-0.47	132	-0.56	150	-1.52
Ith2	Trento	-2.96	253	-0.34	113	-0.26	121	-1.40
Ith3	Veneto	0.16	117	0.15	80	0.13	87	-0.14
Ith4	Friuli-Ven.Giulia	0.06	128	-0.40	122	-0.35	131	-0.45
Ith5	Emilia-Romagna	0.10	123	0.20	76	0.33	73	-0.23
Iti1	Toscana	0.01	139	-0.21	104	-0.05	104	-0.44
Iti2	Umbria	-0.14	165	-0.40	121	-0.46	143	-0.89
Iti3	Marche	-0.44	194	-0.73	154	-0.60	157	-0.58
Iti4	Lazio	0.26	106	0.33	67	0.44	65	0.49
Itf1	Abruzzo	-0.01	144	-0.64	144	-0.64	161	-0.71
Itf2	Molise	-0.08	152	-0.84	177	-0.68	164	-1.33
Itf3	Campania	-0.08	153	-0.33	112	-0.38	134	-0.07
Itf4	**Puglia**	**-0.50**	**197**	**-0.83**	**171**	**-0.73**	**171**	**-0.41**
Itf5	Basilicata	-0.53	200	-0.89	184	-1.00	201	-1.23
Itf6	Calabria	-0.37	189	-1.05	211	-0.92	194	-0.71
Itg1	Sicilia	-0.22	174	-0.95	194	-1.02	207	-0.38
Itg2	Sardegna	-1.57	240	-1.16	231	-1.17	225	-0.90

Source: RCI 2010, 2013, 2016, 2019.

While Puglia is getting better in terms of Infrastructure, Dytiki Ellada seems to be worsening. Generally, Infrastructure in Italy is at a much higher level than in Greece.

Health

The pillar includes six indicators (road fatalities, healthy life expectancy, infant mortality, cancer disease death rate, heart disease death rate, and suicide death rate). The first, 2010, edition included hospital beds, but it was discarded in 2013 edition as "not consistent with the rest of the indicators" (RCI 2013).

Table 9: Greece: Competitiveness pillar Health

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	0.68	28	-0.05	169	0.22	129	0.08
Gr41	Voreio Aigaio	0.50	55	-0.08	174	0.23	124	0.12
Gr42	Notio Aigaio	0.55	49	-0.40	199	0.16	144	-0.32
Gr43	Kriti	0.48	57	-0.25	189	0.11	156	-0.15
Gr51	An.Makedonia-Thraki	-0.23	184	-0.88	217	-0.23	192	-0.36
Gr52	Kentriki Makedonia	0.28	96	-0.26	190	0.12	156	-0.04
Gr53	Dytiki Makedonia	0.80	17	-0.13	176	0.16	144	-0.19
Gr54	Ipeiros	0.57	44	-0.16	178	0.15	150	0.22
Gr61	Thessalia	0.43	63	-0.27	191	0.23	124	-0.14
Gr62	Ionia Nisia	0.80	18	-0.02	168	0.53	39	-0.03
Gr63	**Dytiki Ellada**	**0.13**	**126**	**-0.59**	**206**	**-0.39**	**202**	**-0.43**
Gr64	Sterea Ellada	0.05	150	-0.58	205	0.20	135	-0.20
Gr65	Peloponnisos	-0.05	158	-0.91	218	-0.10	182	-0.29

Source: RCI 2010, 2013, 2016, 2019.

Table 10: Italy: Competitiveness pillar Health

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	0.32	88	0.46	68	0.42	76	0.44
Itc2	Valle d'Aosta	0.53	51	0.13	150	0.25	121	0.02
Itc3	Liguria	0.62	38	0.71	14	0.57	33	0.75
Itc4	Lombardia	0.42	66	0.60	30	0.57	33	0.64
Itd1	Bolzano	0.40	71	0.55	40	0.46	63	0.36
Itd2	Trento	0.15	123	0.73	11	0.52	39	0.56
Itd3	Veneto	0.37	79	0.54	44	0.48	58	0.54
Itd4	Friuli-Ven.Giulia	-0.07	162	0.50	59	0.29	111	0.46
Itd5	Emilia-Romagna	0.12	134	0.36	100	0.35	89	0.50
Ite1	Toscana	0.67	29	0.61	28	0.58	31	0.55
Ite2	Umbria	0.67	30	0.50	56	0.53	39	0.59
Ite3	Marche	0.62	39	0.63	23	0.61	29	0.54
Ite4	Lazio	0.55	50	0.45	71	0.36	84	0.44
Itf1	Abruzzo	0.67	31	0.42	85	0.49	57	0.47
Itf2	Molise	0.23	106	0.44	72	0.33	89	0.64
Itf3	Campania	0.53	52	0.42	84	0.35	88	0.42
Itf4	**Puglia**	**0.82**	**15**	**0.52**	**51**	**0.52**	**40**	**0.55**
Itf5	Basilicata	0.42	67	0.39	87	0.39	79	0.27
Itf6	Calabria	0.87	11	0.52	49	0.36	84	0.44
Itg1	Sicilia	0.73	20	0.36	98	0.33	89	0.40
Itg2	Sardegna	0.43	64	0.38	90	0.22	129	0.29

Source: RCI 2010, 2013, 2016, 2019.

Health is one of the very few pillars that has gotten positive values in some Greek regions. However, changes in the way it is measured among the four editions of the RCI as well as worsening performance drove most Greek regions, including Dytiki Ellada, to negative scores. Puglia remains in positive ground in all four editions.

Higher education and lifelong learning

The pillar includes four indicators (higher education attainment, lifelong learning, early school leaves, and lower-secondary completion only). Only the capital region of Greece has positive score, while all other regions in both Greece and Italy receive negative values. Generally, Greece outperforms Italy and, particularly, Dytiki Ellada outperforms Puglia in this pillar.

Table 11: Greece: Competitiveness pillar Higher education and lifelong learning

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	0.37	60	-0.16	142	0.21	101	0.42
Gr41	Voreio Aigaio	-1.43	254	-1.41	242	-0.40	181	-0.98
Gr42	Notio Aigaio	-1.57	256	-2.02	258	-1.13	239	-0.93
Gr43	Kriti	-0.91	234	-1.46	244	-0.85	220	-0.58
Gr51	An.Makedonia-Thraki	-0.95	237	-1.22	230	-1.25	246	-0.93
Gr52	Kentriki Makedonia	-0.31	174	-0.83	212	-0.23	163	-0.18
Gr53	Dytiki Makedonia	-0.83	227	-1.65	251	-0.49	191	-0.56
Gr54	Ipeiros	-0.83	228	-1.26	234	-0.52	193	-0.21
Gr61	Thessalia	-0.89	232	-1.28	236	-0.32	171	-0.36
Gr62	Ionia Nisia	-1.64	258	-1.69	253	-0.92	225	-0.42
Gr63	**Dytiki Ellada**	**-0.63**	**213**	**-1.33**	**237**	**-0.61**	**199**	**-0.69**
Gr64	Sterea Ellada	-1.36	252	-1.75	255	-1.06	236	-0.90
Gr65	Peloponnisos	-1.37	253	-1.77	256	-0.98	230	-0.88

Source: RCI 2010, 2013, 2016, 2019.

Table 12: Italy: Competitiveness pillar Higher education and lifelong learning

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	-0.71	221	-0.85	213	-0.86	221	-0.80
Itc2	Valle d'Aosta	-2.15	265	-1.60	250	-1.18	242	-1.18
Itc3	Liguria	-0.54	209	-0.48	172	-0.72	208	-0.69
Itc4	Lombardia	-0.38	186	-0.65	194	-0.75	215	-0.72

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itd1	Bolzano	-1.84	260	-1.27	235	-0.74	212	-0.62
Itd2	Trento	-0.67	217	-0.61	189	-0.41	181	-0.28
Itd3	Veneto	-0.51	203	-0.81	211	-0.67	202	-0.63
Itd4	Friuli-Ven.Giulia	-0.52	204	-0.57	180	-0.58	196	-0.40
Itd5	Emilia-Romagna	-0.34	177	-0.48	173	-0.73	211	-0.55
Ite1	Toscana	-0.45	196	-0.61	190	-0.83	217	-0.65
Ite2	Umbria	-0.38	187	-0.34	160	-0.37	175	-0.36
Ite3	Marche	-0.65	216	-0.74	204	-0.60	197	-0.64
Ite4	Lazio	0.08	108	-0.38	163	-0.47	189	-0.42
Itf1	Abruzzo	-0.38	188	-0.37	161	-0.55	195	-0.78
Itf2	Molise	-0.80	225	-0.55	179	-0.69	207	-0.80
Itf3	Campania	-0.68	219	-0.85	214	-1.32	251	-1.48
Itf4	**Puglia**	**-0.91**	**235**	**-1.08**	**226**	**-1.25**	**246**	**-1.52**
Itf5	Basilicata	-1.26	249	-1.24	232	-0.82	216	-0.95
Itf6	Calabria	-1.03	240	-1.22	231	-1.06	236	-1.30
Itg1	Sicilia	-1.05	241	-1.38	240	-1.59	256	-1.82
Itg2	Sardegna	-1.12	245	-1.06	222	-1.39	253	-1.51

Source: RCI 2010, 2013, 2016, 2019.

Labour market efficiency

Labour market efficiency is composed by nine indicators: employment rate excluding agriculture, long term unemployment, unemployment, labour productivity, gender balanced unemployment, gender balanced employment, female unemployment, share of population between 15-24 not in education employment or training - NEET). This is one of the weakest pillars for Greece, in general, and Dytiki Ellada in particular. Even though Italy is also uncompetitive relatively to the European average, at least in comparison to Greece it is in a significantly better place.

Table 13: Greece: Competitiveness pillar Labour market efficiency

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.36	185	-0.89	227	-1.36	241	-1.38
Gr41	Voreio Aigaio	-0.89	235	-1.46	244	-1.99	254	-1.98
Gr42	Notio Aigaio	-0.74	224	-1.11	237	-0.83	229	-1.28
Gr43	Kriti	-0.69	219	-1.08	235	-1.66	245	-1.66
Gr51	An.Makedonia-Thraki	-1.34	250	-1.79	255	-1.90	249	-1.90
Gr52	Kentriki Makedonia	-1.20	246	-1.63	250	-2.02	257	-1.88
Gr53	Dytiki Makedonia	-1.56	259	-1.80	256	-2.01	255	-2.53

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr54	Ipeiros	-1.46	255	-1.57	246	-1.85	247	-1.85
Gr61	Thessalia	-1.11	244	-1.71	253	-2.20	262	-2.16
Gr62	Ionia Nisia	-0.81	230	-1.12	240	-1.92	250	-1.67
Gr63	**Dytiki Ellada**	**-1.49**	**256**	**-1.71**	**254**	**-2.25**	**263**	**-2.41**
Gr64	Sterea Ellada	-1.23	249	-2.06	260	-2.16	261	-2.29
Gr65	Peloponnisos	-0.99	239	-1.26	243	-2.11	259	-2.01

Source: RCI 2010, 2013, 2016, 2019.

Table 14: Italy: Competitiveness pillar Labour market efficiency

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	-0.01	135	-0.05	150	-0.28	178	-0.31
Itc2	Valle d'Aosta	0.51	76	0.60	69	0.18	128	-0.06
Itc3	Liguria	-0.14	154	0.20	120	-0.21	175	-0.39
Itc4	Lombardia	0.37	97	0.12	128	0.03	144	-0.19
Itd1	Bolzano	0.94	32	0.75	50	0.68	52	0.40
Itd2	Trento	0.47	81	0.46	85	0.06	142	0.03
Itd3	Veneto	0.21	112	0.07	138	-0.34	185	-0.33
Itd4	Friuli-Ven.Giulia	-0.03	138	0.17	125	-0.10	158	-0.32
Itd5	Emilia-Romagna	0.56	69	0.30	108	-0.14	162	-0.19
Ite1	Toscana	-0.16	156	-0.07	155	-0.35	186	-0.28
Ite2	Umbria	-0.16	156	-0.14	161	-0.48	202	-0.65
Ite3	Marche	0.04	120	-0.10	159	-0.45	199	-0.57
Ite4	Lazio	-0.54	200	-0.33	183	-0.43	196	-0.60
Itf1	Abruzzo	-0.61	212	-0.58	203	-0.97	231	-1.26
Itf2	Molise	-1.13	245	-0.78	221	-0.72	219	-0.94
Itf3	Campania	-1.63	261	-1.87	257	-1.95	252	-2.08
Itf4	**Puglia**	**-1.54**	**258**	**-1.63**	**249**	**-1.96**	**252**	**-1.97**
Itf5	Basilicata	-1.43	254	-1.11	238	-1.19	237	-1.35
Itf6	Calabria	-1.49	257	-1.18	241	-2.01	255	-2.05
Itg1	Sicilia	-1.64	262	-1.68	251	-1.87	248	-2.08
Itg2	Sardegna	-1.36	251	-0.97	230	-1.04	235	-1.30

Source: RCI 2010, 2013, 2016, 2019.

Market size

Three indicators compose this pillar: disposable income per capita, potential market size expressed in GDP and, potential market size expressed in population. Greek regions are geographically smaller than Italian ones. However, the most important issue is that Greek regions are much less populated than the average European region. The phenomenon of out-migration from all regions toward the capital region has been taking place for decades in Greece due to a capital-centered development model that has been followed since the ’50s. Although this phenomenon is limited relatively to three or four decades ago it still goes on.

Table 15: Greece: Competitiveness pillar Market size

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	0.53	40	0.35	64	-0.11	104	0.13
Gr41	Voreio Aigaio	-2.86	267	-1.10	224	-1.46	257	-3.18
Gr42	Notio Aigaio	-2.01	257	-1.14	228	-1.29	246	-2.12
Gr43	Kriti	-1.66	245	-1.16	234	-1.46	257	-1.97
Gr51	An.Makedonia-Thraki	-1.70	247	-1.07	221	-1.38	252	-1.87
Gr52	Kentriki Makedonia	-0.75	181	-0.76	184	-1.12	224	-1.08
Gr53	Dytiki Makedonia	-1.88	249	-0.99	212	-1.21	237	-1.65
Gr54	Ipeiros	-1.96	254	-1.11	225	-1.25	240	-1.94
Gr61	Thessalia	-1.43	234	-0.88	201	-1.21	235	-1.53
Gr62	Ionia Nisia	-2.47	264	-1.29	241	-1.27	243	-2.19
Gr63	**Dytiki Ellada**	**-1.57**	**241**	**-1.07**	**223**	**-1.35**	**248**	**-1.72**
Gr64	Sterea Ellada	-1.06	205	-0.56	157	-1.19	233	-0.95
Gr65	Peloponnisos	-1.44	236	-0.90	202	-1.26	241	-1.54

Source: RCI 2010, 2013, 2016, 2019.

Table 16: Italy: Competitiveness pillar Market size

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	0.55	38	0.35	63	0.25	67	0.42
Itc2	Valle d’Aosta	-1.14	211	-0.02	97	-0.19	113	-0.06
Itc3	Liguria	-0.14	113	-0.08	100	-0.07	97	0.05
Itc4	Lombardia	1.21	4	0.86	29	0.86	27	0.92
Ith1	Bolzano	-0.64	168	-0.23	119	-0.13	106	-0.06
Ith2	Trento	-0.43	146	0.01	93	0.07	86	0.22
Ith3	Veneto	0.63	31	0.31	66	0.25	67	0.42
Ith4	Friuli-Ven.Giulia	-0.18	117	-0.09	101	-0.12	106	0.01
Ith5	Emilia-Romagna	0.64	27	0.45	53	0.34	59	0.54
Iti1	Toscana	0.27	61	-0.02	96	-0.09	98	0.07
Iti2	Umbria	-0.50	156	-0.22	117	-0.26	121	-0.17

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Iti3	Marche	-0.24	124	-0.24	121	-0.29	124	-0.17
Iti4	Lazio	0.67	25	0.23	71	0.17	77	0.35
Itf1	Abruzzo	-0.47	152	-0.46	146	-0.43	139	-0.34
Itf2	Molise	-1.10	209	-0.44	140	-0.56	155	-0.48
Itf3	Campania	0.18	74	-0.27	125	-0.33	127	-0.17
Itf4	**Puglia**	**-0.27**	**127**	**-0.71**	**177**	**-0.71**	**175**	**-0.65**
Itf5	Basilicata	-1.04	204	-0.72	178	-0.86	193	-0.87
Itf6	Calabria	-0.76	183	-0.93	207	-0.97	208	-1.09
Itg1	Sicilia	-0.23	122	-0.77	189	-0.77	181	-0.76
Itg2	Sardegna	-0.92	194	-0.99	213	-0.95	206	-1.23

Source: RCI 2010, 2013, 2016, 2019.

Technological readiness

Nine indicators compose this pillar. However, only three -those referring to households- are at the regional level: households with access to broadband, individuals buying on-line, and household access to internet. The rest six, referring to business technological readiness, are at the national level. 2010 and 2013 edition published a household sub-pillar and an enterprise sub-pillar (Tables 17 and 18).

Table 17: Greece: Competitiveness pillar Technological readiness

NUTS code	NUTS name	2010 score bus.	2010 score hous.	2013 score hous.	2013 rank hous.	2013 score total	2013 rank total	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.75	-0.86	-0.92	218	-1.02	226	-1.09	232	-1.14
Gr41	Voreio Aigaio	-1.18	-1.74	-1.56	238	-1.35	236	-1.33	236	-1.91
Gr42	Notio Aigaio	-1.18	-1.74	-1.56	238	-1.35	236	-1.33	236	-1.91
Gr43	Kriti	-1.18	-1.74	-1.56	238	-1.35	236	-1.33	236	-1.91
Gr51	An.Makedonia-Thraki	-1.21	-1.80	-1.63	241	-1.38	240	-1.44	243	-1.74
Gr52	Kentriki Makedonia	-1.21	-1.80	-1.63	241	-1.38	240	-1.44	243	-1.74
Gr53	Dytiki Makedonia	-1.21	-1.80	-1.63	241	-1.38	240	-1.44	243	-1.74
Gr54	Ipeiros	-1.29	-2.13	-2.07	251	-1.60	246	-1.44	243	-1.74
Gr61	Thessalia	-1.21	-1.80	-1.63	241	-1.38	240	-1.60	248	-1.98
Gr62	Ionia Nisia	-1.29	-2.13	-2.07	251	-1.60	246	-1.60	248	-1.98
Gr63	**Dytiki Ellada**	**-1.29**	**-2.13**	**-2.07**	**251**	**-1.60**	**246**	**-1.60**	**248**	**-1.98**
Gr64	Sterea Ellada	-1.29	-2.13	-2.07	251	-1.60	246	-1.60	248	-1.98
Gr65	Peloponnisos	-1.29	-2.13	-2.07	251	-1.60	246	-1.60	248	-1.98

Source: RCI 2010, 2013, 2016, 2019.

Table 18: Italy: Competitiveness pillar Technological readiness

NUTS code	NUTS name	2010 score bus.	2010 score hous.	2013 score hous.	2013 rank hous.	2013 score total	2013 rank total	2016 score	2016 rank	2019 score
Itc1	Piemonte	-0.65	-1.02	-0.91	216	-1.04	227	-0.98	226	-0.72
Itc2	Valle d'Aosta	-0.62	-1.05	-0.76	202	-0.97	221	-0.99	226	-0.93
Itc3	Liguria	-0.66	-1.06	-1.14	229	-1.16	230	-1.01	228	-0.70
Itc4	Lombardia	-0.45	-0.75	-0.64	184	-0.91	212	-0.86	200	-0.60
Ith1	Bolzano	-0.45	-0.75	-0.63	183	-0.91	211	-0.73	194	-0.66
Ith2	Trento	-0.50	-0.75	-0.58	180	-0.88	209	-0.75	195	-0.49
Ith3	Veneto	-0.57	-0.91	-0.82	208	-1.00	224	-0.90	208	-0.64
Ith4	Friuli-Ven.Giulia	-0.51	-0.77	-0.77	203	-0.97	222	-0.78	196	-0.78
Ith5	Emilia-Romagna	-0.45	-0.79	-0.74	200	-0.96	219	-0.81	197	-0.52
Iti1	Toscana	-0.60	-0.77	-0.71	197	-0.94	218	-0.91	210	-0.63
Iti2	Umbria	-0.57	-0.90	-0.95	220	-1.06	228	-0.95	222	-0.79
Iti3	Marche	-0.61	-0.74	-0.75	201	-0.96	220	-0.89	203	-0.63
Iti4	Lazio	-0.46	-0.71	-0.78	205	-0.98	223	-0.93	213	-0.71
Itf1	Abruzzo	-0.69	-0.97	-1.02	221	-1.10	229	-1.07	231	-0.91
Itf2	Molise	-0.75	-1.35	-1.38	233	-1.28	232	-1.19	233	-1.37
Itf3	Campania	-0.75	-1.20	-1.40	234	-1.29	233	-1.31	235	-1.27
Itf4	**Puglia**	**-0.83**	**-1.54**	**-1.72**	**245**	**-1.45**	**245**	**-1.30**	**234**	**-1.22**
Itf5	Basilicata	-0.75	-1.50	-1.50	236	-1.34	235	-1.35	240	-1.12
Itf6	Calabria	-0.86	-1.54	-1.48	235	-1.33	234	-1.41	241	-1.40
Itg1	Sicilia	-0.86	-1.35	-1.54	237	-1.36	239	-1.41	241	-1.38
Itg2	Sardegna	-0.63	-0.99	-0.83	209	-1.00	225	-0.92	212	-0.67

Source: RCI 2010, 2013, 2016, 2019.

Like the results of other pillars Italy and Greece demonstrate uncompetitive performance on technological readiness of both households and enterprises. Italy outperforms Greece and Puglia is more competitive than Dytiki Ellada.

Business sophistication

The four indicators that compose this pillar are: share of employment in 'sophisticated' sectors -K to N NACE sectors which are K: financial and insurance activities, L: Real estate activities, M and N: Professional, scientific, technical administration and support service activities- share of GVA in these 'sophisticated' sectors, innovative SME's collaborating with others, marketing or organizational innovators. It is promising that Dytiki Ellada as well as the rest of Greek regions demonstrate an improving trend. Italian regions perform generally better than Greek ones.

Table 19: Greece: Competitiveness pillar Business sophistication

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.35	146	0.57	38	0.86	27	0.66
Gr41	Voreio Aigaio	-1.50	260	-1.15	215	-0.86	209	-0.48
Gr42	Notio Aigaio	-1.50	261	-1.39	235	-1.12	231	-0.77
Gr43	Kriti	-1.56	264	-1.05	203	-0.78	202	0.11
Gr51	An.Makedonia-Thraki	-0.93	220	-1.40	236	-0.97	220	-0.65
Gr52	Kentriki Makedonia	-1.08	238	-0.84	186	-0.27	150	-0.12
Gr53	Dytiki Makedonia	-1.29	250	-1.85	260	-1.10	228	-0.53
Gr54	Ipeiros	-1.28	248	-1.12	209	-0.96	218	-0.67
Gr61	Thessalia	-1.11	240	-1.13	211	-0.39	164	-0.64
Gr62	Ionia Nisia	-1.53	263	-0.93	192	-0.55	184	-0.39
Gr63	**Dytiki Ellada**	**-1.31**	**252**	**-1.06**	**206**	**-0.57**	**187**	**-0.33**
Gr64	Sterea Ellada	-1.35	256	-1.55	247	-0.87	212	-0.73
Gr65	Peloponnisos	-1.60	266	-1.14	213	-0.80	204	-0.47

Source: RCI 2010, 2013, 2016, 2019.

Table 20: Italy: Competitiveness pillar Business sophistication

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	0.44	45	0.38	52	0.21	82	0.12
Itc2	Valle d'Aosta	-0.54	174	-0.45	161	-0.36	160	-0.36
Itc3	Liguria	-0.30	139	0.65	33	0.22	80	-0.01
Itc4	Lombardia	0.87	20	0.64	35	0.40	59	0.32
Ith1	Bolzano	-0.56	175	-0.39	154	-0.57	187	-0.38
Ith2	Trento	-0.47	166	-0.01	99	-0.10	127	0.24
Ith3	Veneto	0.21	60	-0.01	98	-0.21	143	-0.04

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Ith4	Friuli-Ven.Giulia	-0.15	114	0.44	45	0.06	103	0.03
Ith5	Emilia-Romagna	0.34	52	0.33	56	-0.14	134	-0.22
Iti1	Toscana	0.11	69	0.29	59	0.02	110	-0.01
Iti2	Umbria	-0.62	181	0.09	82	-0.30	154	-0.01
Iti3	Marche	-0.46	165	-0.03	106	-0.39	164	-0.35
Iti4	Lazio	0.45	42	0.80	22	0.59	44	0.36
Itf1	Abruzzo	-0.98	226	-0.33	145	-0.48	178	-0.37
Itf2	Molise	-0.93	221	-0.40	155	-0.57	187	-0.42
Itf3	Campania	-0.48	169	0.11	78	-0.38	163	-0.48
Itf4	**Puglia**	**-0.96**	**223**	**-0.01**	**97**	**-0.45**	**171**	**-0.32**
Itf5	Basilicata	-0.98	227	-0.42	159	-0.83	207	-0.82
Itf6	Calabria	-1.57	265	-0.12	114	-0.60	192	-0.48
Itg1	Sicilia	-1.02	230	0.01	88	-0.57	187	-0.41
Itg2	Sardegna	-1.09	239	-0.03	104	-0.51	180	-0.17

Source: RCI 2010, 2013, 2016, 2019.

Innovation

The pillar includes eight indicators: core creativity class employment, knowledge workers, scientific publications, total intramural R&D expenditure, human resources in science and technology, employment in technology and knowledge intensive, exports in medium-high/high-tech manufacturing, and sales of new-to-market and new-to-firms innovation.

Table 21: Greece: Competitiveness pillar Innovation

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Gr30	Attiki	-0.21	147	-0.05	109	-0.17	132	-0.11
Gr41	Voreio Aigaio	-1.17	236	-0.98	225	-0.93	206	-1.39
Gr42	Notio Aigaio	-1.55	250	-1.33	253	-1.53	255	-1.97
Gr43	Kriti	-0.64	188	-0.83	203	-1.07	229	-0.93
Gr51	An.Makedonia-Thraki	-1.41	247	-1.10	239	-1.51	253	-1.45
Gr52	Kentriki Makedonia	-0.71	191	-0.73	188	-0.96	210	-0.93
Gr53	Dytiki Makedonia	-1.40	246	-0.90	212	-1.37	250	-1.49
Gr54	Ipeiros	-0.88	208	-0.73	187	-1.02	219	-1.08
Gr61	Thessalia	-1.07	221	-0.98	226	-1.36	248	-1.31
Gr62	Ionia Nisia	-1.80	265	-1.32	251	-1.54	255	-1.84
Gr63	**Dytiki Ellada**	**-1.01**	**219**	**-0.74**	**189**	**-1.04**	**222**	**-1.05**
Gr64	Sterea Ellada	-1.62	256	-1.41	258	-1.72	260	-1.52
Gr65	Peloponnisos	-1.57	252	-1.38	257	-1.54	257	-1.68

Source: RCI 2010, 2013, 2016, 2019.

Table 22: Italy: Competitiveness pillar Innovation

NUTS code	NUTS name	2010 score	2010 rank	2013 score	2013 rank	2016 score	2016 rank	2019 score
Itc1	Piemonte	0.15	99	-0.08	113	0.00	110	-0.13
Itc2	Valle d'Aosta	-0.49	171	-0.70	181	-0.54	173	-0.93
Itc3	Liguria	0.18	95	-0.15	122	-0.08	121	-0.06
Itc4	Lombardia	0.29	82	0.01	98	0.08	97	-0.04
Ith1	Bolzano	-0.48	170	-0.54	167	-0.52	172	-0.80
Ith2	Trento	-0.17	144	-0.14	120	-0.14	128	-0.02
Ith3	Veneto	-0.25	153	-0.39	151	-0.44	163	-0.44
Ith4	Friuli-Ven.Giulia	-0.06	132	-0.28	135	-0.05	117	-0.13
Ith5	Emilia-Romagna	0.07	110	-0.26	133	-0.01	112	-0.05
Iti1	Toscana	-0.03	128	-0.31	145	-0.32	149	-0.36
Iti2	Umbria	-0.47	169	-0.72	185	-0.64	183	-0.45
Iti3	Marche	-0.51	174	-0.77	196	-0.48	168	-0.64
Iti4	Lazio	0.23	89	0.25	73	0.10	94	0.26
Itf1	Abruzzo	-0.37	161	-0.76	195	-0.63	181	-0.50
Itf2	Molise	-0.90	210	-1.10	241	-0.89	200	-0.53
Itf3	Campania	-0.54	178	-0.58	172	-0.79	193	-0.66
Itf4	**Puglia**	**-0.77**	**198**	**-0.92**	**216**	**-1.06**	**227**	**-1.05**
Itf5	Basilicata	-0.74	194	-1.08	237	-0.99	215	-0.70
Itf6	Calabria	-0.91	212	-1.11	243	-1.23	239	-1.06
Itg1	Sicilia	-0.49	172	-0.90	211	-1.10	230	-0.90
Itg2	Sardegna	-0.73	193	-1.00	230	-1.16	236	-0.99

Source: RCI 2010, 2013, 2016, 2019.

Italy and Greece are not competitive in this pillar. In 2019 Puglia and Dytiki Ellada got the same score.

5. CONCLUDING REMARKS

The RCI has certainly its limitations. Measurement issues, inclusion and exclusion of indicators from edition to edition as the RCI searches to find indicators that can better capture what is to be measured, are important limitations. Another limitation is the weighing of the pillars based on the stage of development as measured by the relative GDP per capita (PPP adjusted). The GCI the methodology of which RCI follows has stopped assigning weighs on the pillars. The reason is that at the era of the 4th Industrial Revolution (4IR) all factors of competitiveness have similar role to play regardless the income level (WEF, 2018). Following this methodolog-

ical change, Greece and Italy -countries with relatively low performance in pillars composing the Basic dimension- moved quite a few ranks up thanks to their better performance in the other pillars that compose the Innovation dimension. One could argue that something similar may take place in RCI if it stops applying weighs.

Still, there is a lot of things that Dytiki Ellada and Puglia (as well as all Greek regions and most of the Italian south) must do to come closer to the European average. Labour market efficiency, Technological readiness, Institutions, and Infrastructure are the major pillars that Dytiki Ellada must address in priority. Puglia needs to address in priority, Labor market efficiency, Higher education and lifelong training, Institutions, and Innovation. These are the pillars the two regions underperform the most. This is not to say that Dytiki Ellada and Puglia should be happy about the performance of the rest of the pillars. Both need to address issues in all pillars but Dytiki Ellada has a longer way to cover than Puglia. Market size could also be considered a result rather than a cause of low competitiveness. If Dytiki Ellada, a relatively small region in terms of population, improves all other pillars it may very well become an attractive destination for both enterprises and people.

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CHAPTER 3

REGIONAL DEVELOPMENT IN THE LIGHT OF INCOME INEQUALITY, ENTREPRENEURSHIP AND INNOVATION

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ABSTRACT | The relation between economic growth and income inequality is of growing interest to researchers and policy makers. Most existing studies have focused on supply-side factors determining economic growth and development (such as entrepreneurship, innovation, human capital, industrial specialization, etc.) and have overlooked demand-side determinants such as income inequality, although this is partly due to shortage of proper data, especially at the subnational level. The chapter utilizes a well-founded econometric growth model and introduces income inequality. The empirical assessment concerns EU (NUTS-2) regions during 2004-2016. For income inequality data we use the EU-SILC database and we assign the inequality index from the EU-SILC territorial division to Eurostat's NUTS-2 regional division. Our analysis also includes the impact of more traditional factors of economic growth such as innovation, human capital, entrepreneurship, and economic sector shares. We employ a dynamic panel model using the two-step system Generalized Methods of Moments developed by Arellano and Bover (1995) and Blundell and Bond (1998). Our findings suggest that the impact of income inequality on growth is negative and statistically significant in all model specifications. Innovation and human capital have positive statistically significant effects. Entrepreneurship, proxied by self-employment, has a negative sign, possibly because of the generality of the index used.

1. INTRODUCTION

The empirical investigation of the determinants of economic growth has been the subject of an extensive theoretical and empirical literature. Much of the empirical work at the firm, regional and country level provides evidence that the impact of innovation and human capital on economic growth is positive. However, while entrepreneurial activity is theoretically considered to have a positive effect in high-income countries, the hypothesis is not confirmed empirically. This is possibly because the notion of entrepreneurship involves different forms of entrepreneurial activity some of which are not positively related to economic growth (Acs, 2006). On the other hand, rising income and wealth inequality in most highly developed countries during the last thirty years (Piketty and Saez, 2003; IMF, 2007; Atkinson et al., 2011; OECD, 2011; Atkinson, 2015) have placed income inequality at the center of research projects in the domain of social sciences. The empirical literature on the relationship between income inequality and growth is immense, yet inconclusive. Since the 1990s, economists investigate this relationship directly or indirectly and both the causal direction and its magnitude varies according to the country, geopolitical region, state of economic development and the time period (the latter two of which sometimes lead to non-linearities). Nevertheless, due to data shortages it is difficult to examine this relation at the regional level, especially as regards the regions of European Union (EU) as a whole.

This chapter attempts to contribute to the existing literature concerning the determinants of economic growth and development[1] by investigating this relationship across the EU at the regional (NUTS-2) level.[2] To that end regional Gini coefficients are constructed using the EU-Survey on Income and Living Conditions

[1] Economic Development is a broader term than economic growth in that it refers not only to economic factors (e.g., GDP), but also to social factors such as education, health, living conditions etc. To the extent we examine, among other things, the impact of social factors on economic growth, in the pages that follow we use both terms, *development* and *economic growth*.

[2] The *Nomenclature des Unités Territoriales Statistiques* (NUTS) is the five-tier hierarchical structure used in the EU to standardize territorial units. NUTS-1 level units are generally divided into NUTS-2 level units, which in turn are further divided into NUTS-3 level units. The latter are divided and subdivided into two levels local authority units (LAU): LAU-1 and LAU-2, respectively.

The EU-SILC samples solicit microdata at the country or NUTS-1 level, hence, the income inequality measures at the NUTS-2 level, in which the Eurostat regional data are provided, can only be approximated. A convenient way to do this, is by attributing to each region the inequality index calculated for the larger EU-SILC statistical area.

(SILC) database.[3] The challenge of the research strategy lies in the divergence between the territorial division of the EU-SILC database and Eurostat's Regional Statistics database. We resolve this problem by fitting (when needed) the statistics of the (wider) EU-SILC regions to the (smaller) Eurostat's Regional Statistics (NUTS-2 level) regions. Apart from income inequality, the econometric model estimated hereinafter also considers the effects of other factors that are theoretically and empirically identified in the literature as regional growth determinants, such as innovation, human capital, entrepreneurship, alongside other control socio-economic variables.

In methodological terms, we econometrically estimate the regional output per capita by using a balanced panel (the entire cross-sectional aspect is observed every year) from 2004 to 2016, and apply a dynamic panel data technique, in particular the two-step System Generalized method of moments (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998).

The structure of the chapter is as follows. Section two presents a brief review of the literature. Section three presents the data and the methodology. Section four offers an empirical investigation concerning the impact of income inequality, innovation and entrepreneurship on the growth rate of real income per capita. Section five concludes and provides policy recommendations.

2. REVIEW OF THE LITERATURE

Our research orientation, regarding the inequality-growth nexus, rests on the impact of income inequality on economic (output) growth. This relationship is examined as complementary to the impact of other variables likely to affect economic growth, in line with the literature. These variables (factors) are innovation (proxied

[3] It is a valuable source of information on the socioeconomic characteristics, income inequality and the effects of social transfers on the disposable income of households across the EU, solicited annually by the national statistical authorities of the member states under the supervision of Eurostat. The process of ordering and managing the collected micro-data follows the basic principles of a broadly accepted methodology that is applied across the EU and allows for the construction of indices that are methodologically consistent, and comparable across space. This way, the investigation of income inequality between EU countries becomes feasible, given the various qualitative differences that exist between the national welfare states. However, due to the significant time resources required for collecting and retrieving the information of a great number of questionnaires, the publication of EU-SILC surveys is subject to delays. At the time this chapter was written, the most recently published and complete micro-database was regarded the household incomes earned in 2016.

by R&D per inhabitant), entrepreneurship (proxied by the rate of self-employed as percentage of total employment), and human capital (captured by the rate of active population with tertiary education).

The literature presents different empirical results regarding the direction and magnitude of the inequality-growth relationship (Neves and Silva, 2014). This lack of consensus is attributed to differences in the samples employed (country/ies, regions, firms), in the measuring methodologies, the estimation techniques (time series analysis, cross-sectional analysis, panel data analysis), the sources employed (household surveys, national accounts, tax authority data), the time span etc. Apparently, the choice or availability of the above determines the research path.

Since the seminal paper of Kuznets (1955) a growing number of research studies has been dealing with the relationship between income inequality and economic growth. Kuznets (1955) considers a quadratic relationship between economic development and inequality which translates into an inverted U-shape. However, the literature developed on the subject so far yields conflicting results. Two main concerns relate to: (1) The direction of causality between economic development or economic growth, on the one hand, and income inequality, on the other. (2) The sign of this relationship: It may be positive, negative or both, depending on the specific conjuncture that this relationship is estimated, and the time span (i.e., whether a short-run or a long-run relationship is estimated).

Frank (2009a) uses a panel of income inequality measures obtained on an annual basis at the state level during 1945-2004, in order to examine the effect of inequality on growth in the USA via three dynamic panel error-correction estimators: a Fixed Effects (FE) estimator, a mean estimator, and a pooled mean group estimator. Since the original IRS income data that the author employs omit people who earn less than a given level of gross income, the author uses the top decile share of income as the main measure of inequality. It is notable that regional (state-level) trends during 1945-2004 follow closely the pattern at the aggregate level of the US economy. In fact, the top decile share of income was relatively stable between the mid-1940s and the late 1970s only to increase impressively subsequently. The vector of explanatory variables also includes two measures of human capital which are related to the level of education of the respective population. Using cointegration techniques and error correction methods Frank (2009a) shows that a positive long-run relationship exists between the top decile share of income and economic growth. However, when the top decile is split into the top 1% and the top 90%-99%, only the top 1% appears to be positively related to growth. Additional measures of income inequality employed include the Gini coefficient, the Atkinson index, and the Theil entropy index. All measures corroborate the positive long-run relationship between income inequality and economic growth. They also indicate that this relationship probably holds for

the highest income levels, however, are ambiguous about the relationship between the bottom of the income distribution and economic growth.

Frank (2009b) extends the period of analysis to cover the Great Depression and the WWII by using annual state-level data from 1929 to 2000. He examines the relationship between income inequality, human capital and income growth. In this case, the sequence in which developments between the variables occur becomes the object of the analysis, using Granger Causality tests and VAR methodology. In addition, the sign of the relationship between any two variables is examined through Impulse Response Analysis. The variables consist of real income per capita, the top decile of income share and the years of schooling. Granger causality testing between the top decile of income share and income growth carried out both in first differences and in terms of levels indicate that the former Granger-causes the latter, but not the other way around. In addition, the years of schooling Granger-cause income levels, which probably indicates that the relationship between human capital and income per capita is a long-term one. Impulse response functions, on the other hand, indicate a positive response of income growth to a shock in the years of schooling and a negative response of income growth to a shock in the top decile of income share. On the other hand, the top decile of income share responds negatively to a permanent shock in the years of schooling. Population density is also important since higher population density levels are associated with a stronger relationship between the top decile of income share and income growth, as well as a stronger relationship between the years of schooling and income levels.

Atems and Jones (2015) are concerned with the direction of the relationship between inequality and per capita income. For that purpose, they estimate the relationship via a panel VAR model by employing cross-state annual panel data set for the US economy from 1930 to 2005. According to the estimated Impulse Response Functions, a one standard deviation increase in income inequality has an adverse effect on the level of real per capita income, but this is insignificant in the long run. Besides, there is a negative response of the Gini index after an income shock. A trivariate VAR, in which the average years of schooling per state (proxy for human capital) is included in the variables, yields similar results. In addition, an education shock results in a permanent rise in income and a persistent fall in inequality. The study also uses alternative measures of inequality such as the Theil Entropy Index, the Relative Mean Deviation, and the top 10% and top 1% income shares. The results indicate that the response of real per capita income to inequality shocks does not depend on the choice of the inequality measure. Furthermore, sample splitting indicates that the relationship is tied to the particular historical context.

Perugini and Martino (2008) focus on inequality within EU regions. They use the datasets first published by Mahler (2002) and Hoffmeister (2006) for

130 regions in 19 countries at the NUTS-1 level, except France (NUTS-2), Italy (NUTS-2) and Finland (country level). As measure of inequality they use the Gini index and the 90/10 percentile ratio provided by Mahler, and the mean logarithmic deviation (MLD) calculated by Hoffmeister. Unfortunately, the data for these measures of inequality are confined to only one year (1995 for the Mahler data, and 2000 for the Hoffmeister data). Consequently, the authors resort to cross-sectional rather than panel analysis, but use a variety of estimation methods to treat spatial autocorrelation on the one hand; and consider additional factors that may affect inequality and growth such as the initial level of economic development, on the other hand. Hence, in addition to the Ordinary Least Squares (OLS) estimation of the determinants of inequality and of GDP growth, they estimate Maximum Likelihood (ML) models and Instrumental Variable (IV) Two-Stage Least Squares (2SLS) models. The explanatory variables include measures of the regional level of economic development, innovation, human capital, labor market performance, demographic variables and institutional aspects regarding collective bargaining. They test six hypotheses concerning: (i) the assumed positive relationship between regional development and income inequality, (ii) the existence of a positive relationship between innovation, human capital indicators and inequality, (iii) the possibility of a negative relationship between labor market performance and inequality, (iv) the positive effect of rising self-employment on inequality, (v) the negative relationship between increased union density and inequality and (vi) the negative relationship between the size of the welfare system and inequality. Their results regarding the determinants of regional inequality are mixed and stress the importance of country-specific institutional factors as far as the labor market and the welfare state are concerned. On the other hand, it turns out that higher levels of regional inequality are related to higher levels of regional growth. However, as the authors point out, such a finding should not lead to wrong policy implications since a positive relationship in the short term and at the regional level does not preclude a negative one in the long term or at the national level. In addition, this is an outcome that may be true in developed rather than in developing countries.

Barro (2000) points out the significance of a series of macroeconomic determinants as conditioning factors in the inequality-growth relationship. The quality of institutions and the level of development of capital markets reflect the level of economic development in each country. Consequently, institutional infrastructure and capital market efficiency improve as the economy becomes richer. Hence, the effects of inequality on economic growth may differ between high-income and low-income countries. On the other hand, incumbent politicians would be in favor of such a redistribution that smooths out inequality if social and political instability were to be avoided. Finally, inequality may further grow if the former reflects the

potential for increased investment due to higher saving rates. These effects are tested with the use of Gini coefficients from a broad panel of countries for 1960, 1970, 1980 and 1990. The findings corroborate the Kuznets curve insofar as inequality becomes an impediment for growth in low income countries but enhances growth in high income nations.

Barro (2008) revisits the inequality-growth debate by estimating the old-time classic Kuznets curves using United Nations data on world income inequality, along with World Bank data for missing observations. His panels, estimated by seemingly-unrelated-regressions, cover the decades of the 1960s, 1970s, 1980s, 1990s and 2000s. Income inequality measured by the Gini coefficient, the share of income belonging to the lowest quintile of income distribution, and the share attributed to the highest quintile, are each regressed on the log of per capita GDP and of its square, on a variable regarding international openness, and a set of dummy variables. The results confirm the existence of the Kuznets relationships irrespective of the measure of inequality used. A higher GDP per capita initially goes hand in hand with higher inequality. However, the trend is subsequently reversed. The sign of the coefficient associated with openness implies a higher level of inequality as international flows of capital intensify. However, the result should be interpreted with caution as trade has a positive effect on GDP growth which in turn might lower the level of poverty. Barro (2008) also examines the effect of inequality on economic growth for the periods 1965-1975, 1975-1985, 1985-1995 and 1995-2004. His results establish a negative effect of inequality on economic growth which, however, does not seem to hold for rich countries. In other words, inequality is bad for growth only in poor countries.

Castells-Quintana et al. (2015) are interested in the determinants of income inequality in the EU's NUTS-1 regions during 1996-2011. They use panel data derived from the European Community Household Panel (ECHP) survey and the EU-SILC. According to these data, inequality fell during 1996-2007 but rose in most regions during 2007-2011. In order to detect the determinants of inequality the authors regress the Gini coefficient and various percentile measures of inequality on the regional GDP per capita, its square and a number of control variables which include the sectoral composition of the economy, a measure of technological change, population density and institutional variables relating demographic and other features. They carry out both cross-sectional estimations for years 1996, 2000, 2007 and 2011, as well as panel estimations for 1993-2011. The cross-sectional analysis indicates a negative relationship between inequality and economic development. It turns out that tertiary education, sectoral specialization, technological change, population density, rising unemployment, and openness in the economy are associated with increasing inequalities. The panel data analysis yields similar results.

A critical conclusion is that inequality patterns are quite heterogeneous across EU regions whilst inequality is lower in more developed regions.

Braunerhjelm and Borgman (2004) make use of Swedish regional data where production of goods and services has been cross-tabulated with industries and regions during 1975-1999, in order to examine, among other things, the effect of entrepreneurship on growth (defined as Value Added per employee) at the regional and industrial level. OLS estimation techniques are employed to regress a measure of labor productivity on regional entrepreneurship, agglomeration variables, regional absorption capacity, and other control variables. Self-employment is used as a proxy for entrepreneurship and they are both assumed to relate positively to growth. In addition, a positive effect on regional growth might be expected by the average size of firms (due to economies of scale) and by the level of education (as a proxy for the knowledge intensity of firms). The results indicate a positive impact of regional entrepreneurship on growth, especially in the services sector. In addition, firm size and the level of education are both positively correlated to growth.

Partridge (1997) examines the nature of the relationship between inequality and economic growth employing panel data collected from US states following the work of Persson & Tabellini (1994). The study regresses ten-year real per capita income growth on the Gini coefficient of i*nequality* in pre-tax family *income before taxes*, the middle-quantile income share, measures of the average skills of the labor force, the initial level of real per capita personal income, along with variables that indicate varying economic conditions in each state, regional and time period dummies. The results show a positive relationship between initial income inequality and subsequent economic growth which contrasts the negative relationship found by Persson & Tabellini (1994). Partridge (1997) argues that negative relationships might reflect growth differences among different nations as opposed to differences across regions of the same nation. Negative inequality-growth relationships may also be a feature that characterizes developing rather than developed nations. On the other hand, the positive relationship could be explained either on the grounds of rising saving and investment by the wealthy or of inequality being an incentive for greater work effort in the labor market. In addition, the welfare of the median voter appears to be a significant variable since there is also a positive relationship between a rising share of the middle quantile income on the one hand and growth on the other. Besides, a more prosperous middle class connotes and contributes to social and economic stability with beneficial effects on economic growth.

Partridge (2005) revisits the income distribution-growth relationship and employs a variety of methods (pooled OLS, Random Effects (RE), FE, Between Esti-

mator (BE)) for US state data during 1960-2000. Inequality is measured both with the Gini coefficient, to capture the effects of the overall distribution along with its tails, and with the Income Share of the Third Quantile (Q3) to account for the impact of the middle class and the median voter's welfare. Other explanatory variables include human-capital indicators, the industry mix in each state, labor market conditions, welfare spending, and regional indicators. The study interprets OLS, RE and BE results as indicating long run effects. In this context, greater incentives to work that relate to higher inequality are associated with rising growth rates when coupled with an enhanced position for the middle class (greater coefficient of Q3). On the other hand, too much inequality (and weak middle class -low Q3) might have the opposite effect on growth due to political clash and instability. On the other hand, FE results are interpreted as reflecting short run effects that may be ambiguous, though a policy maker should take note of the possible accumulation of such short run effects over time.

Panizza (2002) develops an income distribution set of data for 48 US states in an attempt to overcome the low-quality data problem of previous studies and examine the inequality-growth nexus outside the reduced form estimations by turning to the structural form of the model and looking into the fiscal policy and fertility channel. He uses a variety of inequality measures such as the Q3, the Q3-4, the ratio of the Q1-5, and the Gini index. The estimation results extend to periods of ten, twenty and thirty years, that is long run growth, using panel data where this is possible. The reduced form estimation results point to a negative relationship between inequality and growth, supported especially by the positive correlation of the Q3 with regional economic growth. The fiscal policy variables appear to be positively correlated with inequality and negatively correlated with future growth, whilst this result holds predominantly for tax progressivity.

Ezcurra (2007) focuses on eight EU member states (Belgium, Germany, Spain, Greece, France, Italy, Portugal, the UK) during 1993-2002 in an attempt to explain regional economic growth in terms of income inequality along with other factors considered in the literature. The author uses data from the European Community Household Panel and covers 63 regions, most of them NUTS-1, except in the case of Portugal where NUTS-2 regions are examined. The author employs an econometric model that uses the usual proxies for human capital formation and region specific features, along with two variables that capture the effect of agglomeration economies, such as population density and a market potential index. In addition, he introduces a spatial weights matrix in order to capture regional connections. By employing different versions of the model, he finds a negative relationship between economic growth and income inequality at the beginning of the estimation period. The policy implication is that government intervention to

curb income inequality might indirectly contribute to higher growth rates at the regional level. Yet, suggestions of this sort do not come without reluctance since, they might distort people's incentives and entrepreneurial decisions and inhibit growth. Obviously, striking a balance between the two should be a priority for pro-growth policy planning.

3. DATA AND METHODOLOGY

3.1 Data

The independent variables used in the model are well established in the literature. As mentioned in the Introduction, we employ two different data sources: Eurostat's regional statistics at the NUTS-2 level, and the EU-SILC data that permit the estimation of a regional income inequality index. The former statistics consist of real GDP per capita, total intramural R&D expenditure (GERD) per inhabitant, population with tertiary level education as percentage of the employed population aged 15-64, self-employment as percentage of total employment, long-run unemployment as percentage of total unemployment, the proportion of the population aged 65 years old or older, the sectoral shares of regional Gross Value Added (GVA) and Gross Fixed Capital Formation (GFCF) in agriculture-fishing-forestry, manufacture-mining-quarrying-electricity-water supply and the like, construction, trade-transportation-storage-accommodation-food services and the like, information-communication, financial-real estate services, professional-scientific-technical-administrative-support services. The public administration and other services serve as reference.

Of these, the real GDP per capita serves as the model's depended variable and the rest as independent variables. When faced with omitted data we consider: (a) excluding the variable and turning to a close substitute (if any), (b) estimating and filling in the missing values by linearly interpolating values in order to save as many variables as possible or (c) excluding the observation (region) from the analysis. For instance, the R&D data suffer from serious under-reporting, so 20 regions are dropped. As a rule, we resort to interpolations in the regions and variables whose missing values are no more than 30% of the total; and we exclude the regions for which the data is inadequate. Accordingly, the methodology and interpretation are developed along the lines of the aforesaid conditions and restrictions.

Due to these limitations the analysis covers 184 regions from 18 of the 28 EU member states for which data can be consistently processed (Austria, Belgium, Bulgaria, Cyprus, Czechia, Germany, Greece, Finland, Italy, Latvia, Luxembourg,

Malta, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom) in the course of 2004-2016. As the inequality measures are calculated on the basis of the disposable income of individuals, total household incomes are converted into individual incomes, using the modified OECD equivalence scale: The first household member is given the weight of 1, all additional adults take a weight of 0.5 and each child a weight of 0.3. The overall household income is divided by the sum of weights attributed to each individual member. Lastly, following Eurostat, households with zero or negative income are excluded from our sample.

The EU-SILC samples used to be solicited microdata at the country or NUTS-1 level. Hence, the income inequality measures at the NUTS-2 level, in which the Eurostat regional data are provided, in several cases may only be approximated. A convenient way to do this, is by attributing each region to the inequality index calculated for the larger statistical area within which the regional entities belong. By assuming that the level of inequality does not deviate much from the representative index generated for the sample taken by the broader statistical area, we are in a position to match some consistent measurements of inequality.

Following this process of matching inequality indices between NUTS-1 and 2 level areas, we come across several difficulties. From 2004 to 2016, the regional structures and NUTS codes of several counties changed. For instance, in Greece, the NUTS-1 level area coded EL1 used to encompass three NUTS-2 level areas coded EL11, EL12 and EL13. However, after 2015 Eurostat has revised the codes, turning EL1 to EL5 (Table 1). Similar changes occurred in many other countries as well. So, we took the time to review each and every entry in order to ensure that we study the same area year after year.

Income inequality is measured in a variety of ways. The most widely used measures are the mean logarithmic deviation (mld), Theil (T), Gini (G), the Squared Coefficient Variation (c2) and the Atkinson indices. Their extensive usage is attributed to the critical statistical properties they fulfil (Cowell, 2011) and to the straightforwardness of their interpretation. The Gini index (see Appendix A) is one of the most employed, prominent and comprehensible. Its range of values run from 0 to 1, with the lower boundary standing for absolute equality, and the upper boundary standing for the exact opposite, i.e., absolute inequality. For our purposes, apart from the numerous interpretations proposed to understand what the Gini actually means, it captures the average distance between the actual distribution of income and the distribution that would have been if absolute equality had prevailed, as a percentage of the total disposable income. In other words, higher (lower) values of the Gini index correspond to a higher (lower) level of inequality. Table 2 provides the definitions and descriptive statistics.

Table 1: Matching the EU-SILC statistical codes to the NUTS-2 codes

EU-SILC 2004-2014			EU-SILC 2015-2016		
EU-SILC codes	NUTS-2 codes	Regions - names	EU-SILC codes	NUTS-2 codes	Regions - names
EL1	EL11	Anatoliki Makedonia, Thraki	EL5	EL11	Anatoliki Makedonia, Thraki
	EL12	Kentriki Makedonia		EL12	Kentriki Makedonia
	EL13	Dytiki Makedonia		EL13	Dytiki Makedonia
EL2	EL21	Ipeiros	EL6	EL21	Ipeiros
	EL14	Thessalia		EL14	Thessalia
	EL22	Ionia Nisia		EL22	Ionia Nisia
	EL23	Dytiki Ellada		EL23	Dytiki Ellada

Table 2: Descriptive statistics (184 regions, 2004-2016)

Variable	Obs	Mean	Std. Dev	Min	Max
logRGDP: Real GDP per capita (log)	2396	10.054	.594	7.959	11.422
GINI: Gini coefficient	2396	.297	.037	.203	.465
logR&D: R&D per inhabitant (log)	2396	5.414	1.416	.588	8.226
Tertiary: Tertiary educ., (%) 15-64 employed	2396	82.081	5.481	59.8	91.2
Self-employ: Self-employed, (%) Tot. employment	2396	.165	.078	.037	.464
LongUnemploy: Long-term unemployment, (%) Tot. unempl.	2396	2.089	.543	.642	3.611
Age65: Proportion of population aged 65+	2396	2.897	.174	2.272	3.339
Sectoral GVA share in regions GVA:					
sh agr: Agriculture-fishing-forestry sector	2396	.029	.031	0	.2
sh manu: Manufacture-mining-quarrying-electricity-water etc.	2396	.174	.083	.011	.422
sh const: Construction sector	2396	.064	.022	.017	.161
sh serv: trade-transportation-storage-accommodation-food ser.	2396	.198	.05	.087	.523
sh infcom: Information-communication service sector	2396	.036	.023	.004	.156
sh _finres: Financial-real estate service sector	2396	.229	.059	.097	.475
sh profserv: Professional-scientific-technical-admin. etc. serv.	2396	.077	.034	.014	.212
Sectoral GFCF share in regions GFCF:					
invsh agr: Agriculture-fishing-forestry sector	2396	.034	.031	-.006	.277
invsh ind: Manufacture-mining-quarrying-electricity-water etc.	2396	.222	.109	.003	.722
invsh const: Construction sector	2396	.047	.055	-.027	.533

Variable	Obs	Mean	Std. Dev	Min	Max
invsh serv: trade-transportation-storage-accommodation-food ser.	2396	.137	.052	.011	.414
invsh infcom: Information-communication service sector	2396	.037	.03	-.03	.208
invsh _finres: Financial-real estate service sector	2396	.351	.125	.008	.686
invsh profserv: Professional-scientific-technical-admin. etc. serv.	2396	.067	.052	.001	.501

2.2 Methodology

We estimate a standard cross region catch-up equation, which can be described as follows:

$$y_{it} - y_{it-1} = \alpha y_{it-1} + \beta_1 X'_{it} + \mu_i + \lambda_t + \varepsilon_{it} \qquad (1)$$

Where y_{it} is the logarithm of the real GDP per capita for region i in period t, α is the conditional convergence factor, X'_{it} represents a vector of variables affecting regional growth, μ_i represents the unobservable region-specific effects, λ_t the time specific fixed effects and ε_{it} is the error term. Equation (1) can be re-parameterized as follows:

$$y_{it} = \alpha_1 y_{it-1} + \beta_1 X'_{it} + \mu_i + \lambda_t + \varepsilon_{it} \qquad (2)$$

where $\alpha_1 = 1 + \alpha$. The inclusion of the lagged dependent variable as an explanatory variable raises endogeneity concerns. Since y_{it} is a function of μ_i, it follows that y_{it-1} is also a function of μ_i, and therefore the explanatory variable correlates with the error term. Hence, the OLS estimator is biased and inconsistent even if the ε_{it}s are not serially correlated (Baltagi, 2005). Furthermore, even if we apply the "within" transformation to wipe out the μ_is, $y_{it} - \bar{y}_{it-1}$ will still be correlated with $\varepsilon_{it} - \bar{\varepsilon}_{it}$ even if the ε_{it}s are not serially correlated, because y_{it-1} is correlated with $\bar{\varepsilon}_{it}$ (Baltagi, 2005). Hence, both the OLS and the FE estimators are inconsistent due to endogeneity, with the former yielding upward biased estimates, and the latter downward biased estimates (Nickell, 1981).

As our panel has "small T and large N" and we suspect the presence of endogeneity, we turn to instrumental variables. The most appropriate course for our panel and model characteristics to mitigate the endogeneity problem is to employ a technique proposed by Arellano and Bond (1991) for a first-difference GMM estimator by which individual FEs are eliminated and then the lagged values of the endoge-

nous regressors are used as instruments. To prevent a "weak instrument" problem Arellano and Bover (1995) and Blundell and Bond (1998) propose a system-GMM estimator, which results from a system of two equations -one in levels, one in differences- where the endogenous variables are instrumented by their lagged differences and lagged levels, respectively.

As our number of periods is short, we apply the two-step system GMM estimation method. Since heteroskedasticity and autocorrelation across panels can be important across regions, the standard errors for the coefficients are based on Windmeijer's finite-sample correction for the two-step covariance matrix. According to Roodman (2009) the system-GMM performs better than the difference-GMM given that the standard errors are corrected with Windmeijer's (2005) small-sample correction procedure. The problem in the system-GMM estimator arises when the time period increases, generating too many instruments, therefore rendering the model's specification tests (Hansen test) weak.

A precondition for the application of the GMM method is that the error term does not suffer from autocorrelation. For that reason, we test for first and second order serial correlation in the first differences (Arellano and Bond, 1991). We also follow the recommendation of Roodman (2009) that the number of instruments be smaller than the number of regions.[4] In addition, we test the validity of the moment condition using the Hansen test of which the null hypothesis is that all instruments as a group are exogenous.

3. ESTIMATION RESULTS

Table 3 reports the main results of the estimations. The model described above allows us to look into the impact of our three core variables on EU regional economic growth: (1) the Gini coefficient stands for income inequality; (2) innovation is captured by total regional expenditures on R&D per inhabitant; and (3) entrepreneurship is approximated by the portion of self-employed in total employment. The regression also involves a number of control variables regarding human capital (tertiary level education), demographic characteristics (people aged 65 years old or older in the population), long-run unemployment, and variables that determine the productive structure of each region (shares of regional GVA and GFCF in the various sectors).

[4] For the estimation of our model we use the Stata program and for the specific estimation method we use the xtabond2 command created by Roodman (2009). In consequence, we use the collapse command that ensures the number of instruments remains less than the number of regions.

Table 3: Regression results using a two-step system GMM estimation (2004-2016)

logRGDP	(1)	(2)	(3)
L.logRGDP	0.957***	0.963***	0.970***
	(0.005)	(0.009)	(0.007)
GINI	-0.135***	-0.146***	-0.174**
	(0.041)	(0.035)	(0.077)
logR&D	0.009***	0.007*	0.007**
	(0.003)	(0.003)	(0.003)
Tertiary	0.001***	0.001***	0.002**
	(0.000)	(0.000)	(0.001)
Self-employ	-0.044**	-0.044*	-0.020
	(0.020)	(0.025)	(0.035)
LongUnemploy			0.001
			(0.001)
Age65			0.001
			(0.001)
sh_agr		0.105	
		(0.082)	
invsh_ind		0.025	0.037**
		(0.025)	(0.017)
invsh_infcom		0.086	
		(0.086)	
invsh_profserv		0.058***	
		(0.011)	
invshConst			0.090
			(0.075)
invsh_serv			0.079*
			(0.041)
Constant	0.379	0.350***	0.200*
		(0.072)	(0.118)
AR(1) (p-value)	0.043	0.004	0.007
AR(2) (p-value)	0.329	0.842	0.662
Hansen (p-value)	0.540	0.563	0.561
Number of Regions	184	184	184
Number of Instruments	155	155	155
Number of obs	2.178	2.178	2.178

Note: The dependent variable is the real GDP per capita (logRGDP); Windmeijer-corrected standard errors are in parenthesis; *, ** and *** denote significance levels of 10%, 5% and 1%; Regional and temporal dummies are included but not reported for brevity; All explanatory variables are treated as potentially endogenous in the system GMM estimator; Instruments for differenced equation: 2-4 lagged core variables; Instruments for levels equation: differenced (sectoral) control variables.

We estimate three distinct specifications of Eq. 2 using the two-step system GMM estimator, and additional control variables in order to check how sensitive the estimated coefficients of our core variables are. In all specifications the regional and temporal dummies are considered but not reported for brevity.

In the first regression we estimate the effects of the three core independent variables - assuming they are endogenous, using as instruments their lagged and differenced values along with some predetermined variables (private sector R&D per inhabitant, share of investment in Industrial sector, Information and Communication sector, Financial and Residential sectors, Professional services sector). In the second regression we add four control variables regarding the investment shares in specific productive sectors of the regions. In the third regression we take into account the investment shares of the three major economic sectors, a demographic variable and long-run unemployment.

All three regressions behave well based on the diagnostic tests including the AR(1) and AR(2) test for the first and second order serial correlation, respectively, and Hansen's over-identifying restrictions test for instrument validity. In line with Roodman (2009) the number of instruments is kept below the number of regions (we have 155 instruments and 184 regions). In addition, the estimated coefficient of our lagged dependent variable lies within the credible range defined by the FE and the OLS point estimates, as suggested in Roodman (2009). All three specifications perform well: 0.957 within the range of 0.638-0.969 (specification 1), 0.963 within the range of 0.585-0.967 (specification 2) and 0.970 within the range of 0.553-0.971 (specification 3).*

The estimated coefficient of the lagged dependent variable is positive and highly significant (at the 1% level) in all model specifications. Hence, the convergence coefficient (α) is negative (i.e. regions with initially lower GDP per capita register higher growth rates) indicating that a conditional convergence result has taken place in the EU regions during the period under study.

The estimated coefficient of income inequality (GINI) is negative and highly significant (at 1% level) in all specifications (i.e., under different sets of control variables) and econometric methods used in this chapter (SGMM, FE, pooled-OLS). This is a good sign for the robustness of our results; however, we also test them against various inequality measures. Our findings are in line with those obtained by Ezcurra (2007) for EU-regions during 1993-2002 using cross-sectional data analysis, and Panizza (2002) who used panel-data analysis techniques on US states. They are also consistent with the results obtained among others by Alesina and Rodric (1994), and Persson and Tabellini (1994) who used country-level data.

* For the pooled-OLS and FE estimations, see Appendix B.

The estimated coefficient of the innovation proxy is positive and statistically significant in all model specifications (at the 1%, 10% and 5% level for specifications 1, 2 and 3, respectively). The positive impact of human capital on economic growth has been repeatedly confirmed in the literature both in cross-country studies and panel data analyses (Barro, 2000, 2008; Partridge, 1997, 2005; Panizza, 2002; Ezcurra, 2007; Perugini and Martino, 2008; Frank, 2009b).

The estimated coefficient of entrepreneurship is negative in all model specifications and significant in the first and second specifications (at the 1% and 10% level, respectively). The negative sign is quite odd compared to what one might expect based on economic theory and the more recent empirical literature. We do submit that the rate of self-employed as percentage of total employment may be a poor entrepreneurship proxy. First, the notion of self-employment is too encompassing for our purposes because there is no distinction between self-employed with or without personnel or between "opportunity entrepreneurship"' and "necessity entrepreneurship" (Acs, 2006). The EU regional statistics do not classify self-employment by sector and hence the self-employed in the agricultural sector are also included. Braunerhjelm and Borgman (2004) who find a similar result suggest that the negative sign of their entrepreneurial variable reflects the importance of economies of scale in the manufacturing sector. The positive sign of the size of the firms variable (supposed to generate internal economies of scale) seems to support this argument.

Of the remaining variables employed in the second and third specifications only the estimate (effect) associated with the investment share in the professional-scientific-other relevant services and in the industrial sector is positive and significant at the 1% and 5% level, respectively. This means that high investment rates are associated with higher economic growth as the productivity of the production factors increases.

Agglomeration economies are considered to be an important factor when it comes to explaining regional performance (Fujita and Thisse, 2002). We control for this factor using population density; however, we omit it as it turns out to be statistically non- significant in all specifications (also found in Ezcurra (2007)).

4. CONCLUSIONS

The chapter contributes to our understanding of the potential relation between income inequality and economic growth at the regional level. Our investigation is conditioned by the effects of innovation, entrepreneurship, and human capital formation proxies. We utilize Eurostat regional statistics and the EU-SILC dataset

for 184 EU regions in 18 countries, generate consistent approximations of income inequality at the regional level during 2004-2016, and carry out empirical analyses via a two-step system GMM estimator.

The empirical results suggest that income inequality has a negative and significant impact on regional economic growth. Innovation and human capital have a positive and significant impact on regional economic growth. Self-employment turns out to be a poor proxy for entrepreneurship as it reveals a puzzling negative impact on regional growth which is statistically significant in two of the three specifications presented. This finding might be the result of multiple factors such as: the wide conceptual content of the variable used, the inclusion of farmers, fishermen and others in the self-employment EU regional data or even economies of scale issues.

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APPENDIX A

Gini index is often used in measuring the inequality as it is presented by a Lorenz curve. It corresponds to the area between the Lorenz curve and the 45-degrees line.

Formally, it is written as: $G = 1 - 2\int_0^1 L(F,q)\,dq$.

The above formula can also be expressed in a different form: $G = \frac{2}{\bar{y}}\ \mathrm{cov}(y, F(y))$.

If a distribution is comprised by n observations, y_i denotes the income of household $i \in \{y_1, y_2, \ldots y_n\}$ while we define $X_i = \frac{i}{n}$ as the cumulative share of the population and $Y_i = \frac{\sum_{j=1}^{i} y_j}{\sum_{j=1}^{n} y_j}$ as the cumulative share of income. Hence, the Gini can be re-written as:

$$G = 1 - \sum_{i=0}^{n-1}(X_{i+1} - X_i)(Y_{i+1} + Y_i) = \frac{2\sum_{j=1}^{i} iy_j}{n\sum_{j=1}^{n} y_j} - \frac{n+1}{n}$$

APPENDIX B

The OLS and FE estimation results are presented below (Table 4 and 5).

Table 4. Regression Results, OLS estimator (2004-2016)

logRGDP	(1)	(2)	(3)
L.logRGDP	0.969***	0.967***	0.971***
	(0.004)	(0.005)	(0.005)
GINI	-0.174**	-0.228***	-0.226***
	(0.078)	(0.087)	(0.086)
L.GINI	-0.015	0.056	0.063
	(0.101)	(0.109)	(0.108)
L2.GINI	0.049	0.096	0.102
	(0.082)	(0.088)	(0.089)
logR&D	0.071***	0.058***	0.060***
	(0.010)	(0.009)	(0.010)
L.logR&D	-0.032***	-0.021**	-0.021**
	(0.011)	(0.010)	(0.010)
L2.logR&D	-0.033***	-0.032***	-0.031***
	(0.007)	(0.007)	(0.007)
Tertiary	0.005***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)
L.Tertiary	-0.003***	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
L2.Tertiary	0.001*	0.000	0.000
	(0.001)	(0.001)	(0.000)
L3.Tertiary	-0.003***	-0.002*	-0.002*
	(0.001)	(0.001)	0.001
L4.Tertiary		-0.001**	-0.002**
		(0.001)	(-0.001)
Self-employ	-0.221*	-0.263**	-0.258**
	(0.122)	(0.115)	(0.115)
L.Self-employ	-0.233	0.336**	0.345**
	(0.152)	(0.150)	(0.150)
L2.Self-employ	-0.274**	-0.145	-0.163
	(0.136)	(0.109)	(0.109)
L3.Self-employ	0.188*		
	(0.111)		
LongUnemploy			0.001
			(0.000)
Age65+			0.000
			(0.000)

logRGDP	(1)	(2)	(3)
sh_agr		-0.172**	
		(0.067)	
invsh_ind		0.012	0.013
		(0.014)	(0.014)
invsh_const			-0.019
			(0.041)
invsh_serv			0.062***
			(0.021)
invsh_infcom		0.029	
		(0.040)	
invsh_profserv		0.038*	
		(0.023)	
Constant	0.379***	0.342***	0.241***
	(0.062)	0.048	(0.056)
R-squared	0.994	0.995	0.995
Number of Obs.	1819	1635	1635
F-test	10949.7	11042.7	10135.6
Prob>F	0.000	0.000	0.000
AIC	-6211.3	-5732.0	-5730.7
BIC	-6073.6	-5575.4	-5568.7

Note: The dependent variable is the log of the real GDP per capita (logRGDP); Time dummies are included but not reported for brevity; White-corrected standard errors in the parentheses; *, ** and *** denote significance levels of 10%, 5% and 1%.

Table 5. Regression Results, OLS with fixed effects estimator (2004-2016)

LogRGDP	(1)	(2)	(3)
L.logRGDP	0.638***	0.585***	0.553***
	(0.016)	(0.019)	(0.020)
GINI	-0.156**	-0.132*	-0.099
	(0.074)	(0.078)	(0.077)
L.GINI	-0.096	-0.008	0.054
	(0.077)	(0.084)	(0.083)
L2.GINI	-0.005	-0.009	0.028
	(0.068)	(0.072)	(0.073)
logR&D	0.057***	0.052***	0.053***
	(0.006)	(0.007)	(0.007)
L.logR&D	-0.009***	-0.005	-0.005
	(0.007)	(0.008)	(0.008)
L2.logR&D	-0.035***	-0.036***	-0.037***
	(0.006)	(0.007)	(0.007)
Tertiary	0.007***	0.006***	0.004***
	(0.001)	(0.001)	(0.001)

LogRGDP	(1)	(2)	(3)
L.Tertiary	0.000	0.001	-0.001
	(0.001)	(0.001)	(0.001)
L2.Tertiary	0.002***	0.002**	0.001
	(0.001)	(0.001)	(0.001)
L3.Tertiary	-0.001***	0.000	0.000
	(0.001)	(0.001)	(0.001)
L4.Tertiary		-0.001**	0.000
		(0.001)	(0.001)
Self-employ	-0.281***	-0.400***	-0.438***
	(0.105)	(0.109)	(0.108)
L.Self-employ	-0.170	0.206	0.244*
	(0.121)	(0.128)	(0.126)
L2.Self-employ	-0.158	-0.227**	-0.234**
	(0.116)	(0.115)	(0.113)
L3.Self-employ	0.204**		
	(0.096)		
LongUnemploy			-0.006***
			(0.001)
Age65+			0.009***
			(0.002)
sh_agr		-0.885**	
		(0.219)	
invsh_ind		-0.077***	-0.042
		(0.026)	(0.028)
invsh_const			-0.043
			(0.039)
invsh_serv			0.177***
			(0.036)
invsh_infcom		-0.414***	
		(0.083)	
invsh_profserv		0.063	
		(0.051)	
Constant	3.075***	3.758***	4.049***
	(0.131)	0.164	(0.202)
R-squared	0.788	0.779	0.785
Number of Obs.	1819	1635	1635
F-test	249.0	179.6	179.0
Prob>F	0.000	0.000	0.000
AIC	-6881.7	-6312.4	-6351.5
BIC	-6744.1	-6155.8	-6189.5

Note: The dependent variable is the log of the real GDP per capita (logRGDP); Time dummies are included but not reported for brevity; White-corrected standard errors in the parentheses; *, ** and *** denote significance levels of 10%, 5% and 1%.

CHAPTER 4

THE APULIAN INNOVATION OVERVIEW: A KNOWLEDGE TOOL FOR BETTER INFORMED PUBLIC DECISIONS

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ABSTRACT | "Policy makers often decide in uncertain conditions where results are rarely known and can be reliably evaluated". The speech by the former President of the European Central Bank, Mario Draghi, in 2019, confirms the necessity for policy makers to base their decisions on knowledge and verification of the facts in order to reduce intrinsic uncertainty. On the basis of these considerations about the necessity of an evidence-based approach for policy making, the Regional Strategic Agency for Technology and Innovation of Apulia Region intended to contribute in reducing part of this uncertainty providing a versatile and intuitive tool for the basic knowledge of the socio-economic system and innovation in Apulia (South Italy). The Apulian Innovation Overview (AIO) is a web-based informative tool aimed at the systematic valorisation of the information resulting from the institutional activity of survey, monitoring, elaboration and analysis of the Regional Innovative System carried out by the Regional Agency for Technology and Innovation (ARTI). The AIO has a flexible structure: it is both dynamic, since it is continuously updated, and integrated, since it allows over time to add further indicators elaborated on information taken from different sources belonging to other sectors of the regional administration, as the experience of Open Data has shown. For its implementation, an initial step-by-step approach was adopted. The tool can now be accessed through the Agency's portal via various navigation modes and leads to pages dedicated to individual indicators, including detailed descriptions; comparative tables with time and other territorial breakdowns (usually, Italy and South); possible other disaggregation (by type, sector, etc.); direct connection to the data source; graph and other functionalities. The AIO allows analysts to study the degree and dynamics of specialization of the Apulian production and research system, with particular regard to innovative phenomena that affect it, in order to redefine and implement the new regional interventions inspired by the principles of the Smart Specialization Strategy.

1. INTRODUCTION

The importance of information in economic and political processes is generally recognised, and has become even more relevant during the ongoing Covid-19 pandemic crisis. The ever-increasing availability of information is also due to the rapid technological transformations in the field of Information and Communication Technology (Giovannini, 2008). In the last decades, we have witnessed an *informational flood*, but information does not necessarily beget knowledge. Indeed, it is more necessary than ever that information is carefully screened to recognise its sources, assess its reliability, and interconnect it in an integrated system in order to generate knowledge. The provision of systematic information is necessary in all phases of the policy cycle: not only in the preparatory and implementation phases, but is also of fundamental importance in a later stage for accountability issues, as it improves the democratic evaluation of policy makers by citizens. In particular, how public opinion influences politicians, and therefore influences public policy decisions was the core issue in a paper prepared by a former member and a former chairman of the White House Council of Economic Advisers, Blinder and Krueger, in 2004.

If up until a few decades ago there was intensive use of statistics for policy analysis (Fairley and Mosteller, 1977), nowadays the access to open data and big data has paved the way for more and more sophisticated data mining procedures to extract usable data ─hence, information─ from a larger set raw data, combining methods of statistics, data analysis and machine learning (Tufféry, 2011), and has opened up scenarios that are still not fully explored and predictable, especially in public policy applications.

As regards policy making at the regional level, the concept of smart specialisation raised a rapid and significant impact on the policy audience in Europe (Foray, 2013), and became the most recent substantial change in this field. Initially elaborated by a group of experts in 2009 (Foray *et al.*, 2009), the concept has become a key element for the *Europe 2020 Strategy* so as to be set as an *ex ante* conditionality for some thematic objectives of the 2014-2020 Cohesion Policy. From the very introduction of this new approach to territorial development policy planning, the need for regional policy makers to rely on available data to draw appropriate indicators about the specializations of their territories became immediately apparent: "[t]he process of identification and selection of desirable areas for intervention is about some technologies, fields, sub-systems that could be favoured. […] In short, it is a policy approach that involves letting and helping the regional economy to discover new activities with strong potential; making a sound analysis of potential and defining a process which will empower those actors most capable of realising the potential." (Foray *et al.*, 2009, p. 3). The policy cycle of observation, identification, evalua-

tion and decision became as prominent on the agendas of regional policy makers as ever before. It became essential to identify disciplines, technologies, domains (a) with enormous market potential and with the capacity to create externalities on the research and production system or (b) that showed critical masses (scale and/or agglomeration economies). At the same time "[w]ithout measurement activities leading to the production of indicators and the regular collection of systematic data, smart specialization is hardly visible and policies have no way to track progress, assess structural transformations and compare performance. [..] S & T[1] indicators and data are, therefore, needed to make smart more visible so that policy makers can grip it in order to design and bring innovative policy responses to science and technology issues" (David *et al.*, 2009). Consequently, it became indispensable to equip regional structures involved in the Smart Specialization Strategy (S3) definition with operational tools for continuous observation, detection and evaluation.

Moreover, as underlined in McCann and Ortega-Argilés (2011), the identification of sectors and technological domains became particularly complex for the regions which, as Apulia, were not innovation leaders: according to the last Regional Innovation Scoreboard, Apulia is a Moderate Innovator (European Commission, 2019). On the other hand, its regional administration, Apulia Region participates in the *Regional Innovation Strategies for Smart Specialisation (RIS3) Support to Lagging Regions* project carried out by the Joint Research Centre[2] to support the implementation of RIS3s in some less developed regions in EU. In order to further their capacity to monitor and evaluate the outcomes of their RIS3s, these regions recently developed (a) a report to share experiences for better tools and (b) opportunities to compare policy processes, outputs and outcomes via open data (open government data), open science and open innovation (Martí *et al.*, 2020).

In this context, in early 2015, as Apulia Region finalized its first specialization strategy, the regional administration asked its Technology and Innovation Agency, ARTI, to develop a tool to systematically collect data on regional economic structure and S & T indicators. As already mentioned, Apulia is a moderate innovation region. It ranks 235th in terms of the overall value of the RCI composite indicator among the 268 European regions included in the last edition of the Regional Competitiveness Index (RCI; Annoni and Dijkstra, 2019), and gains some points (218th place) in relation to its innovative performance. Apulia shows a good positioning in Europe in general, and in particular with respect to its "peer" regions, as regards specialization in high-potential sectors ("financial and insurance activities; real es-

[1] This abbreviation stands for Science and Technology, as usual in this strand of literature.

[2] https://s3platform.jrc.ec.europa.eu/ris3-in-lagging-regions

tate activities; professional, scientific and technical activities; administrative and support service activities") both in terms of gross value added and number of employees. Still compared to its "peers", it shows a relative advantage in terms of innovation pervasiveness both on the production system side (number of innovative SMEs, turnover from innovations, strategic innovations) and on the research side (scientific publications and R&D expenditure) (ARTI, 2020). Despite the increased attention to innovation by policymakers and the improved dynamics of high-tech activities, Apulia is still lacking substantial innovation performance. During the last decade, the share of intramural R&D expenditure on GDP rose and reached a maximum in 2015, 0.99%. After 2015, it decreased again: compared with 2015, in 2018 the share of R&D expenditure decreased (the value was equal to 0.78%), and continues to decrease compared with the EU28 and Italian average (2.11% and 1.43%, respectively) (Eurostat).

Consequently, this chapter is especially addressed to policy makers and practitioners ─especially those in need of updated information and structured analysis operating at the sub-national level─ that may find in the web tool developed by ARTI a good practice on which to graft a useful comparison.

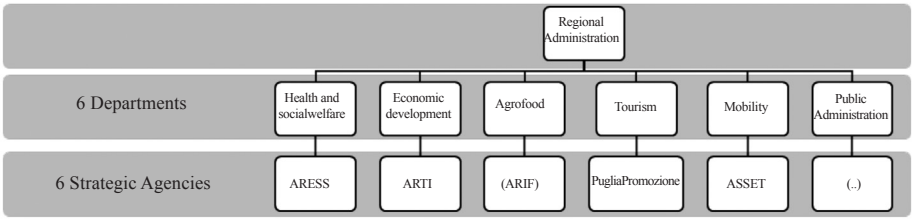
2. THE ROLE OF THE STRATEGIC AGENCY FOR ECONOMIC DEVELOPMENT IN APULIA REGION

Set up in 2004 by the Apulian Regional Council (Regional Law n.1/2004), ARTI became fully operational in 2005, becoming the main instrument to achieve the specific objectives set in the regional innovation strategy, based on the role of research and innovation for economic growth and social cohesion.

The reorganisation law adopted in 2018 (Regional Law n. 4/2018) further expanded the Agency's institutional aims, giving it the role of a Strategic Agency, in accordance with the provisions of the overall revision of the regional administrative apparatus denominated MAIA, launched in 2015 (Deliberation of the Regional Government n. 1518/2015). In particular, in the Apulian Government each of the 6 Regional Departments is now supported by its own Strategic Agency (Figure 1). In this institutional framework, ARTI supports the Department of Economic Development, Innovation, Education, Training and Jobs with a strong aptitude for *exploration activities*, i.e., the ability to identify and implement appropriate paths of innovation and change (O'Reilly and Tushman, 2004).

ARTI's activity aims at promoting and satisfying both the demand for innovation expressed by local enterprises and production systems, and the qualifications of human resources. Its main roles are strengthening of the regional innovation

Figure 1: MAIA, the Regional administrative apparatus in Apulia Region



ecosystem, and furthering relations between regional innovation players to promote technology transfers from research to industry. In line with national and European policies, the Agency contributes to the sustainable growth of Apulia, the promotion of a network of relations and exchanges between the subjects involved in the creation and use of new knowledge and new technologies, stimulating and encouraging innovative behaviour in the region, and furthering international technological exchanges in addition to participation in European research programmes (INTERREG, H2020). Moreover, the Agency supports the Regional Administration by collaborating in the preparation of policy documents and through the monitoring and evaluation of R&D programmes, activities and actions at the regional level. ARTI develops actions and projects in cooperation with and in support of a number of regional structures, particularly in the fields of economic development and innovation, education, training and work, and youth policies.

Its main institutional functions can be listed as follows:

- Analyses of the regional context (socio-economic, innovation).
- Policy-making proposals.
- Animation for territorial development.
- Management of innovation tenders.
- Monitoring and evaluation of policies and measures.

Among the main activities currently implemented by the Agency:

- The Apulian Innovation Overview (AIO) is a tool that systematizes the data of the socio-economic system and regional innovation collected by ARTI, converting them into synthetic indicators. The tool can be consulted on the Agency's portal and will be discussed in detail in the next section.
- The Regional Observatory of Education and Training Systems (ORSIF) is a systemic action of identifying the dynamics and orienting the planning of the Apulian training offers in a way that is consistent with the real needs of the territory and with the employment trends, verified on a national and international basis, in order to make the regional education and training system competitive

and attractive for students. The Observatory also support the Regional Administration in the identification and application of the most adequate simplification cost options - as required by European regulations - for regional tenders financed by the Eurpean Social Fund.

- The management of the Research for Innovation (REFIN) intervention, by which 170 researchers in Apulian universities with three-year contracts are hired to carry out research in priority innovation areas for the Region.
- The management of the Talents' Extraction intervention, which finances personalised support and acceleration courses aimed at teams of aspiring entrepreneurs within the priority areas of innovation indicated by the S3 of Apulia Region. Following a first call, the responding Factories, partnerships of public and private entities that will transfer skills and know-how to the teams, according to the best standards of business acceleration, are selected.
- The management of "PIN-Pugliesi Innovativi", i.e., the initiative of the Youth Policies of the Apulia Region aimed at young people who intend to implement innovative entrepreneurial projects with high potential for local development and good prospects for consolidation.
- The consideration of the regional cluster law's impact on regional production and its potential reform. In collaboration with the Regional Council of Apulia, ARTI is carrying out a policy monitoring activity, which consists of a scientific approach to assemble information in order to evaluate the impact of this legislation especially at a time when clusters are considered as essential players for the EU strategies.
- The monitoring of S3, through reconnaissance of S3 implementation policies, identification of appropriate methods, indicators and data to follow-up progress.

ARTI therefore intervenes at various stages of the decision-making process for regional policies, apart from the policy choices that remain the sole prerogative of the political decision maker.

3. APULIAN INNOVATION SCOREBOARD: THE RATIONALE BEHIND

The initial request for an instrument to collect data about the regional economic structure in general and indicators of innovation, science and technology in particular was triggered by the finalization of the Apulian specialisation strategy in early 2015. In the opening phase, the tool was called Apulian Innovation Scoreboard (AIS) and its purpose was twofold: to measure the performance of the Regional Innovative System (RIS), and provide policy guidance consistent with the S3.

For its implementation, a step-by-step approach was adopted:

- a careful recognition and reclassification of all information produced and/or gathered by the Agency;
- the conversion of the information into synthetic indicators useful for the desired purposes;
- clustering single indicators into contiguous sub-sets called “dimensions”;
- cataloguing of dimensions in five “Areas”: Context, Innovation drivers, Enterprises, Results, Policies;
- structuring the Scoreboard in a spreadsheet.

The first phase was particularly complex since the Agency, in its institutional and project activities, had collected data differentiated by source, survey methodology, sectoral focus, time horizons investigated. Starting from the individual reports produced, the areas of the indicators contained therein were carefully identified. Wherever possible, the individual indicators were also organized at the sectoral level (e.g., exports by NACE sectors, patents by IPC sectors, etc.).

In its first release, AIS was a simple spreadsheet in which very specific and homogeneous fields (columns) were identified for each indicator (raw/record). The brief description of the AIS is provided in Table 1.

Table 1: Description of AIS fields

AREAS	Each of the five areas AIS is composed of (context, innovation drivers, enterprises, results, policies)
DIMENSION	Sub-sets of indicators identified within each Area
COD_INDICATOR	Unique indicator code
TITLE	Indicator title
UNIT_MEASURE	Unit of measurement in which the value of the indicator is expressed
VALUE	Value assumed by the indicator
SECTOR_SPECIALIZATION	Special survey sector (wherever applicable) for which the indicator reaches the maximum value of the survey
INNOVATION_ AREA_S3	Reports the corresponding Priority Innovation Area, as identified in the Apulian S3
SUB_SETTOR_S3	Specialisation sub-sector(s) (wherever applicable)
COMMENT	Brief comment on the value of the indicator
YEAR_REFERENCE	Year to which the value of the indicator refers
SOURCE	Source of the data (from official source or from ARTI experimental survey)

Even in the original spreadsheet form, the AIS contained and accommodated multiple levels of use:

- By line: The immediate and most intuitive way to read the AIS was, of course, per line. Each line provided the value of each individual indicator along with comments and/or other information of interest.
- By column (in the case of SECTOR_SPECIALIZATION) featuring the category (NACE sector, S3 Priority Innovation Area, etc.) in which Apulia exhibited an "advantage" in relative terms (at the regional level) and/or in absolute terms (i.e., in comparison with the respective national value of the same indicator).
- By "dimension": Grouping contiguous indicators made it possible to easily and in a short time obtain a collection of up-to-date data from both official and *ad hoc* surveys, on a specific topic of interest.

4. AIO AS A WEB-BASED TOOL

In early 2016, taking advantage of the new functionalities offered by the transition of the Agency's website to its portal, ARTI began to design a web-based tool for easily updating in real time and publishing AIS indicators.

Over time this developed into a web-based information system[3], constantly updated, designed and implemented by ARTI, which systematizes historical series of indicators about the socio-economic system and innovation in Apulia. The tool is user-friendly and enhances the availability of information. It contains the most relevant official statistic indicators and information directly collected by ARTI (by experimental surveys, monitoring activities). To mark the discontinuity and underline the prospect of wide access to a comprehensive view of Puglia's innovation ecosystem, the instrument was renamed Apulian Innovation Overview (AIO).

To some extent, the structure of the AIO retraces the one developed for AIS: single indicators are grouped in DIMENSIONS, and dimensions in AREAS. In fact, the data continue to be grouped on the basis of five AREAS:

- CONTEXT: overview of the main Apulian macro-economic variables and of the international economic scenario;
- INNOVATION DRIVERS: allocation of human capital, resources invested in R&D activities, etc.;
- ENTERPRISES: innovative entrepreneurship, professional needs, competitiveness, partnerships, etc.;
- RESULTS: scientific publications, patents, spin-offs, etc.;

[3] www.arti.puglia.it/apulian-innovation-overview/

- POLICY: data deriving from monitoring activities.

These five areas are organized in 30 dimensions and 133 indicators (data updated on February 15, 2021, but continuously increasing). The system has three navigation modes:

- "standard";
- by "index": consulting the ordered list of all indicators;
- "fast": experienced users can easily select the desired indicator without having to navigate in a particular AREA or DIMENSION.

The standard navigation mode commences with the selection of a specific AREA. Each AREA page provides an explanatory text introducing its DIMENSIONS. Each DIMENSION page provides a list of all relevant INDICATORS along with a short preview text. Each INDICATOR page features:

- a detailed and rigorous description;
- comparative tables for time comparisons and territorial comparisons (usually with the national average and the level NUTS 1 "Sud");
- possible breakdowns by type, sector, category;
- guided graphs to display the evolution over time (e.g., the selection of a manufacturing sector creates a visual display of the sectoral share in overall regional exports);
- a direct link to the data source.

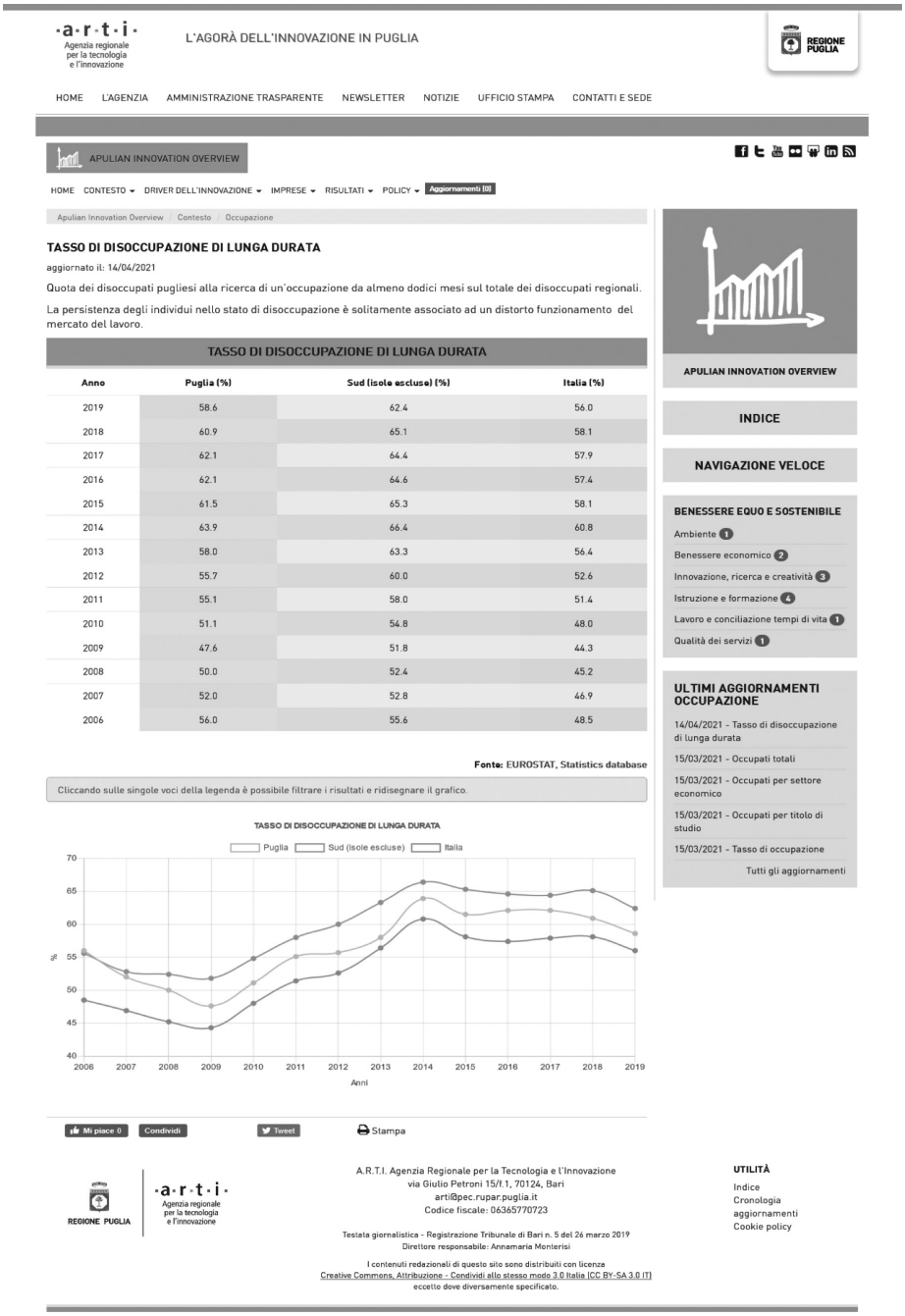
In Figure 2, an example of how an AIO page regarding an illustrative indicator is presented.

For the most part, the data currently contained in the AIO come from official, national (ISTAT, Register of Enterprises) and international (IMF, Eurostat) sources. As a result, the AIO may be considered as *one stop show* for a user interested in an easily accessible information on Puglia, and thanks to its user-friendliness, AIO allows also inexperienced users to have access to statistical information that is already available on official websites (IMF, Eurostat, etc.), but not easily accessible and/or consultable by non-professional users.

Before making it fully accessible to the public, the system was tested among relevant stakeholders selected from academics, representatives of the regional business community, and eminent national and international bodies representatives, in order to collect comments and suggestions. Subsequently, the web-tool was formally presented to the public in the institutional framework of the 81st "Fiera del Levante" in Bari in September 2017. Moreover, to make it easier to use, a user manual was prepared.

During 2020-2021, the AIO underwent a complete revision in order to resolve some structural problems (related to the computer code) and enhance the update and modification of indicators, and the organization of the material by ARTI's sta-

Figure 2: Example of how an indicator is presented in the AIO tool



tistical analyst. Additional functionalities and links to ARTI's thematic publications (Instant Report and inPillole) which are based on the datasets, were added. Now the date of the last update is specified for each and every indicator, the right column shows a summary of the five most recent updated indicators, and the "Update history" page shows all indicators, with their respective update dates, and it is feasible to search by field and by dimension.

Overall, the AIO is a dynamic tool as it is constantly updated, a tool integrated with other instruments developed by ARTI, and a flexible tool as it is easily expandable over time with additional ARTI or official source indicators.

5. POLICY IMPLICATIONS AND CONCLUSIONS

"Policy makers often decide in uncertain conditions where results are rarely known and can be reliably evaluated". The speech held by the former President of the European Central Bank, Mario Draghi, for the *Laurea Honoris Causa* from the Università Cattolica in Milan in October 2019, reiterates the need for policy makers to base their decisions on knowledge and verify the facts in order to reduce intrinsic uncertainty.

The new Apulian law (2018) requires the region's Strategic Agency for Economic Development, ARTI, to strengthen its exploration skills, making them synergic with those of exploitation. Previously, the Agency's activities had mainly focused on the latter ones. This regulatory requirement is one of the main challenges that arise in the transition phase that the Agency is going through, and is expected to greatly affect and redefine the Agency and its new organizational structure. In this perspective, one of the strategic objectives of the Agency is to equip itself with a *Knowledge Hub*, with the task of collecting, rationalizing, analysing data to produce and disseminate knowledge in the thematic areas of interest for ARTI. The Agency, through its relations on the territory and a continuous dialogue with its international partners, is therefore constantly listening not only to the exigencies expressed, but also to latent needs, always with an eye to *collaborative innovation governance*.

Essential it is also the continuous comparison with other regional experiences in the area of tools to support evidence-based policies. In this respect, relevant good practice can be traced in Italy for example in:

- Tuscany, with *Toscana Open Research*, the regional portal to communicate and enhance the Tuscan research, innovation and higher education system and to promote an increasingly transparent and inclusive governance;
- Emilia-Romagna, with *Innodata*, a smart aggregator of data and information

that can be used in a simple and intuitive way thanks to interactive dataviz that allow the user to get timely answers. In this portal the graphs are organized by themes and topics in order to facilitate navigation and make it easier for the user to find the area of interest.

In other European regions, good practises have been developed in Catalonia in Spain (with the Portal de Recerca de Catalunya), in the Netherlands (with NARCIS) or in Denmark (with the Danish National Research Database).

The AIO differs from other portals, insofar as it features a wide scope (not only related to higher education, research and innovation, but also to a good number of other relevant socio-economic variables), provides a rigorous yet simple description of the indicators employed, and direct access to data sources. In this perspective, according to a pre-defined rank index, the tool was selected via the INTERREG Greece-Italy project, egov_INNO, as one of the top 16 business intelligence applications to monitor the regional and cross-border entrepreneurship and innovation.

Continuously interpreting its institutional role as a strategic agency in support of regional economic development, ARTI builds and improves tools designed to support the regional innovative system. The AIO can be considered as a first step in this direction within the quadruple helix that comprises:

- policy-makers, who need to rely on updated information in order to reach policy decisions;
- researchers and entrepreneurs, who need updated background information about the Apulian Regional Innovation System;
- the general public, who want analyses expressed in a simple but rigorous language in order to form informed opinions and check on the decisions of policy-makers, thus keeping policy-making decisions accountable;
- researchers, investors and other agents to be attracted to the region by providing them with updated data on human capital, regional skills and the region's growth potential.

In the perspective that is essential to always take a step forward, the AIO created also a thematic series, "Instant Report". It is the ARTI series of on-line publications with in-depth thematic insights on the regional innovative system told through national and international analyses and comparisons. Other developments concern the creation of the catalogue of scientific and technological research in order to identify the connections between research groups and facilitate the processes of aggregation and integration on R&D projects. The new tool, currently in the evolutionary maintenance phase, will be in all respects the Apulia Research Gate (ARG).

Consequently, ARTI will continue to provide the regional innovation ecosystem with innovative services, considering also new potentialities offered by new

instruments, as open data, and by new technologies, as artificial intelligence. New services will be proposed as real products that ARTI makes usable externally: not only by the other regional structures, but, in a logic of open government and accountability, as a return to citizens and stakeholders of the results of political and administrative action.

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CHAPTER 5

REGIONAL AID TO COMPANIES: A PROPOSAL FOR ADDITIONAL EVALUATION CRITERIA

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ABSTRACT | Within EU policy development, evidence-based policy making has become more and more important, resulting in a greater attention to measuring the policy impact. During the current programming period (2014-2020), there has been a focus on monitoring the impact of projects funded by the EU for enterprise investments. More informed policies require more accurate data. In this chapter we propose new indicators to monitor the impact of EU funding for enterprise investments.

In this context Apulia Region's Administration, through its Section for Competitiveness and Research of the Production Systems, asked the Regional Strategic Agency for Technology and Innovation (ARTI) to identify a wider set of indicators for evaluating the impact of business aid on regional territories. These criteria could potentially trigger a more virtuous entrepreneurial behaviour from the medium to the long run.

The main purpose of this chapter is to contribute to improve the quality of public spending and investment support by proposing a set of criteria and indicators for selecting and evaluating investment projects proposed by Apulian companies. In addition to criteria currently in use, the proposed criteria are useful for assessing the overall impact of aid on the regional territory, identified along five macro-categories of indicators: Attractiveness, Supply chain vision, Human capital and workers' well-being, Innovation, and Circular economy. For each of these categories, we suggest several indicators measured from the start of the investment project and up to the end of the implementation phase. The authors detected adequate indicators and categorized them into five dimensions based on the Regional Operational Programme, the Industry 4.0 paradigm, the Regional Competitiveness Index, externalities connected to the Societal Challenges, and an explorative analysis of the data about regional aid to companies in the previous programming period (2007-2013).

1. INTRODUCTION

In the programming period 2014-2020 at the European level there has been a growing attention to the measurement aspects, considering both the improvement of the policies design and their impact on the territories. This tendency will become more evident in 2021-2027: the need for a stronger focus on results in Cohesion Policy post-2020 can be traced in Berkowitz *et al.* (2019). Authors claim that is important to measure impact at beneficiary level, especially at firm level, to trace transmission channels of intervention in different policy areas, including support to enterprises.

In this context, the Apulia Region is currently engaged in an overall reconsideration of its framework of aid to enterprises. The aim is, on the one side, the definition of policies that contribute more to the adoption of virtuous behaviour by the companies themselves and, on the other, the identification of criteria for monitoring and evaluating the impact that these policy actions produce on the territory. Puglia is located in the South of Italy: it covers an area of 19,370 km^2 and it is Italy's 7th largest region (out of 20) and also one of the most densely populated regions. Still, for the programming period 2014-2020, Puglia has been included among the less developed regions of those benefiting from European Structural Funds (i.e., with a GDP per capita less than 75% of the EU28 average). In 2018 the regional real GDP amounted to almost 77 million euros, in slight but steady growth from 2013, corresponding to about 4.5% of the national one (Eurostat, 2020). Regional GDP per inhabitant at PPS was 19,300 euros in 2018: if compared with the previous year, it increased by 3.2%. Puglia region is historically specialized in traditional manufacturing, such as textiles and metal products, but also in some more advanced sectors, such as aerospace technologies. The biggest steel production plant of Europe is located in Taranto. In 2017, in Puglia there were almost 271 thousand local units of active enterprises, corresponding to the 5% of all local units in Italy. Of these, 106 local Apulian units consist of large enterprises, while the vast majority are micro enterprises with fewer than 10 employees (95.8%). Overall, the local units employed more than 820 thousand workers. For the most part, local units are concentrated in commercial activities (32.3% out of all local units), professional, scientific and technical activities (15.3%), and construction (10.7%). The manufacturing units are more than 22 thousand. The largest number of workers are employed in food industries (26.5 thousand of people), the manufacture of metal products (15.8 thousand), clothing (13.9 thousand), and metallurgy (11.8 thousand) (ISTAT). The highest concentration of firms is in the provinces of Bari (a third of the total regional local units) and Lecce (21.7%).

This growing attention to measurement aspects is part of the context of the EU programming period 2014-2020: measurement is understood not only in relation to the progress of policies, but also with regard to their territorial impact. There is an increasing need to have and use accurate data for the elaboration of more informed and more responsive policies to the real needs of the territories for which they are designed, i.e., an evidence-based policymaking approach (Banks, 2010; Nutley *et al.*, 2010; Head, 2016).

In this context, the Section for Competitiveness and Research of the Production Systems of the Apulia Region asked ARTI, the Regional Strategic Agency for Technology and Innovation, to contribute towards identifying, on one hand, criteria and awards that can trigger a virtuous entrepreneurial behaviour in the short-medium term and, on the other, a more comprehensive dashboard of indicators to assess the impact of business aid on the regional territory.

Moreover, in a longer-term perspective, the Regional Administration's intention is to facilitate some territorial dynamics, in order to lead different areas on a more attractive path towards more sustainable living conditions for citizens and businesses, and for this reason more desired by present and future generations to live and work there.

Therefore, the main purpose of this chapter is to contribute to improve the quality of public spending and investment support by proposing a grid of criteria and indicators useful for the selection and evaluation of investment projects proposed by Apulian companies: a comprehensive list of "operational" indicators to assess the overall expected impact of the aid on the regional territory, identified along five main lines.

The criteria and the indicators included in the grid proposed in this study would therefore allow the Regional Administration to pursue different objectives: *i*) a more targeted selection of applications for aid with respect to their economic, social and environmental impact; *ii*) a more extensive monitoring of the interventions implemented, with particular emphasis on their territorial outcomes; *iii*) a possible recalibration of the measures; *iv*) more accountability, thus permeating all stages of policy making.

For the study, the authors consulted and used:

- resources found through desk researches, such as documents of institutional bodies and international organizations (United Nations, European Commission, Italian Parliament, Apulia Region), as well as other material considered of particular interest;
- the "Preliminary evaluation of applications for aid" of a number of projects under evaluation, which were provided by the Regional Administration itself to ARTI;

- data of some regional measure supporting business investments during the programming periods 2007-2013 and 2014-2020 provided to the Agency by the Intermediary Body, Puglia Sviluppo. These data were analysed using econometric techniques. Details of these analyses are provided in Section 6.

2. IMPACT OF COHESION POLICY AND REGIONAL AIDS IN THE LITERATURE

One of the first seminal work on State aids and the respective regional policy dimension can be found in Wishlade (2003). The author clarifies the legal basis for Community action in the field of regional development (1987 Single European Act, 1993 Maastricht Treaty, 1997 Treaty of Amsterdam, 1998 Guidelines on National Regional Aid), and discusses the justification for the use of subsidies in regional development policy.

Once national and regional intervention were legally justified, in the literature there were numerous efforts to measure the economic impact of Cohesion Policy on territories using different analysis approaches (diff-in-diff estimation techniques, spatial regression discontinuity design, spatial growth model, synthetic control, etc.). Some attempts were specifically directed at estimating rural development programmes: this is the case of the impact in less developed regions in Hungary (Bakucs *et al.,* 2019) and across all European countries (Castaño *et al.,* 2019). Both these research studies cast some doubts on the real effectiveness of rural development policy.

Quite different are the results regarding Cohesion Policy in general: for example, very recently Butkus *et al.* (2019) assessed the return of the EU's regional financial support at the NUTS 3 level over the 2000-2006 programming period confirming a positive effect on economic growth, even if highly conditioned by the institutional quality of the supported region (the same findings in Arbolino *et al.*, 2019). The estimates of Cerqua and Pellegrini (2018), Fiaschi *et al.* (2018) and Crescenzi and Giua (2019) are along the same lines. In the latter paper, Cohesion Policy is shown to have an impact on regional growth and employment, even if the effects are not equally distributed at the EU level, but rather concentrated in Germany (growth) and the UK (employment). Concerning this last aspect, the fear of losses resulting from Brexit had already been addressed in Di Cataldo (2016). He showed the improving effects on labour markets and economic performance in two of the most heavily subsidised regions in the UK and how these effects would disappear in the event of a reduction - or interruption - of EU aid. Evidence about the temporary effect of regional aid can be found in Barone (2016): in Abruzzi no

permanent higher per-capita GDP growth has been detected after Abruzzi's exit in 1996 from Objective 1.

Other authors focused their research towards assessing the impact of regional state aid on specific territories: Getzner (2007) considered Austrian federal states to test for the determinants of state aid and concluded that subsidies were used to support already competitive regions, whereas Ramboer and Reynaerts (2019) find evidence of Flanders' main industrial policy programme on manufacturing employment in terms of jobs safeguarded in declining industries.

A relatively substantial strand of literature looks into the impact of EU regional policy on the local labour market in Italy. Giua (2016) presents a positive impact on employment levels especially in key economic sectors for Italian Objective 1 regions; Arbolino et al. (2019) confirm that EU funds supported the resilience of Italian regional labour market during the Great Recession. By contrast, Cerciello et al. (2019) show a negative impact of the EU funds on labour market participation in Southern Italy.

3. THE CRITERION OF MAINTAINING AND INCREASING EMPLOYMENT

As remarked in the 2006 Commission Regulation No. 1628, "National regional investment aid is designed to assist the development of the most disadvantaged regions by supporting investment and job creation in a sustainable context" (p. 1). The aid should guarantee additionality: "It is important to ensure that regional aid produces a real incentive effect to undertake investments which would not otherwise be made in the assisted areas" (p. 3). As regards additionality in employment, the definition in the Regulation clarifies that "job creation means a net increase in the number of annual labour units (ALU) directly employed in a particular establishment compared with the average over the previous 12 months" (EC, 2006).

According to these regulatory provisions, in Apulia Region the applications for aid granting Programme Contracts (PCs) to Large Enterprises and Integrated Facilitation Programmes (IFPs) to SMEs are submitted to the Intermediary Body (Puglia Sviluppo) for a preliminary examination of their admissibility, practicability and feasibility (in terms of workability, timing of implementation, financial coverage, technical quality of the proposal). In this phase, particular attention is paid to the assessment of the impact of the project on economic development and employment in the regional territory. Currently, the sole criterion for evaluating a project's impact is based on "maintaining the levels of annual labour units (ALU) already present and the relative increases when fully operational".

In fact, an empirical verification carried out on the data available for the 45 Programme Contracts requested in the programming period 2007-2013 by Large Enterprises in Apulia Region proves how the average variation in employment (in relative percentage terms) has decreased over the years (Figure 1).

Figure 1: Apulian Programme Contracts 2007-2013. Employment - relative percentage change, years 2009-2014*

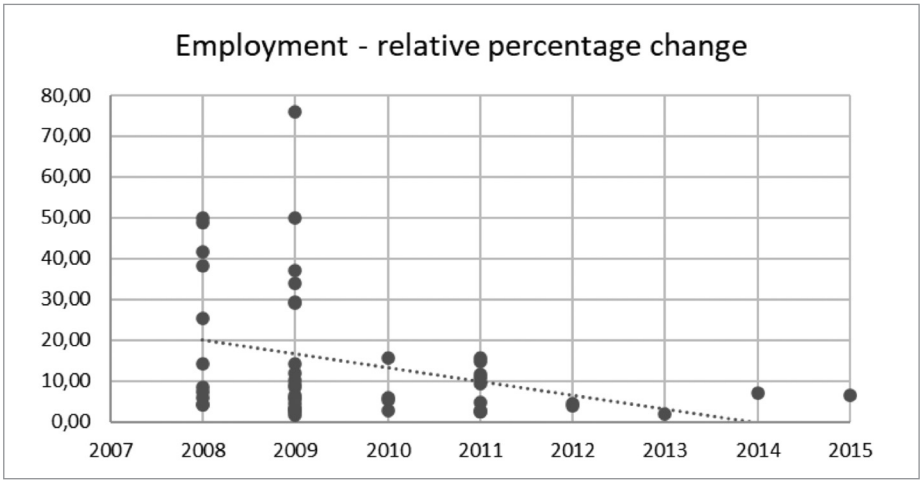


*Chart built on data from 66 companies with a non-anomalous change (less than 100%)
Source: ARTI elaboration on Puglia Sviluppo data

Therefore, the criterion of "maintaining the levels of annual labour units (ALU) already present and the relative increases when fully operational" has proved increasingly unsatisfactory in proving the additionality of regional interventions. To this end, some refinements of this criterion have been advanced, such as:

- to proportionate the increase in ALU with the public benefit granted, establishing "thresholds" in consideration of the minimum and the maximum investment amounts allowed. Anyway, it is important to note that existing literature (tested for the Italian Law No. 488/1992) raises critical issues as far as the application of this criterion is concerned (Brancati, 2001; Macchia, 2010; Pellegrini and Carlucci, 2003; Ministerial Reports 2003 and 2004);
- to assess the typology of additional ALU. On the basis of this criterion, it should be ensured during the assessment that there is consistency between the nature of the proposed investment and the additional ALU positions. Particular attention ought to be paid in the case of investments in Research and Development and in the activation of related new jobs.

Moreover, not only the increase in ALU should be considered, but also its effects in terms of productivity.

4. REFERENCE FOR THE PROPOSAL FOR ADDITIONAL INDICATORS

Moving to the core of this study, we propose a grid of additional operational indicators in order to contribute to improve the quality of public spending and supporting regional investment.

To advance its proposal, ARTI has drawn indications from a number of regional, national and European references:

- Regional Operational Programme 2014 – 2020.
- Industry 4.0.
- European Regional Competitiveness Index.
- Externalities and Societal Challenges.

In addition, in the short-to-medium term, further considerations will be made for the objectives of the Agenda 2030. In September 2015, the United Nations approved the Global Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), further subdivided into 169 targets to be achieved by 2030. The Italian Regions are called upon to contribute to the achievement of these objectives. As the Italian Association for Sustainable Development reports: "It is at the territorial level, in fact, that the impact of many policies and the translation of the achievement of the Agenda 2030 Objectives into a higher welfare of citizens is concretely observed. And it is in the territories that those policies of consultation, inclusion and participation of citizens in the monitoring and evaluation phase of the policies implemented can be more effectively implemented" (ASviS, official website).

In this regard, the Apulia Region has successfully participated in the public notice addressed to the regional structures committed to the fulfilments foreseen for the implementation of the National Strategy for Sustainable Development (by art. 34 of the Legislative Decree no. 152 of April 3, 2006 and subsequent amendments and additions), with particular reference to the process of elaboration of the Regional Strategies for Sustainable Development. In particular, during 2018 Apulia Region participated in two expressions of interest published by the Italian Ministry of the Environment, receiving a contribution of two hundred thousand euros to start the process of adopting the regional sustainable development strategy[1]. Moreover,

[1] To that end, a Regional Steering Committee has been set up. The committee operates in three

in October 2019, Apulia Region adopted the first law in Italy on the Regional Strategy for Sustainable Development called "Fair and Sustainable Welfare to support regional financial and budgetary planning". With this measure, the Apulian Regional Council defined the indicators of fair and sustainable welfare in support of the regional financial and budgetary planning, and envisaged a scientific committee for monitoring.

On the subject of externalities and Societal Challenges, the Apulia Region itself, in its Regional Strategy for the Smart Specialization Strategy (S3) "SmartPuglia 2020" (approved on August 1, 2014), links the public need for innovation to five Societal Challenges:

- Sustainable cities and territories.
- Health, well-being and socio-cultural dynamics.
- Sustainable energy.
- Creative industry (and cultural development).
- Food security and sustainable agriculture.

The reference to the Regional Societal Challenges, included in some regional calls for Thematic Objective 1 - "Research, Technological Development and Innovation", could certainly find space also in the examination of companies' investment projects.

In addition, a careful examination and comparison between European Societal Challenges (H2020) and regional Societal Challenges show a clear convergence of themes (Table 1). However, it is important to note that in the strategic document "SmartPuglia 2020" there is no reference to "secure societies" (Societal Challenge no. 7) ─a challenge that can be clearly pursued only at the national level. On the other hand, it is worth noting the interesting regional reference to the challenge for Sustainable Cities and Territories. It will be necessary to focus on this aspect for a broader and longer-term policy: to create better conditions and make territories more attractive in a citizens, students, and businesses' perspective. This topic would be grafted onto the broader theme of the circular economy: "the great challenge that Italy [...] will face in the next decade is to respond adequately and effectively to the complex environmental and social dy-

different areas: *i*) the elaboration of a regional governance for the coordination of the institutional actors involved in the procedure; *ii*) the identification of tools for information sharing and the participation of stakeholders; *iii*) the drafting of a strategy based on the contributions collected and in line with the aims of the Regional Agenda 2030. All regional departments with competences on environment, economic development, financial resources and budget, health, tourism and culture, along with the regional section for the safety of the citizen, and the Managing Authority of the Regional Operative Programme Puglia 2014-2020, are part of the Governance cabin.

namics, while maintaining the competitiveness of the productive system" (Italian Ministry of the Environment and Minister of the Economic Development, 2017). The circular economy, together with digital transition, may define an economic paradigm shift, understood as a new way of conceiving the relationship between economy and environment.

Table 1: Comparison between the Societal Challenges of Horizon 2020 and the social challenges of SmartPuglia 2020

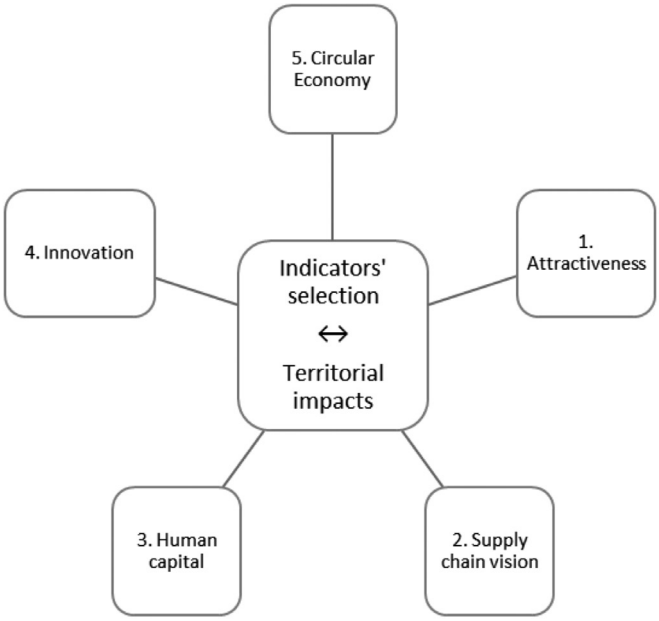
H2020 Societal Challenge	Social Challenges SmartPuglia 2020
1. Health, demographic change and wellbeing	Health, well-being and socio-cultural dynamics
2. Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy	Food security and sustainable agriculture
3. Secure, clean and efficient energy	Sustainable energy
4. Smart, green and integrated transport	
5. Climate action, environment, resource efficiency and raw materials	
6. Europe in a changing world - inclusive, innovative and reflective societies	Creative industry (and cultural development)
7. Secure societies - protecting freedom and security of Europe and its citizens	-

Source: ARTI's adaptation

5. SELECTION AND RECLASSIFICATION OF ADDITIONAL INDICATORS ACCORDING TO THEIR IMPACT ON REGIONAL TERRITORY

According to the region's Section for Competitiveness and Research of Production Systems, criteria and indicators have been selected and reclassified on the basis of five main "guiding principles" (Figure 2), in order to highlight the impact, i.e., the overall spill-over effects that business investment proposals may produce (in ex ante terms) or have produced (in ex post terms) on the territory.

Figure 2. Reference scheme for additional new criteria for ex-ante and ex-post monitoring and evaluation. Guiding principles for the selection of indicators



In detail, the five guiding principles are:

1. Attractiveness

There are several considerations regarding attractiveness. At the micro level (i.e., the level of a single enterprise) and in the medium-term, attractiveness means the ability of the single enterprise to create in its territory the critical mass necessary to trigger a process of sectoral agglomeration. However, in a longer-term perspective, the intention of the Regional Administration is to facilitate the territorial dynamics, in order to lead them on a path of a greater attractiveness, a path towards more sustainable living conditions for citizens and businesses and therefore desired by present and future generations to live and work there. The presence on the territory of more virtuous companies can certainly support a process of this kind. From an industrial point of view, we could speak of an ecosystem: it is formed not only by companies operating in the regional area, but also by companies that manage material and immaterial infrastructures and industrial relations, by public administrations that facilitate the process of establishment and growth of the company, by schools and universities. At an even more general level, we can speak of *Apulian life style*.

2. Supply chain vision
This guiding principle considers the company not as a single entity, but rather a component part of a comprehensive value chain model, with relationships upstream (suppliers) and downstream (customers). Also the horizontal relationships with other companies beyond commercial relationships are of paramount importance to strengthen the so-called "social capital" or the "shared value".

3. Human capital
The Regional Administration is aware of the role of human capital and higher education for the territorial development. For this reason, a series of considerations have been included in the grid that take into account the active role of SMEs and large enterprises in the processes of lifelong learning, skill adaptation, and their involvement in tertiary training institutions (Higher Technical Institutes and Universities). Moreover, further aspects related to the working and personal conditions of workers, gender equality, and non-discrimination have been added in the grid.

4. Innovation
Considerations regarding the "driving" role of innovation for the development of a territory, with particular attention to the digital transition of the regional production system, along with the leading role that larger companies can play in the territory have been taken into account.

5. Circular economy
Considerations regarding sustainability, the externalities of production processes and social challenges are certainly the most original ones of the proposed approach. The issues related to the circular economy may lead to a radical reconsideration of current production processes, and will certainly have a lasting and long-term impact. Bottom-up decisions, starting from the production choices of a single company, can ignite imitation and snowballing processes for entire cities and territories about becoming more sustainable. The territories that will be the first to recognise the strategic nature of this change and act to promote it may gain a competitive advantage and therefore see their attractiveness increased.

Therefore, starting from the careful considerations developed on these individual guiding principles, the Regional Administration will be able to identify an effective dashboard of additional criteria and indicators for the selection and monitoring of funded projects.

The criteria identified are in fact organized:

- At the ex ante level. Since the intensity of regional aid can be quantitatively

modulated between a maximum and a minimum, it will be possible to provide for increases in the incentive system and, thus, contribute towards triggering a virtuous behaviour by companies, in line with the regional strategic guidelines.

- At the ex post level. The Regional Administration will identify and use specific indicators assessing the impact of aid to businesses on the regional territory.

All five guiding principles selected are equally important for the formation of the grid, but they may be 'weighted' differently depending on the specific objective of the individual regional measure.

The table below summarizes the criteria and indicators proposed for each guiding principle (Table 2).

Table 2: Proposal for a grid of additional criteria for the evaluation of large (PCs) and small and medium-sized enterprises (IFPs) investment programmes

Guiding principle	Indicators' basket
1. Attractiveness	Agglomeration Production process upgrading Foreign investments attracted Sustainability
2. Supply chain vision	«Demand effect» of investments Impact on the local supply chain Networking and social capital Positioning in foreign markets
3. Human capital	Attracted and trained resources Upskilling of existing ALU Training of additional ALU Links with the secondary and tertiary education system Working conditions Gender equality Disadvantaged persons
4. Innovation	Product innovation Process innovation R&D expenditure R&D personnel Industrial Spin Off
5. Circular economy	Environmental impact Carbon reduction/CO_2 Reduction and/or reuse of process waste

6. EXPLORATORY ANALYSIS OF TWO REGIONAL AID MEASURES: THE PROGRAMME CONTRACTS (PCS) AND THE INTEGRATED FACILITATION PROGRAMMES (IFPS)

In order to complete this study, we carry out an exploratory analysis of the data of the projects financed by two regional measures: the "Programme Contracts" (for Large Enterprises) and the "Integrated Facilitation Programmes" (for SMEs) approved during two programming periods (2007-2013 and 2014-2020). A similar empirical analysis has been proposed for Czech food processing firms in a paper where the impact of the 2007-2013 Operational Programme Enterprise and Innovation has been assessed (Dvouletý and Blažková, 2018).

It is important to note that the econometric analysis presented below is essentially empirical and conducted to obtain some insights for the identification of additional indicators. Therefore, it is an exercise without claiming to identify robust relationships between the available variables.

6.1. The model

The objective of the empirical exercise is to consider the signs of the coefficients of a hypothetical linear relationship between employment variation in the Apulian enterprises supported by regional aid (PCs or IFPs) and some explanatory variables, selected among those available. Other specification may better fit the data, however, in the context of an initial experimental analysis at the regional policy level, employing a simple linear expression may better help grasp the fundamental issues.

For the purposes of this study, a multivariate linear regression is set up:

$$y = \beta * x$$

where:

- y is the dependent variable, namely the relative change in employment;
- x is the set of independent variables, i.e., the factors that may have influenced the employment level;
- β is the set of regression parameters (coefficients), which give a measure of how much a unitary variation in the independent variables affects a variation in the dependent variable. The relationships between dependent variable and independent variables can be either positive or negative, depending on the signs of the parameters.

As regards the employment variation, the relative percentage variation has been considered and not the absolute variation, since in these cases the relativization of the data is to be considered appropriate.

6.2. PCs in the programming period 2007-2013

In the programming period 2007-2013, 45 Programme Contracts were initially granted, for a total of 84 companies involved. The data refer to all the companies that, individually or in groups, applied for the regional grant, regardless of whether the investment has been made or not. The data refer to the information available at the time of granting, and do not take into account the fact that some companies subsequently declined.

Several model specifications were analysed (Table 3).

Table 3: 2007-2013 PCs. Model specifications

	Dependent variable: employment relative percentage variation					
	1° model#	2° model#	3° model#	4° model#	5° model*	6° model*
Independent Variables	Total Eligible Investments (Location of investments at NUTS3 level)	Eligible investments in tangible assets Eligible investments in R&D activities (Location of investments at NUTS3 level)	Total grants (Location of investments at NUTS3 level)	Grants for tangible assets Grants for R&D activities (Location of investments at NUTS3 level)	Share Capital Turnover	Share Capital Profits

#Models 1-4 have been estimated with or without territorial dummies[2]
*Share capital, turnover and balance sheet profit data are available only for 82 of the 84 companies.

Main results in Table 4.

[2] To enter the province of investment location in the model, as many dummy variables as there are provinces were built. The dummy variable assumes a value of 1 if PCs proposes investments

Table 4: 2007-2013 PCs. Multivariate linear regression results

Model	Significant variables (p-value<0.05) and regression parameter value. No. obs. = 84	
	with territorial dummies – at NUTS3 level	*without territorial dummies*
1	Location of investments _Foggia (0,229) Total Eligible Investments (0,360)	Total Eligible Investments (0,413)
2	Location of investments _Foggia (0,243) Eligible investments in tangible assets (0,384)	Eligible investments in tangible assets (0,429)
3	Location of investments _Foggia (0,313) Location of investments _Taranto (0,283)	Total grants (0,249)
4	Location of investments _Foggia (0,313) Location of investments _Taranto (0,283)	Grants for tangible assets (0,267)
	Significant variables and regression parameter value	
5	Share Capital (0,545)	
6	Share Capital (0,545)	

Source: ARTI elaboration on Puglia Sviluppo data

On the basis of this empirical evidence regarding the programming period 2007-2013 and the 45 Programme Contracts under review, it seems that increased investments in tangible assets affected the expectation of increased employment. A larger share capital (to be understood as a possible proxy for a company's solidity) also affected the expectation of increased employment.

The provinces of Foggia and Taranto featured a higher average increase in employment compared to other provinces or, perhaps, in the territories of the provinces of Foggia and Taranto, generally more fragile from an economic and social point of view (ARTI, 2020), investments were expected to have a greater leverage effect.

6.3. PCs and IFPs in the programming period 2014-2020

On the basis of the information provided by the Intermediary Body (updated in November 2018), in the programming period 2014-2020:

- 40 Programme Contracts (62 enterprises in total, including 45 large enterprises, 4 medium-sized enterprises, 13 small enterprises),

in that province, otherwise it assumes a value of 0. In the model, the provinces of Bari and BAT have been aggregated, for a total of five territorial dummies. The intercept has been excluded from the model to eliminate collinearity problems.

- 71 IFPs to small enterprises, and
- 67 IFPs to medium-sized enterprises

were granted.

Given the incompleteness of the ALU data, only a sub-set of investment projects were taken into account in the analysis:

- 36 Programme Contracts from a total of 58 enterprises involved (including 41 large, 4 medium and 13 small enterprises);
- 67 small enterprises and 55 medium-sized enterprises involved in as many small and medium-sized IFPs.

To deal with the issue of "scale" in the amount of investment, we carried out differentiated analyses: on the one hand all the companies involved in the PCs, regardless of their size, and on the other hand those involved in the IFPs, both small and medium. In both cases, the size of the individual companies was incorporated in the model in the form of an additional independent variable.

Moreover, with respect to the programming period 2007-2013, in the period 2014-2020 there is more information for each investment programme in the form of connections with one (or more) Priority Innovation Areas among those identified in the Regional Smart Specialisation Strategy, "SmartPuglia 2020".

In summary, the different specifications of the model us ed to analyse the two measures in the programming period 2014-2020 are shown in Table 5.

Table 5: 2014-2020 PCs and IFPs. Model specifications

Independent Variables	Total Eligible Investments	Eligible investments in tangible assets	Total grants	Grants for tangible assets
	(Location of investments at NUTS3 level)	Eligible investments in R&D activities	(Location of investments at NUTS3 level)	Grants for R&D activities
	S3 Priority Innovation Area	Eligible investments in innovation services	S3 Priority Innovation Area	Grants for innovation services
	Enterprise Size	(Location of investments at NUTS3 level)	Enterprise Size	(Location of investments at NUTS3 level)
		S3 Priority Innovation Area		S3 Priority Innovation Area
		Enterprise Size		Enterprise Size

#Models 1-4 have been estimated with or without territorial dummies

For each of the two regional measures examined, the results of the multivariate linear regression model are provided: the significant variables are listed, each with its own regression parameter (Table 6).

On the basis of the evidence regarding the programming period 2014-2020, we may conclude that in the case of Programme Contracts the increase in employment is connected to the value of investments, in particular to the component linked to investments in Research and Development, and that in the province of Foggia the expected increase in employment was greater than in other provinces.

Table 6: 2014-2020 PCs and IFPs. Multivariate linear regression results

2014-2020 PCs		
Model	Significant variables (p-value<0.05) and regression parameter value. No. obs. = 58	
	with territorial dummies – at NUTS3 level	*without territorial dummies*
1	Location of investments _Foggia (0,382) Total Eligible Investments (0,217)	Total Eligible Investments (0,316)
2	Location of investments _Foggia (0,416) R&D Investments (0,231)	Eligible investments in tangible assets (0,217) Eligible R&D Investments (0,247)
3	Location of investments _Foggia (0,371) Total grants (0,286)	Total grants (0,373)
4	Location of investments _Foggia (0,417) R&D grants (0,256)	Large companies (0,321)
2014-2020 IFPs		
Model	Significant variables (p-value<0.05) and regression parameter value. No. obs. = 122	
	with territorial dummies – at NUTS3 level	*with territorial dummies – at NUTS3 level*
1	Location of investments _Taranto (0,166) Total Eligible Investments (0,381)	Total Eligible Investments (0,420)
2	Location of investments _Taranto (0,166) Eligible R&D Investments (0,160) Eligible investments in tangible assets (0,273)	Eligible investments in tangible assets (0,311) Eligible R&D Investments (0,164)
3	Location of investments _Taranto (0,165) Total grants (0,382)	Total grants (0,421)
4	Location of investments _Taranto (0,159) R&D grants (0,174) Grants for tangible assets (0,266)	Grants for tangible assets (0,399)

Source: ARTI elaboration on Puglia Sviluppo data

On the other hand, in the case of the Integrated Facilitation Programmes, we may conclude that the expected increase in employment was greater in the province of Taranto compared to other provinces, and that both components of the investment, in synergy, "drove" the expected employment increase.

As far as Priority Innovation Areas are concerned, there are not significant differences between them with regard to their possible impact on employment growth.

A more in-depth examination of the datasets used in the analyses, and in particular of the dependent variable, reveals the presence of some anomalous values (so-called *outliers*). These values are by and large observed when the starting ALU value is zero, which implies a very high relative variation. Anyway, particular attention should be drawn to the possible influence of these outliers on the estimates and the need to evaluate the results with due caution.

In conclusion, the main results of this exploratory exercise are summarised as follows.

With reference to the Programme Contracts for the period 2007-2013:

- employment growth could be especially due to the solidity of the company (measured by share capital);
- in the provinces of Foggia and Taranto (NUTS3 level) there is a greater additionality of the interventions, again in terms of employment growth;
- the size of the investment in tangible assets would be among the first factors to contribute to employment growth.

With reference to the 2014-2020 Programme Contracts:

- despite the small number of firms involved in the province of Foggia (4 out of 58), it is precisely in this province that we can observe a greater additionality of measures in terms of increased employment. Moreover, the available data indicate that 44 new jobs will be created for every 100,000 inhabitants in active age (the result is second only to that recorded for the province of Bari, with 49.4 new jobs for every 100,000 inhabitants in active age);
- unlike what was observed in the previous programming period, the size of the investment in R&D would be among the first factors contributing to the increase in employment.

Finally, considering the Integrated Facilitation Programmes in the programming period 2014-2020 we can affirm that:

- although there are only six enterprises involved (out of 122), in the province of Taranto there is a greater additionality in terms of the expected increase in employment. In this case, the data indicate about 37 new jobs for every 100,000 inhabitants in active age;
- despite the fact that there is no obligation, the investments in research and development of the small and medium enterprises involved in the IFPs have

reached about 85% of the total investments in material assets. In this case, the close synergy between the two types of investments may lead the local production system to a virtuous circle of strengthening production levels and, therefore, employment.

In conclusion, the investment projects of firms considered during the programming period 2014-2020 may be more effective in terms of boosting employment in the provinces (NUTS3) of Foggia and Taranto, despite the small number of firms affected by the measures so far. Moreover, the strategic role of investments in research and development for both measures analysed is apparent in the empirics.

7. EXPERIMENTAL APPLICATION OF NEW CRITERIA

Once the criteria and indicators are activated for the selection (in terms of *ex ante* plus) and/or for monitoring of regional funding for business support (*ex post*), additional phases regarding their study ought to be carefully planned:

1. testing of reward criteria on selected call (as explained below);
2. exact definition of the indicators (in terms of unit of measurement, reference time interval, expected sign, minimum thresholds, etc.). At this stage, also the Sustainable Development Goals (SDGs) must be considered;
3. development of the survey instrument deemed most appropriate;
4. design and implementation of an information tool for data collection (data warehouse);
5. analysis and processing;
6. presentation of the results.

Particular attention should be paid to points 3 and 4, since for the implementation of this system it is crucial to have an information system for data collection and processing, equipped with an architecture that allows strategic governance of the data and the "continuous" provision of data (as proposed by Berkowitz *et al.*, 2019).

In fact, from February 2020 the Apulian Regional Government started a first pilot application of this approach to be applied to the last phase of the programming period 2014-2020 of the European funds. For this purpose, a first set of indicators, in compliance not only with regional industrial policies but also with the framework of regulation and restriction on state aid provided by European law, was introduced in the public call of Programme Contracts to Large Enterprises and Integrated Facilitation Programmes to SMEs.

This procedure required three different steps:

1. Sharing of the indicators with the economic and social partnership of the Apulian ERDF-ESF Regional Operational Programme, composed by employers' associations, trade unions and other stakeholders responsible for the protection of emerging interests in the region.
2. Adoption of a resolution by the political direction of the Regional Government.
3. Final approval by the Section for Competitiveness and Research of Production Systems.

To date, the experimental indicators, in the *ex ante* phase, do not represent indispensable requirements for access to regional instruments, but help generate positive consideration. Specifically, additional points - in terms of higher aid percentages - are allocated to:

- Enterprises forming a business network and to SMEs achieving a legality rating: in such case the project receives an aid intensity of 5 percentage points higher. If the business network includes the participation of a start-up, the aid intensity increases by 10 percentage points.
- Enterprises that anticipate an employment increase equal to at least one annual labour unit (ALU) for every three thousand euros contribution received by Apulia Region, or commit to maintain the level of employment at full capacity for a period of time longer than one year: in such case, the regional aid increases by 5 percentage points.
- Enterprises that demonstrate particular attention to female employment by featuring 50% women employed in at least one of the categories of workers employed in the year (full capacity), and in the following three years: in such cases the aid intensity increases by 5 percentage points.
- Companies that present projects aiming to enhance human capital, such as the adoption of an advanced training plan, school-work projects, the acquisition of an ethical and/or social certification or, in general, the implementation of projects for the improvement of workers' conditions: in such cases, the project receives aid increased by 5 percentage points.
- Companies that implement sustainable production systems, in line with the principles of circular economy and with a sustainable and long-term impact: in such cases the aid intensity increases by 5 percentage points.
- Companies that put forward projects for the purchase and recovery of existing and unused buildings: in such cases the increase in the aid percentage is 10 percentage points.
- Companies that locate the initiative within the two Apulian Special Economic Zones, called "Adriatica" and "Jonica", where a more favourable tax regime is applicable: in such cases the aid intensity increases by 5 percentage points.

The results of the application of this aid intensity mechanism will be evaluated

for the drafting of the calls for proposals in the coming programming period 2021-2027, in which they will certainly have a more significant application.

8. CONCLUSIONS

Which are the industrial sectors and which are the sizes of business in which co-financing public funds are most valued? In which territories and with which type of investment is the maximum multiplier in terms of jobs created achieved? How can we face the substitution effect between man and machine caused by Industry 4.0 and artificial intelligence technologies?

These are all questions that policy makers in charge of regional industrial policies ask themselves. The answers to these questions, and the data collected and made available to political decision-makers, are in themselves the determinants of regional development. They provide, however, evidence whose importance and necessity are increasingly universally considered as useful in decision making.

Since S3 is composed not only of "smart" or "strategy" but also and above all of "specialization", this means making choices. Given that these choices are taken by the elected representatives of the people, the policy makers deserve to make as best informed decision as possible on the options, the facts, the prospects, and choice — where "decision" means "irreversible allocation of resources".

Therefore, one can understand how important for the different phases of the policy cycle is to have: the correct identification of the relevant indicators, the collection of *ex ante* data in relation to those indicators, the application of the indicators as requirements or as a source of reward in the incentive instruments, the collection of *ex post* data, and the elaboration of the same in order to understand the consequences of the choices made, namely their territorial impact.

The pilot experiment Apulia Region is working on and the procedure described in this work will have, among others, the advantage of activating a data collection circuit upstream and downstream through shared methodologies and standards at the European level, so as to make the local economic situation more understandable, before and after the activation of regional policies. In addition, the same methodology, slightly adapted, could be easily applied in other regions, and make available a greater amount of data. It is increasingly essential in cases of benchmarking exercises to have an objective database from which to start making comparisons and adaptations.

The expected result in the medium and long term, on the other hand, is to activate virtuous phenomena in the target companies of the projects co-financed by the Region, in their suppliers, their customers, their partners in the scientific or

industrial symbiosis projects, in their workers (trained or re-trained for the work to be done), and the industry at large.

For this reason, the present work must be considered only as a "first step" of a series of steps that will accompany an overall process of a broader methodological reform that will systematically accompany the development of the contents of the regional industrial policy of the Apulia Region in the coming programming period.

Acknowledgements: The authors would like to thank Rossana Mancarella for her helpful assistance in data elaboration.

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CHAPTER 6

DEVELOPING E-SERVICES AND DATA COLLECTIONS TO IMPROVE THE BUSINES CLIMATE IN WESTERN GREECE

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ABSTRACT | The chapter focuses on the development of both electronic government-to-business services and an on-line observatory as means to further entrepreneurship and innovation (E&I) and, thus, improve the business climate in Western Greece. More specifically, it describes (i) eleven services employed around the world to promote E&I, which are missing in Western Greece, and (ii) an on-line system for collecting and presenting official statistics and data obtained from local businesses and the general public ─ statistics and data that are deemed useful at the international level for constructing E&I measures, and carrying out sectoral, local, regional and other analyses to inform stakeholders and policy-makers on E&I matters. It also reports on the progress made, and provides some thoughts on how the agenda will unfold in the years to come.

1. INTRODUCTION

In 2016, in order to address the consequences of Greece's the 2009-16 economic downturn, the regional authorities of Western Greece, with the limited powers delegated to them by the central government and the scarce resources available to them, took the initiative to reverse the situation from the supply side. With the help of KEPE, the largest economics research institute in Greece, they wrote down a

low cost action plan which became their *European Entrepreneurship Region (EER) Strategy of 2017* (Region of Western Greece, 2016). A key-goal was to advance entrepreneurship and technology (i.e., the two components of multifactor productivity, MFP) via a number of ways, including the development of an on-line platform with (a) electronic tools and services, and (b) data-collection and presentation systems (Economou et al., 2016; Prodromidis and Papaspirou, 2017). This was carried out in 2019-20, and is fleshed out hereinafter.

The rest of the chapter is organized as follows: Section 2 outlines the electronic data-collection and presentation system envisioned, and the progress made thus far. Section 3 describes a number of electronic tools and services considered. Section 4 reports on the said tools' development, and provides some thoughts on the work ahead. Section 5 provides the conclusions.

2. DATA-COLLECTION AND PRESENTATION SYSTEMS

The data-collection and presentation systems are intended to support entrepreneurship and innovation (E&I) by:

(a) Bringing together via automated and semi-automated downloads regional and subregional statistics produced by Eurostat, the European Commission, nationally authorities, and others, in order to develop indices of (i) average firm size, market size, and profitability at the sectoral level, (ii) worker productivity at the sectoral level, (iii) human capital, (iv) consumer income, (v) funding directed to research and innovation activities (see Table 1), and (vi) other aspects that may become available, with the aim of identifying strengths and weaknesses, and formulating and assessing policy interventions.

(b) Soliciting from the general public, business people, and aspiring business men and women, via structured questionnaires (i) their views regarding entrepreneurship and the business environment, (ii) their entrepreneurial experiences and expectations, (iii) the views of their community, with the aim of charting their business background and involvement, and understanding the local business culture.

(c) Soliciting from business people:
   - E&I facts and figures so as to engage in better informed policy. For instance: (i) the reasons for starting an enterprise, the obstacles, the ease of doing business, the export opportunities; (ii) information on the introduction of goods or services and of process innovations, on research and development (R&D) expenditure, on where innovations were developed.

Table 1: A quick guide for estimating useful indices after the measures provided by Eurostat and the European Commission at the NUTS 2 level

(i) The firm size measure is proxied by the number of persons employed over the number of firms. Profitability is proxied by the ratio of gross operating surplus over turnover. For both see item 1, below. The market size measure is estimated from the population. See item 2.a.i, below.
(ii) Worker productivity is broken down into (a) gross value added per hour of work and (b) hours of work per worker, to better track developments. See item 2, below.
(iii) Human capital is proxied by the share of people with a tertiary education degree, and the share of people with secondary education degree(s). See item 3, below.
(iv) Consumer income is proxied by the GDP per capita. See item 2, below.
(v) The funding directed to research and innovation activities is proxied by the EU's structural and investment funds directed to research and innovation per capita during the 2014-2020 and/or the 2021-27 planning periods. See the penultimate link provided in Table 2.

With the exception of the elements mentioned under item (v), the rest are accessed via Eurostat's regional datasets link:
https://ec.europa.eu/eurostat/data/database > Database by themes > General and regional statistics > Regional statistics by NUTS classification

1. Regional structural business statistics > SBS data by NUTS 2 regions and NACE Rev. 2 (from 2008 onwards) [sbs_r_nuts06_r2]
2. Regional economic accounts
   a. Gross domestic product indicators
      i. Average annual population to calculate regional GDP data (thousand persons) by NUTS 3 regions [nama_10r_3popgdp]
      ii. Gross domestic product (GDP) at current market prices by NUTS 2 regions [nama_10r_2gdp]
   b. Branch and household accounts
      i. Gross value added at basic prices by NUTS 3 regions [nama_10r_3gva]
      ii. Employment (thousand hours worked) by NUTS 2 regions [nama_10r_2emhrw]
      iii. Employment (thousand persons) by NUTS 3 regions [nama_10r_3empers]
3. Regional education statistics > Regional education statistics - ISCED 1997 > Population aged 25-64 by educational attainment level, sex and NUTS 2 regions (%) [edat_lfse_04]

These are factors considered in other such surveys in the EU and elsewhere, as well. (See Table 2.)

- Basic production information (on inputs and output) in order to estimate TFP and input productivity measures at the local, regional, good or service or sectoral level. (E.g. by Prodromidis, 2019; and the sources cited therein.)

(d) Soliciting from business people (i) their satisfaction levels from the price, quality, and other features of the inputs and transportation used, along with (ii) significance weights assigned to the said features, in order to identify and weigh the importance of problems or glitches along the value chain, and to

Table 2: Links to data and indices considered in E&I research projects

Eurostat Entrepreneurship Indicator Programme: https://ec.europa.eu/eurostat/web/structural-business-statistics/entrepreneurship/indicators

Global Entrepreneurship Index: https://thegedi.org/global-entrepreneurship-and-development-index/

Global Entrepreneurship Monitor: https://www.gemconsortium.org/

OECD Indicators of entrepreneurial determinants: https://www.oecd.org/sdd/business-stats/indicatorsofentrepreneurialdeterminants.htm

Regional Entrepreneurship and Development Index: https://ec.europa.eu/regional_policy/en/information/publications/studies/2014/redi-the-regional-entrepreneurship-and-development-index-measuring-regional-entrepreneurship

Apulian Innovation overview: https://www.arti.puglia.it/apulian-innovation-overview

Community Innovation Survey: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190312-1

European Innovation Scorecard: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

Innobarometer: http://ec.europa.eu/growth/industry/innovation/facts-figures/innobarometer_en

Regional Innovation Scoreboard: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en

Smart Specialisation Platform - R&I Viewer: http://s3platform.jrc.ec.europa.eu/synergies-tool

Eurostat: https://ec.europa.eu/eurostat/web/main/home.

help both policy-makers to engage in well-targeted interventions, and businesses to improve their operations.

Of these, an electronic warehouse of statistical data along the lines of item (a), and an electronic questionnaire with the features of items (b) and (c), were developed at KEPE's advice by the Regional Development Fund (RDF) of Western Greece (a regional administration subsidiary) and by the Patras-based Computer Technology Institute (CTI) 'Diophantus' in the second half of 2019. See www.interregegovinno.eu, under the headings *Innobarometer*, and *Entrepreneurship and Innovation Survey*, respectively.

The open access data collected from Eurostat and other authorities is currently available to the general public from the said web-site; and, a number of key-aggregates produced from the surveys carried out among the general public and the business community will be made available from the same web-site as well. In addition, both types of data (i.e., the aggregated open access data collected from outside sources, and the micro-data collected from surveys) will be processed −processed separately− into regional or sub-regional indices, and used in the preparation of reports and analyses (analyses similar to those carried out by Economou, 2018) for the general public, stakeholders, and policy-makers. Indeed, one is supplied in Chapter 1. Furthermore, the micro-data may be used to econometrically trace the effects of multiple factors on E&I and measure MFP ─i.e., the more or less innovative technological and/or entrepreneurial way in which the inputs are combined during production. Additionally, an on-line library or repository of reports and studies on E&I in Western Greece will be available on-site. This repository is expected to grow as users, all users of the anonymized raw data (whether postgraduates students writing their theses or professors, researchers, private analysts and so on) will be required to turn in a copy of their analyses. As a rule, by and large, visitors will be able to view the repository, as well as the progress of selected key-indices over time at an aggregated sub-regional and/or sub-sectoral level (in both table and graph format) or view selected indices at a particular point in time (in both table and radar/spider charts), as long as the body of observations is sufficiently large to prevent de-anonymization.

To ensure the above and the project's operation –an E&I Observatory in all but name− in the months and years to come, the RDF, KEPE, and CTI, along with the region's Chambers (namely, the Chambers of Achaia, the Chamber of Ilis, and the Chamber of Aetolia-Akarnania, representing the sub-regional business communities), will form a consortium. However; the discussion on the Observatory's name, charter and bodies was put on hold in the advent of the coronavirus disease of 2019 (COVID-19).

Another electronic questionnaire, along the lines of (d), envisioned in the *EER Strategy*, was pilot-tested by KEPE from February 2016 to February 2017 as part of the *EER Strategy*. At the time, the Region of Western Greece opted not go ahead with it. However, the local Chambers of trade took notice of the pilot-test and of the idea of identifying problems across space and sectors from their members' microdata. Therefore, when the COVID-19 became a pandemic in the spring of 2020, they collaborated with KEPE and the regional chapter of the Economic Chamber of Greece (ECG), and formed a consortium. KEPE set up a digital *Observatory on the COVID-19's Impact on Economic Life* (Chamber of Achaia, 2020), in the templates of which local business owners (Chamber members) and accountants (ECG members) would fill in or tick on-line (i) some basic business information, (ii) business turnover, VAT, cash reserve, full- and part-time employment figures every two weeks, and (iii) the firm's use of relief measures taken by the central government, for KEPE analysts to analyze.

3. ELEVEN PROPOSED ELECTRONIC TOOLS AND SERVICES

The second, crucial component was the development of a collection of electronic tools and services intended to support E&I in a number of ways. After careful consideration, 11 such tools and services (*e-tools* for short, hereinafter) were selected in mid-2019 (See Table 3.) They were (a) based on electronic applications or ideas put into practice in non-digitized form in one or more countries around the world, (b) consistent with legal requirements in Greece, (c) and not available to prospective users in the country. A description of each is provided below.

3.1 E-tool 1: Help consumer ideas reach product developers

The e-tool is envisioned as bridging the communication gap between citizens with useful or novel ideas and businesses and product developers aspiring to achieve innovation, in a way that encourages the former to provide suggestions, and feeds these suggestions to the latter. It is based on the idea of the EU-funded *Living Lab project* (http://livinglabs.regione.puglia.it/en/home), run by the Italian region of Puglia (Apulia). In the original version it was an innovative approach to develop technological solutions in a range of public-sector issues via a network of researchers, companies, and groups of citizens, all of whom became co-developers of the new products (see Box 1). However, here the idea is tweaked so as to match information and communications technology (ICT) innovation with market needs, and get citizens involved by expressing their views or needs for private goods and ser-

Table 3: Eleven electronic tools and services organized in four types of action

I. Fostering innovation
   1. Help consumer ideas reach product developers
II. Providing information and helping to plan
   2. On-line business plan builder
   3. On-line set of business-related courses
   4. On-line directory of useful links and services
III Smart matchmaking for businesses
   5. Employers with prospective employees
   6. Businesses with potential investors/sponsors
   7. People selling/buying ready-made businesses
   8. Businesses with experts/consultants/mentors
   9. Businesses and others interested in R&D cooperation
   10. Businesses interested in sharing working spaces
IV Facilitating exchange of information and networking
   11. On-line forum for businesses

Box 1: The example of Apulia

The project focused on public-sector needs. It initially identified the domain-specific requirements through a call for ideas. All 450 approved needs were catalogued and published as the Living Labs Partnership Catalogue (LLPC), which was followed by a corresponding call for proposals. These needs covered a wide range of areas, including: the environment, transportation, the digital economy, education, health and wellness, culture, electronic governance, renewable energy, tourism. Then, local businesses submitted their proposals for testing and validating new and innovative ICT solutions aiming at satisfying the requirements listed. Each project proposal had to be submitted by at least one local ICT, small or medium-sized enterprise (SME), and only partners previously registered in the LLPC could join. Furthermore, each proposal had to include at least one association or public body and one research laboratory in the formal partnership. Over 200 different entities, ranging from SMEs to established businesses and individual entrepreneurs, developed solutions for over 400 public-sector needs. 75 innovation projects were financed, affecting 15,000 citizens from 40 different municipalities.

Source: https://ec.europa.eu/regional_policy/en/projects/italy/puglias-living-lab-matches-ict-innovation-with-market-needs.

Box 2: Excerpt from Eurostat's coded classification of goods and services

25	Fabricated metal products, except machinery and equipment
25.1	Structural metal products
25.11	Metal structures and parts of structures
25.11.1	Prefabricated buildings of metal
25.11.2	Structural metal products and parts thereof
25.11.21	Bridges and bridge-sections of iron or steel
25.11.22	Towers and lattice masts of iron or steel
25.11.23	Other structures and parts of structures, plates, rods, angles, shapes and the like, of iron, steel or aluminum
25.11.9	Subcontracted operations as part of manufacturing of metal structures and parts of structures
25.12	Doors and windows of metal

Source: https://ec.europa.eu/eurostat/web/cpa-2008/overview.

vices (i.e., identifying market gaps) via a digital platform. Subsequently, people's views (needs) are grouped and *a pool of ideas* is made available to companies and higher teaching/learning and research institutes.

In essence, companies, university units, research centers and citizens sign in an on-line platform by providing a username, email address, password, and by accepting the site's rules of conduct. An open call for ideas allows citizens and groups of citizens to submit their ideas/needs for products (for instance, more sturdy clothespins, a new phone application) to the platform. They do so by simultaneously selecting (checking) the product from a list-box. (See Box 2.) These needs/ideas may be automatically grouped by category and popularity, and reviewed on-line by companies, university units, research centers that have signed in the platform. Thus, the design of new goods and services that cover real needs and might be successful may be stimulated or advanced.

The proper operation of the e-tool will require an administrator to check the appropriateness of the content posted (and perhaps check the grouping of ideas). The e-tool can be accompanied by an on-line forum (much like the *Apulian Living Labs Cafè*, www.sistema.puglia.it/portal/page/portal/SistemaPuglia/LivingLabs) where members can discuss and express their needs for goods, exchange ideas, and share or promote their research results. Alternatively, the forum may be incorporated in e-tool 11.

3.2 E-tool 2: On-line business plan builder

The e-tool is an on-line business plan builder that can help a non-expert business owner or aspiring entrepreneur to clarify his or her business idea, spot potential problems, set out the goals, measure progress, and, by-and-large, organize his/her thoughts into a comprehensive, multilevel document that describes the business in a meaningful way (from objectives and strategy to sales, marketing and financial forecasting) so as to secure investment or a loan from a bank, and convince customers, suppliers, and potential employees to support the endeavor. The plan builder described here is based on a good practice tried and used for a long time by the US government's Small Business Administration (SBA) but discontinued in September of 2019.

As in the case of e-tool 1, one may register and enter by providing a username, an email address, a password, and by accepting the site's rules of conduct. Then, by filling in the fields (cells) of a digital template he/she may create (a) a cover page, (b) an executive summary, (c) a company description, (d) a basic market research analysis, (e) the product's profile, (f) a marketing & sales outline, (g) financial projections for 1-3 years (see Tables 4-5); and by saving the work so as to continue at a more convenient moment (essentially working at his/her own pace), completing the fields, and, eventually, by exporting the file, one can generate a well-structured plan in pdf format.

The site may be linked to other e-tools (the SBA opted for business education

Table 4: Essential fields of a business plan

(a)	Company name. Owner's name. Region. Locality (city, town, village). Post code. Company logo (uploadable).
(b)	The product (good or service) that the business will provide. Who are the target customers. The company's goals.
(b)	The company's mission statement, legal structure, principal members and their roles.
(d)	The industry (sector) that the company operates in. The customers. The competitors. The company's advantages over the competition. The regulations that apply to the company.
(e)	The pricing structure. The product's life cycle stage. The filer's intellectual property rights on the product. The R&D activities that he/she performs or plans.
(f)	The company's growth plan. The filer's communication with the customers. His/her understanding of how the product will be sold.
(g)	The assumptions made. The filer's estimates for the company's profits and losses, cash flow, and balance sheet (see Table 5).

Table 5: The financial information needed for the construction of a business plan

Profit & Loss	Sales. Cost of products sold. Operating expenses: Salary, Payroll, Other expenses (OE) (i.e., Outside services, Supplies, Repairs & maintenance, Advertising, Car-delivery-travel, Accounting & legal, Rent, Telephone, Utilities, Insurance, Taxes, Interest, Depreciation, Other). Income taxes. Owner draw or dividends.
Cash flow	Cash on hand. Cash receipts (Cash sales, Collections from credit accounts, Loans, Other cash injection). Cash paid out (Gross wages, OE as above). Loan principle payment. Capital purchases. Other startup costs. Reserve and/or escrow. Other withdrawal.
Balance Sheet	Current assets (Cash in bank, Accounts receivable, Inventory, Prepaid expenses, Deposits, Other). Fixed assets (Machinery & equipment, Furniture & fixtures, Leaser-holder improvements, Lands & buildings, Other). Other assets (Intangibles, Other). Current liabilities (Accounts payable, Interest payable, Taxes payable, Notes due in one year, Current part of long term debt). Long term debt (Bank loans payable, Notes payable to stockholders, Value of sold company stock not owned by the company, Other). Owner's equity (Common stock, Retained earnings).

Note: Additional summation cells are automatically calculated as the information is entered.
Source: SBA.

topics on market research, funding, buying an existing business or franchise etc.). The e-tool developed for Western Greece (prepared by three of the authors and by RDF staff) is located at http://egovinno.rdfrwg.gr/el.

3.3 E-tool 3: On-line set of business-related courses

The e-tool is an on-line learning center: a platform where the visitor may receive information, advice, and (above all) basic training in starting and/or running a business -ideally, by choosing from a variety of courses. It is based on a good practice tried by the SBA (https://www.sba.gov/learning-center) through which the user finds a menu of courses –each organized in short lectures (see Table 6)– that:

- feature short descriptions and the time required to complete,
- commence by clicking on the relevant link or icon,
- are conducted on-line via interactive slides supplemented with audio and visual material,

Table 6: An example of four courses and their individual lecture titles

How to plan your business
1. How to write a business plan
2. Legal requirements for small businesses
3. Financing options
4. Young entrepreneurs
5. Buying a business
6. Competitive advantage
7. Encore entrepreneurs: An introduction to starting your own business
8. Encore women entrepreneurs
9. Introduction to franchising
10. Market research
11. Pricing models for successful businesses

How to launch your business
1. Sales for small businesses
2. Social media marketing
3. Finding and attracting investors
4. Savings plans for small businesses
5. Financing options for small businesses
6. Introduction to pricing

How to manage your business
1. Introduction to accounting
2. Introduction to human resources
3. Introduction to marketing: A guide to winning customers
4. Understanding your customer
5. Customer service
6. Crime prevention: a guide for small businesses
7. Cybersecurity for small businesses
8. Disaster recovery
9. Establishing values for your business
10. Patents, trademarks and copyrights
11. Business planning and operational management
12. Selling your business
13. Small business: employee recruitment and retention
14. Taking your high-tech product to market

How to grow your business
1. Growing an established company
2. Take your business global
3. Introduction to government contracting
4. How to prepare a government contract proposal
5. Business opportunities: A guide to winning government contracts
6. Counterfeit parts – prevention and guidance
7. Encore entrepreneurship for women (over 50 years old)
8. How to prepare a loan package
9. Small business primer
10. Strategic planning
11. Take your business global – An introduction to exporting

Source: SBA

- may be concluded in one's own time, and repeated as many times as one wishes,
- may be downloaded in pdf format along with selected examples to be studied later on.

The on-line learning center developed for Western Greece provides five introductory-level courses on accounting, marketing, pricing, strategic planning and busi-

ness planning, identifying and developing a competitive advantage (all in Greek, prepared in late 2019 by the authors), accessible via http://egovinno.rdfrwg.gr/el, under the heading *Toolkit*, in the form of PowerPoint presentations and pdf-type transcripts, followed by a set of self-evaluation questions and answers.

3.4 E-tool 4: On-line directory of useful links

The e-tool is a user-friendly on-line directory of updated links on (a) the creation of a business, (b) possible sources of funding and access to financial services, (c) counseling, (d) training opportunities, (e) mediator services, and (f) business support structures at the national and regional level. Set up after the example of the SBA (www.sba.gov), it may be quite a useful e-tool.

Table 7: An example of topics and links available in Greece

1. How to transform an idea into a business
   - https://www.theegg.gr/el/enter-ela-me-ti-startup-sou
   - https://www.nbg.gr/en/nbgseeds
   - http://www.enterprise-hellas.gr/eimai-kai-thelo#4
2. How to fund a business
   - www.enterprise-hellas.gr/hrimatodotisi
   - https://www.piraeusbank.gr/el/agrotes
   - https://www.nbg.gr/el/business/liquidity-financing
   - https://www.theegg.gr/el/grow-ekseliksou-epixeirimatika/xrimatodotisi
   - https://startupgreece.gov.gr/el/Funds4U
   - http://ec.europa.eu/archives/budget/funding/index_el.html
3. Networking: www.enterprice-hellas.gr/epiheirimatikes-synergasies
4. How to set up a business (administrative support)
   - https://eyms.businessportal.gr/auth
   - www.enterprise-hellas.gr
   - http://www.enterprise-hellas.gr/eimai-kai-thelo#2
5. Development & growth
   - https://www.theegg.gr/el/grow-ekseliksou-epixeirimatika
   - https://www.theegg.gr/el/scale-up
6. New markets & exports
   - https://www.nbg.gr/el/corporate/international-trade
   - http://www.enterprise-hellas.gr/eimai-kai-thelo#5
   - https://www.eurobank.gr/en/group/corporate-social-responsibility/innovation/go-international

The idea is that by clicking on the site's topics and links (e.g., in Table 7), a person interested in starting a business or a person running a business (e.g., a farmer seeking funding, a small manufacturer of food products interested in developing a new product or selling to a foreign market) will access potentially helpful information regarding the steps he/she needs to take.

3.5 E-tool 5: Matching employers with prospective employees

The e-tool is a smart matchmaker for employers and prospective employees, which ought to help the former reduce their recruitment costs in finding and hiring the personnel they need, and help the latter improve their options.

One registers and enters the platform by providing a username, an email address, a password and by accepting the site's rules of conduct. Then, two log-in options will be available depending on whether the user is a prospective employer or a prospective employee. In the case of the:

- Former, a business profile featuring the place of business (city, town, village), and sector/economic activity (all selected from standard classifications in list-boxes, as in Box 2) will be requested and prepared. This profile will be visible by the other members of the e-community or (optionally) by anyone who visits the site. Additional information regarding the employer's legal form, year of establishment, size in terms of employees and/or annual turnover (also selected from standard classifications) may also be useful to include.
- Latter, a basic CV with blank fields about the person's (a) past and present economic activities and skills, and (b) contact details; as well as blank fields regarding his/her (c) preferred work locations (postal areas) and (d) availability, will have to be filled out. (The fields under items (a), (c), (d) will be selected from standard classifications in list-boxes.)

Understandably, all users will be able to modify/update their information at any time by changing their account's settings; and prospective employers will be able to create *recruitment announcements,* i.e., short descriptions of the posts they wish to fill, including fields such as: location(s) in terms of postal areas, the required and desired candidate qualifications (i.e., the education, work experience, the roles performed and skills needed), the expected job duration, the weekly number of hours needed, the benefits -all selected from standard classifications in list-boxes- the preferred deadline for filling the vacancy, and contact details. A matching and/or a search engine will identify the most relevant candidates based on the aforementioned information provided. However, people may also filter the data by using some or all criteria.

Employers will have the option to directly contact the candidates that seem to be most suitable for each post. Persons looking for a job may be automatically notified (via email alerts) about a relevant recruitment announcement, so that they may express their interest in the post, even invite previous employers to directly send references to the recruiter to further support the candidacy. In addition, employers will be automatically notified when a potential new candidate with a profile that suits the position creates an account. When a vacancy is filled the relevant *recruitment announcement* is deactivated. (See Box 3.)

Box 3: An example of a good practice

Startup Greece used to provide a matchmaking tool for (a) startups wishing to recruit and (b) individuals looking for a job. The matching procedure is based on the two online forms: the "Startup Work offer" form to be filled by startups and the "Looking for a career in a Startup" form to be filled by individuals looking for a job. However, the website (https://startupgreece.gov.gr/el/Matchmaking) does not seem fully functional nowadays.

3.6 E-tool 6: Matching businesses seeking funding with potential investors and sponsors

The e-tool is envisioned as an on-line platform with three applications (an investor search application, a project financing matching application, a project sponsor matching application) that solicit information from businesses looking for funding, advise on what kind investor each business should turn to, and, ideally, match the business looking for funding with prospective sponsors and investors. (See Box 4.)

The *investor search application* is an e-tool that is based on a good practice provided by *Hub-Finland* (https://thehub.fi/tools/investor-matching-tool), through which:

- Companies that need financing register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they are asked questions regarding (a) their main activity,[1] (b) their legal form, (c) their location, (d) their size in terms of employees and turnover, (e) their funding needs, (f) the business idea (in brief), (g) the product to be developed, (h) the progress already made, (if) their communication details. They select their replies regarding items (a)-(e) and (g)-(h) from

[1] A comprehensive list of economic activities is available at: https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC.

list-boxes (the code under item (g) may vary from the code under item (a)), and are informed of the kind of investor that would be suitable for their needs: a business accelerator/incubator or angel, venture capital, applied research funding, crowdfunding, public funding, bank financing, and so on. (See Box 5.)

- Potential investors supply their sector and legal form information, as well as communication details; and relate the kind of companies (legal form, large or small, startups or companies situated in rural areas etc.) and the activities or

Box 4: A note on developing financing e-tools

A cautionary note regarding Western Greece's development of a Government-to-business financing tool is in order. First and foremost, there exists strict national legislation concerning crowdfunding (L. 4351/2015, L. 4416/2016), while the EU's legislative framework requires the involvement of at least one licensed financial institution/firm in the financing process (European Commission (COM(2018)113/DOCUMENT-2018-31146), European Parliament (P8_TA(2019)0301.) This is not to say that the regional authority cannot act as an intermediary between the financial institution/firm and the borrower. Yet, financial activities entail both economic risk for the lender and the borrower, as well as political risk for the elected regional Head and delegates. The only financing tool, which circumvents these shortcomings takes the form of donations (i.e., contributions for the benefit of the local community rather than business financing). A relatively successful example of this kind of crowdfunding occurred during 2017-18 in the municipality of Antiparos (http://funding.crowdapps.net/antiparos/προϊόν/απορριμματοφόρο) in the Cyclades.

Box 5: A special glossary

Over the last decades, financial innovation has yielded numerous tools or vehicles of business financing: (a) Business accelerators relate to the incubator model involving financing, mentoring and accommodating start-ups. (Incubator models aim at overcoming the problems associated with startups being small and new in a sector. These models focus on reducing the cost of the necessary infrastructure for blossoming a nascent firm by means of providing office space, communication technology, managerial assistance, research facilities, and expert staff.) (b) By and large, business angels are wealthy individuals with experience in specific business activities, who are also ready to finance new entrepreneurs in the same or similar field. (c) Venture capitals and seed capitals are doing the same job in a more structured way. (d) Microfinancing is associated with unsecured loans provided by state agencies or non-profit organizations. (e) Peer-to-peer lending is similar to micro-financing, however, employs stricter criteria by which a would-be borrower is chosen. This means that peer-to-peer lending is preferable if a borrower's creditworthiness is high. (f) Crowdfunding is a popular form of financing that involves the use of information technology which, in turn, reduces transaction costs for the firm. The entrepreneur presents his/her project on an electronic platform in the form of an on-line fundraising campaign. There are four types of crowdfunding: donations, perks (pre-order or presales), debt, equity.

products they are interested in funding. To facilitate matching, in each field the choices will be provided in (and selected from) list-boxes.

- Registered companies looking for funding and likely registered investors are matched with each other based on the activity or product codes and company-types codes. In addition, people may also filter the dataset by using some or all of the above criteria.

The *financing matching application* is an e-tool based on a good practice provided by *Startup Greece* (https://startupgreece.gov.gr/el/Matchmaking, however, the website is not fully functional nowadays), through which:

- Companies looking for potential investors register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they create a *project announcement* with information about their (a) main activity, (b) legal form, (c) location, (d) size (in terms of employees and turnover), (e) funding requirements, (f) project (a short description of the project they wish to get funding for will suffice), (g) product to be developed, (h) time limitations (i.e., the time needed to complete the project), and (i) communication details.
- Potential investors register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they enter information about their legal form, sector, communication details, and create a *funding announcement* relating the sectors and products, the kind of companies, and short- or long-term projects they are interested in, along with the maximum funding they can provide.
- A matching and/or search engine identifies companies looking for investors and investors looking for companies based on the sectoral, product, location, company-type codes, and the project duration and funding amounts provided. (People may also filter the dataset by using some or all criteria.) Potential investors may reply to the *project announcement* they prefer. Interested companies may reply to the *funding announcement* that seems to cover their needs. Companies and investors may also be automatically notified about new *funding* and *project announcements*, respectively, via email if they so choose in their account settings. If the parties agree to each other's terms the *project announcement* is rendered inactive. (See Box 6.)

The *sponsor matching application* is an on-line e-tool based on a good practice provided by *Startup Greece* (https://startupgreece.gov.gr/joinforces, however, the website is not fully functional nowadays). Through this:

- Companies looking for potential sponsors register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in the on-line platform, they create a *looking*

Box 6: An example of a financing matching tool

A software start-up company is looking for 50.000€ to develop a project. It can create a project announcement by providing a short description of the project, the respective funding requirements, and the time needed to complete the project. The announcement is then posted and all registered investors may find the announcement in the platform and/or be automatically notified. Investors who are interested in the project reply to the announcement. When agreement is reached the announcement is rendered inactive.

for sponsor announcement with information about (a) their main activity, (b) their legal form, (c) their location, (d) their size (in terms of employees and turnover), (e) the project or event to be sponsored (a short description will suffice), (f) the sponsorship requirements, (g) the preferred way that the sponsorship will be acknowledged, and (h) their communication details.

- Potential sponsors register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they may enter information about their legal form, sector, communication details, and create a *sponsor announcement* relating the projects/events they are interested in supporting, the maximum sponsorship they wish to provide, and the preferred way the sponsorship will be acknowledged.
- A matching and/or search engine identifies (a) companies looking for sponsors and (b) potential sponsors looking for companies based on the sectoral, product/event, location, company-type codes provided. (People may also filter the dataset by using some or all criteria.) Potential sponsors may reply to the *looking for sponsorship announcement* they prefer. Companies looking for sponsors may reply to the *sponsor announcement* that seems to cover their needs. Companies and sponsors may also be automatically notified about a new *sponsor* or *looking for sponsor announcement* via email if they so choose in their account settings. If the parties agree either announcement or both announcements are rendered inactive. (See Box 7.)

3.7 E-tool 7: Matching people interested in selling/buying ready-made businesses

Matching people interested in selling and buying ready-made businesses so that the continuous existence and commercial activity of enterprises is assured, is seen by the European Commission (2012) as a way to reduce wasting skills, jobs, market presence and goodwill when such a business closes down.

Box 7: An example of a sponsor matching tool

Through the JoinForces initiative of Startup Greece, seven large enterprises offered sponsorship plans to help newcomers in the field: (a) Coca-Cola Tria Epsilon with a program addressed to young people, aiming to develop professional and personal skills. (b) CNN Greece with a program set up to promote Greek startups. (c) The Union of Companies of Mobile Telephony with a mentoring business and communication program. (d) The Titan Group with a special seminar program on the use of appropriate services for meetings of startupers. (e) Chipita SA with an advisory-guidance program to extrovert companies. (f) Intrasoft International with a startup mentoring program. (g) Papastratos SA with consulting and guidance services to startups.

A smart e-tool which does that is accessed if one registers by providing a username, an email address, a password, and by accepting the site's rules of conduct. Then, two log-in options become available depending on whether the user is a business owner who wishes to sell his/her business or a potential buyer. The:

- Former creates *a business selling announcement* in which he/she provides the (a) location, (b) sector/economic activity, (c) size (in terms of employees and annual turnover), (d) approximate estimated value of the business (all selected from list-boxes), as well as the name of the business, and the reason for selling it (e.g., retirement).
- The latter creates a *business buying announcement* in which he/she specifies the characteristics of the business he/she is interested in by filling in information that is similar to the information under items (a)-(c), and the maximum amount he/she can offer.

Then a matching/search engine identifies potential buyers and potential sellers for the *business selling* and the *business buying announcement*, respectively. (People may also filter the dataset by using some or all criteria.) Sellers may reply to *a business buying announcement* that seems to cover their needs, and potential buyers may reply to *a business selling announcement* they find interesting. Both parties may also be automatically notified about new *business selling* or *buying* announcements via email if they so choose in their account settings. As soon as the business owner finds a buyer for his/her business the *selling announcement* is cancelled. *The House of Entrepreneurship* in Luxembourg may serve as a model (http://businesstransfer.houseofentrepreneurship.lu/fr).

3.8 E-tool 8: Matching businesses seeking expert advice with experts/ consultants/mentors

A smart e-tool that matches businesses seeking expert advice (on the one hand) with experts, consultants or mentors (on the other hand) helps companies find professional advice and practical assistance in every stage/phase of their business activity: when starting, when looking for funding, when growing, when aspiring to penetrate in new markets, to export/import, to engage in marketing campaigns etc.

Both business people looking for advisors/mentors and advisors/mentors register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in (a) those looking for advisors/mentors create a *looking for advice announcement* and provide information about the type of advice they seek (tax, legal, technical etc., by selecting from a detailed list-box), the desired duration of the collaboration, and their own communication details; and (b) companies and relevant professionals that offer advisory services create an *advisor announcement* and provide information regarding their field of expertise (the type of advisory services they offer by selecting from a detailed list-box), their availability, and communication details.

A matching and/or search engine identifies businesses looking for mentors/advisors and mentors/advisors looking for businesses based on the type of advice sought/offered, and their time frames. (People may also filter the dataset by using some or all criteria.) Businesses may reply to *advisor announcements* that seem to cover their needs and advisors/mentors may reply to *looking for advice announcements* which are of their interest. Businesses looking for advice and advisors/mentors may also be automatically notified about new *looking for advice* and *advisor announcements* via email if they so choose in their account settings. As soon as a business finds/agrees with an advisor/mentor, the *looking for advice announcement* is cancelled. As in the previous case, *the House of Entrepreneurship* in Luxembourg may serve as a model (http://www.businessmentoring.lu/en/the-mentorship/coordinating-body).

3.9 E-tool 9: Matching businesses and others interested in R&D collaboration

A smart e-tool that matches businesses interested in R&D collaboration ought to help companies find a partner in R&D activities/projects.

Initially, business people and others looking for R&D partners register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they can create a

R&D request announcement and provide information about the R&D project, such as (a) the type of product, (b) the state of its development (concept stage, under development/lab tested, prototype etc.), (c) the funding source (European or national or regional funding, private resources), (d) the kind of expertise or partner sought (e.g., technical, marketing; SME, research institution, university), (e) the project's duration -all by selecting from detailed list-boxes- and (f) their own contact details.

Businesses and other organizations that offer R&D infrastructure, services and related expertise register and enter the platform by providing a username, an email address, a password, and by accepting the site's rules of conduct. Once they sign in, they can create a *R&D offer announcement* specifying (i) the sector or type of products they are active in, (ii) the type of R&D services/expertise they offer, (iii) their legal form, (iv) their availability -all by selecting from detailed list-boxes- and (v) their own contact details. (The Enterprise Europe Network (http://www.enterprise-hellas.gr/el/ypiresies) provides matchmaking services for business, R&D, and technology partnerships, based on on-line *request* and *offer* forms.)

A matching and/or search engine identifies potential matches (partners) for both *R&D request* and *R&D offer announcements* based on the aforementioned fields. (People may also filter the dataset by using some or all fields.) Businesses may reply to *R&D offer announcements* that seem to meet the requirements; and businesses, R&D institutes or university units may reply to *R&D request announcements* that suit their interests. All potential partners may also be automatically notified about new *R&D request* and *R&D offer announcements* via email if they so choose in their account settings. As soon as a R&D partnership agreement is achieved the particular *R&D request announcement* is cancelled.

3.10 E-tool 10: Matching businesses interested in sharing working spaces

A smart e-tool matching businesses interested in sharing working spaces ought to help businesses find a co-working space and enjoy benefits in terms of collaboration, knowledge diffusion, productivity improvement, reduction in operation costs etc.

In this setting, businesses that look for a co-working space and suppliers of such spaces register and enter the platform by providing their usernames, email addresses, passwords, and by accepting the site's rules of conduct. Once they sign in, the:

- Former can create a *co-working space request* to provide information about (a) the preferred size of the space, locality and district, (b) the number of enterpris-

es they would prefer to share the working space with, (c) the preferred sector/activity of their co-workers, (d) the rent they are willing to pay (choosing from a range), (e) potential accompanying services they would like to be offered (e.g., visitor reception, internet, telephony, printers etc.) -all these fields are filled from detailed list-boxes- and (f) their contact details.

- Real-estate companies/agents or companies and related organizations that offer spaces can create a *co-working space offer* specifying (i) the characteristics of the space offered (size, location, number and type of businesses sharing the space), (ii) the monthly rent required, (iii) the type of accompanying services they offer -these fields are filled from detailed list-boxes- and (iv) their contact details. (A useful example is provided by Brussels Greenbizz (http://www.greenbizz.brussels/en).)

A matching and/or search engine identifies potential matches for those looking for a co-working space and those offering such spaces based on fields (a)-(e) and (i)-(iii). (People looking for spaces and people offering spaces may also look at each other's announcements by filtering some or all fields.) Businesses may reply to the *co-working space offers* that seem to cover their needs, and real estate companies/agents and others may reply to the *co-working space requests* which seem to suit them. Businesses looking for a co-working space and real estate companies/agents may also be automatically notified, respectively, about new *offers* and *requests* via email if they so choose in their account settings. As soon as a business that has put in for a co-working space finds and agrees to a co-working space, the *co-working space request* is cancelled.

3.11 E-tool 11: On-line forum for businesses

The on-line forum for businesses is intended to function as a virtual place where entrepreneurs and/or aspiring entrepreneurs will be able to discuss, share and exchange ideas, knowledge, and experiences on topics they consider relevant for their business activity; as well as connect, collaborate and network with other entrepreneurs; and find assistance in addressing their problems and meeting their needs.

Following the example of the *UK Business Forums* (https://www.ukbusiness-forums.co.uk), the prospective user will initially create an account by completing a number of required fields regarding his/her (a) user name (i.e., the name that will be displayed publicly in forum discussions), (b) password, (c) email address, (d) first and last or company name, and by ticking boxes regarding his/her (e) sector of economic activity (as in e-tool 6), and (f) agreement with the terms and conditions of the forum. Understandably, additional, optional information regarding the date

of the company's establishment, size in terms of employees and/or annual turnover, may also be solicited.

Once the account is created, the user becomes a member of the forum and may be instantaneously informed of what is going on in the forum (see Box 8), participate in any existing discussion or start a new discussion (see Box 9.) In effect, he/she selects the topic he/she interested in and either replies to a post already made by another member or creates a new post by picking the relevant tab. In either case, the option of uploading a file (usually in pdf, xls, jpeg format) will be available. In addition, by using a search engine, he/she will be able to check whether there is already a discussion on the issue of his/her query. The search engine will produce results based on specific criteria, such as keywords, the topic, and the date the conversation took place. Also, the forum will enable users to send private messages to other users by clicking their name and picking the option "send a private message". Besides, each user may opt to be automatically notified (by email alert) when a conversation starts on a topic of his/her interest. This option may be activated either when the account is created and topics of interest are selected or at any time by clicking "change my account details".

It goes without saying that the proper operation of the forum will require an

Box 8: Knowing what is going on in the forum

Once in the forum, the user will have real-time information regarding the number of the members on-line, the number of discussions and messages per topic, as well as the last post in each topic (who made it, when, on which subject). If interested, he/she may also access the list of on-line members by picking the relevant link. This way, the user can see the username, the name of the company, the total number of posts and the topic and time of the last post of each member who is active in the forum at that moment.

Box 9: A list of possible forum labels/discussions

Discussions are organized in topics, namely:

- starting a business,
- finance,
- legal,
- international business,
- marketing & public relations,
- e-commerce,
- information & communication technologies,
- employment & human resources,
- general business (for issues and queries that do not fit with the other topics).

administrator to check the appropriateness of the content posted; and the emails or personal details submitted by users to sign in (whether in this case or in the case of other e-tools) will be protected: They will not be publicly available or for sale.

Last, but not least, in order to facilitate users at large, logging-in could be unified, so that the platform (or platforms) recognizes (recognize) one's username, password and other details as, say, the user enters e-tool 1 for the first time, even if he/she initially registered the username and other details in order to enroll in e-tool 11.

3.12. Likely beneficiaries

Based on the descriptions of the eleven e-tools outlined above:

- The 1st *e-tool* aims to bring fresh, innovative ideas from consumers in the product development process. Hence (a) product developers (researchers and entrepreneurs) who are both willing and able to tap on the ideas/stimuli, (b) investors and co-workers (employees, other associates) of those who will produce and trade the new products, as well as (c) potential consumers, may all benefit.
- The 2nd-4th and 11th *e-tools* aim to advance (i) business planning, sophistication, networking, as well as (ii) access to business information and the exchange of business information. Hence, the likely beneficiaries are those who are short in one or more of these aspects, for instance: (a) relatively unsophisticated, untaught or not well connected businessmen and women or prospective entrepreneurs who need courses, more instruments, information, and to talk/listen to other business-people or (b) businessmen and women who are rather inexperienced is searching the world wide web to find links and resources.
- The other *e-tools* are smart matching applications which can improve (a) the operation of economic actors who either ask for or supply funding, expert advice, ready-made businesses, labor, working spaces, and (b) the collaboration of businesses and others carrying out research. Consequently, the 5th *e-tool* ought to benefit prospective employers and employees; the 6th *e-tool* ought to benefit businesses, prospective sponsors and investors; the 7th *e-tool* ought to benefit aspiring and retiring businesspeople, the employees, clients and suppliers of the latter; the 8th *e-tool* ought to benefit businesses, experts, consultants, mentors; the 9th *e-tool* ought to benefit businesses, as well as other people and organized groups involved in collaborative R&D; and the 10th *e-tool* ought to benefit businesses, and real estate owners and agents.

All of these e-tools are open to improvements and adjustments. Accordingly, there may exists additional potential winners. For instance, if some of the basic business information submitted (namely, location and sector/activity) were projected on a digital map of Western Greece, and made available to all platform members, then the detection of areas with saturation/lack of businesses might be easily detected by those interested in the information.

4. SOME THOUGHTS ON THE WORK AHEAD

It should be noted that none of the aforesaid Observatories and e-tools is a prerequisite for another. To the extent the E&I Observatory and *e-tools 2 and 3* were developed in 2019 via the EGOV_INNO project (as part of the 2014-2020 Greece-Italy Interreg Program), and the Observatory on COVID-19's economic impact was developed in extenuating circumstanced in the spring of 2020, the other e-tools, the additional e-lectures for the on-line training center (e-tool 3), and the waves of the E&I survey will be completed in the months and years to come. (In all likelihood, the new e-lectures will benefit from user feedback on the e-lectures developed already, the future survey-waves will benefit from responder feedback obtained in earlier waves.) In addition:

- The public recognition of the positive outcomes resulting from using these e-tools will probably reinforce and feed into the promotion of E&I and of the whole project. (A step in that direction would be to award the ideas submitted via *e-tool 1*. The award may not be monetary. For instance, it could take the form of a free business course or mentor coaching).
- *E-tool 4* can be enriched with foreign currency exchange (converter) links. *E-tool* 5 can be enriched with links to job-posting sites. *E-tool* 6 can be enriched with sites that list projects funded by the EU, and *e-tool* 8 can be enriched with a list of mentors.
- Commercial banks should be invited to participate *in e-tool* 6. Local Chambers should be asked to participate in *e-tool 7*. Patra's Science Park, Patra's Innovation Hub, Patra's IQ, and local universities should be asked to participate in *e-tool 9*. In our view, the office of the General Secretariat for Research and Technology (http://www.gsrt.gr/central.aspx?sId=126I491I-1148I323I528397) ought to keep an eye on the flow of ideas expressed in *e-tool 1* (hence, have access to it). Bank personnel could help in the preparation of *e-tool 2*. Special theme experts from teaching/learning and research institutes, the market and government (e.g., public servants in the Operational Program regarding Competitiveness, Entrepreneurship and Innovation (http://

www.antagonistikotita.gr/epanek_en/index.asp)), and communication specialists (in mass media and elsewhere) could help with the materials prepared for *e-tool 3*. Last but not least, central government staff (from ministries and independent authorities) could get involved in the preparation and operation of *e-tool 4*.

- The regional administration should make use of *e-tool 6* (especially the Economic Development Department), as well as *e-tools 2-3, 10-11* (especially in connection with the project to develop co-working spaces).
- It might be useful if the E&I Observatory's sectoral findings were made available to the users of *e-tool 1*.

In so far as all e-tools promote EU's SME policy, they may be eligible for EU funding from the Structural Funds (European Commission, 2012). Additional support for development and maintenance may be provided (a) on a voluntary basis from local chambers and associations; and/or (b) by advertisement -preferably advertisement promoting local businesses or associations of businesses. *E-tools 4* and *11* may be partially self-funded if a small fee were paid by users, and *e-tools 5-10* may be partially self-funded if a small brokerage fee were paid by either or all parties matched. Likewise, e-tool 1 may be partially self-funded if a small fee were paid for ideas used. (NB: In line with the conditions set for using EU funds, both advertisement and user-charges cannot be applied immediately on the e-tools on the E&I Observatory developed via the Interreg Program, but later on.)

The *on-line forum* will require an administrator; and the E&I Observatory will require a small academic/statistical supervisory board in order to periodically review and decide on data issues, on new analytical instruments, on studies submitted to the library/repository, and identify areas worth studying ─especially if it becomes *de facto* an official agency of the Hellenic Statistical System (http://www.statistics.gr/en/hellenic-statistical-system).

The *e-tools*, much like the two Observatories, ought to be replicable in case they are requested by other regions, especially regions closely connected with Western Greece through the value (business) chain. Indeed, a good number of positive externalities in Greece as a whole could to be generated via:

- access to more business courses, to more ideas, to more potential R&D collaborators, aspiring entrepreneurs and others;
- access to more Observatory-type data and libraries/repositories to help carry out spatial, regional, cross-regional, and sectoral research, analysis and policy; as well as
- a wider distribution of costs.

5. CONCLUSIONS

A key-goal of Western Greece's 2017 *EER Strategy* is currently taking shape though the development by the RDF of Western Greece (in close collaboration with the Strategy's authors and other specialists) of an on-line platform with government-to-business tools and services, and data-collection and presentation systems intended to promote E&I in region. Some elements are already in place and use, while other elements are being built. In close collaboration with the Strategy's authors, the local Chambers seem keen to develop additional on-line systems in order to collect information on the impact of the coronavirus epidemic on local businesses or map and identify glitches along the value chain. Overall, key agents in Western Greece are actively developing on-line applications for businesses and for analyzing business life, and, in our view, are taking measured steps in the right direction.

Though it is probably too early to tell of each and every application's impact, building an on-line infrastructure in order to reach, teach, inform, interact with and help local businesses, is the right thing to do in the both the pandemic and the post-pandemic era.

Acknowledgments: The helpful role of the Regional Development Fund of Western Greece is greatly appreciated, and the financial support by the European Union via the EGOV_INNO project of the 2014-2020 Greece-Italy Interreg Program is gratefully acknowledged.

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CHAPTER 7

INNOBAROMETER: AN E-TOOL TO COLLECT AND ANALYSE DATA ON ENTREPRENEURSHIP AND INNOVATION IN WESTERN GREECE AND APULIA

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ABSTRACT | In this chapter we present the *Innobarometer* e-tool which was developed via the *egov_INNO* project, funded by the Greece – Italy Interreg program. The *Innobarometer* is an on-line platform that collects information about entrepreneurship and innovation. The information is used for the development and presentation of reports for the regions of Western Greece and Apulia. It includes the following functionalities: (a) an online questionnaire to periodically collect feedback on entrepreneurship and present information based on it, (b) automated and semi-automated collection of information on entrepreneurship and innovation indicators from various sources (e.g. Eurostat), (c) display of indicators and graphs based on information collected via (a) and (b), and (d) a repository of relevant research work and e-tools to support aspiring, new, and existing entrepreneurs. Users are able to view the progress of selected indicators over time at an aggregated level (in both table and graph format) or to view selected reports at a particular point in time (in both table and chart formats). The chapter describes the tool's architecture, design issues, functionalities and actual results from its application.

1. INTRODUCTION

The *Innobarometer* is an on-line platform that collects information about entrepreneurship and innovation, to be used for the construction and presentation of reports

regarding the regions of Western Greece and Apulia. It includes the following functionalities:

i. An online questionnaire to periodically collect feedback on entrepreneurship and to present important information based on it.
ii. Automated and semi-automated collection of information on entrepreneurship and innovation indicators from various sources (e.g. Eurostat, national statistic organizations).
iii. The display of useful regional information at the aggregate level in the form of indicators and graphs based on the collected via (a) and (b).
iv. A repository of anonymized local level data, of relevant research work and of e-tools to support aspiring, new, and existing entrepreneurs.

Consequently, it is expected to benefit the two regions by helping measure local business needs and evaluate regional business support policies; providing additional means to support entrepreneurship and opportunities to enhance innovation and research and development (R&D) activities, and making information services available to the general public and local small and medium-sized enterprises (SMEs), thus filling multiple gaps in e-government services for business (e.g. for startups).

We next present the *Innobarometer*'s architecture, design issues, functionalities, along with actual results from its application.

2. RELATED WORK

To develop the *Innobaromet*er, extensive desk research on e-tools employed around the world was initially undertaken. The shortlist comprised:

a) The Apulian Innovation Overview: An information system which systematically collects data from official national, supranational and regional reports and datasets or via experimental investigations so as to construct socio-economic and innovation indicators in Apulia (ARTI, 2020).
b) BundOnline: A software product that creates electronic one-stop systems so that stakeholders and interested parties can make easy use of joint Government web-portals and other stakeholders' ICT-systems (Kleindiek and Wittkemper, 2003).
c) The Digital Economy and Society Index: A collection of statistics and indicators that brings together and measures EU member-states in terms of digital competitiveness (i.e., their progress towards a digital economy and society). (European Commission, 2020)
d) The Slovenian Business Register: An easy to search, central database contain-

ing information about all business entities involved in profit or non-profit activity located on the country (AJPES, 2020).

e) Eurostat: The statistical office of the European Union provides high quality statistics on a wide range of important and interesting indicators over time and across EU member states, regions, subregions, affiliated countries, economic sectors, population groups, and more. This is information that is highly useful to policy makers, analysts, business-people, journalists, and the general public (Eurostat, 2019).
f) The Hellenic Statistical Authority's data visualizations: An easily understandable presentation of statistics through short texts, graphs and interactive visualization tools. It covers the need to produce statistics that are useful—relevant—for public policy, the economy, and more broadly, the life of the people in Greece (Hellenic Statistical Authority, 2020).
g) The Information System of the National Statistical Institute of Bulgaria: Provides statistical information on the demographic and socio-economic conditions and development in Bulgaria by allowing users to create tables with various indicators and view graphs of the results. It also allows businesses to submit data online (Infostat, 2020).
h) The Innovation Scoreboard: A web application that assesses the innovation performance of Balkan and Mediterranean regions on the basis of numerical indicators grounded on actual data; and allows users to compare and correlate performance scores and visualize country profiles (Innoplatform, 2020).
i) The Open Innovation Lombardia platform: Brings together academia, industry, government and citizens in order to enhance the use of resources and human and social capital and, thus, promote a functional, collaborative approach to innovation in the region of Lombardy (Regione Lombardia, 2020).
j) The Regional Entrepreneurship and Development Index (REDI): An index composed of three sub-indices covering entrepreneurial attitudes, abilities and aspirations, assigning scores to EU regions and member-states and intended to advise policy (Acs et al., 2013).
k) Statistics Estonia (2020), the national statistical institute of Estonia. Its website provides reliable information on the economic, demographic, social and environmental situation, as well as on other innovation related issues in Estonia.
l) The Technology Barometer: Measures Finland's techno-scientific competence and its performance capacity based on the level of its economic and social development, and annually provides detailed reports for the country (Loikkanen et al., 2008).

Based on their relevance to the specifics and needs of Western Greece and Apulia, to develop the *Innobarometer* the emphasis was placed on collecting:

- Information on entrepreneurship and innovation from various national, regional and EU sources.
- Information on the business climate of the two regions via questionnaires.

3. SYSTEM ARCHITECTURE AND FUNCTIONALITY OVERVIEW

In software architecture, there may be many layers between the hardware and end user. The front is an abstraction, simplifying the underlying component by providing a user-friendly interface, while the back usually handles business logic and data storage. The *Innobarometer* is composed of a MySQL database, a backend / frontend, and a Linux OS server. The server hosts the application, the database stores data, the backend communicates with the server for each request and the frontend presents the information to the user. In addition, the *Innobarometer* is developed with different user permission levels, providing each logged-in user, different functionalities.

3.1 Software Description

Server: The application is implemented and hosted in a Linux Ubuntu OS VPS with proper configurations, and the Apache HTTP Server is used as web server.

Database: The application is composed by a MS SQL database (www.mysql.com) to store the application's data. MySQL is an open-source relational database management system. The design of the database is based on datasets stored in separate tables: a different table for every set of data.

For the Inserts and Exports functions 48 separate tables with different columns and sets of data, have been designed and developed. The chart function uses some of these tables to present graphs. For the questionnaire, we used the Lime Survey library (www.limesurvey.org) that has its own tables with complex relations between them depending on the needs. Also, for the purpose of multiple user roles, there is a table which is called "roles'' and a table "users". The former table relates to the tasks (all different roles) performed. The latter table relates to all registered users. Each user is assigned one role each time.

Backend: For the development of the backend, we use the Laravel (laravel.com) PHP web development framework. Laravel is a free, open-source PHP web framework, intended for the development of web applications following the model view controller (MVC) architectural pattern. The whole application for the back-

end part is written in PHP (www.php.net) general-purpose scripting language. We developed functions such as import and export of big data sets. The system is able to store and retrieve thousands of rows of data. We also developed functions to present the said data into table format and charts. Each dataset can be exported into table format. Additionally, we developed a file manager to create a repository structure for storing special files.

Frontend: The frontend consists of the logged in and non-logged in user areas. For the non-logged in general public users, the layout is divided into a top horizontal menu, the main part, and the footer, and provides information, data sets, charts, and other functionalities. For the logged in users, the functions and the layout are different. There is a left sidebar menu that provides many functions depending on the user's permission level. After the user logs in, the system redirects him or her to the "dashboard" area so that he or she may utilize the tool's functionalities. We used Bootstrap Framework (getbootstrap.com) and programming languages such as HTML, CSS, and Javascript for its development. Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS and (optionally) JavaScript-based design templates for typography, layouts, buttons, navigation, and other interface components.

Libraries: We use several predefined libraries. To present our data into table format we use Tabulator (tabulator.info) JavaScript library. Tabulator allows us to create interactive tables from any HTML Table, JavaScript Array, AJAX data source or JSON formatted data. For the purpose of the questionnaire, we use the LimeSurvey Open Source tool for online surveys (www.limesurvey.org). To present our data into charts we use Chart JS (www.chartjs.org). Chart.js is a Javascript library that allows designers and developers to draw all kinds of charts using the HTML5 canvas element.

3.1.1 MVC Architecture

The MVC is a software design pattern commonly used for developing user interfaces, which divides the related program logic into three interconnected elements. This is done in order to separate internal representations of information from the ways information is presented to and accepted from the user. This kind of pattern is used for designing the layout of the tool's main page.

Model: The central component of the pattern. It is the application's dynamic data structure, independent of the user interface. It directly manages the data, logic and rules of the application.

View: Any presentation of information such as a chart, table and content. Multiple views of the same information are possible, such as a bar chart for management and a tabular view for accountants.

Controller: Accepts input and converts it to commands for the model or view.

Besides the division of the application into these components, the MVC design defines the interactions between them. The model is responsible for managing the data of the application. It receives user input from the controller. The view presents the model's data to the user in a particular format. The controller exists between the view and the model, responds to user input and performs interactions on the data model objects. The controller receives the input, optionally validates it and then passes the input to the model.

3.2 Functionalities

The Innobarometer provides several functionalities to the user. We present in short all of them:

- Insert data from various sources. For each set of data we create separate tables to insert information. 48 tables have been created to organise the whole information to be imported.
- Export data, for each of 48 tables (in table format), export and download all or specific information.
- Charts for some of the tables, to present useful graphical information to the user.
- An online questionnaire to collect periodical feedback on entrepreneurship and provide important information. Presentation of responses with tables and graphs.
- A repository of research work and good practices on e-tools for entrepreneurship support.

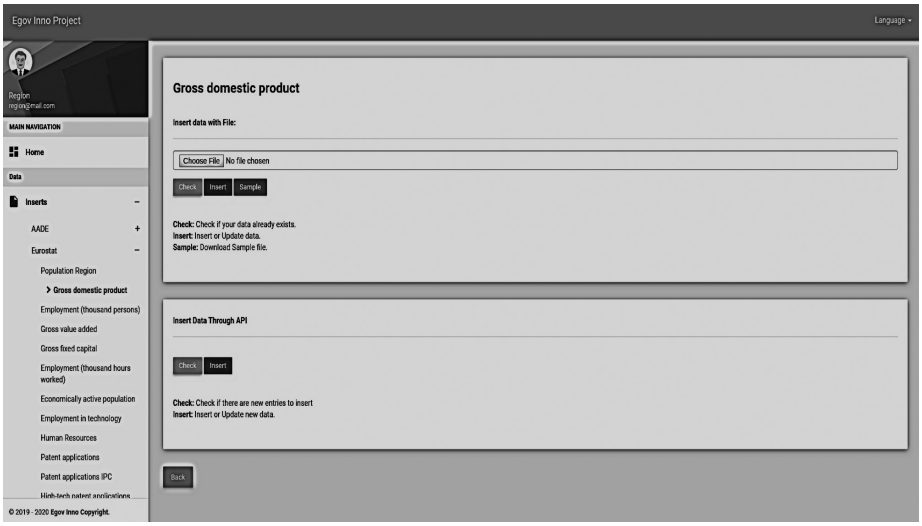
In the next chapter we analyse further all functionalities.

4. APPLICATION FUNCTIONALITIES

4.1 Inserts

The Innobarometer, collects information from five main sources, the Independent Authority for Public Revenue (AADE: www.aade.gr), Eurostat (ec.europa.eu/Eurostat), the ARTI (www.arti.puglia.it), the Regional Viewer (s3platform.jrc.ec.europa.eu) and the Greek National Documentation Center (metrics.ekt.gr). From these sources the system collects specific datasets that provide useful information about entrepreneurship, such as the regional market size ("Population"), the "Gross domestic product" and "Gross value added'', the "Innovative Companies" and allocation of "Structural Funds", and many others, which is stored in different tables in the database. There are two different ways through which the system collects data:

Figure 1: Inserts



manually via a file import, and automated via API Web Service (in case the source provides an API for automated import). The left side menu (Figure 1) provides the layout of all this data.

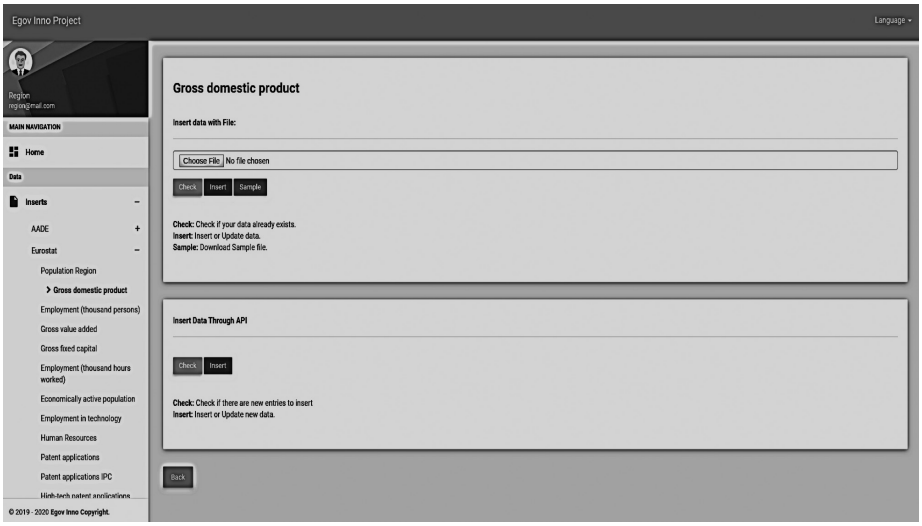
Manual insert. The user clicks "Choose File", selects the file to upload, and clicks the "Insert" button. Next, the system validates the file and imports the data to the database. The "Check" button, is used for checking if the data already exists in the database. The "Sample" button provides the user with a file format example.

Automated insert through API. It is an automated way with which the user is able to import the data directly from the predefined source with the insert button. The "Check" button, is checking if data already exist in the database.

Of the aforesaid data sources only Eurostat provides an API Web Service, so the user may utilise either the manual or the automated manner. For each of the other sources the user can only utilize the manual way. As we see in Figure 1, all inserts provide the first input file form, and only Eurostat provides also the second way through API.

From the left side menu, for Inserts → Eurostat → Gross domestic product, the user is able to import data (in this case, data regarding the "Gross domestic product") to the database in two ways. The first way is with a file, and the second way is through Web Service API.

Figure 2: Exports - "Gross domestic product"



4.2 Exports

Using the "Export" function the user is able to view the whole set of imported data regarding each table (Figure 2). Each table features columns with indicators that provide useful information. Each column is fitted with a search bar that lets the user explore the dataset using specific criteria depending on his/her needs. In addition, the user can export and download this information in various formats. Figure 2 presents the information of "Gross domestic product" with specific header columns such as, Year, Location, Unit and Value. The user can export and download the dataset he/she needs and study it further using the search fields (criteria).

Below we give a short explanation of the selections presented in Figure 2.

- *Add Gross domestic product data*: This redirects the user to the insert function to import new data.
- *Download csv*: This exports and downloads data in csv format.
- *Download Excel:* This exports and downloads data in xls format.
- *Greek:* This translates column headers in Greek.
- *English:* This translates column headers in English.
- *Italian:* This translates column headers in Italian.

Figure 3 provides another export example, regarding employment.

Figure 3: Exports - "Employment (thousand persons)"

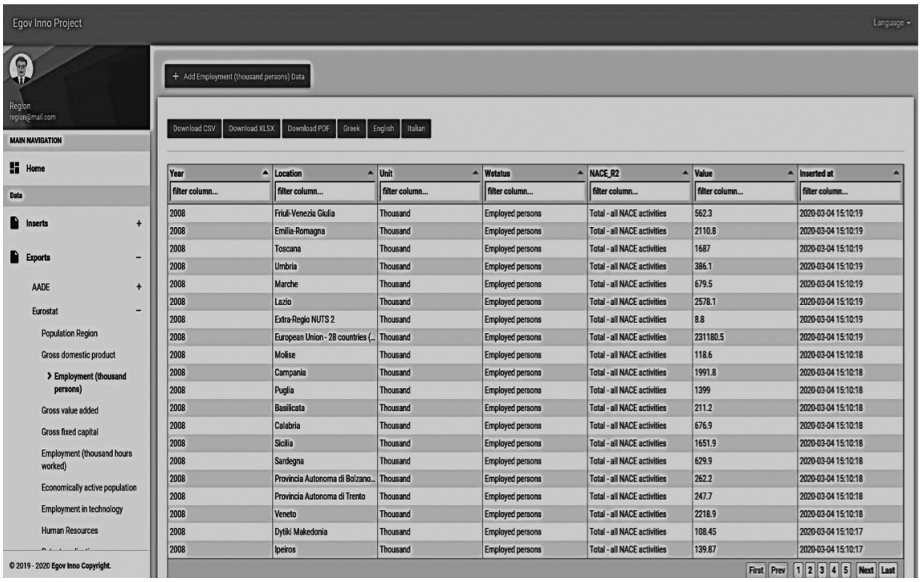


Figure 4: Charts - "Employment (thousand persons)"

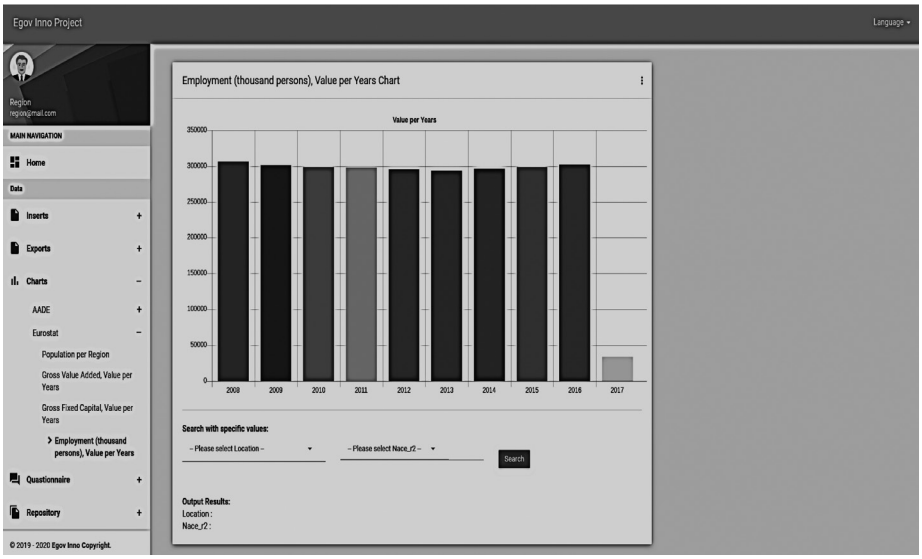
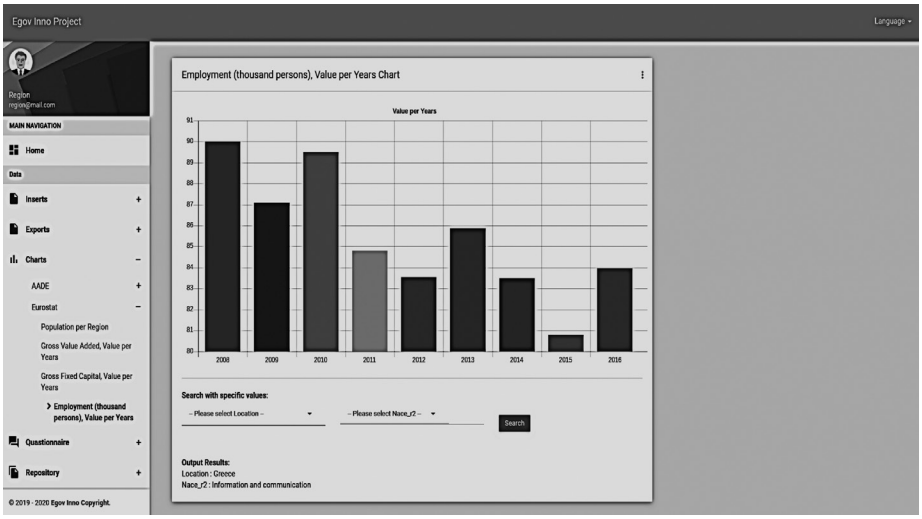


Figure 5: Charts - "Employment (thousand persons)"



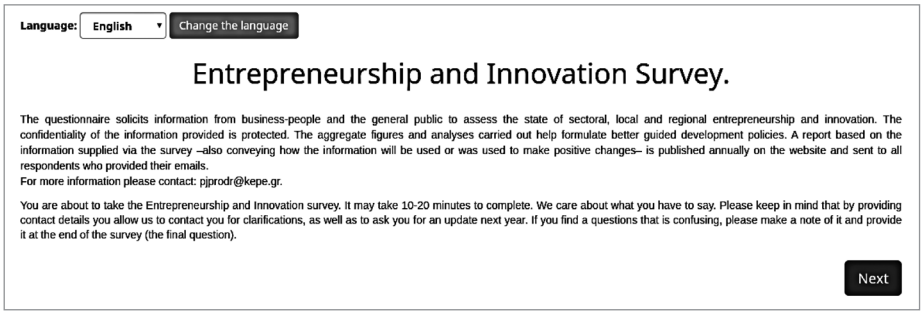
4.3 Charts

The Innobarometer also provides information in graph format. At its current version the Graph reports provided are developed based on the feedback received from an external expert on regional development. Figure 4 provides a chart regarding the annual "Employment (thousand persons)" aggregates across the EU and all NACE sectors; and Figure 5 provides a variant regarding a particular county and sector, namely, the number of employed people (thousand persons) in Information and communication in Greece.

4.4 Questionnaire

The on line questionnaire is created with the LimeSurvey library, an open source online survey tool built for such purposes, and is hosted on the application's server. The aim is to periodically collect information on regional entrepreneurship and innovation (E&I) from specific responders (mostly members of the business community plus members of the general public to whom the questionnaire's URL is given), review the information, and inform policy on the basis of the aggregated/ anonymized E&I data collected. To that end the questionnaire has been determined with a well-defined protocol, and includes in its logic many conditions based on the needs of the two regions. See Figure 6.

Figure 6: Run of the questionnaire



The questionnaire is organised in four sections, collectively containing 89 questions that solicit responses (information) via text fields, check boxes, drop downs etc. in xls/csv format (see Figure 7). Each of the four sections concentrates on:

- The respondent's personal information: 12 Questions.
- The respondent's views and experiences on entrepreneurship: 25 Questions.
- The enterprise: 26 Questions.
- The enterprise's innovation policy: 26 Questions.

The first section collects personal information about the respondent such as gender, year of birth, country of birth, education etc. The next section collects in-

Figure 7: Insert Responses

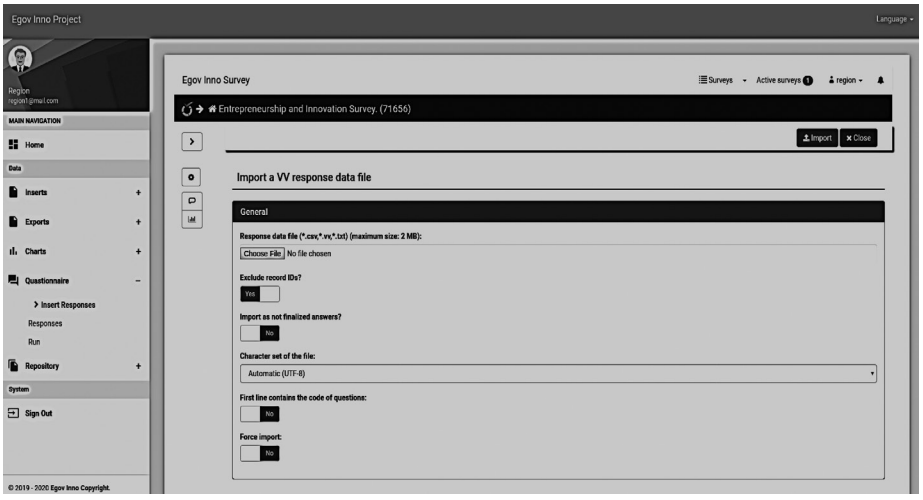
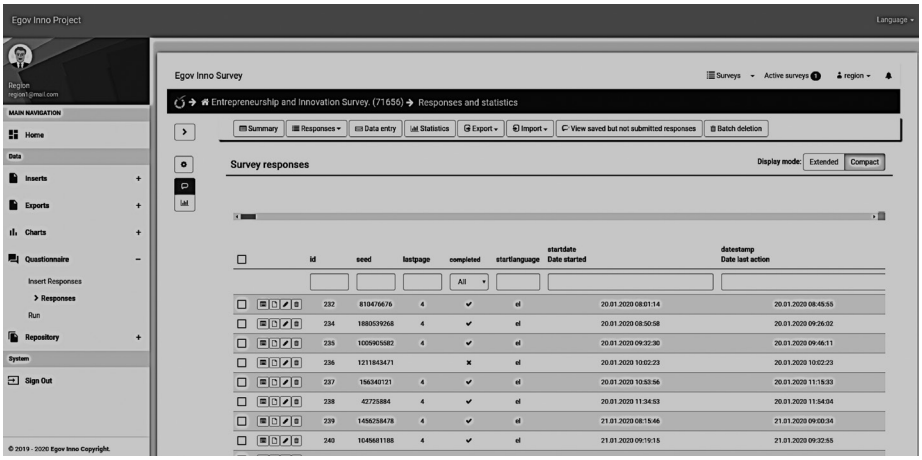


Figure 8: Responses



formation about entrepreneurship depending on the respondent's business, motivation, outcomes and expectations. Next, the enterprise section collects data about the name, email, role, employees and many more data of an enterprise. Finally, the innovation section collects information about the use of innovation and the impact of innovation on the enterprise.

A built in response function allows users of specific accounts with proper confidentiality authorization to view individual responses of the questionnaire. E.g. in Figure 8.

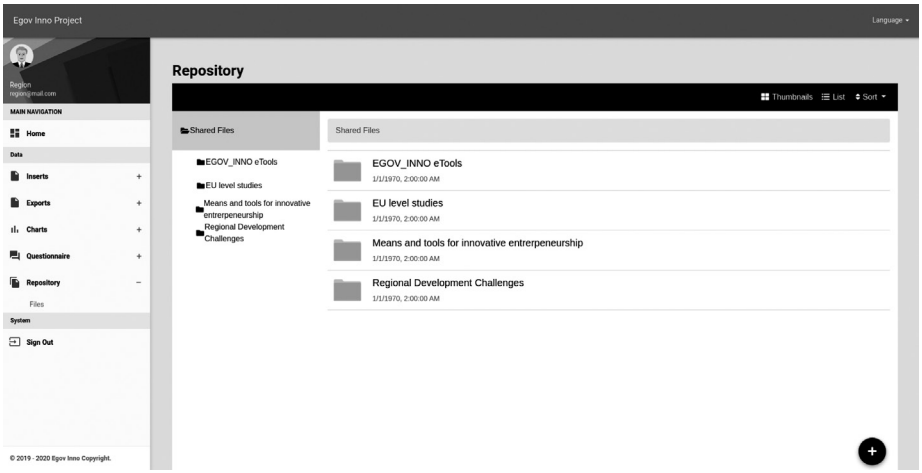
Designwise, the questionnaire is dynamic and can be customised (by the admin user) at any time depending on the revision of requirements, conditions and the needs of its scope. The sections may be changed, and questions may be added or removed. The General Data Protection Regulation legislation is taken into consideration via the introduction of a specific Disclaimer in the early steps, before the user proceeds to fill-in of the questionnaire.

4.5 Repository

The Repository is a structured "tree" with several folders, sub-folders and files. Only a small number of logged in users working for the regional authorities who sponsored the Innobarometer, and representatives of the research and business community have the permission to create folders and subfolders and upload useful files (e.g., files listing good practices in support of entrepreneurship, reports and analyses relying on the Innobarometer database etc. The general public (the set of

users who are not logged in) that visits the website is able to view (a) the repository files and the progress of selected indices over time or (b) selected indices at a particular point in time. Both sets of indices are based on aggregated data. The former are supplied in both table and graph format, and the latter are supplied in both table and charts. See Figure 9.

Figure 9: Repository structure tree



The top, dark colored horizontal row has three functions: (i) "Thumbnails" that presents the folders and files in thumbnails format. (ii) "List" that presents the folders and files in list format. (iii) "Sort" that presents the folders and files in alphabetic or chronological order.

The left hand vertical area supplies the folder structure. By clicking on each folder, the user sees the contents of the folder in the main area with the uploaded files. By selecting the icon on the bottom of the right hand corner the user can easily create a new folder or upload a new file.

5. IN OPERATION

During the project's trial / pilot period, the Innobarometer:

- Functioned with a concrete set of secondary data (more than 170.000 rows of data) that was previously dispersed in the five agencies mentioned in section 4.1.
- Allowed the regional authorities to take an important step towards building its

own regional and subregional statistical database by launching an e-questionnaire through which it collected 90 primary replies directly from local businessmen and women in the course of 6 months (see Figures 10-13).

- Was visited by regional stakeholders, policy makers (executives from the regional authorities of Western Greece and Apulia and executives from the Chamber of Achaia) and researchers, who provided feedback on the above features in a series of meetings and other occasions. By and large, they consider the new tool as useful in their efforts to study E&I issues and/or design business support policies and activities. This newly developed tool was probably visited by other members of the local community as well, as in the course of its three month pilot operation it averaged 440 visits per month in at least one functionality. This is considered quite promising a result.

The functionality with the higher usage (most visits) was the export of secondary data. As already mentioned, the secondary data base was (and is) quite diverse: at the time featuring the number of companies and turnover at the postal and sectoral (NACE) levels (from the AADE), variables on population, GDP, employment etc. (from Eurostat), down to information of innovative companies (from the ARTI), and the distribution of structural funds and Horizon 2020 funds (from the Regional Viewer) and R&D personnel (from the EKT). These were collected (imported) via the CSV functionality. (The Eurostat data sets could had been automatically imported through Eurostat's web services.) They were available to the general public in the form of export tables, while two AADE and four Eurostat variables were also available in graph form.

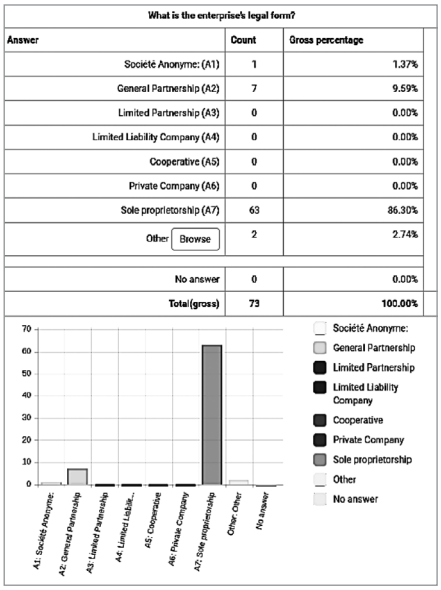
6. CONCLUSIONS AND FURTHER WORK

In an attempt to support businesses and inform and strengthen the capacity to carry out innovative entrepreneurship policy, the regional government and chambers of Western Greece and Apulia, along with members of the research community collaborated to set up the Innobarometer. The Innobarometer brings together needed information and data from various sources, such as the European and national statistics offices, the academia, and SMEs. Its innovation lies in the fact that it collects data from various sources about enterprises, innovation outcomes, and economic aspects, and presents them combined with field research information (solicited via questionnaires) provided by local SMEs. Using data from various sources is essential in effectively designing and providing policies and mechanisms to strengthen SMEs innovation and economic development.

During a pilot operation phase, the Innobarometer's functionalities were reviewed

Figures 10-13: Looking at the primary data

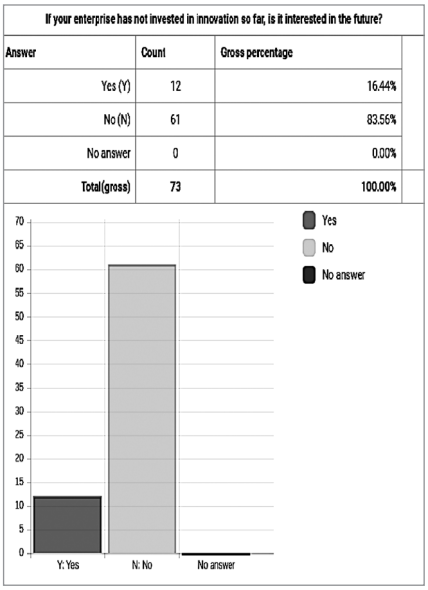
Figure 10



What is the enterprise's legal form?

Answer	Count	Gross percentage
Société Anonyme: (A1)	1	1.37%
General Partnership (A2)	7	9.59%
Limited Partnership (A3)	0	0.00%
Limited Liability Company (A4)	0	0.00%
Cooperative (A5)	0	0.00%
Private Company (A6)	0	0.00%
Sole proprietorship (A7)	63	86.30%
Other Browse	2	2.74%
No answer	0	0.00%
Total(gross)	73	100.00%

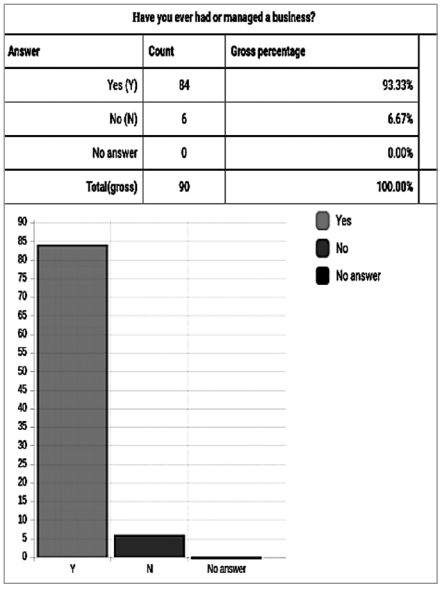
Figure 11



If your enterprise has not invested in innovation so far, is it interested in the future?

Answer	Count	Gross percentage
Yes (Y)	12	16.44%
No (N)	61	83.56%
No answer	0	0.00%
Total(gross)	73	100.00%

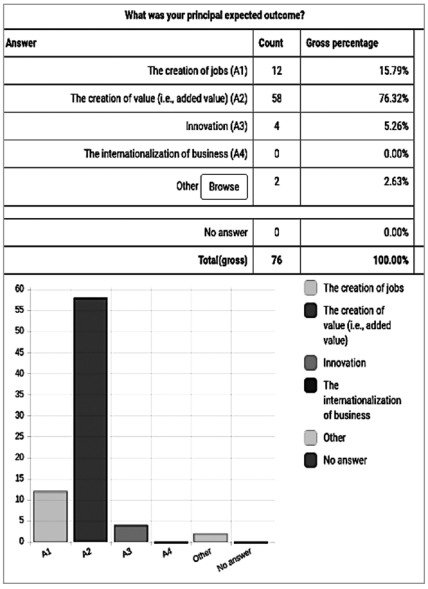
Figure 12



Have you ever had or managed a business?

Answer	Count	Gross percentage
Yes (Y)	84	93.33%
No (N)	6	6.67%
No answer	0	0.00%
Total(gross)	90	100.00%

Figure 13



What was your principal expected outcome?

Answer	Count	Gross percentage
The creation of jobs (A1)	12	15.79%
The creation of value (i.e., added value) (A2)	58	76.32%
Innovation (A3)	4	5.26%
The internationalization of business (A4)	0	0.00%
Other Browse	2	2.63%
No answer	0	0.00%
Total(gross)	76	100.00%

from specific users. Key stakeholders consider the tool useful in their effort to design business support policies and activities. From this interaction several extensions have been identified as of additional importance for the Region of Western Greece:

- The collection of additional information from national or EU sources (e.g., additional data from AADE in Greece, ARTI in Italy or the EU on specific issues and sectors such as tourism, the creative industries, the labor market).
- The preparation of reports on tourism, the creative industries, the labor market etc.
- The inclusion of additional functionalities through the utilization of machine learning technology (Georgiadis et.al., 2019) in order to carry out reports on projections.
- The addition of metadata input when a file is attached in a repository folder, and the development of a search function for users to employ.
- The expansion of the graphs presentation system to other variables.
- The selection by experts, and calculation from the system, of specific indicators based on data supplied by various sources (e.g., indicators regarding economic development trends, regional innovation etc.).

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CHAPTER 8

PILOT ANALYSES OF MICRO DATA COLLECTED IN 2020 IN WESTERN GREECE VIA AN ENTREPRENEURSHIP & INNOVATION QUESTIONNAIRE

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ABSTRACT | The chapter engages in exploratory analyses of business activity views, and entrepreneurship and innovation (E&I) information, collected via a survey carried out in Western Greece between January and August of 2020. More specifically, it illustrates how such views and information may be analyzed econometrically and algorithmically. In particular, it econometrically analyzes people's views about social values regarding entrepreneurship, local business people's motivation and expected outcomes of starting a business, business performance, and the factors that impede the growth and expansion of local businesses. In addition, it uses these and other responses on several aspects solicited via the questionnaire with the purpose of algorithmically clustering respondents in homogeneous groups on the basis of their response patterns. This, too, may be very useful both for analytical and for business policy purposes.

1. INTRODUCTION

The chapter engages in an exploratory analyses of business activity views and entrepreneurship and innovation (E&I) information collected between January and August of 2020, via a questionnaire discussed in chapter 6.2 and developed in late 2020 in the manner described in chapter 7.4.4. This is the EGOV_INNO questionnaire, and may be found in the Appendix. The views and information were provided by a small sample of local entrepreneurs who talked about their businesses,

as well as members of the general public residing in Aetolia-Akarnania and parts of Achaia (i.e., the first wave of respondents). The expectation is that in years to come, in subsequent waves, the response rate will increase.

The questionnaire solicited:

- Views regarding entrepreneurship and the business environment, as well as entrepreneurial experiences and expectations from the general public, businesspeople, and aspiring business men and women, with the aim of understanding their business background, business involvement, and local business culture.
- E&I facts and figures from business people. For instance: (i) the reasons for starting the enterprise, the obstacles, the ease of doing business, the export opportunities; (ii) information on the introduction of goods or services, on processes, on research and development expenditure, on where innovations were developed. These are factors considered in other such surveys in the EU and elsewhere.

In the pages that follow we illustrate how such views and information may be successfully analyzed econometrically and algorithmically. The former analysis is based on the questionnaire's section about social values, people's own motivations and expectations in starting their businesses, the performance of their businesses, and the factors that impede the growth and expansion of the said businesses. The aim is to present a method via which the impact of certain factors on the said features (as well as the impact of other elements on interesting aspects solicited via the questionnaire) may be identified and measured. The latter analysis uses the full set of responses (i.e., all fields) and engages in a modest number of independent execution runs (11 runs) in order to cluster the enterprises in homogeneous groups on the basis of their patterns (i.e., the questionnaire responses): This can be very useful both for analytical and for business policy purposes.

The rest of the chapter is organized as follows: Section 2 describes the sample. Section 3 econometrically analyzes the views (mostly, the views of local businessmen and women, but also of other people) about social values regarding entrepreneurship. Section 4 econometrically analyzes the motivation of the said local business people, and the expected outcome of starting a business; while Section 5 econometrically analyzes business performance and the factors that impede the growth and expansion of local businesses. Section 6 describes the algorithmic clustering approach, and supplies its results. Section 7 provides the conclusions.

2. A BRIEF DESCRIPTION OF THE SAMPLE

The survey was filled out by 86 respondents:

(a) 72 entrepreneurs who responded to all questions about their age, qualifications, occupation, household composition, their views of the social environment, their motivation to start a business, the expected outcome and performance of their businesses, as well as the factors that impeded their businesses. These were 51 males and 21 females (59 and 24%, respectively, of all respondents), mostly professionals (50%), with higher secondary or post-secondary education or BA level qualifications (70%), often from the town of Agrinion and its suburbs (49%). See Table 1.

(b) 11 entrepreneurs who responded to all questions except for the questions about the performance of their businesses and the factors that impeded their businesses. The entrepreneurs consisted of eight males and three females (13% of all respondents), with a distribution that resembles the one under item (a). See Table 2.

(c) Three people from the general public who responded to the questions regarding their age, qualifications, occupations, household compositions, and the views of their social environment. See Table 3.

Interesting features, such as their views, performance etc., are now analyzed econometrically as explained variables, in terms of likely explanatory variables also solicited in the survey, such as their gender, qualifications etc., using STATA. Thus, the impact of each explanatory variable considered is estimated and isolated as follows (e.g., Gujarati, 1995):

$$\text{Explained variable} = \text{constant} + (\text{coefficient \#1} \times \text{explanatory variable \#1}) + (\text{coefficient \#2} \times \text{explanatory variable \#2}) + \ldots$$

The Sample Selection-Bias Correction (SSBC) process proposed by Heckman is also applied (e.g., Killingsworth and Heckman, 1986; Wiggins, 2021).

Table 1: 72 entrepreneurs who provided information on their business involvement, their personal and household characteristics, and their views

Gender, qualifications, and residence	Fre-quency	Av-erage age	Average household composition			Number of respondents with																										
						Views regarding social values			Businesses												Views on the factors that impede businesses											
									Primary motives to start the business					Principal expected outcome				Perfor-mance													
			Kids	Other earn-ers	Other adults	A	B	C	I	II	III	IV	V	1	2	3	4	α	β	a	b	c	d	f	g	h	i	j	k				
Males	51	47	1	0	1	12	9	3	6	16	25	2	2	2	44	4	1	27	46	0	4	10	7	39	3	44	45	34	41				
Females	21	48	1	1	0	1	2	3	3	6	9	3	0	0	13	6	0	11	17	2	3	4	5	17	3	19	19	14	17				
Qualifications																																	
• Basic education certificate	5	64	0	0	0	2	1	1	2	2	0	1	0	0	3	2	0	3	3	1	1	2	1	5	1	5	5	5	5				
• Higher secondary education or BA diploma	60	47	1	0	1	7	7	2	7	18	33	1	1	1	48	8	1	29	53	1	5	10	6	45	5	53	52	40	48				
• MA degree	7	38	1	0	1	4	3	3	0	2	1	3	1	1	6	0	0	6	7	0	1	2	5	6	0	5	7	3	5				
Professionals	69	48	1	0	1	13	11	5	7	21	34	5	2	2	57	7	1	38	62	1	6	13	11	55	5	61	62	46	57				
Other occupations	3	61	0	1		0	0	1	2	1	0	0	0	0	0	3	0	0	1	1	1	1	1	1	1	2	2	2	1				
Place																																	
• Agrinion	42	48	1	0	1	9	8	6	6	1	17	5	1	2	30	9	1	19	36	2	5	8	11	29	5	35	36	25	33				
• Amphilochia	7	48	1	0	1	2	0	0	0	5	1	0	1	0	7	0	0	4	7	0	0	2	1	7	1	7	7	6	6				
• Astakos	2	47	0	0	1	0	0	0	0	1	1	0	0	0	2	0	0	1	2	0	1	1	0	2	0	2	2	1	2				
• Katouna	3	45	1	1	0	0	1	0	0	0	3	0	0	0	3	0	0	1	2	0	0	1	0	2	0	3	3	2	3				
• Panaetolion	2	51	0	1	0	1	1	0	0	1	1	0	0	0	2	0	0	2	2	0	0	0	0	2	0	2	2	2	1				
• Elsewhere in Aet.-Akanr.	12	46	1	0	0	0	0	0	2	1	9	0	0	0	10	1	0	9	11	0	0	2	0	12	0	12	12	10	11				
• Patras	1	48	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0				
• Kalavrita	3	40	1	1	0	1	1	0	0	1	2	0	0	0	3	0	0	2	3	0	0	0	0	2	0	2	2	2	1				

Views regarding social values based on responses provided on a five-point Likert-scale:
A. Entrepreneurship is very much perceived as a good career choice in my social environment.
B. A successful entrepreneur very much enjoys high status in my social environment. C. Entrepreneurship very much attracts positive media attention in the society I live in.
Primary motives to start the business:
I. Necessity, e.g., cannot find another job. II. Opportunity to enjoy more independence. III. Opportunity to make more money, earn a satisfactory income.
IV. Opportunity to make my mark, a name for myself. V. Wish to affect/achieve a market improvement.
Principal expected business outcomes: 1. Innovation. 2. Creation/addition of value. 3. Creation of jobs. 4. Other.
Business performance based on responses provided on a five-point Likert-scale: α. The business performed very well. β. The business performed well or very well.
Views on the factors that impede businesses based on responses provided on a five-point Likert-scale (if either of the two top points out of five):
a. Technology risk / uncertainty. b. Market risk / uncertainty. c. Difficulty in accessing external finance.
d. Difficulty in finding business partners. e. Difficulty in recruiting highly-skilled employees. f. Too much competition in the market.
g. Not enough revenues to reinvest in growing the business. h. Continuously changing taxation regulations. i. High tax rates.
j. Lack of business support mechanisms. k. The current economic climate.

Table 2: Eleven entrepreneurs who provided information on their business involvement, their personal and household characteristics, and their views, but not on their business performance

Gender, qualifications, and residence	Frequency	Average age	Average household composition			Number of respondents with											
						Views regarding social values			Businesses								
									Primary motives to start the business					Principal expected outcome			
			Kids	Other earners	Other adults	A	B	C	I	II	III	IV	V	1	2	3	4
Males	8	38	1	0	1	2	2	1	1	0	6	0	1	2	5	1	0
Females	3	46	1	0	0	1	0	0	0	1	1	1	0	0	1	0	1
Qualifications																	
• Basic education certificate	0																
• Higher secondary education or BA diploma	9	40	1	0	0	2	0	0	0	1	7	1	0	1	5	1	1
• MA degree	2	44	2	0	2	1	2	1	1	0	0	0	1	1	1	0	0
Professionals	8	39	1	0	0	2	1	1	0	0	6	1	1	2	4	1	0
Other occupations	3	44	2	0	1	1	1	0	1	1	1	0	0	0	2	0	1
Place																	
• Agrinion	4	43	2	0	1	2	1	1	0	1	2	0	1	1	1	1	1
• Amphilochia	4	29	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0
• Panaetolion	1	65	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
• Patras	1	50	1	0	2	0	1	0	1	0	0	0	0	0	1	0	0
• Kalavrita	1	41	2	0	1	0	0	0	0	0	1	0	0	1	0	0	0

Views regarding social values:
A. Entrepreneurship is very much perceived as a good career choice in my social environment.
B. A successful entrepreneur very much enjoys high status in my social environment.
C. Entrepreneurship very much attracts positive media attention in the society I live in.
Primary motives to start the business:
I. Necessity, e.g., cannot find another job.
II. Opportunity to enjoy more independence.
III. Opportunity to make more money, earn satisfactory income.
IV. Opportunity to make my mark, a name for myself.
V. Wish to affect/achieve a market improvement.
Principal expected business outcome:
1. Innovation. 2. Creation/addition of value. 3. Creation of jobs. 4. Other.

Table 3: Three respondents from the general public

Gender, qualifications, and residence	Frequency	Average age	Average household composition		
			Kids	Other earners	Other adults
Males	1	68	0	0	1
Females	2	37	2	0	0
Qualifications					
• Basic education certificate	0				
• Higher secondary education or BA diploma	1	68	0	0	0
• MA degree	2	37	2	0	2
Professionals	1	41	3	0	0
Other occupations	2	51	0	0	1
Place					

3. THREE VIEWS AND THE ENTREPRENEURIAL ACTIVITY OF THE RESPONDENTS

Three five-point Likert-scaled views regarding the social status of entrepreneurship were solicited from all respondents. Of these, the highest scaled versions were: (A) Entrepreneurship is *very much* perceived as a good career choice in my social environment. (B) A successful entrepreneur *very much* enjoys high status in my social environment. (C) Entrepreneurship *very much* attracts positive media attention in the society I live in. They are modestly correlated ($r_{A,B}$=55%, $r_{B,C}$=47%, $r_{A,C}$=40%); and the econometric analyses of them (Table 4) reveal that:

- Men believed more than women that the social environment perceived entrepreneurship very much as a good career choice (the coefficient of column A, line 2 is negative and associated with a p-value of 1%: definitely, a low probability of error); while those employed or with MA degrees or living in Agrinion, Amphilochia (p-value of 9%) and Panaetolion (p-value of 0.2%) believed so more than the rest (see column A).
- Women believed more than men and people in Agrinion, Panaetolion, Katouna and Kalavrita believed more than the rest that their social environment appreciated a successful entrepreneur (i.e., that the successful entrepreneur very much enjoyed a high status) (see column B).
- People with MA degrees believed more than the rest that entrepreneurship very much attracted positive media attention in the society they lived in (see column C).

Table 4: Econometric analyses of the probability of occurrence in a binary classification (probit) with robust standard errors (RSE) (N=86)
A. Entrepreneurship is very much perceived as a good career choice in my social environment.
B. A successful entrepreneur very much enjoys high status in my social environment.
C. Entrepreneurship very much attracts positive media attention in the society I live in.

		A		B		C	
		Coeffi-cients	P-values	Coeffi-cients	P-values	Coeffi-cients	P-values
1	Constant	-2.49	0.000	-2.08	0.000	-1.76	0.000
2	Female	-1.30	0.010	1.47	0.004		
3	MA degree	1.46	0.006			1.62	0.000
4	Employed	0.85	0.066				
	Place:						
5	• Agrinion			0.85	0.059		
6	• Agrinion, Amphilochia	1.03	0.090				
7	• Kalavrita			1.24	0.090		
8	• Panaetolion	3.82	0.002				
9	• Panaetolion, Katouna			1.65	0.009		
	Pseudo R^2	31.15%		20.80%		22.28%	

In addition, the econometric analysis of the probability that a respondent engaged in entrepreneurial activity (Table 5) suggests that the particular probability decreased over time and among people with basic (i.e., elementary, and lower higher secondary) education; and featured a Λ-shape with respect to the respondent's age (it peaked at the age of 50 years old) as per the first order condition with respect to age.[1]

Table 5: Probit with RSE on a respondent being an entrepreneur (N=86)

		Coefficients	P-values
1	Constant	-0.36	0.939
2	Time (survey: Jan.-Aug.)	-0.04	0.066
3	Respondent's age	0.41	0.001
4	Respondent's age, squared	-0.00	0.094
5	Basic education certificate (k-9)	-1.77	0.021
	Pseudo R^2	48.54%	

[1] Peoples' age and the attainment of basic educational were modestly correlated (r=45%), while the other explanatory variables were weakly correlated (r<20%).

Then, measures of respondent heterogeneity associated with all four probability analyses of Tables 4 and 5 are estimated in order to serve as SSBC variables in the analyses that follow.

4. THE PRIMARY MOTIVATIONS AND THE EXPECTED OUTCOMES OF STARTING A BUSINESS

Each entrepreneur picked one of the following as his or her primary motive for starting a business: (I) Necessity (e.g., not finding a job). (II) The opportunity to enjoy more independence. (III) The opportunity to make more money or earn a satisfactory income. (IV) The opportunity to make his or her mark, a name for him or herself. (V) The wish to affect or achieve a market improvement. In addition, each entrepreneur selected one of the following as his or her principal expected outcome when he or she commenced the business: (1) Innovation. (2) The creation/addition of value. (3) The creation of jobs. (4) Something else.

Table 6: Probit with RSE on an entrepreneur's primary motivation to start the business (N=83)
I. Necessity, e.g., cannot find another job.
II. Opportunity to enjoy more independence. (no coef. was associated with a p-value ≤ 10%)
III. Opportunity to make more money, earn a satisfactory income.
IV. Opportunity to make my mark, a name for myself.
V. Wish to affect/achieve a market improvement.

		I		III		IV		V	
		Coef.	P-values	Coef.	P-values	Coef.	P-values	Coef.	P-values
1	Constant	0.36	0.671	-0.31	0.308	-2.33	0.000	-4.93	0.001
2	Time (survey: Jan.-Aug.)	-0.01	0.055						
3	Gender: Female					0.83	0.116		
	Educational qualifications								
4	• Higher sec. school cert.			0.89	0.007				
5	• MA degree					1.46	0.008	1.56	0.108
6	Occupation: Professional	-1.21	0.026						
	Number of household members								
7	• Children							1.08	0.008
8	• Non-earning adults	0.56	0.104	-0.50	0.032			1.04	0.054
9	Place: Panaetolion					1.26	0.119		
10	Sample selection bias correction variable (SSBC): respondents who are entrepreneurs (estimated from Table 5)	3.17	0.055	0.21	0.905	1.63	0.285	3.15	0.165
	Pseudo R^2	23.55%		10.05%		30.01%		46.23%	

The econometric analyses of the former five, under items I-V (Table 6), suggest that as a motive:

- Necessity waned over time and was weaker among professionals compared to other occupations. In addition, it was perhaps more (less) pressing in households with a higher (lower) number of non-income-earning adults.[2] (The p-value regarding non-income-earning adults was marginally over 10%.) (See column I.)
- Independence was probably not affected by any of the factors considered. (No coefficient was associated with a p-value less than or equal to 10%.)
- Making more money was less (more) pressing in households with a higher (lower) number of non-income-earning adults, and stronger among higher secondary school graduates vis-à-vis holders of other qualifications.[3] (See column III.)
- Making one's mark was higher among MA degree holders vis-à-vis holders of other qualifications, and perhaps among women and people from Panaetolion. (See column IV.)
- Affecting a market improvement was more (less) pressing in households with a higher (lower) number of children and non-income-earning adults, and, perhaps, stronger among MA degree holders vis-à-vis holders of other qualifications. (See column V.)

The econometric analyses of the other four variables regarding the principal expected outcome, under items 1-4 (Table 7), indicate that the expectation of achieving:

- Innovation was higher among entrepreneurs with MA degrees vis-à-vis other entrepreneurs,[4] and rose with the number of non-income-earners adults in the household. (See column 1.)
- More value was higher among professionals compared to other occupations, and featured a V-shape with respect to respondent's age (it bottomed out at the age of 56).[5] (See column 2.)

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[2] Time and people's occupations were modestly correlated with the SSBC variable (the respective r's were equal to 36% and 23%) and weakly correlated among themselves (r<20%), while the other explanatory variable considered was weakly correlated with them and with the SSBC variable.

[3] The higher secondary school qualifications and the SSBC variable were modestly correlated (r=35%), while the other explanatory variables were weakly correlated (r<20%).

[4] The MA qualification and number of non-earning household adults variables were modestly correlated with several SSBC variables, as were some SSBC variables with each other ($r_{8,11}$=-65%, $r_{12,13}$=-55%, $r_{5,13}$=-54%, $r_{5,12}$=53%, $r_{8,12}$=52%, $r_{8,13}$=-49%, $r_{11,12}$=-44%, $r_{11,13}$=35%, $r_{10,12}$=20%), while the other explanatory variables were weakly correlated (r<20%).

[5] The peak results from the expression's first order conditions with respect to age. The

Table 7: Probit with RSE on the entrepreneur's principal expected outcome from the business (N=83)

1. Innovation. 2. Creation / addition of value. 3. Creation of jobs. 4. Other.

		1		2		3		4	
		Coef.	P-values	Coef.	P-values	Coef.	P-values	Coef.	P-values
1	Constant	-16.08	0.088	15.57	0.021	-65.61	0.003	-3.79	0.000
2	Respondent age			-0.56	0.036	2.42	0.004		
3	Respondent age, squared			0.00	0.063	-0.02	0.004		
	Educational qualifications								
4	• BA degree							2.52	0.008
5	• MA degree	7.45	0.031						
6	Occupation: Professional			2.11	0.006	-3.77	0.002		
	Number of household members								
7	• All other adults							1.19	0.009
8	• Non-earning adults	15.14	0.046						
9	Place: Agrinion					1.56	0.007		
	SSBC variables								
10	• Respondents who are entrepreneurs (Tab. 5)	38.44	0.056	-7.16	0.032	28.05	0.002	-204.26	0.021
	• Entrepreneur's primary motivation (Tab. 6)								
11	I (necessity)	11.11	0.048	-1.45	0.013	2.43	0.002		
12	III (make more money)	-20.35	0.040						
13	V (affect market impr.)	-2.56	0.036	0.38	0.026				
	Pseudo R^2	59.93%		24.88%		50.66%		45.66%	

- More jobs were higher among those living in Agrinion, lower among professionals compared to other occupations, and featured a Λ-shape with respect to respondent's age (peaked at the age of 51).[6] (See column 3.)
- Something else was higher among BA degree holders vis-à-vis holders of other qualifications, and rose with the number of adults in the household.[7] (See column 4.)

Then measures of entrepreneurial heterogeneity associated with all eight aforesaid analyses are estimated to be used as SSBC variables in the analyses that follow.

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occupational and certain SSBC variables were modestly correlated, as were certain SSBC variables with each other ($r_{6,11}$=57%, $r_{11,13}$=35%, $r_{10,11}$=-32%, $r_{6,10}$=-23%), while the other explanatory variables were weakly correlated with the rest and with each other (r<20%).

6 The occupational and two SSBC variables were modestly correlated, as were the SSBC variables between themselves ($r_{6,11}$=57%, $r_{10,11}$=-32%, $r_{6,10}$=-23%), while the other explanatory variables were weakly correlated with the rest and with each other (r<20%).

7 The BA qualification and a SSBC variable were modestly correlated ($r_{4,10}$=-27%), while the other explanatory variable considered were weakly correlated with them (r<20%).

5. BUSINESS PERFORMANCE

An econometric comparison between the 73 entrepreneurs who opted to report their business performance and the ten entrepreneurs who opted not to do so (Table 8) suggests that the probability of reporting one's business performance was higher among professionals, increased with the number of other earners in the household, was lower among those living in Patras, and featured a Λ-shape with respect to respondent's age (peaked at the age of 51). Following that, a measure of entrepreneurial heterogeneity is estimated in order to be used as a SSBC variable for each respondent in the analyses of business performance and the factors that obstructed this performance. [8]

Table 8: Probit with RSE on the entrepreneurs who reported their business performance (N=83)

		Coefficients	P-values
1	Constant	-50.88	0.006
2	Respondent's age	1.91	0.002
3	Respondent's age, squared	-0.02	0.037
4	Occupation: Professional	2.38	0.004
5	Number of other earners in the household	1.12	0.034
6	Place: Patras	-2.23	0.005
	SSBC variables		
7	• Respondents who are entrepreneurs (Tab. 5) • Entrepreneur's principal exp. outcome (Tab. 7)	46.63	0.007
8	1 (innovation)	0.07	0.050
9	3 (job creation)	0.51	0.011
	Pseudo R^2	45.55%	

The econometric analyses of the 73 responses on whether a business performed very well or not very well (Table 9, column α) suggests that the particular probability decreased with the number of income-earning adults in the household;[9] and the econometric analysis on whether business performed well or very well as opposed to performing worse (Table 9, column β) suggests that the former of the two decreased with the number of income-earning adults in the household, decreased in the cases of businesspeople with basic education, and featured a V-shape with respect to respondent's age (bottomed out at the age of 50).[10]

[8] The occupational and a spatial variable, the occupational and SSBC variables, the age and SSBC variables, and a couple of SSBC variables were all modestly correlated ($r_{3,9}$=-50%, $r_{8,9}$=32%, $r_{4,6}$=26%, $r_{4,8}$=23%, respectively), while the other explanatory variables were weakly correlated (r<20%).

[9] The number of other earners in the household and SSBC variables were modestly correlated, as were certain SSBC variables between themselves ($r_{6,9}$=39%, $r_{6,8}$=37%, $r_{5,6}$=20%), while the other explanatory variables were weakly correlated (r<20%).

[10] The age and educational variables were modestly correlated, as were the age the educational variable and the number of other earners in the household with SSBC variables, and certain

Table 9: Probit with RSE on the entrepreneurs who reported that their business performed (a) very well and (b) well or very well (N=73)

		α		β	
		Coef.	P-values	Coef.	P-values
1	Constant	1.42	0.080	52.21	0.007
2	Respondent's age			-2.08	0.006
3	Respondent's age, squared			0.02	0.006
4	Basic education certificate (k-9)			-3.66	0.021
5	Number of other adult earners in the household	-0.87	0.009	-2.30	0.000
	SSBC variables				
6	• Respondents who are entrepreneurs (Table 5) • Entrepreneur's primary motivation (Table 6)	-4.05	0.022	-6.00	0.800
7	I (necessity)			1.18	0.018
8	IV (make my mark)	-0.62	0.042		
9	• Entrepreneur's principal expected outcome 3 (job creation) (Table 7)	0.18	0.006		
10	• Entrepreneurs who reported their business performance (Table 8)	-0.73	0.373	-1.46	0.393
	Pseudo R^2	17.79%		51.72%	

The same 73 entrepreneurs who opted to report their business performance also selected one or more of the following as factors that impeded the growth/expansion of their businesses: (a) Technology risks/uncertainty. (b) Market risk/uncertainty. (c) The difficulty in accessing external finance. (d) The difficulty in finding business partners. (e) The difficulty in recruiting highly-skilled employees. (f) Increased market competition. (g) Lacking revenue to reinvest. (h) The continuously changing taxation regulations. (i) The high tax rates. (j) The absence or shortage of business support mechanisms. (k) The economic climate. Of these, the pair regarding taxes was highly correlated (ρ_{hi}=75%), a good number of factors were modestly correlated (r_{ab}=52%, r_{fi}=56%, r_{fh}=37%, r_{jk}=33%, r_{bf}=-28%, r_{ij}=28%, r_{dg}=27%, r_{ag}=r_{cf}=26%, r_{cd}=25%, r_{cg}=r_{hj}=23%, r_{aj}=21%), while the other factors were weakly correlated.

The econometric analyses of the 73 entrepreneurial views (Table 10) regarding the factors that impeded business growth, suggest that the adverse impact of:

a. Technology risks and uncertainty were lower among those with basic education.[11] (See column a.)

SSBC variables among themselves ($r_{2,4}$= 42.87%, $r_{6,7}$= -37.25%, $r_{5,7}$= 35.25%, $r_{4,6}$= 24.75%, $r_{5,10}$= 20.31%, $r_{4,7}$= -20.28%, $r_{2,7}$= -20.12%, respectively), while the other explanatory variables were weakly correlated (r<20%).

[11] The educational variable and two SSBC variables were all modestly correlated ($r_{13,14}$=38%, $r_{6,14}$=34%, $r_{6,13}$=25%), while the other explanatory variables were weakly correlated (r<20%).

Table 10: Probit with RSE on the factors that according to the entrepreneurs impeded the growth/expansion of the business (N=73)
a. Technology risk / uncertainty. b. Market risk / uncertainty. c. Difficulty in accessing external finance.
d. Difficulty finding business partners. e. Difficulty recruiting highly-skilled employees. f. Too much competition in the market.

		a		b		c		d		e		f	
		Coef.	P-val-ues	Coef.	P-val-ues	Coef.	P-val-ues	Coef.	P-val-ues	Coef.	P-val-ues	Coef.	P-val-ues
1	Constant	-8.95	0.015	-20.21	0.001	0.09	0.827	1.23	0.356	0.07	0.908	1.47	0.048
2	Time (survey: Jan.-Aug.)							-0.03	0.056	-0.02	0.086	0.02	0.131
3	Time, squared							0.00	0.022	0.00	0.088	-0.00	0.036
4	Respondent's age			0.76	0.005								
5	Respondent's age, squared			-0.01	0.008								
	Educational qualification												
6	• Basic education certificate (k-9)	-3.64	0.000							1.48	0.028		
7	• MA degree							2.00	0.001				
8	Occupation: Professional							-1.89	0.119				
	Number of household members												
9	• Other earning adults											-1.27	0.011
10	• All other adults: earning & non-earning					-1.38	0.001						
11	Place: Astakos			1.63	0.107								
	SSBC variables												
12	• Respondents with social view A (Table 4)	1.15	0.040										
13	• Respondents who are entrepreneurs (Table 5)	8.51	0.093	6.89	0.000	-2.62	0.149	-3.73	0.188	1.13	0.525	-0.57	0.749
14	• Entrepreneur's principal expected out-come 2: creation of value (Table 7)	5.50	0.089			0.66	0.046						
15	• Entrepreneurs who reported their business performance (Table 8)	-14.63	0.150	2.75	0.000	-0.72	0.213	-4.81	0.029	0.59	0.409	-1.45	0.093
	Pseudo R^2	71.48%		23.46%		21.05%		36.76%		11.48%		26.25%	

Table 10 (continued)

g. Not enough revenues to reinvest. h. Continuously changing taxation regulations. i. High tax rates. j. Lack of business support mechanisms. k. The current economic climate.

		g		h		i		j		k	
		Coef.	P-values	Coef.	P-values	Coef.	P-values	Coef.	P-values	Coef.	P-values
1	Constant	-17.46	0.001	-4.54	0.037	1.84	0.058	-0.22	0.243	19.76	0.068
2	Time (survey: Jan.-Aug.)	0.01	0.084	0.11	0.005	0.04	0.012			-0.24	0.065
3	Time, squared			-0.00	0.007	-0.00	0.007			0.00	0.094
4	Respondent's age	0.55	0.024								
5	Respondent's age, squared	-0.01	0.041								
8	Occupation: Professional					-1.33	0.107	1.27	0.087	3.02	0.031
	Number of household members										
	• Children					0.90	0.021				
9	• Other earning adults			-2.95	0.005	-1.84	0.001				
11	Place: Kalavrita									-1.31	0.080
	SSBC variables										
13	• Respondents who are entrepreneurs (Table 5)	4.21	0.031	-9.19	0.008	-2.20	0.276	-1.31	0.309	10.41	0.068
14	• Entrepreneur's principal exp. outcome 2: creation of value (Table 7)			0.24	0.021	-0.38	0.641	-0.95	0.219	-0.80	0.307
15	• Entrepreneurs who reported their business performance (Table 8)	-0.49	-0.49	0.91	0627	-0.38	0.641	-0.95	0.219	-0.80	0.307
	Pseudo R^2	22.14%		50.49%		35.25%		5.76%		34.96%	

b. Market risk and uncertainty were perhaps higher among those living in Astakos, and featured a Λ-shape with respect to respondent's age (peaked at the age of 49). (See column b.)
c. The difficulty in accessing external finance fell with the number of other adults in the household.[12] (See column c.)
d. The difficulty in finding business partners was higher among MA degree holders, perhaps lower among professionals, and featured a V-shape with respect to time (bottomed out at the end of March: during the first CoViD-19 lockdown in Greece).[13] (See column d.)
e. The difficulty in recruiting highly-skilled employees was higher among those with basic education, and featured a V-shape over time (bottomed out in the last week of April: during the first lockdown).[14] (See column e.)
f. Market competition fell with the number of other income-earning adults in the household, and probably featured a Λ-shape over time (peaked at the end of March: during the first lockdown).[15] (See column f.)
g. Lacking revenue to reinvest rose over time and featured a Λ-shape with respect to age (peaked at the age of 52).[16] (See column g.)
h. Continuously changing taxation regulations fell with the number of other earning adults and featured a Λ-shape with respect to time (peaked in mid-May: after the first lockdown).[17] (See column h.)
i. High tax rates were perhaps lower among professionals, rose with the number of children in the household, fell with the number of other earning adults in the household, and featured a Λ-shape with respect to time (peaked in mid-April, during the lockdown).[18] (See column i.)

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[12] Two SSBC variables were modestly correlated ($r_{13,14}$=38%), while the other explanatory variables were weakly correlated (r<20%).

[13] The time, the occupational, and the household composition variables were modesty correlated with SSBC variables ($r_{2,13}$=36%, $r_{8,15}$=-24%, $r_{9,15}$=-20%), while the other explanatory variables were weakly correlated (r<20%).

[14] Both the time and the educational variable were modestly correlated with a SSBC variable ($r_{2,13}$=36%, $r_{6,13}$=25%), while the other explanatory variables were weakly correlated (r<20%).

[15] The time and SSBC variables were modestly correlated ($r_{2,13}$=36%), while the other explanatory variables were weakly correlated (r<20%).

[16] The time and a SSBC variable were modestly correlated ($r_{2,9}$=36%), while the other explanatory variables were weakly correlated (r<20%).

[17] The time and household composition variables were modestly correlated with SSBC variables ($r_{2,9}$=36%, $r_{2,10}$=34%, $r_{8,11}$=-20%), while the other explanatory variables were weakly correlated (r<20%).

[18] The two household composition variables were modesty correlated, while the time, the occupational, and one of the household compositions variables were (each) modesty correlated

j. Lacking business support mechanisms was higher among professionals.[19] (See column j.)
k. The economic climate was higher among professionals, lower among people from Kalavrita, and featured a V-shape with respect to time (bottomed out in the first week of August: the core tourist season, at the beginning of the second CoViD-19 wave in Greece). [20] (See column k.)

In the same manner additional survey issues and larger samples may be analyzed.

6. CLUSTER ANALYSIS

Switching gears, we turn to an algorithmic approach of analyzing the business activity views and E&I information collected via the questionnaire. It is an evolutionary clustering approach based on biologically-inspired optimization and machine learning algorithms aiming to organize enterprises into homogeneous groups by identifying patterns in the questionnaire responses. The goal is threefold: (1) To explore the dataset and handle potential data challenges, such as data imperfection (e.g., missing values), data inconsistency, data confliction, data alignment/correlation and so on. (2) To find the most critical questions of the survey using feature-selection-based data mining techniques. (3) To investigate the composition of the clusters (i.e., groups) that emerge for pattern recognition purposes.

6.1. A description of the problem and the mathematical formulation

Clustering is an unsupervised machine learning approach of grouping a set of objects into clusters so that objects belonging to different clusters differ among themselves much more than objects belonging to the same cluster (Wierzchoń and Kłopotek, 2018). So, a typical clustering approach aims to group a collection of patterns into clusters based on similarities in order to uncover a certain kind of natural structure in the dataset. As a result, objects in the same cluster should be as similar as possible, while objects in different clusters should be as dissimilar as possible.

The clustering problem can be formalized as an optimization problem. In our setting, the objects are the survey participants (i.e., the enterprises). Each enterprise (ob-

with SSBC variables ($r_{2,9}$=36%, $r_{6,9}$=-34%, $r_{7,8}$=30%, $r_{6,11}$=-23%, $r_{8,11}$=-20%), while the other explanatory variables were weakly correlated (r<20%).

[19] The time and occupational variables were modesty correlated with SSBC variables ($r_{2,9}$=36%, $r_{6,9}$=-34%, $r_{6,11}$=-23%), while the other explanatory variables were weakly correlated (r<20%).

[20] The time and occupational variables were modesty correlated with SSBC variables ($r_{2,9}$=36%, $r_{6,9}$=-34%, $r_{6,11}$=-23%), while the other explanatory variables were weakly correlated (r<20%).

ject) can be seen as a multi-dimensional data cube or, considering the questionnaire responses, as a set of values that corresponds to numerical and categorical features with respect to the possible responses in the questionnaire. Therefore, the problem is one of grouping *m* enterprises, featuring *n* questionnaire responses, into *k* clusters. We describe the decision variables and parameters of the optimization problem below.

A set of *m* enterprises $\Xi = [\xi_1, \xi_2, ..., \xi_m]$ is given. Each enterprise, $\xi_i (i = 1, ..., m)$, is described in terms of its features as an n-dimensional vector of features, $\psi_i = (\omega_{i1}, \omega_{i2}, \ldots, \omega_{in})^T$, where ω_{ij}, hereinafter referred to as feature, denotes the value (i.e., the response) of the j-th survey's question of the i-th enterprise, ξ_i. For the purpose of our analysis, the features of the enterprises are organized in a matrix $\Psi = [\psi_1, \psi_2, ..., \psi_m]$ or, rather, its transpose, $\Psi = \Psi^T$, with the *i*-th row corresponding to the features of the *i*-th enterprises. When all features are quantitative, each enterprise may be visualized as a point in the *n*-dimensional Euclidean *space,* R^n. Enterprises which are similar in features can then be visualized as clouds of nearby points in this high dimensional space. The objective of the clustering approach is to classify all enterprises into *k* clusters of enterprises with similar features, with respect to some suitable notion of similarity, which is usually understood as some appropriate notion of distance (Irani et al., 2016). Here, we take the number of clusters k as given, and quantify the similarity in terms of an appropriate distance in the space of features. The Euclidean distance

$$d(\xi_i, \xi_j) = \left\| \psi_i - \psi_j \right\| = \sqrt{\sum_{r=1}^{n} (\omega_{ir} - \omega_{jr})^2}, \tag{1}$$

is used as a measure of dissimilarity.

Another crucial element (to be found) is a cluster's center, in the case of the *j*-th cluster:

$$c_j = \frac{1}{N_j} \sum_{i=1}^{|g|} w_{ij} \psi_i, j = 1, ..., k \tag{2}$$

where $|\Xi|$ is the cardinality of set Ξ, i.e., the number of enterprises; N_j is the number of enterprises to be allocated to the *jj*-th cluster, $j = 1, ..., k$ (*k* is given); the weight w_{ij} denotes the membership of enterprise *i* in cluster *j*: It is equal to 1 if the enterprise i(i = 1, ..., m) is allocated to cluster j and equal to 0 otherwise.

In this setting, the objective of the K-means Algorithm is to assign each object to the cluster whose center is closest to it. It can be formulated as an optimization problem where the elements of a set of $m = |\Xi|$ objects have to be allocated to k clusters in a manner that the sum of the squared Euclidean distances between each object and the center of the cluster, in which each element is assigned to, is minimized.

$$\min_{\{w_{ij}\}} \sum_{i=1}^{|gl|} \sum_{j=1}^{k} w_{ij} \left\| \psi_i = c_j \right\|^2, s.t. \tag{3}$$

$$\sum_{j=1}^{k} w_{ij} = 1, i = 1,...,|\Xi| \tag{4}$$

$$w_{ij} \in \{0,1\}, i = 1,...|\Xi|, j = 1,...,k, \tag{5}$$

where c_j is given by expression (2). Therefore, the sum of the squared Euclidean distances between each object and the center of its cluster (to be found) for every such allocated object should be minimized as per the objective function (3). Constraints (4) indicate that each object is allocated exactly once (i.e., an object is related to only one of the k clusters), whereas constraints (5) are the domain constraints (i.e., the decision variable w_{ij} is a binary variable).

6.2. Evolutionary learning

A typical cluster analysis consists of two major phases: (a) the feature selection and (b) the clustering algorithm (Xu and Wunsch, 2005).[21] Here, a repetitive procedure containing characteristics from both phases is implemented with the intention to obtain a near-optimal feasible solution for the optimization problem. It is a data-driven procedure that aims to explore the available data in depth, recognize patterns and group data objects (i.e., enterprises) into explainable clusters with respect to the most significant ─statistically significant─ subset of features.

The first phase, feature selection, can be seen as a dimensionality reduction technique to mitigate the noise produced by the large number of parameters of interest (Hastie et al., 2008; Liu and Motoda, 2012). In particular, filter-based, wrapper-based, and hybrid feature selection approaches[22] are employed in order to ex-

[21] One of the most important research topics in this day and age is how to capture reliable, valuable and accurate information in massive data (Rashinkar and Krushnasamy, 2017). Working with Big Data is associated with difficulties and challenges attributed to the "5Vs", i.e., volume, velocity, variety, veracity and value (Meng et al. 2020). Inadequate data acquisition processes can lead to incomplete, inconsistent, biased, or low predictive value data. To avoid these errors, mechanisms can be and are established to guarantee the quality of the data, which is an essential component to reduce uncertainty in data-based modelling. Indeed, information fusion is becoming a major need in mining multi-dimensional databases (Torra, 2003). Hence, to tackle management problems in a feature selection context, it is important to identify the features that contribute to decision-making the most.

[22] For instance: (a) classic filter-based approaches such as the Pearson Correlation (linear

tract knowledge from raw data by selecting the most appropriate subset of features that maximizes a chosen performance measure.

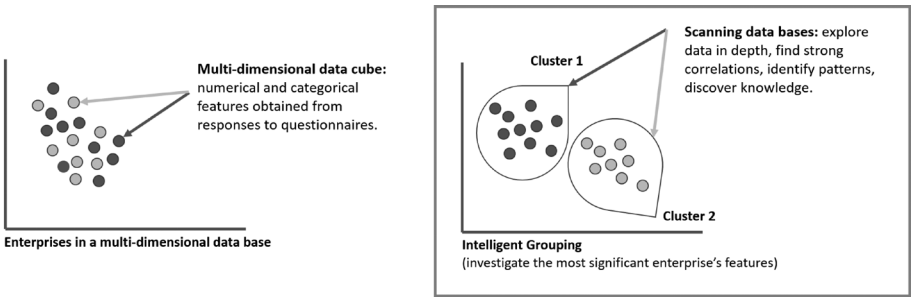
The second phase may be carried out via several clustering methods introduced in the literature, generally organized in three categories: (a) the partitional clustering (e.g., the K-means Algorithm, mentioned prior to expression (3)) aiming to divide the data points into a specific number of partitions, (b) the density-based clustering (e.g., DBSCAN Algorithms) aiming to create arbitrary-shaped clusters, and (c) the hierarchical clustering (e.g., the CURE Algorithm) aiming to divide or merge a dataset into a sequence of nested partitions.

In our case, an evolutionary clustering method is designed and applied based on (i) an evolutionary optimization algorithm, namely, the Genetic Algorithm (GA),[23] for the feature selection phase, and (ii) an unsupervised machine learning algorithm, namely, the K-means Algorithm, for the clustering phase (Lloyd, 1957; MacQueen, 1967; Chakrabarti et al., 2006; Koutsibella and Koutroumpas, 2020). Both algorithms are used in an iterative way to find the most significant subset of features that can better distinguish objects into homogeneous clusters. Figure 1 illustrates the method's main goal. After mining a multi-dimensional database that consists of questionnaire responses given by enterprises, the method helps analysts to group enterprises into clusters so that enterprises in the same cluster are as similar as possible.

correlations) or the Spearman Correlation (non-linear correlations), (b) ranking filter-based approaches like the Mutual Information or Chi-square statistic, (c) wrapper-based approaches such as the Forward Feature Selection, the Backward Feature Elimination or Meta-heuristic algorithms (Dhaenens and Jourdan, 2016; Wang et al., 2015).

[23] The GA is a population-based search meta-heuristic algorithm inspired by the principles of the biological evolution and the natural selection process of the survival of the fittest (Holland, 1975; Lappas and Yannacopoulos, 2021; Lappas et al., 2018; Talbi, 2009; Lappas and Yannacopoulos, 2021)."Heuristic" comes from the Greek word for "find" or "discover" ("*εύρίσκω"* (heurískō) is akin to "eureka"), and refers to a family of approximation algorithms for finding near-optimal solutions to Nondeterministic-Polynomial-hard problems (i.e., problems for which solutions cannot be obtained in polynomial time) (Papadimitriou and Steiglitz, 1982). The "meta-" part in the term "meta-heuristic" is used to distinguish these algorithms from classic heuristics, such as the local improvement heuristic algorithms which, are built to find a local optimum (minimum or maximum). Actually, metaheuristics are general algorithmic ideas that use clever/smart strategies to escape from local optima and tackle large-size problems in a reasonable time. In addition, metaheuristics can be classified into two classes: (a) single-point search metaheuristics which manipulate and transform a single solution during the search and (b) population-based search meta-heuristics which consist of a population of candidate solutions to some problem, and via iterations, the candidate solutions evolve to a better solution to the problem.

Figure 1: Clustering



6.2.1. The principal terms of the Genetic Algorithm

A candidate solution is referred to as an "individual", and its data structure representation is referred to as a "chromosome". Each chromosome stands for a subset of features in the form of a bit string (0: when a particular feature is not selected; 1: when the feature is selected). For instance, if the available features are ten, then the chromosome takes the form of a 1 x 10 row vector consisting of binary (0/1 values (e.g., the row vector [1000111001] suggests that of the set of features considered only the 1st, 5th, 6th, 7th and 10th features are selected). A chromosome contains "genes" that capture the decision variables within a solution. In terms of the example employed, a gene is a binary variable in the vector that specifies whether a feature is selected or not.

Each iteration of the optimization algorithm is called a "generation". Usually, the population is maintained and evolves from generation to generation (until a pre-defined terminal/stopping criterion is satisfied) using genetic operators such as "selection", "crossover", "mutation" and "evaluation". (The evaluation function that is used for scoring/assessing individuals is referred to as the "fitness function". All four operators are described momentarily.) The genetic operators guarantee the exploration and exploitation of the evolutionary learning method (Sivanandam and Deepa, 2008). Generally, exploration is the search for clever strategies to allow the GA to escape from a potential local optimum (e.g., mutation operators). Exploitation is the use of clever strategies that have been proven successful in the past (e.g., crossover operators). Crossover operators are based on parent selection methods.

6.2.1.1. Parent Selection and Fitness Evaluation

In order for a population to evolve from generation to generation, individuals (i.e., parents) should be chosen to produce children (i.e., offspring). A common parent

selection method is a fitness-proportional selection approach in which each individual has a probability of being selected that is proportional to the individual's fitness. Here, we turn to the Roulette-wheel selection method. Given a population of *N* individuals, the pseudocode provided in Table 11 shows how to select one parent from *N* individuals using roulette-wheel selection. It assumes the fitness value fi ≥0 for all i ∈ [1, N]. The process is repeated as many times as necessary to select parents for the creation of offspring for the next generation. Therefore, the higher the individual's fitness value is, the more likely the individual is to be selected.

Table 11: Pseudocode for the Roulette-wheel selection method

$p_i \leftarrow$ *ith individual in population,* $i \in [1, N]$
$f_i \leftarrow$ *fiteness* (p_i) *for* $i \in [1, N]$
$f_{sum} \leftarrow \sum_{i=1}^{N} f_i$
Generate a uniformly distributed random number $r \in [0, f_{sum}]$
$F \leftarrow f_1$
$k \leftarrow 1$
while $F < r$ ***repeat***
  $k \leftarrow k + 1$
  $F \leftarrow F + f_k$
end
$selected\_parent \leftarrow p_k$

The individual's features relate the questions of the questionnaire on which we should focus in order to cluster enterprises in homogeneous groups. Effectively, an individual reduces the dimension of the available dataset; and the selected features dataset is used by the K-means Algorithm to group enterprises. In this direction, the sum of squared Euclidean distances described in expression (3) can be used to construct a fitness function. However, since the clustering problem is a minimization problem, the fitness for each chromosome is defined as follows:

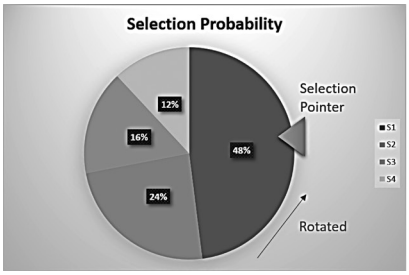
$$fitness = \frac{1}{\sum_{i=1}^{|g|}\sum_{j=1}^{|k|} w_{ij}\left\|\psi_i - c_j\right\|^2} \tag{6}$$

To the extent each individual has a probability of being selected that is proportional to the individual's fitness, if the value of the denominator in expression (6) goes down, the fitness value goes up, and so does the likelihood of the individual being selected. Figure 2 provides an example of parent selection among four parents (i.e., four solutions), in which the solution with the best fitness (i.e., S1 = 0,1) is associated with the highest selection probability (i.e., $\frac{0,1}{0,208} \times 100 \cong 48\%$).

6.2.1.2. Crossover Operators

Moving on, we first clarify that a uniform crossover is selected and proceed to explain the vocabulary and short-hand notation used: Suppose there exists a pop-

Figure 2: Example using roulette-wheel selection



Solution	Fitness Value (6)	Selection Probability
S1	0.1	48%
S2	0.05	24%
S3	0.033	16%
S4	0.025	12%
Sum	**0.208**	**100**

ulation of N individuals $\{p_1, p_2, p_3, ..., p_N\}$. Each individual has n features, and the k-th feature of the i-th individual is denoted with $p_i(k)$ for $k \in [1, n]$. So, p_i can be represented by the row-vector $p_i = [p_i(1), p_i(2), p_i(3), ..., p_i(n)]$, i = 1, ..., N. An offspring, that is the result of a crossover, is denoted by o. The k-th feature of the offspring is denoted by o(k). Hence, $o = [o(1), o(2), o(3), ..., o(n)]$.

If two parents, p_a and p_b, exist then the uniform crossover ought to produce offspring o, the k-th feature of which is: $o(k) = p_{i(k)}(k)$ for each $k \in [1, N]$, where i(k) is randomly chosen from the set {a, b}. Therefore, each offspring's feature is randomly chosen from one of the offspring's two parents, each with a probability of 50% (see Table 12). A significant parameter for the crossover phase is the crossover probability (or crossover percentage) that indicates how often the crossover operator is employed (e.g., an 80% crossover probability means that 80% of the next generation is made by crossover, namely from parts of parents' chromosomes).

6.2.1.3. Mutation Operators

The mutation operator is based on the bit flip mutation that is usually considered in binary evolutionary algorithms: In a population of N individuals, where each individual has n bits, and the mutation rate is 0, at the end of each generation each bit in each individual is flipped with a probability of $r \leftarrow U[0,1]$, as follows:

$$p_i(k) = \begin{cases} p_i(k), if\ r \geq \theta \\ 0, if\ r < \theta\ and\ p_i(k) = 1 \\ 1, if\ r < \theta\ and\ p_i(k) = 0 \end{cases} \quad (7)$$

Table 12: Uniform crossover operator

for k = 1: *n* ***repeat***
  $r \leftarrow U[0, 1]$
  if $r \geq 0{,}5$ ***then***
    $o_1(k) \leftarrow p_1(k)$
    $o_2(k) \leftarrow p_2(k)$
  else
    $o_1(k) \leftarrow p_2(k)$
    $o_2(k) \leftarrow p_1(k)$
  end

for $i \in [1, N]$ and $k \in [1, N]$, where U[0, 1] is a random number that is uniformly distributed in the interval [0, 1]. A significant parameter for the mutation phase is the mutation percentage that indicates the percentage of the parents from a population that will be mutated. On the other hand, the mutation rate conveys how many parts of a chromosome are changed.

6.2.2. Evolutionary clustering

To explain the GA and the main genetic operators employed, we present the evolutionary clustering approach in which feature selection and clustering are dealt with in an iterative way in order to identify the features (i.e., survey questions) that better classify enterprises into homogeneous clusters (in terms of similarity).

Table 13 presents the pseudocode for the evolutionary clustering approach. All appropriate parameters for the evolutionary clustering algorithm are given: population size, number of generations (operating as the stopping criterion for the iterative procedure), crossover percentage, mutation percentage, mutation rate and number of clusters.

An initial population is randomly generated, with each individual in the population standing for a candidate solution (subset of features) to the feature selection problem, as described in sub-section 6.2.1. The appropriate dataset, one that uses only the columns that correspond to the selected features, is selected and then the K-means clustering Algorithm is employed in order to calculate the fitness value of

Table 13: Evolutionary clustering

1: *Parents* ← {*randomly generated popoulation*}
2: *Calculate the fitness of each parent in the population using the Kmeans clustering algorithm*
3: *Store the best fitness value as the current best known solution*
while not (*maximum number of generations*)
  while not (*number of offspring*)
    4: *Parent selection using roulette wheel*
    5: *Crossover using uniform crossover operator to produce offspring*
  end
  while not (*number of mutants*)
    6: *Parent selection randomly*
    7: *Mutation using bit flip mutation operator to produce mutants*
  end
  8: *Calculate the fitness of offspring and mutants using the Kmeans clustering algorithm*
  9: *Merge parents, offspring andmutants*
  10: *Sort new population with respect to individuals' fitness values*
  11: *Keep only the best individuals with respect to the defined population size (constant size)*

each individual, as shown in expression (6). The individual with the highest fitness value is stored as the best-known solution. This is followed by the main process of the evolutionary clustering algorithm. Based on the crossover percentage, parents are selected using the Roulette-wheel selection algorithm, and via a uniform crossover operator produce offspring. Based on the mutation percentage, parents are selected randomly, and via the bit flip mutation operator produce mutants. The K-means clustering Algorithm is applied to evaluate offspring and mutants. Parents, offspring, and mutants are merged to construct the population for the next generation and then are sorted with respect to the fitness values of the individuals. The best individual of the new population is compared to the previous best-known solution in order to keep (from one generation to the next and across generations) the best solution ever obtained as the best-known solution. With the population size constant, the best individuals are kept for the next generation. The main process is repeated as long as the stopping criterion is not satisfied.

6.3. Computational Results

As the evolutionary clustering approach operates better with quantitative rather than categorical features, a data cleaning approach is carried out in order to handle missing values, duplicates and outliers, quantify categorical features using the "one hot encoding" approach,[24] and transform data by standardizing them (setting the mean equal to 0 and the standard deviation to 1). As a result (especially, on account of the one hot encoding approach), the original dataset is reshaped into a dataset that consists of 86 rows (one for each respondent) and 273 columns developed from the original 176 questions (features).

The algorithm organizes the responses in five clusters,[25] and Table 14 supplies the computational results obtained on cluster composition (the number of respondents allocated to each cluster), the number of features in the selected subset of features, and the relative fitness value, per execution, after eleven independent ex-

[24] To better understand the approach, suppose a categorical feature related to the respondent's gender. The possible values are two: male and female. As a result, the feature can be reshaped and replaced by two new 0/1 features, namely "male" and "female". In the former, when male = 1 the meaning is that the respondent is male and not female, while in the latter, when female = 1 the meaning is that the respondent is female and not male. Effectively, all categorical features are dropped and a new dataset is produced based on the one hot encoding approach.

[25] The algorithm was developed in the Python programming language (3.8 release) and executed on a DELL personal computer with an Intel Core i3-2120, clocked at 3.30GHz, a microprocessor with 4GB of RAM memory under the operating system Microsoft Windows 7 professional. As far as the overall computation time is concerned, the export of the computational results reported in this study took approximately 14 hours and 40 minutes.

Table 14: Computational results

Execution	Fitness Value	Features (x/272)	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
1	0.0082	59	54	1	11	4	16
2	0.0100	51	53	15	1	11	6
3	0.0194	37	45	11	4	25	1
4	0.0095	51	46	11	16	12	1
5	0.0106	45	13	19	1	42	11
6	**0.1226**	21	73	8	1	3	1
7	**0.1570**	20	72	3	1	8	2
8	0.0764	21	17	11	1	54	3
9	0.0738	17	67	10	2	5	2
10	**0.1597**	24	70	1	11	3	1
11	0.0073	64	49	11	13	1	12

ecution runs. It is worth mentioning that each independent execution run is associated with a repetitive evolutionary process characterized by 500 iterations (i.e., number of generations). Although more independent execution runs can be applied, we decided to place the emphasis on a small number of executions due to the small sample of the dataset, verifying thus the effectiveness and the robustness of the proposed evolutionary algorithm. As to the main contribution and novelty of the second part of this work, we propose a methodology for analyzing questionnaires in an intelligent way by exploring available data in depth. Hence, focusing on the methodology part we introduce a feature-selection based evolutionary clustering algorithm to strengthen the ability of interpretation of the predictive power of each feature (i.e., questionnaire response) in the process of classifying enterprises. In this direction, the proposed methodology can be easily extended and applied to large-scale datasets.

Table 15 supplies the most significant features used in grouping respondents into five clusters in the said three executions, so that respondents (enterprises) in the same cluster are as similar as possible; with the common features highlighted. The highest fitness values correspond to the 6^{th} (0.1226), 7^{th} (0.1570), and 10^{th} (0.1597) executions. To the extent that a good number of features are common in these executions, it seems that when the algorithm reaches high fitness values the feature's importance is repeated and thus validated. (The description of the questions and responses is provided in the Appendix.)

Table 16 focuses the best solution obtained (the 10^{th} execution) by reporting the most significant questions of the survey in order to highlight the factors on which

Table 15: Most significant questions and responses for the highest fitness values (per execution)

Execution	Fitness Value	Selected Features (Responses)
6	0.1226	Q00051, Q00053, **Q00054,** Q00059, **Q00081 [SQ001] [SQ006],** Q00006, Q00034, **Q00063 [SQ002] [SQ003]** [SQ004], **Q00070,** Q00080 [SQ001] **[SQ004] [SQ005] [SQ006] [SQ007], Q00084 [SQ001] [SQ002]**
7	0.1570	Q00056 [SQ001], Q00081 [SQ002] [SQ005] [SQ008], Q00007, Q00047, **Q00049,** Q00061 [SQ002], **Q00063 [SQ002], Q00065, Q00070, Q00079,** Q00080 [SQ002] **[SQ004] [SQ005] [SQ006], [SQ007]**
10	0.1597	**Q00054,** Q00055 [SQ001], Q00056 [SQ004], **Q00081 [SQ001] [SQ006], Q00014, Q00049, Q00063 [SQ003] [SQ004], Q00065, Q00079, Q00080 [SQ004] [SQ005] [SQ006] [SQ007],** Q00083 [SQ003], **Q00084 [SQ001] [SQ002]**

an analyst can focus on with the intention to identify/recognize patterns among survey participants. The factors are analytically described in Table 16 and seem to be the most important for grouping enterprises. These results can be further used from a data scientist to train supervised machine learning (ML) models for prediction purposes. Hence, the trained ML models can be used from analyst to classify responses from new submitted questionnaire into known groups of enterprises as these groups obtained from the proposed evolutionary clustering algorithm.

7. CONCLUSIONS

Our econometric analysis of people's business activity views and business people's E&I information, as provided in the questionnaire's 33 opening questions, illustrates the use of SSBC variables and identifies a number of interesting aspects.

For instance, based on the findings associated with p-values ≤ 0.5%: (a) People in certain localities believed more than others that the social environment perceived entrepreneurship very much as a good career choice. Women believed more than men that the successful entrepreneur very much enjoyed a high status. People with MA degrees believed more than others that entrepreneurship very much attracted positive media attention in the society they lived in (Table 4). (b) The probability that a respondent engaged in entrepreneurial activity increased with age (perhaps up to the age of 50) (Table 5). (c) Entrepreneurial expectations, at the time of starting a business, to affect the creation of more jobs, was lower among professionals compared to other occupations, and increased with respondents' age (perhaps up to

Table 16: Best solution obtained

Question Code	Description	Factor (to focus on)
Q00054	What was last year's value of the output (service or good produced, whether sold or not)? Round up to the closest thousand or 500 euro	Last year's value of output
Q00055 [SQ001]	What was the value of the capital stock (i.e., buildings, machinery, vehicles, materials available) at the end of last year? [Buildings]	Value of buildings
Q00056 [SQ004]	What was the value of capital flows? Net investment minus replacement and depreciation in the course of the year [Other inputs]	Value of other inputs
Q00081	What are the reasons your enterprise will invest in innovation in the next 12 months? (1) Certainly not a reason. (2) Probably not a reason. (3) Possible reason. (4) Probable reason. (5) Certainly a reason	
[SQ001]	[Market potential]	Reason to invest in innovation: market potential
[SQ006]	[Collaboration with businesses and/or others who engage in innovation]	Reason to invest in innovation: collaboration
Q00014	Have you ever had or managed a business?	Management experience
Q00049	In which sector of economic activity is the enterprise primarily involved?	Main sectoral activity
Q00063	Approximately what percentage of your enterprise's turnover (previous year) came from sales in each of the following markets?	
[SQ003]	[Rest of the EU] 0%	No sales to the rest of the EU
[SQ004]	[Other countries] 0%	No sales to the rest of the world
[SQ004]	[Other countries] 26% - 50%	26%-50% of sales to the rest of the world
Q00065 [SQ005]	Has since January (3 years ago) your enterprise introduced new or significantly improved marketing strategies (e.g. packaging, product promotion, placement or pricing strategies)?	Significantly improved marketing strategies
Q00079	Do you plan to engage in investment dedicated to innovation in the next 12 months? Yes	Planning to invest in innovation
Q00080	What will be the focus of your planned investment in innovation in the next 12 months?	
[SQ004]	[Input flows and/or output distribution processes] No	Not planning to invest in input flows & distribution innovation
[SQ005]	[Organizational structure and operation] Unknown	Unsure about investing in organization structure & operation innovation
[SQ006]	[Marketing strategies (e.g. packaging, product promotion or placement or pricing strategies)] Unknown	Unsure about investing in marketing strategy innovation
[SQ007]	[Don't know] Yes	Unsure about investing in innovation
Q00083 [SQ003]	Have you used any of the following technologies? [Tools which combine flexibility, precision and zero-defects (e.g., high precision machine tools, advanced sensors or 3D printers)] No	Have not used flexible- precision-zero defect tools
Q00084	Do you plan to use any of the following technologies in the next 12 months?	
[SQ001]	[Technologies which use energy and materials more efficiently and drasti-cally reduce pollution]	Planning to use energy-materials efficiently, reduce pollution
[SQ002]	[Technologies which digitalize the production processes]	Planning to digitalize production processes

the age of 51) (Table 7). (d) The probability that entrepreneurs would report their business performance was higher among professionals, lower among those living in Patras, and increased with respondent age (perhaps up to the age of 51) (Table 8); while the probability that the business turned out to perform well or very well, as opposed to performing worse, decreased with the number of income-earning adults in the household (Table 9). (e) The probability that business growth was adversely affected by (i) market-related risks and uncertainty increased with respondent age (perhaps up to the age of 49); (ii) technology-related risks and uncertainty decreased among entrepreneurs with basic education qualifications; (iii) difficulties in finding business partners increased among entrepreneurs with MA qualifications; (iv) difficulties in accessing external finance decreased with the numbers of other adults in the household, (v) the high tax rate decreased with the number of other earning adults in the household; (vi) the continuously changing taxation regulation decreased with the number of other earning adults in the household, and featured a Λ-shape with respect to time (it peaked in mid-May: after the first lockdown) (Table 10).

In addition, an evolutionary clustering algorithm based on biologically-inspired optimization (i.e., the GA) accompanied by an unsupervised machine learning approach (i.e., the K-means Algorithm) groups respondents in clusters by identifying patterns across the full set of questions. Special emphasis is placed on identifying the most significant questions of the questionnaire so as to organize respondents (enterprises) into homogeneous clusters for dimensionality reduction purposes. For instance, question 80, regarding the focus of the planned investment in innovation in the next 12 months (on input flows and/or output distribution processes, organizational structure and operation, marketing strategies, not known yet) appears to be the most significant questions in all three executions with the highest fitness values (Table 15).

The computational results show that the proposed algorithm can help analysts to address data-driven complex problems in a reasonable time. In particular, when the number of responses or/and the number of participants increases (e.g., by adding new questions or/and allowing infinite number of enterprises to participate in a survey), then an automated approach for exploring data in depth, addressing big data challenges, recognizing patterns and discovering knowledge is needed. In terms of future research, the goals are to: (i) further tune the parameters of the proposed algorithmic approach with more independent execution runs and a large number of iterations to seek near-optimal solutions for big datasets (e.g., over 500 enterprises), (ii) facilitate the decision-making approach in strategic, tactical and operational levels by prioritizing groups with respect to multi-criteria analysis and expert knowledge (e.g., apply an evolutionary fuzzy or a fuzzy analytic hierarchy

process to find low-risk, medium-risk and high-risk groups), and (iii) use evolutionary clustering outputs (i.e., groups) to apply similar strategies based on econometric analyses per group.

May future survey waves solicit more responses from more places across Western Greece, to be analyzed in the ways described above, in order to help devise territorial development policy.

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APPENDIX: THE FIELDS OF THE EGOV_INNO QUESTIONNAIRE

A. Respondent segment
Q00001. Gender: Male/Female
Q00002. Age in years:
Q00003. Country of birth:
Q00004. If you reside in Greece please type the place of residence (by postal code). Find your postal code from a drop box.
Q00005. If you reside outside Greece, select the country. Find the country from a drop box.
Q00006. Current activity. Find the activities from a drop box.
Q00007. Highest education degree. Find the degrees from a drop box.
Q00008. Have you studied, worked or lived your adulthood in other countries? Find the country or countries from a drop box here. Please fill in the number of years, example: 0.5 or 1 or 1.5 or 2 etc.
Q00009. How many people aged less than 15 years old are there in your household?
Q00010. How many people aged 15 or older are there in your household?
Q00011. How many of the people entered in the previous question are earners (breadwinners)?
Q00012. Are you the main earner or one of the main earners? Yes/No.
Q00013. Social values: 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree.
[SQ001] Entrepreneurship is perceived as good career choice in my social environment.
[SQ002] A successful entrepreneur enjoys high status in my social environment.
[SQ003] Entrepreneurship attracts positive media attention in the society I live in.
Q00014. Have you ever had or managed a business? Yes/No.
If the response is 'No' proceed to Q00017.
Q00015. Have you ceased your business operations? Yes/No.
If the response is 'Yes' proceed to Q00017.
Q00016. Do you have or manage a business for 3.5 years or more? Yes/No.
Q00017. Are you an employee involved in developing/launching a new good/service or setting up a new business unit/establishment/subsidiary? Yes/No.
If the response is 'Yes' proceed to Q00022.
Q00018. Do you have the skills and knowledge to start a business? 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree.

Q00019. Do you see good opportunities to start a business in the area of residence? Yes/No.
Q00020. Does the fear of failure prevent you from setting up a business? Yes/No.
Q00021. Is this fear of failure related to 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree.
[SQ001] Concerns regarding the likelihood of finding funds for your business.
[SQ002] Your running a business.
[SQ003] Concerns regarding the ups and downs in business life (i.e., the prospect of having an uncertain future).
[SQ004] Concerns over the opportunity costs for either money or time (i.e., a work-life balance).
[SQ005] Concerns regarding your social status and esteem (for instance, experiencing shame and embarrassment).
[SQ006] Concerns over upsetting important others.
[SQ007] Concerns over important others losing interest.
Q00022. Do you intend to start a business, say, in the next 3 years, whether alone or with others? Yes/No. *If the response is 'No' proceed to Q00022.*
Q00023. *If the response to Q00016 is 'Yes':* What was your primary motivation to start?
[SQ001] Necessity (e.g., cannot find another job).
[SQ002] Opportunity to enjoy more independence.
[SQ003] Opportunity to make more money. Earn a satisfactory income.
[SQ004] Opportunity to make my mark, a name for myself.
[SQ005] Wish to affect/achieve a market improvement.
[SQ005] Other.
Proceed to Q00026.
Q00024. *If the response to Q00016 is 'No' and to Q00017 is 'Yes':* What was your employer's primary motivation?
[As in Q00023]
Proceed to Q00027.
Q00025. *If the responses to Q00016 and Q00017 are 'No' and to Q00022 is 'Yes'*: What is your primary motivation?
[As in Q00023]
Proceed to Q00028.
Q00026. *Following Q00023:* What was your principal expected outcome?
[SQ001] Innovation.
[SQ002] The creation of value (i.e., added value).
[SQ003] The creation of jobs.
[SQ004] Other.

Proceed to Q00029.

Q00027. *Following Q00024:* What was his/her principal expected outcome?
[As in Q00026]
Proceed to Q00030.

Q00028. *Following Q00025:* What is your principal expected outcome?
[As in Q00026]
Proceed to Q00031.

Q00029. *Following Q00026:* Did this expectation materialize? 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree

Q00030. *Following Q00027:* Has this expectation materialized? 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree

Q00031. *Following Q00028:* Has the expectation materialized? 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree

Q00032. Overall, how has the business performed? 1: Very poorly, 2: Poorly, 3: So and so, 4: Well, 5: Very well

Q00033. Which of the following factors have impeded your enterprise's growth and expansion of business activities? 1: Strongly disagree, 2: Disagree, 3: Undecided/neutral, 4: Agree, 5: Strongly agree

[SQ001] Technology risk / uncertainty.
[SQ002] Market risk / uncertainty.
[SQ003] Difficulties in accessing external finance.
[SQ004] Difficulty in finding business partners.
[SQ005] Difficulty in recruiting highly-skilled employees.
[SQ006] Too much competition in the market.
[SQ007] Not enough revenues to reinvest in growing the business.
[SQ008] Continuously changing taxation regulations.
[SQ009] High tax rates.
[SQ010] Lack of business support mechanisms.
[SQ011] The current economic climate.

Q00034. At the present, how many other enterprises accommodate the market you operate in?

[SQ001] Many. In addition, their products are (or are perceived to be) quite similar.
[SQ002] Many, however the products are (or are perceived) not to be very dissimilar.
[SQ003] A few, and their products are (or are perceived to be) quite similar.
[SQ004] A few, however the products are (or are perceived as) quite differentiated.
[SQ005] None.

Q00035. In addition to the above, several consumers may (self) produce and consume the product (or close substitutes) themselves. Putting your own business aside (if it exists):

Q00036. What is your assessment of your entrepreneurial ecosystem? 1: Very unsatisfactory, 2: Somewhat unsatisfactory, 3: Neutral, 4: Somewhat satisfactory, 5: Very satisfactory

[SQ001] Ease of starting a business.
[SQ002] Demand for your products.
[SQ003] Importing environment.
[SQ004] Exporting environment.
[SQ005] Legal environment.
[SQ006] Physical infrastructure.
[SQ007] Entrepreneurial financing.
[SQ008] Entrepreneurship education.
[SQ009] Government entrepreneurship programs.
[SQ010] Quality of labor.
[SQ011] Labor cost.
[SQ012] Social security contributions.
[SQ013] Cost of energy.
[SQ014] Other non-labor costs.
[SQ015] R&D transfers.
[SQ016] Cultural and social norms.
[SQ017] Access to quality inputs.
[SQ018] Taxation.
[SQ019] General government policy (beyond SQ009 and SQ018).
[SQ020] Macroeconomic environment.

If the response in both Q00017 and Q00022 was 'No', terminate.

B. Segment regarding the enterprise

Q00037. Name (for contact purposes):

Q00038. Telephone:

Q00039. Email (if there is need to contact for clarifications, if respondent wishes to obtain records etc.):

Q00040. Tax ID number:

Q00041. Postal code. Find the postal code from a drop box.

Q00042. Municipality (LAU I)

Q00043. Region (NUTS II)

Q00044. What is the enterprise's legal form?

[SQ001] Société Anonyme.

[SQ002] General Partnership.
[SQ003] Limited Partnership.
[SQ004] Cooperative.
[SQ005] Private Company.
[SQ006] Sole proprietorship.
[SQ007] Other.

Q00045. Is the enterprise part of a group? Yes/No

Q00046. What is your role in the enterprise?
[SQ001] One of the founders.
[SQ002] Sole founder.
[SQ003] Owner.
[SQ004] Manager.
[SQ005] Employee or associate assigned to fill out the questionnaire.

Q00047. *If the responses to Q00046 is SQ002-004*: How many founding members were there (other than the respondent)? (If you are the only founding member, please revise your previous answer.)

Q00048. *Following Q00047:* Fill in the information for the other founders:
[SQ001] Age.
[SQ002] Gender: Male/Female.
[SQ003] Education Degree. Find the degrees here.

Q00049. In which sector of economic activity is the enterprise primarily involved? Find the sectors from a drop box.

Q00050. Please provide a short description of the business activity:

Q00051. How many employees (in terms of full-time equivalents: 8 hrs/day x 5 days/week) does your enterprise currently have?

Q00052. How many of these do you consider skilled?

Q00053. How many do you consider unskilled?

Q00054. What was last year's value of the output (service or good produced, whether sold or not)? Round up to the closest thousand or 500 euro.

Q00055. What was the value of the capital stock at the end of last year?
[SQ001] Buildings.
[SQ002] Machinery.
[SQ003] Vehicles.
[SQ004] Other inputs (i.e., seeds, fertilizers, feeds, PCs, other available materials and tools).

Q00056. What was the value of capital flows (net investment minus replacement/depreciation in the course of the year)?
[As in Q00026]

Q00057. What was value of the energy used?

Q00058. What was the size of the farm/aquafarm/forest, quarry or other ground used, if any (in thousands of m^2)?

Q00059. When was your enterprise established? Select the year here. *If the answer is "last year" proceed to Q00079.*

Q00060. *If the response to Q00060 is 3 years ago (N-3) or earlier*: Since January 1st, N-3, has your enterprise…?

[SQ001] Been taken over or merged with another enterprise.
[SQ002] Sold off a part of its business.
[SQ003] Bought another enterprise.
[SQ004] Other.
[SQ005] None.
[SQ006] DK/NA.

Q00061. Please indicate the average annual turnover of your enterprise during the last three years (excluding VAT): 1: Up to 100,000 euro, 2: 100.001 to 500,000 euro, 3: 500,001 to 2.000.000 euro, 4: 2.000.001 to 10.000.000 euro, 5: 10.000.001 to 50.000.000 euro, 6: 50.000.001 euro or more, 7: DK/NA

[SQ001] End of year N-3.
[SQ002] End of year N-2.
[SQ003] End of last year.

Q00062. Since January of N-3 has your enterprise's turnover?

[SQ001] Risen by more than 25%.
[SQ002] Risen by 5- 25%.
[SQ003] Remained approximately the same.
[SQ004] Fallen by 5-25%.
[SQ005] Fallen by more than 25%.
[SQ006] DK/NA.

Q00063. Approximately what percentage of your enterprise's turnover in N-3 came from sales in each of the following markets? 1: 0%, 2: 1% - 25%, 3: 26% - 50%, 4: 51% - 75%, 5: 76-100%, 6: DK/NA

[SQ001] Local/regional within a distance of 50 km.
[SQ002] Rest of the country.
[SQ003] Rest of the EU. (Fill in the number of countries.)
[SQ004] Other countries. (Fill in the number of countries.)

C. Segment regarding innovation in the enterprise

Q00064. Has your enterprise introduced any of the following types of innovation since January of N-3? (Excluding marginal changes and solely aesthetical changes developed by others.)

[SQ001] New to the enterprise or significantly improved goods.

[SQ002] New to your enterprise or significantly improved services.
[SQ003] New to your market goods.
[SQ004] New to your market services.
If SQ001 or SQ002 were selected proceed to Q00067. If SQ003 or SQ004 were selected proceed to Q00066.

Q00065. Has, since January N-3, your enterprise introduced new or significantly improved?
[SQ001] Production processes.
[SQ002] Provision/distribution processes (involving inputs, outputs or their transportation along the value chain).
[SQ003] Organizational structure (e.g., functional and product based, decentralized and team based, turning to outsourcing).
[SQ004] Management techniques (e.g., first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management).
[SQ005] Marketing strategies (e.g., packaging, product promotion or placement or pricing strategies).
[SQ006] Other.
[SQ007] None at all.
If SQ007 was selected go to Q00077.

Q00066. Has your enterprise improved its process through investment in the circular economy? Yes/No

Q00067. If yes, which ones?

Q00068. Has your enterprise implemented any smart working systems? Yes/No

Q00069. If yes, which ones?

Q00070. Related to Innovation, has your enterprise setup collaboration with other enterprises or universities?

Q00071. If your enterprise has not invested in innovation so far, is it interested in the future?

Q00072. To the best of your knowledge, were any of your new products:
[SQ001] New to the national market?
[SQ002] New to the EU market?
[SQ003] New to the world market?
[SQ004] DK?

Q00073. Approximately what percentage of your enterprise's turnover in N-1, was due to innovative goods or services that have been introduced since January N-3?
[SQ001] 0%.
[SQ002] Between 1 and 25%.

[SQ003] Between 26 and 50% .
[SQ004] 51% or more.
[SQ005] DK/NA.

Q00074. What was your approach to protect the invention/innovation developed in your enterprise?
[SQ001] Registration of patents/patents.
[SQ002] Register a European utility model.
[SQ003] Register a design right.
[SQ004] Register a trademark.
[SQ005] Copyright Secrecy.
[SQ006] Complexity of design
[SQ007] Lead-time advantage on competitors.
[SQ008] Other.
[SQ009] None of the above.

Q00075. Thinking about the commercialization of your enterprise's innovative goods or services since January N-3, have any of the following been? 1: a major problem, 2: a minor problem, 3: not a problem at all, 4: not applicable to your enterprise
[SQ001] Training personnel in the development and/or introduction of innovations.
[SQ002] Carrying out R&D within the enterprise in order to increase the stock of knowledge or devise new goods or services.
[SQ003] Purchasing R&D and processes.
[SQ004] Licensing out (selling) a patent, design right, copyright, trademark, non-patented inventions, know-how.
[SQ005] Licensing in (buying) a patent, design right, copyright, trademark, non-patented inventions, know-how.
[SQ006] Adapting or modifying goods/services originally developed by others.
[SQ007] Cooperating with other enterprises or organizations to invent products.
[SQ008] Finding/using new technologies, acquiring machines, equipment, software.
[SQ009] Other phases of the realization (actual implementation) of preparing-producing-delivering the new goods/services.
[SQ010] Availability of trained staff to market-test before a launch, promote or sell innovative goods/services.
[SQ011] Access to external marketing expertise in introducing new products to the market (e.g., market research, market tests, launch advertising).
[SQ012] Access to financial resources.
[SQ013] Cost or complexity of meeting regulations or standards.

[SQ014] Applying for or maintaining/protecting intellectual property rights.
[SQ015] Legal issues, issues involving the central or regional administration.
[SQ016] Organizing internal business processes.
[SQ017] Business reputation and brand, including web design.
[SQ018] Market dominated by established competitors.
[SQ019] Low demand for your innovative goods or services.
[SQ020] Participation in conferences, trade fairs, exhibitions.
[SQ021] Accessing/reinforcing presence in foreign markets: carrying out exports.
[SQ022] Weak provision channels (inputs).
[SQ023] Weak distribution channels (outputs).
[SQ024] Other.

Q00076. How did the innovation activity affect the enterprise? The degree of impact was: 1: High, 2: Medium, 3: Low, 4: Not relevant
[SQ001] Increased range of goods or services.
[SQ002] Increased market or market share.
[SQ003] Improved quality of goods or services.
[SQ004] Improved production flexibility.
[SQ005] Increased production capacity.
[SQ006] Reduced labor costs per produced unit.
[SQ007] Reduced materials and energy per unit produced.
[SQ008] Improved environmental impact or health and safety aspects.
[SQ009] Met regulations or standards.
[SQ010] Other.

Q00077. Did your enterprise receive any public financial support for your innovation activities during N-3 to N, from:
[SQ001] Local or regional authorities?
[SQ002] Central government (including institutions working on behalf of central government)?
[SQ003] The European Union?
[SQ004] Other?

Q00078. Did your enterprise undertake any innovation activities as part of a contract to provide goods or services to a public sector organization? Y/N

Q00079. Do you plan to engage in investment dedicated to innovation in the next 12 months? Y/N *In the case of 'No' proceed to Q00083, and Q00085 onwards.*

Q00080. What will be the focus of your planned investment in innovation in the next 12 months? (max: 2 answers)
[SQ001] Goods.

[SQ002] Services.
[SQ003] Production processes.
[SQ004] Input flows and/or output distribution processes.
[SQ005] Organizational structure and operation.
[SQ006] Marketing strategies (e.g., packaging, product promotion or placement or pricing strategies).
[SQ007] Other.
[SQ008] DK/NA.

Q00081. What are the reasons your enterprise will invest in innovation in the next 12 months? 1: Certainly not a reason, 2: Probably not a reason, 3: Possible reason, 4: Probable reason, 5: Certainly a reason
[SQ001] Market potential.
[SQ002] Customer request.
[SQ003] To offset increased competition.
[SQ004] New legal (or state) administrative requirements coming into force in the coming years.
[SQ005] Part of an agreement to receive funding.
[SQ006] Collaboration with businesses and/or others who engage in innovation.
[SQ007] Usual upgrading as part of the process of doing business.
[SQ008] A conviction that innovation advances the enterprise's competencies and interests.
[SQ009] Other.
[SQ010] DK/NA.

Q00082. What are the reasons your enterprise decided NOT to invest in innovation in the next 12 months? 1: Certainly not a reason, 2: Probably not a reason, 3: Possible reason, 4: Probable reason, 5: Certainly a reason
[SQ001] Lack good ideas for innovation.
[SQ002] Lack qualified staff (with knowledge and/or experience) within the enterprise.
[SQ003] Organizational rigidities within the enterprise.
[SQ004] High cost.
[SQ005] Lack internal finance for innovation.
[SQ006] Lack credit or private equity.
[SQ007] Difficulty in obtaining government grants or subsidies for innovation.
[SQ008] Lack the necessary infrastructure.
[SQ009] Lack information on technology.
[SQ010] Lack information on the market.

[SQ011] Lack customer responsiveness to new goods/services.
[SQ012] Difficulty to find cooperative partners.
[SQ013] Fear / high risk of failure in the attempt to innovate.
[SQ014] Low or uncertain market demand (even if the development and production of the innovation were successful, the costs and estimated returns would not render the enterprise profitable/very profitable).
[SQ015] Too much competition in the market.
[SQ016] The legal or administrative requirements or standards are inflexible or too complicated.
[SQ017] No compelling reason to innovate.
[SQ018] No need to innovate due to previous innovations.
[SQ019] No need to innovate due to very little competition in the market.
[SQ020] Other.
[SQ021] DK/NA.

Q00083. Have you used any of the following technologies?
[SQ001] Technologies which use energy and materials more efficiently and drastically reduce pollution.
[SQ002] Technologies which digitalize the production processes.
[SQ003] Tools which combine flexibility, precision and zero-defects (e.g. high precision machine tools, advanced sensors or 3D printers).
[SQ004] None.
[SQ005] DK/NA.

Q00084. Do you plan to use any of the following technologies in the next 12 months?
[As in Q00083]

Q00085. Thinking about your enterprise's innovation activities 5 years from now, in which of the following areas do you think your innovations could make a positive impact? 1: Certainly not a reason, 2: Probably not a reason, 3: Possible reason, 4: Probable reason, 5: Certainly a reason.
[SQ001] Job creation.
[SQ002] IT and the digital economy.
[SQ003] Resource efficiency (i.e., more efficient use of raw materials).
[SQ004] Lifelong learning and skills improvement.
[SQ005] Environmental protection.
[SQ006] Availability and quality food.
[SQ007] Construction solutions for future smart cities.
[SQ008] Health and medical care.
[SQ009] Transport and transport infrastructures.
[SQ010] Space applications.

[SQ011] Other.
[SQ012] You do not plan to introduce any innovations in the next 5 years.
[SQ013] DK/NA.

Q00086. Please evaluate the importance of the following sources of knowledge regarding the need to innovate. 1: Not important, 2: Slightly important, 3: Moderately important, 4: Important, 5: Extremely important.
[SQ001] Internal sources (staff, in house lab etc.).
[SQ002] Other enterprises in the group. *(In case that the response of Q00045 is affirmative.)*
[SQ003] Suppliers.
[SQ004] Clients or Customers.
[SQ005] Other enterprises in the same sector.
[SQ006] Consultants.
[SQ007] University/Higher education community.
[SQ008] Commercial labs/R&D enterprises.
[SQ009] Private non-profit institutes.
[SQ010] Public sector research centers.
[SQ011] Chamber of Commerce.
[SQ012] Other Government agencies.
[SQ013] Professional fairs, conferences, meetings exhibitions etc.
[SQ014] Academic journals.
[SQ015] Other.

Q00087. Which of the following cooperates with you on innovation and what is his/her/their importance? Importance: 1: High, 2: Medium, 3: Low, 4: None.
[SQ001] Staff.
[SQ002] Other enterprises in the group. *(In case that the response of Q00045 is affirmative.)*
[SQ003] Suppliers.
[SQ004] Clients or Customers.
[SQ005] Other enterprises in the same sector.
[SQ006] Consultants.
[SQ007] University/Higher education community.
[SQ008] Commercial labs/R&D enterprises.
[SQ009] Private non-profit institutes.
[SQ010] Public sector research centers.
[SQ011] Chamber of Commerce.
[SQ012] Other state agencies.
[SQ013] Other.

Q00088. In the cases of high importance, indicate the location. 1: In the region, 2: In the country, 3: In the rest of the EU-27, 4: In the UK, Switzerland, Norway, 5: In the rest of the Balkans (excluding Bulgaria, Romania), 9: in the USA/Canada, 10: Elsewhere.

[As in Q00087]

Q00089. Was there a question that was confusing to you? Please comment below to improve our research.

CHAPTER 9

AGRICULTURAL RESEARCH AND INNOVATION IN THE EU DURING 2014-2020

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ABSTRACT | Appreciation of the relationship among research, innovation and productivity has affected the EU-2020 strategy, including the CAP 2014-2020, and placing more weight on competitiveness, innovation and resource efficiency. Research and innovation are potentially key explanatory variables of changes in productivity growth. In the 2014-2020 programming period, and in the rural development leg of it, innovation has a prominent role, including new connections with research, especially through the new instrument of the European Innovation Partnership (EIP-AGRI) and the Horizon 2020 initiative.

1. INTRODUCTION

Since 2014, EU agricultural policy has taken on a planning and implementing agricultural research and innovation (R&I) element. It has introduced, major novelties both directly under the 2014-2020 Common Agricultural Policy (CAP) via the rural development policy of the 'European Innovation Partnership (EIP-AGRI) for agricultural productivity and sustainability', and indirectly under the Horizon 2020 framework (H2020), the biggest EU R&I programme ever, especially via its "Societal Challenge 2".[1]

Agricultural research is often confused with innovation. However, there are important differences between the two. Research concentrates on the production of new knowledge (e.g., in genetics, robotics, information and communication,

[1] To get a sense of the relative sizes, we submit that the proposed allocation for rural development is €89.9 billion and H2020 budget on food security, the bio-economy and sustainable agriculture is €4.5 billion (Rural Review, 2013).

nanotechnology etc.) which may or may not be used in practice. It certainly contributes to innovation. However, engaging in more research does not necessarily bring about more innovation. Understandably, additional action is needed for working methods to change and for new goods or services to reach the consumer.[2] Innovation, on the other hand, has to do with the process of change in the production and marketing of goods and services: changes that may or may not be driven by research. In addition, innovation is implemented: whether in the form of a new or improved product introduced in the market, or in the form of a new processes or marketing or organizational method brought into actual use in a firm's operations. Thus, innovation is a broader concept than research and development (R&D) (OECD, 2019). The difference between the two means that governments have more instruments to promote innovation than to promote research, for instance, education, extension work (a process of working with rural people in order to supports them and prepares them to confront their problems more successfully), fiscal measures, credit guarantees, innovative procurement, inducements such as prizes, other incentives. Thus, it makes sense to have an innovation policy in addition to a science and research policy (European Commission, 2016).

Innovation may be technological or non-technological (i.e., it may be organizational or social). A broad definition of innovation is given by the 3rd edition of the Oslo Manual (OECD/Eurostat, 2005). Innovation "*is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations*". The minimum requirement for an innovation is that the product, process, marketing or organisational method be new (or significantly improved) to the firm. However, the revised 4th edition of the Oslo Manual (OECD, 2018) states that "*an innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)*". The new definition uses the generic term "unit" to describe the actor responsible for innovation, including households and their individual members.

According to the FAO (2018), agricultural innovation is the process by which individuals or organisations bring (a) new or existing products and/or (b) processes or ways of organisation into use for the first time in a specific context so as to increase effectiveness, competitiveness, resilience to shocks or envi-

[2] For farmers and for small businesses such innovation activities are full of risks and have to be managed; while collaboration with partners or support and feedback from colleagues or experts may be very helpful (European Commission, 2016).

ronmental sustainability. So, continuous innovation in technologies, practices and organization to some or considerable extent facilitates the development of a more productive and environmentally sustainable food and agriculture sector. And agricultural innovation, on the whole, contributes to food security and nutrition, economic development, and sustainable natural resource management. In short, agricultural innovation is doing "more with less". In addition, many, if not most, agricultural innovations are the result of public and private investments in agricultural R&D. Indeed, many empirical studies find a long-term impact of agricultural R&D on productivity growth (e.g., Aston, 2010; Heisey and Fuglie, 2018).[3] Overall, R&I have an important role in driving productivity growth in the short and long term (OECD 2011; Sauer, 2017; Pokrivčák et al., 2019), so productivity growth is often used as an indicator for the impact of research or innovation (OECD, 2019).

Innovation is at the heart of the Europe 2020 strategy, which aims to promote smart, sustainable and inclusive growth.[4] Its importance is also recognized by agricultural and rural development policy-makers, and by the CAP of 2014-2020, which sees innovation as a key driver of sustainable agriculture and rural development. From 2014 on, the CAP's second pillar expanded its focus vis-a-vis competitiveness, innovation, climate change and environment.[5] Overall, the food and agriculture sector is expected to (a) provide healthy, safe and nutritious food for a growing population, (b) supply feed for more and more farm animals, and (c) furnish fibre and fuel and other bio-based products for a range of industrial uses. It is also expected to use natural resources more sustainably, to preserve available land, water, and biodiversity resources, and respond to climate change. To meet these challenges and respond to opportunities, the sector will need to embrace innovative approaches to improve productivity in a sustainable manner. New knowledge, and especially, innovation is essential for a competitive and sustainable European farming and forestry sector insofar as farmers, foresters, food and bio-based industries face challenges such food and nutrition security,

3 Revealingly, in Greece, public investments in agricultural R&D fell by 19% between 2008 and 2018.

4 These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion.

5 The CAP of 2014-2020 accounted for 38% of the EU budget. It consisted of two 'pillars'. The first included direct payments (i.e., annual payments to farmers to help stabilise farm revenues in the face of volatile market prices and weather conditions) and market measures (to tackle specific market situations and support trade promotion). The second pillar (rural development policy) aimed at achieving balanced territorial development and sustaining a farming sector that was environmentally sound and promoted competitiveness and innovation.

environment and biodiversity, healthy and safe food and inequality (European Commission, 2015).

In view of the above, the purpose of this chapter is to present the two main instruments funded under the two policies working in close synergy to promote R&I agriculture: the H2020 and the EIP-AGRI. So, the rest of the chapter is organized as follows: Section 2 introduces the H2020 and the EIP-AGRI and show how they are related. Section 3 describes the Agricultural Knowledge and Innovation System, the operation of which is crucial for running the projects supported by EIP-AGRI at the local and transnational level. Section 4 provides the conclusions.

2. EUROPEAN SUPPORT FOR AGRICULTURAL INNOVATION

The two EU funding instruments specifically supporting innovation in agriculture and forestry are the rural development policy of the EIP-AGRI and H2020.

2.1 Horizon 2020 - Societal Challenge 2

The H2020 programme, with nearly €80 billion of funding available over seven years (2014-2020) aims to couple R&I in all sectors, including agriculture and forestry, as a mean to achieve smart, sustained and inclusive growth and create jobs. It directs funding to seven Societal Challenges (SC) which tackle social and economic problems. The SC2 "*Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy,"* with a budget of €3.8 billion over the 2014-2020 period, is highly relevant to agriculture and rural development. According to Regulation EU 1291/2013 (Annex 1), the objective of SC2 is "*to secure sufficient supplies of safe, healthy and high quality food and other bio-based products, by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains. This will accelerate the transition to a sustainable European bioeconomy, bridging the gap between new technologies and their implementation."*

In line with the above objective, SC2 is structured around five activity lines. One of these, "*2.1 Sustainable agriculture and forestry*" is implemented through two main calls: (a*) Sustainable food Security (SFS)* and b) *Rural Renaissance (RUR)* that aims to:

- Improve the management of resources and ecosystems, and to provide healthier

and more diverse food to people while safeguarding the environment and adapting to climate change.

- Develop smarter, greener and more circular rural economies through modernised policies, generation renewal (the substitution of older farmers with young farmers), more innovative value chains and enhanced uptake of digital opportunities.

There are two types of Horizon 2020 projects that contribute to the EIP-AGRI: multi-actor projects and thematic networks.

The former address the needs and problems of farmers and other practitioners. They should involve relevant stakeholders and, whenever possible, operational groups at every stage of their implementation; forming a consortium of actors that offer complementary knowledge (scientific, practical etc.).

The latter are intended to:

- Focus on identifying existing best practices and applicable research results that are not well known by farmers, foresters and agribusinesses.
- Translate this knowledge into easily understandable material for end users such as short, informative recommendations and solutions, leaflets, guidelines and audio-visual material. This material should be made available beyond the lifespan of the project, through the main existing dissemination channels that farmers and foresters commonly use, as well as through the EIP-AGRI website.

So they should map existing scientific knowledge and best practices for specific topics, and develop easily accessible materials for the practitioners that facilitate the exchange of knowledge. In addition, as in the case of the multi-actor projects, thematic networks should involve all the stakeholders concerned (researchers, farmers, advisors, enterprises, education actors, NGOs, administration, regulatory bodies, etc.).

2.2 The EIP-AGRI's rural development side

The 2014-2020 EIP-AGRI's rural development programme is intended to stimulate innovation and the development of knowledge that can be out into practice (European Commission, 2012). It comprises six priorities, the first of which aims at fostering knowledge transfer and innovation in agriculture, forestry and rural areas with a focus on the three following areas:[6]

a) Fostering, innovation, cooperation and the development of the knowledge base in rural areas (Focus Area 1A). Through this member states are able to

[6] https:/enrd.ec.europa.eu/policy-in-action/rural-development-policy-figures/priority-focus-area-summaries_en.

provide to their stakeholders a flexible package of soft measures related to advice, training, cooperation and knowledge transfer.

b) Strengthening the links between agriculture, food production, forestry and R&I, for the purpose of improved environmental management and performance (Focus Area 1B). Through this, member states support cooperation among rural development stakeholders and researchers in order to boost innovation in rural sectors.

c) Fostering lifelong learning and vocational training in the agricultural and forestry sectors (Focus Area 1C).

The above areas are implemented via the following measures ─measures that directly affect innovation: (M1) Knowledge transfer and information actions. (M2) Advisory services. (M16) Cooperation.

The overall design goes beyond the "linear innovation model" of acceleration from lab to practice, by introducing the "interactive innovation model", which brings together specific actors (e.g., farmers, foresters, advisors, entrepreneurs, consumers, researchers, etc.) to work together in multi-actor projects to find a solution for a specific issue or to develop a concrete opportunity. (Linear innovation stands for a science and research driven approach, where new ideas resulting from research are brought into practice through one-way (linear) knowledge transfer.) In an interactive system, building blocks for innovation are expected to come from science, but also from practice and intermediaries, including farmers, advisors, NGOs and businesses, as actors in a bottom-up process. Both approaches are equally valid. However, innovation generated through an interactive approach tends to deliver more focused solutions, which are easier to implement. Actors involved in projects become co-owners of the solution, which makes them more inclined to put innovation into practice (EU Rural Review, 2013). Through the interactive innovation model, EIP-AGRI aims at fostering innovation by favouring cooperation and knowledge flows between all research and innovation actors, in particular, by giving farmers a pivotal role. Innovation under EIP-AGRI is multivariate and takes time. It may be technological, non-technological, organizational or social, and based on new or traditional practices (Détang-Dessendre et al., 2018).

At the core is the establishment of Operational Groups (OGs): i.e., groups of relevant actors that develop innovations in a bottom-up manner. These groups hold great potential for creating the innovative solutions that will make farming smarter, more efficient and more sustainable. The composition of an OG is tailored to the aims of the specific project and will vary from project to project. OGs may be made up by -for instance- farmers, farmers' organizations, advisors, researchers, NGOs, businesses or anyone else who has something to bring to the table, often within

the boundaries of national or regional programme areas, but also across the EU, including multi-actor projects of Horizon 2020 [7] (projects that focus on real problems or opportunities that farmers and foresters face). This ensures the necessary cross-fertilising interactions between, businesses, farmers/producers, advisors and end-users. In addition, OGs may draw up plans for an innovative project, implement the plans through measures financed by the rural development programs and disseminate the results of their project. As already mentioned, the key measures revolve around 'cooperation', 'knowledge transfer', 'information actions', 'advisory services', as well as 'investment' and 'business development'. At the same time a Brussels-based network facility works as a mediator enhancing communication between science and practice and fostering cooperation. This "EIP Service Point" encourages the establishment of OGs and supports their work through focus groups, seminars, workshops, the establishment of databases (on relevant research results and good practice examples), support for partnering, and helps desk functions. In order to widen the knowledge base and sharing of experience, OGs report back to the EIP network about their innovation actions, and the EIP network facilitates the effective flow of information beyond the local and regional level of each OG (Inge Van Oost, 2013).

2.3 Policy frameworks

Funding, implementation, and prioritisation of actions take place through the delivery mechanisms embedded in the respective policies.

Several measures under the Rural Development Regulation 2014-2020 can be used to stimulate innovation and the activities of the OGs. The co-operation measure (Article 35) plays a key role in the implementation of the EIP. Support can be given both for the establishment and operation of OGs and for the implementation of their projects. This support can also be combined with support under other measures such as training (Article14), advice (Article15), investments (Article 17), etc. The Rural Development Program can fund bottom-up innovation projects with a 100% support rate. OG's may also be funded via H2020. There are also potential synergies with other policies like the EU Regional Development Fund, national or regional funding schemes, private funding etc.

The H2020's SC2 multi-actor projects aim to address the needs, problems and opportunities of end-users and to generate the necessary interaction between researchers and end-users such as farmers/producers, advisors and enterprises by attributing a clear role for the different actors in the work "all along the project". This

[7] http://ec.europa.eu/eip/agriculture/en/eip-agri-concept.

combination of practical and scientific knowledge is expected to generate innovative solutions that are more likely to be applied as a result of the cross-fertilisation of ideas between actors and the cocreation and the generation of co-ownership for eventual results.

At the same time, the SC2 thematic networks mobilize all concerned actors on specific thematic areas. The aim is to develop end-user material to facilitate the discussion on sharing and dissemination of knowledge in an easily accessible way, providing input for education and a research database for end-users and making results long term available. Next to this, a range of existing instruments continue to operate under H2020 (collaborative projects, ERA-NETs, JPIs and COST actions).

3. THE AGRICULTURAL KNOWLEDGE AND INNOVATION SYSTEM (AKIS)

The AKIS concept was introduced in the 1960s as an Agricultural Knowledge System (AKS) related to agrarian extension. With the development of Information and Communication Technologies (ICTs) and through the incorporation of ICTs into the AKS, AKS became AKIS.

The formal definition of an AKIS is "a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergistically to support decision making, problem solving and innovation in agriculture" (Röling and Engel, 1991).

Rivera and Zijp (2002) have recently sought to broaden the AKIS concept to include rural development, renaming this as AKIS/RD. Their model looks at four main actors with an interest in agricultural/RD innovation:

- Research.
- Extension services.
- Education and training.
- Support systems (producers' associations, all providers of credit and inputs, etc.)

It focuses on knowledge flows to understand how underlying systems can incentivize innovation. Although different AKIS-components, namely extension work, education, research, are often stressed, it is important to realize that there are many more actors in the food chain that directly influence the decision making of farmers and their innovations. Hence, farmers, advisory and research or education/training input suppliers, retailers, media, services, ministries etc., that need,

produce or exchange knowledge, are all part of the AKIS. Collaboration between these diverse groups can affect more interaction and cross-fertilisation, and affect innovation.

In an ideal world an AKS/AKIS would function as an interconnected system or network. However, in reality, existing AKS/AKISs are often fragmented. According to Dockès et al. (2011):

Research is often not sufficiently related to farm practice. This is partly due to the poor connections among those involved in and those presumed to benefit from agricultural research. 'Translational research', valorisation of research results, the responsiveness of research to its own content and access to results are all issues that need to be addressed. It is important to verify the extent to which research and innovation result in actual change and what happens to the knowledge produced. One important indicator of AKS/AKIS is the societal benefit of the knowledge that it generates.

The Education / Learning system ought be effective: rapidly and responsively taking up new issues and ideas and integrating them in education plans, course outlines and research projects. Collaborative social learning is an important aspect of this, but is currently not well embedded in the institutional settings of AKS/AKIS.

Farmers and other vocational actors are important drivers of innovation. Farmers have always been inventors, but are not keen on others earning money from their inventions. Women in rural areas are often mentioned as drivers of innovation, because they are often outward looking and stabilize the farm by bringing in income from diversified sources. Food is a unifying concept for society and for the AKS/AKISs. However, a new set of concerns, beyond traditional agricultural discourses, is entering the arena. These include: food security, public health, new/alternative supply chains, the vulnerability of globalized markets and the search for territorial food resilience. Social connectors, such as teachers, consultants, innovation brokers, organizers etc., have crucial roles in transferring new knowledge and helping generate induced / embedded innovations.

The transfer of knowledge is subject to the gaps that exist between research and practice. Research generally ends with the publication of one's results and little further involvement of stakeholders or target groups. There is a need for more and stronger face-to-face contacts between researchers and farmers. In all likelihood, additional funding may be needed for the transfer of knowledge.

Extension work is important in relating new knowledge to practice (and vice versa), and in all likelihood, there is a need for both private and public interests to be involved in extension work. Innovation is by definition risky. Developing and applying new knowledge always implies risk, so risk avoidance may pose a barrier for innovation. A properly functioning AKS/AKIS can help reduce risk.

As the AKIS system works differently across countries (Knierim et al., 2015; Rivera et al., 2005), its scope and the scopes of AIS,[8] of PRO-AKIS,[9] and of other research systems are not clear, and a number of different public research systems coexist (Sandoval, 2017; Prager et al., 2017), crucial segmets of the population may perceive them as competing or rival systems. Authors, such as Dockès et al. (2011), highlight that "there are many disconnections between the various subsystems within AKIS, and that "these disconnections impede learning and hamper effective research and innovation". In addition, AKS/AKIS is often perceived as being unresponsive and overregulated. Competition between the AKS/AKIS actors (researchers and institutes) for funding further impedes collaboration between researchers and innovators" (Dockès et al., (2011)).

3.1 Strengthening farm advisory services within the AKIS

The role of farm advisors within the AKIS is particularly important, as farm advisors constitute one of the main information sources for farmers' decision-making. During their one-to-one interactions with farmers, in addition to giving advice, they obtain feedback and information on farmers' needs and opportunities. The efficiency and effectiveness of advisory services may be upgraded by improving advisor connections within the AKIS, by sharing knowledge and innovative applications more widely,[10] feeding farmer needs and opportunities into the AKIS for further development -possibly as an "innovation support service"- thus, helping knowledge systems to improve their impact, and sharing what they learn with their clients and beyond.

Farm advisors need to access the newest knowledge, and regularly upgrade their technological, farm management, interactive and digital skills. So, close in-

[8] The AIS (Agricultural Innovation Systems) are defined as '*a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect the way different agents interact, share, access, exchange and use knowledge*' (Leeuwis and Ban, 2004). They go beyond the creation of knowledge.

[9] The evolution of innovation systems has led to the appearance of PRO-AKIS. PRO-AKIS aims at the development of an inventory of agricultural advisory services in the EU. Targeted both at knowledge flows and the dynamics between advisory service organizations and other actors operating in the agricultural knowledge system, it aims at putting together the AKIS and the Advisory services.

[10] See SWG SCAR-AKIS Policy Brief on the Future of Advisory services on advisor's future interactive competences, interconnections, and roles: https://ec.europa.eu/eip/agricilture/sites/agri-eip/files/policy_brief_on_the_future_of_advisory_services_scar_akis_06102017.pdf.

volvement in innovative developments, and in training and thematic or cross-sector events are essential. Moreover, exchange visits for peer-to-peer learning (esp. with advisors abroad) may be very effective. Farm advisors should also be trained to act as innovation brokers/facilitators, and help prepare, and participate in and sharing knowledge from EIP-AGRI OG and H2020 multi-actor projects.

Funding advisors' time spent with researchers is a useful means to enable closer interactions with research. A system of sharing knowledge and tools and training for advisers across the EU is needed. The first two EU farm advisors' networks were to commence operation in 2019 and 2020 via H2020 funding.

3.2 Supporting digital transition in agriculture

Agriculture and rural areas are and will be changing significantly with the availability and multiplication of modern technologies, accompanied by smart devices, their increased "intelligence", autonomous behaviour and connectivity. Also, in the AKIS, ICT plays a role. On the one hand, many farmers need to be supported in the digital transformation process, especially if they are unable to keep up with new technologies. Therefore, having impartial advisory services in place with sufficient digital knowledge and access to the data is very important to help minimise a digital divide and make better use of the digital novelties. The future role of farm advisory services may include facilitating innovation projects on digital technologies, as well as supporting farmers to orient themselves in the digital landscape. On the other hand, the AKIS itself will become more and more "digitised". New decision support tools become available every day and open knowledge reservoirs will be built.

To maximise the positive contributions digitisation can bring for agriculture and rural areas in the AKISs, a comprehensive approach combining investments in knowledge and in the enabling environment is needed. Support for digitisation at the farm level and for the establishment of high-speed internet connectivity across the EU is essential. Good ideas for digital innovations need attention and funding. This can be done via OGs on digital tools and agricultural Digital Innovation Hubs.

The current CAP legislative proposal requires from Member States a strategic and comprehensive approach that reinforces the links between the broader AKIS, digitisation and existing advisory services. With these and other measures, the EU aims for a fast deployment of digital solutions for a sustainable agriculture, fair and accessible for all.

4. CONCLUSIONS

Knowledge and innovation have a key role to play in helping farmers and rural communities meet challenges both today and tomorrow. Policy makers, farmers, researchers, advisors, associations and media need to step up their efforts to develop new knowledge and innovative solutions. Moreover, there is a need to set up a conducive environment across the EU for quicker innovation and better valorisation of existing knowledge to achieve the CAP objectives and deliver on international commitments needs.

The European Innovation Partnership for agricultural productivity and sustainability (EIP-AGRI) is a unique policy framework to support interactive innovation projects at the local and transnational level. To boost the commencement and development of innovation projects, to disseminate projects results and to use them as widely as possible it is essential to build stronger Agricultural Knowledge and Innovation Systems (AKIS). Successful AKIS strategies include four types of actions: Enhancing knowledge flows and strengthening links between research and practice; strengthening all farm advisory services and fostering their interconnection within the AKIS; Enhancing cross-thematic and cross-border interactive innovation; Supporting the digital transition in agriculture.

The modernisation of the Common Agricultural Policy will provide a transition pathway towards resilient, sustainable and climate friendly farming systems and value chains. It will help secure the long-term supply of nutritious food and biomass, and the achievement of the 2030 Sustainable Development Goals. With well-functioning AKISs in Member States, knowledge and innovation will play a central role in this evolution. This includes also tackling the digital divide in agriculture and related sectors (European Commission, 2019).

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CHAPTER 10

CROWDFUNDING AS A METHOD TO HELP THE PUBLIC SECTOR PROMOTE INNOVATION AND CARRY OUT DEVELOPMENT POLICY

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ABSTRACT | Crowdfunding is a method of raising funds, usually via platforms in the internet, that is growing rapidly around the world. It involves many people contributing relatively small amounts of money to support a business or project, especially startups and small ventures. It is an alternative type of funding, distinct from the banking system and the established capital markets, that taps into the wisdom and potential of the crowd, which for a long time have been disconnected from the funding process. Different types of crowdfunding have been applied in different cases; and in the pages that follow we show that crowdfunding may be useful and harnessed by the public sector in Greece and elsewhere in the EU to fund social (non-profit) projects, promote innovation, even manage structural or other public funds.

1. INTRODUCTION

Crowdfunding is a form of crowdsourcing, which involves using the vast potential of contributors to obtain products or services, often time via the internet (Geiger & Schader, 2014). It is inspired by microfinance, social fundraising crowdsourcing (Morduch, 1999; Poetz & Schreier, 2012). Crowdfunding is defined as the practice in which an entrepreneur or individuals use the internet to receive funding from a large crowd of individuals, each providing a small amount (Belleflamme et. al., 2014). Crowdfunding may be reward-based, equity-based, lending-based, and donation-based, depending on the type of involvement and the return expectations the contributors may have (Kuppuswamy & Bayus, 2013). Even though there exist

similar concepts that can also be executed through mail-order subscriptions, benefit events, and other methods, the term crowdfunding refers primarily to internet-mediated registries. This modern crowdfunding model is generally based on three types of actors (Gupta, 2018):

- A project initiator seeking funds.
- A crowd of potential contributors to provide funds.
- A technology platform.

Crowdfunding has been used to fund a wide range of for-profit, entrepreneurial ventures such as artistic and creative projects, medical expenses, travel, and community-oriented social entrepreneurship projects. If a crowdfunding project launches a request for funding but fails to reach its goals, most platforms return the money to contributors, and the initiator receives nothing. This is a safety mechanism known as a pledge containing an all-or-nothing feature. In certain cases, when crowdfunding allows small and medium-sized investors to purchase shares in new companies, it contributes to the "democratisation of finance". The term refers to the virtuous processes of co-decision, co-creation, engagement, and ownership that it brings about. Another variant is designed "civic crowdfunding". In this, citizens in collaboration with the government, propose, fund, and deliver projects that aim to provide a community service or deliver public value through a local-area- improvement project. The peculiarity of civic crowdfunding is that, by leveraging on the close ties that crowdfunding platforms enjoy with local communities, it can promote a sense of engagement and belonging among citizens by enabling them to contribute to specific projects for the common good in their territories. Both financial and non-financial benefits have increasingly attracted the attention of a wide range of public and private stakeholders, such as local and regional authorities, development agencies, banks, private foundations. These entities are partnering with crowdfunding platforms all over Europe and setting up "match-funding" schemes through which resources collected by crowdfunding campaigns in specific areas are topped-up with additional resources of their own. According to Passeri (2018), combined (crowd- and match-) funded projects often occur in causes with environmental social inclusion, entrepreneurial, agricultural, cultural, creative industry or health research features.

2. CROWDFUNDING MODELS AND TYPES

Crowdfunding may be carried out on a variety of projects. There exist four types of crowdfunding to choose, each employed depending on the task at hand (Soltes & Stofa, 2016):

- **Debt-based crowdfunding:** In this case investors are providing funds in exchange for money paid back with interest according to the repayment terms specified in a loan contract or debt security. This means that debt-based crowdfunding can be compared to traditional bank lending or to peer-to-peer (P2P) loans; however, in all likelihood, the contributors expect a higher interest rate than the one offered to them (as depositors) by the bank and the initiators expect a lower rate compared to the rate offered to them (as borrowers) by the bank, more flexibility in making the repayment, the task to be easier than approaching venture capitals, and additional benefits from reaching the masses.
- **Equity-based crowdfunding:** In this case the number of contributors is smaller and the level of funding provided by each contributor is larger compared to other types. As contributors earn the right to participate under legal and statutory conditions, and usually gain a minor equity share in the business, legalization and regulation are needed. E.g., the Jumpstart Our Business Startups Act in the USA and the Alternative Investment Fund Managers Directive in the EU. The latter has not created a fully integrated framework for equity crowdfunding throughout the EU. There exist two equity-based crowdfunding models: In the one the contributor receives stocks taking ownership of the company (becomes partner) in exchange for contributing. In the other the contributor receives a share of the profits but does not become a partner (UKIE, 2012)
- **Reward-based crowdfunding:** In this case initiators get funds for their projects and, in exchange, contributors get a reward or repayment in kind or discounts on the products or receive products earlier. The practice is currently very popular around the world, especially start-ups. In one model, lower status contributors are reward based (minor contributions to the project are acknowledged by a reward usually worth less than the contribution, average contributions are treated as product pre-orders), while higher status contributors are equity or debt based.
- **Charity-based or donation-based crowdfunding:** In this case the crowdfunding activity, led by organizations, associations or individuals, raises funds for non-profit social projects, and therefore relies on user contributions and other people's contributions in the form of grants to support non-profit social projects. The platform provides information on the status of the project; the potential for interaction between users, developers, and project beneficiaries; and opportunities for real-time monitoring. Individual contributors who expect no reward for their contributions can be described as philanthropists; and company managers may take advantage of donation-based crowdfunding activities to maximize their company's corporate social responsibility activities. The synergy from so-

cially driven corporate and crowdfunding activities can be a significant source of funding while fulfilling social goals.

Kirby & Worner (2014) refer to the first two categories as "crowd investing" and to the latter two as "crowd sponsoring".

3. LEGISLATION ISSUES

In the EU, a number of member states have adopted domestic regulatory frameworks that cover investment-based crowdfunding issues; so crowdfunding platforms that offer investment instruments in the said countries have to obtain authorisation from the respective financial authorities. In other cases, they have to comply with the more general and strict rules set out by the European Commission. As a result, there exist different regulations for initiators and contributors in terms of capital requirements, disclosure provisions and other limitations that have to be applied. The absence of common crowdfunding rules across the EU prevents existing platforms from offering their services beyond the confines of national markets, hence, from reducing compliance and operational costs and from expanding. Indeed, only a handful of regulations on investment and lending instruments ─not specifically tailored for crowdfunding-related activities─ exist (Chervyakov & Rocholl, 2019). As a result, crowdfunding is underdeveloped in the EU compared to other major economies around the world.

There are three ways via which the platforms that offer investment-based crowdfunding may be authorised (Chervyakov & Rocholl, 2019):

1. Platforms can carry out regulated investment services in their home countries and in other EU countries in accordance with the so-called single authorisation principle.
2. Platforms can only receive and transmit orders and provide investment advice.
3. If a platform chooses not to offer any instruments regulated by the Markets in Financial Instruments Directive, such as non-readily realisable securities, authorisation has to be obtained under the relevant domestic regime.

While the absence of a coherent regulatory framework across the EU will most likely not hinder the regional development of crowdfunding any more than it does at the state level, weak cross-border activity and often burdensome provisions in all likelihood will undercut crowdfunding market growth. Crowdfunding can provide start-ups and SMEs with much needed access to finance, so widening the availability and use of crowdfunding may contribute to the regional economy's development. Some of the priority actions outlined in the Capital Market Union (CMU) plan are pointed directly at the current shortcomings in the crowdfunding

market. Under the CMU plan we can have improved cross-border distribution of investment funds and provide guidance on EU rules for treatment of cross-border investment.

There are three major shortcomings which policy makes need to address:

- A clear legal definition of the miscellaneous crowdfunding instruments is currently missing. We need to have a common foundation in order to facilitate cross-border investment. As national regimes allow a number of exemptions, crowdfunding platforms tend to offer instruments tailored to specific frameworks. Thus, a small firm seeking cross-border finance would need in-depth knowledge of multiple legal regimes in order to find a financing model that best suits its needs.
- The current regulations in the Markets in Financial Instruments Directive (MiFID) (II) framework are not designed for crowdfunding activity. Nevertheless, obtaining a MiFID passport is the only way for crowdfunding platforms to operate on a multi-country level. The additional disclosure requirements and the regulation on the prospectus that has to be published when securities are offered to the public or admitted to trading entail extra costs that are often too burdensome for platforms, initiators and contributors. Those seeking to finance themselves through crowdfunding are mostly start-ups, SMEs and individuals. That is, the least likely to absorb additional regulatory costs compared to big investment firms for whom the MiFID framework was designed.
- The consideration of national regimes yields very few best practices. And the significant differences between the less-restrictive frameworks (UK and France) and the regimes that focus on single issuer limits and disclosure requirements (e.g., Germany) have brought about a 'wait and see' climate that inhibits the convergence of national regulatory frameworks in the foreseeable future. This may result in the fragmentation of the crowdfunding market, thus undercutting the vision of a single capital market.

In March 2018, the European Commission proposed a regulation on crowdfunding service providers. Once it is adopted across the EU, the new regulation will allow platforms to apply for an EU passport based on a single set of rules. This will make it easier to offer their services across all member states, and for small investors and businesses in need of funding to access this innovative form of financing with a higher level of protection and guarantee. I.e. (a) clear rules on information disclosure for project initiators and crowdfunding platforms, (b) rules on governance and risk management, (c) a coherent approach to supervision.

In Greece the regulatory framework about crowdfunding and crowdfunding

platforms is quite limited. In article 49 of Act 4351/2015 there is a provision about donations and crowdfunding. In particular, the law mentions that when a fundraising is conducted by a credit institute under its corporate social responsibility and social economy and entrepreneurship actions, then its duration may be up to three years. Fundraising may relate to financial support for one or more actions, entities or persons and may be carried out through physical or electronic deposits to an account or accounts held with the credit institution. Another Act, 4416/2016 about crowdfunding for investment purposes, in conjunction with Act 3401/2005, mentions, among other things, that exceptionally, a public offer may be made without the preparation and disclosure of the prospectus that has to be published when securities are offered to the public or admitted to trading, provided that:

1. The tender shall be made exclusively through an electronic system administered by an investment firm licensed to provide at least the investment service of Article 4 (1) (a) and the ancillary service of Article 4 (2) (a). of act 3606/2007 (A-195), or alternative investment management limited firm licensed to provide ancillary services in case b) of paragraph 4 of Article 6 of act 4209/2013 (A-253) or a credit institution under investment service of receipt and transmission instant commands. An electronic system will be an online platform that presents the investment proposals of issuers via the internet and receives investor orders in the same way for securities.
2. Securities of the above issuers are offered at a total value of less than 500,000 euro, a limit calculated per issuer over a period of twelve months.
3. The participation of the private client, within the meaning of Article 8 (2) of Act 3606/2007, may not exceed (i) 5,000 euro, and in each case 10% of the average income statement declared in the previous three years per issuer and (ii) 30,000 euro per year per investment firm licensed or per alternative investment management limited firm licensed of the first case in this paragraph or per credit institution.

4. COMBINING CROWD FUNDING AND PUBLIC FUNDS

Hong & Ryu (2019) argued that government involvement in crowdfunding provides a type of accreditation or certification that attests to a project's aim to achieve public rather than private goals, thus mitigating information asymmetry and improving mutual trust between initiators (private sector organizations) and potential contributors. To support this argument, he showed that crowdfunding projects with government involvement achieved a greater success rate and

attracted more funding than comparable projects without government involvement. This evidence shows that governments may take advantage of crowdfunding to "co-fund" with the citizenry public projects that addressing complex challenges.

Passeri (2018) examines the role of the public administration in the civic crowdfunding paradigm and finds that the role may range from simple sponsors to co-funder. Davies (2014) suggests four models through which cities get involved in civic crowdfunding. Cities may (a) initiate a civic crowdfunding action as either a sponsor or a manager or (b) act as project curators or facilitators while others (third parties) are the initiators. The same models are proposed or employed by other authors describing crowdfunding for local authorities and regional governments (subnational public administrations, SPAs, hereinafter).

- **Sponsor:** The SPA selects and proposes initiatives to be funded and uses a special civic crowdfunding platform. (It may co-fund or not fund the initiatives.) If the subnational public administrational both proposes the initiative and contributes to its funding, then the project may be considered public.
- **Manager:** The SPA develops a crowdfunding platform to foster the development of the subnational territory by promoting entrepreneurial for-profit projects and non-profit civic initiatives.
- **Curator:** The SPA identifies from an existing crowdfunding platform or from a number of such platforms a list of projects that reflect the administration's agenda, i.e., projects that fall within the local or regional investment priorities and are therefore selected as beneficiaries of additional (either financial or technical) support from the public budget.
- **Facilitator:** The SPA assumes the role of selector and co-funder of initiatives proposed by citizens and the civil society on a specialised civic crowdfunding platform: It issues the planning permission, provides financial and technical expertise support, co-screens and/or co-designs projects etc.

Additional scope of cooperation between SPAs (as main fundraisers, responsible for receiving and spending the money) and existing crowdfunding platforms in the EU is provided in the context of the European Structural and Investment Funds thematic objectives 3 (Enhancing the competitiveness of SMEs), 8 (Promoting sustainable and quality employment and supporting labour mobility) and 9 (Promoting social inclusion, combating poverty and any discrimination).

The availability of additional resources is only one of the factors that drive public administrations in designing crowdfunding or match-funding schemes. According to a number of cases studies (ECN, 2018, as reported) increased citizen participation and sense of ownership, the investment's return in terms of visibility and accountability in a jurisdiction, the communication of perceived needs and

priorities, and the likelihood of an initiative's success are also important when deciding public budget allocation issues.

The development of crowdfunding campaigns allows project initiators and public officials to acquire a whole new set of skills, through a learning-by-doing process. In the case of initiators (organisations or individuals who decide to seek funding for their projects by activating a crowdfunding campaign): a combination of communication, planning, and management competences that can then become valuable assets in the broader labour market, and the expansion of existing networks of contacts. From the public officials' perspective, the design of a match-funding scheme widens the options regarding economic development and social inclusion and strengthens the relationship with different territorial stakeholders by renewing partnerships and offering new opportunities.

According to ECN (ECN, 2018), match-funding schemes and crowdfunding campaigns that enjoy the participation of a public authority have significantly higher chances to achieve their funding goal. When a public authority partners with a crowdfunding platform and commits to supporting a match-funding or crowdfunding scheme, the overall success rate of projects funded under that programme increases from an average of 60% up to an average of 80-90%. This performance is primarily attributed to the combination of training and support actions that all platforms offer to project initiators, and to the presence of the authority ─generally perceived as a trustworthy partner and co-funder. The main hindrance to the dissemination of match-funding schemes is the scarce knowledge about the functions of crowdfunding and the underestimation of the advantages it brings about by empowering and connecting different stakeholders or groups of stakeholders with similar aspirations.

The crowdfunding platform of South Tyrol (Open Innovation & Crowdfunding of South Tyrol, 2020) offers an example of a platform in which project initiators are not required to pay any fee for uploading their campaigns but only a fee to the payment system provider (visa, mastercard etc.). A specific contract is set up with each initiator, depending on his or her needs; and through open innovation (the early involvement of different external actors in product improvements, application, creative designs etc.) the initiator may overcome hurdles in the development and innovation process early, quickly and cost-effectively. This way, fresh, creative ideas materialize and reach the market.

Another example (an example of government involvement in crowdfunding) is the Wadiz platform (WADIZ services, 2020). It was founded in May 2012 by a group of entrepreneurs and was officially approved by the Korean government as a crowdfunding platform in January 2016. It features both an equity-based and a reward-based variant. The former is similar to angel investments, in which

the contributors become shareholders who receive financial rewards based on the realized profits. The latter provides only nonfinancial rewards to the contributors.

5. CASE STUDY: GREECE

In Greece a number of platforms already operate online (Directory for Greek start-ups & entrepreneurship, 2020) allowing individuals to post their ideas or start-ups and raise money from people, usually without equity. The majority of projects hosted on Greek platforms usually feature a social or artistic ambition with small financing targets. Projects with technological or entrepreneurial ambitions are generally scarce, and often do not reach their financing targets (ECN, 2018). The reader ought to keep in mind that the long economic recession (2009-2016) adversely affected the funding of all sorts of projects. The involvement of the public sector in crowdfunding initiatives is and has been negligible. However, there is scope for more, especially at the subnational level.

In December 2015, Law 4351 allowed banks to create donation accounts in the context of their corporate social responsibility. For example, National Bank of Greece, created the *act4Greece* program and platform, which is the first program of this size to support actions by the public and by businesses. In its first years of operation the platform supported more than 25 actions with a total budget of 1.8 million euro.

A small number of public corporations also commenced operating crowdfunding platforms on the basis of their institutional framework about donations. First the insular Municipality of Antiparos in the Aegean created -and is the sole proprietor of- a portal which operates as a public fundraising (crowdfunding) platform for the purpose of collecting for itself or for non-profit entities particular monetary donations or bids in-kind (Crowdfunding & Donation Platform of the Municipality of Antiparos, 2020). The Region of Crete has also set up a similar mechanism (Crowdfunding & Donation Platform of the Region of Crete, 2020).

In our view local and regional communities could enjoy additional benefits if the crowdfunding principle – a low-effort engagement activity– were incorporated in the respective territorial development policies: If the Regional Funds or Development Agencies set up in each territory: (a) Cooperated with platforms permitted to provide the service according to Greek law, and also matched the funds raised by individuals. (b) Had and used platforms on which ideas and projects proposed by the public were presented in order to raise funds and/or to be considered for inclusion in the public investment programme.

The former is in line with the principles of open innovation and public sector involvement: The SPA issues an open call as per the provisions of Act 4416/2016 in order to select existing eligible platforms that comply with Greek law and will operate the crowdfunding service in the SPA's borders. In addition, the SPA will provide a percentage of the total investment as a grant that matches the privately raised funds. Certain criteria and thresholds may be incorporated in the crowdfunding process: for instance, criteria regarding the business sector and/or the applications, thresholds regarding the range (minimum or maximum) of own contributions per offer, the minimum number of offers, the range of the project's budget. This way, the public sector policy maker or managing authority, the SPA, will utilize the service and the expertise that is offered by the platform provider (along with any possible additional services, like mentoring or marketing services, which might also be eligible for funding by the SPA) and have an active involvement in promoting open innovation in its jurisdiction, with no need for *heavy infrastructure investments* to support this action.

In the latter, the SPA, in line with Act 4314/2014, sets up a crowdfunding platform where innovators can subscribe and upload their ideas, and contributors respond according to their preferences. In this case a minimum number of individuals is set as a threshold for indicating the acceptance or impact of the idea to the public. Depending on the type of funding solicited (micro-funding, pre-seed capital etc.) and the size of the grant, the SPA can choose to verify the contributor's identity. Once a proposal has reached the minimum level of support, it is eligible for granting —provided it does not breach public state-aid rules. The SPA may opt to trigger or not trigger additional capital from the crowd, but overall an open and inclusive way of managing and distributing public funds, while bringing into light the innovation potential is reached.

Alternatively, the SPA may proceed by issuing a public call for proposals, resorting to a mix of the above schemes, and setting criteria so that it selects from ideas and projects reaching a threshold of crowdfunds from existing (certified) platforms, without having to come to any type of agreement or contract with them.

In a similar way, public authorities may try to promote open innovation by intermixing crowdsourcing with Pre-Commercial Procurement and Public Procurement of Innovation Solutions. For instance, a public authority may seek a solution to a specific issue (i.e. a public service, a process or a product etc.) by inviting ideas from the public and letting the proposals be assessed by the public itself in terms of votes raised per proposal (and afterwards rewarding the best proposals), in line with Act 4412/2016.

6. CONCLUSIONS AND AVENUES OF FURTHER RESEARCH

Crowdfunding appears to offer (a) new financing opportunities to certain types of small, innovative firms, especially startups experiencing difficulties in raising capital, and (b) a solution in the cases of funding gaps. The public sector may have a crucial role as a financial supporter of innovation, and getting involved in crowdfunding may widen the scope for funding non-profit as well as other projects that affect economic development and growth.

An interesting avenue for future research is the role of regulation. As countries around the world set up different crowdfunding frameworks, it is probably worth considering which setting is more conducive to promoting innovation.

There is no doubt for the necessity of a uniform legal framework at the EU level: A framework that would clearly define the role of the public sector in the multi-helix innovation process, and release the potential of this emerging funding mechanism for affecting and making the most of innovation. Until this happens Greek regions should embrace the international experience and take the initiative to support the new business practice as it may help the regional economy become more innovative, entrepreneurial, competitive and wealthy.

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CHAPTER 11

USING INNOVATION AS A WAY TO CREATE VALUE, JOBS, AND PROMOTE ENVIRONMENTAL GOALS: A PLAN TO INTRODUCE A NEW MARKET CONCERNING TRADITIONAL OLIVE OIL PRODUCTION

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ABSTRACT | The olive mills are among the agricultural industries that produce high organic load in waste, due to their physicochemical composition (containing a high percentage of organic compounds in complex structure). The decomposition of this waste burdens the olive mills and, consequently, leads to improper disposal, loss of resources and major environmental problems.

This chapter proposes the creation of a unit that processes and exploits the generated byproducts of a district's olive mills through (a) the production of polyphenols from the liquid waste and (b) the co-production of electrical energy and heat. This way is eco-friendly and there will be zero financial burden for the olive mills.

INTRODUCTION

The production of olive oil holds special social and economic significance for the countries that produce it, mostly Mediterranean countries, where 95% of the global olive oil output is produced (principally in Spain, Italy, Greece, and also in Portugal, Turkey, Syria, Morocco and Tunisia). Greece in particular is not only one of the largest per capita producers, but also one of the largest per capita consumers of olives and olive oil.

However, the small, seasonally operating mills employed in the production of olive oil across the country, also produce waste of high organic load; a waste which, due to its physicochemical composition (the presence of a complex structure of organic compounds), is hard to decompose. Its disorderly disposal in the ecosystem, despite the strict restrictions set by the national and EU authorities,

raises serious environmental concerns. What is more, the volume of waste is increasing over time as the production of olive oil goes up, and traditional olive mills are replaced by centrifugal. However, it is possible nowadays to convert this waste through a series of processes to harmless and clean. The cost raises concern as to whether the attempt is economically viable.

To deal with the situation, this chapter proposes the extraction and utilization of high value-added byproducts –namely, of the polyphenols contained in the liquid waste and in the olive leaves– via a three-phase olive oil production process, along with the generation of thermal and electric energy. The solid byproducts are usually used as a fertilizer (See Tzagaroulakis et al., 2005). Thus, it contributes to the goals of the UN's 2030 Agenda for Sustainable Development.

1. PROCESSING THE OLIVES

1.1. Basic issues associated with the production of olive oil

The main issues that hinder the processing of liquid waste by conventional methods are related to:

- the high organic load
- the presence of polyphenolic compounds at high concertation; substances that are consisted of a benzoic ring, in which one or more directly linked hydroxyl groups are contained (Christoforidou, 2011)
- the seasonal operation of the processing units
- the operation of many small olive mill units that are scattered across the country

The main practice that currently most olive mills use to manage their waste, is preprocess with flocculation so as to remove the solids and dispose the produced mud in the ground, while the liquid, usually (but not always), is drained off and saved in lagoons for a specific amount of time. Afterwards, the remaining liquid is disposed to natural receivers. Concurrently, the separation of the solid from the liquid phase is carried out with the method of precipitation. After the evaporation of the liquid waste, the remaining solids are usually used as fertilizer (Tzagaroulakis et al., 2005).

It becomes evident that the above-mentioned way of handling this issue is not efficient, since the inactivation of toxic and non-biodegradable compounds contained in waste is not taken into account. Moreover, significant problems arise by applying this particular practice, such as (McNamara et al., 2008):

- Large surfaces are required to build them.
- Long period of time (more than 60 days) is also required to process the waste.

- Deterioration of groundwater quality characteristics due to waste reclamation, where lagoons have not been properly sealed.
- Nuisances that are created in a significant radiant around the lagoons, that are the result of strongly unpleasant odors release.
- Aesthetic degradation of the wider area.

1.2. Methods of olive oil production

1.2.1. Preliminary stage

Firstly, the harvest is passed in front of air blowers to remove stems, leaves, twigs and light contaminants, and sank in water to remove pesticides, dirt and heavy objects. Then the olives are crushed, and the paste produced is piped into special welding chambers. From this point on, the production process is differentiated into three distinctive production systems, that are presented in the following sections (Niaounakis & Halvadakis, 2006).

1.2.2. Traditional olive mills

In this system, after the process in the special welding chambers is completed, the viscous blend is transferred to a compression system where the olive oil, the olive kernel and liquid waste are produced. This technique is a non-continuous process. It is also expensive, because plenty manual work is needed and tends to be abandoned.

1.2.3. Two-phase processing

In this system after the completion of the process in the special welding chambers, the paste is transferred in a horizontal decanter, without adding warm water, leading to the paste's separation into two parts-the olive oil and the olive kernel**.**

1.2.4. Three phase processing

Similarly, after the completion of the process in the special welding chambers the blend goes through a horizontal separator (decanter) with the addition of warm water, that separates the liquid from the solid elements of the blend by using the centrifugal force or other mechanical techniques.

This method results in three different phases and subsequently in three different products. These are the main product (olive oil), the primary liquid waste (olive mill liquid waste) and the secondary solid byproduct (olive kernel). The solid residue is either placed in natural drying apparatus and is later further processed in order to be used as soil conditioner or is directly shipped to pomace factories for the extraction of pomace oil (Niaounakis & Halvadakis, 2006). Meanwhile, the ol-

ive leaves, which are the result of the production process, are marketed as a natural fertilizer for the fields.

This process is associated with little manual work, better control of the process, a higher quality and increased production of olive oil (Niaounakis and Halvadakis, 2006), the use of more water (750 kg per ton of olives) and results in more phenols being transferred from the oil to the liquid waste, which makes the waste harder to biodegrade (Boskou et al., 2006). According to Balis et al. (1982) and Niaounakis et al., (2004) olive oil comprises 20-28% of the initial weight of the processed olives, the leaves etc. 3-5%, the solids 35-45%, the liquid waste100-120%. Let us call this Point A.

2. THE CHARACTERISTICS OF BYPRODUCTS

2.1. Physicochemical characteristics of the liquid waste obtained in three phase processing

The liquid waste consists of (a) water (80-83%), (b) organic compounds (15-18%), such as lignins, tannins, polyphenolic compounds and acids with a large number of atoms in their chain, (c) inorganic compounds; and may be described in terms of its biochemical oxygen demand, chemical oxygen demand, and the total content of phenols (Zaharaki and Komnitsas, 2009). The polyphenols are both antioxidant and antibacterial. Both the organic content and its characteristics depend on the type (variety) and maturity of the olive, its origin, the climate conditions, and the olive oil production method. The main elements and the range of their value are presented in Table 1.

2.2. The chemical composition of the leaves obtained in the preliminary stage

The chemical composition of olive leaves depends on the olive's variety, climate conditions, the age of the tree, the time of the harvest, the presence or absence of insecticides, fertilizers, etc. Generally, the leaves contain significant amounts of polyphenols (bioactive ingredients) ─more than the amount contained in olive oil[1]─ which can be used by the food, the pharmaceutical and the cosmetic industries. In addition, they are rich in trace elements, minerals and vitamins, which from a dietary perspective, is very useful to humans. Thus, olive leaves, besides be-

[1] For instance, the quantity of oleuropein ranges from 0,005 to 0,12% in olive oil, and from 1% to 14% in olive leaves.

Table 1: Physicochemical characteristics of liquid waste in three phase olive mills

Factor	Value
Potential of hydrogen (pH)	4.5-6
Biochemical oxygen demand BOD_5 (g/L)	35-100
Chemical oxygen demand COD (g/L)	40-195
Total Phenols TPh (g/L)	3-24
Total organic carbon (TOC) (g/L)	33.35-46.29
Lipids and oil (g/L)	1-2.28
Organic acids (g/L)	1.98-4.44
Tannins (g/L)	2.47-5.55
Total proteins g/L	11.03-24.79
Total sulfur (mg/L)	51-75
Total chlorine (mg/L)	121-147
Total suspended solids (g/L)	0.6 – 5
Total solids (g/L)	39.1-87.9

Sources: Vlyssides et al., 2004; Niaounakis and Halvadakis, 2006

ing used as fertilizer in the fields, may constitute a cheap substitute to other plants cultivated for these purposes.

According to Sansoucy (1985) the amount of phenols drops in dry leaves (it is 36% less compared to fresh leaves). At the same time, measurements of leaves dried at 60 ^{0}C, via the High-Performance Liquid Chromatography (HPLC) method, show the chemical composition of olive leaves to be as in Table 2:

Table 2: Chemical composition of olive leaves in powder form dried at 60 ^{0}C

Components	Content (g/100g dry weight)
Organic matter	76.4 - 92.7
Proteins	6.31 - 10.9
Fat	2.28 - 9.57
Total nitrogen *	35.2 - 49.2
Total polyphenols	0.14 - 4.3
Edible fibers	34.9 - 41.3
Lignins	14.1 - 21.1
Tannins	0.669 - 1.11

*For the nitrogen contained in the cell wall of leaves
Source: Molina, 2003.

3. PRODUCTION OF THREE PHASE OLIVE MILL BY PRODUCTS IN ACHAIA

Table 3 supplies the most recent olive tree cultivation statistics in the region of Western Greece.

Table 3: Cultivated areas, total olive trees, production of olives for oil, in the Region of Western Greece

Subregional divisions	Cultivated area (in acres)	Number of trees	Production of olives for oil (in tn)
Achaia	192,26	4,172,468	83,247
Etolia & Akarnania	231,724	5,424,404	31,439
Ilia	401,353	8,692,818	335,939
Total	825,903	18,289,690	450,625

Source: Hellenic Statistical Authority, 2017

In Achaia in accordance with the competent authority in 2017, the production of olive oil is achieved through the use of 44 local two phase processing olive mills, 40 three phase processing olive mills (45%), four olive mills featuring both technologies, and one traditional olive mill. So, it is probably reasonable to assume that about (or at least) (83,247 x 45% =) 37,461 tn of olives were processed in three phase processing olive mills. To the extent the average liquid waste produced from three phase olive mills equals the initial weight of processed olives (see Point A), it is evident that 37,461 tn of liquid waste were also annually produced in the process. Let us call this Point B.

Insofar as the leaves account for 4% of the initial weight of processed olives (see Point A), then it is reasonable to assume that some (83,247 x 4% =) 3,33 tn of leaves were also produced in the process. Let us call this Point C.

In the pages that follow we will try to figure out the prospects of a facility that treats the aforesaid amounts of liquid waste and leaves coming out from the three phase olive mills operating in Achaia in a year.

4. THE MARKET OF AROMATIC PLANTS AND PHARMACEUTICAL PRODUCTS

In Greece, the sector of growing aromatic and pharmaceutical crops is fragmented and not very developed. It consists of very few, relatively small production units,

some of which ship the raw or semi-processed material overseas (0.1% of all such international exports) to be mostly used by pharmaceutical or food companies (Ministry of Rural Development and Food, 2017). The organization of crop production, the manufacture and the distribution of products using such inputs is still in embryonic stage. The number of products is small, the value is low, large capital investments are scarce, and whatever is produced, is produced in a non-standard way.

However, at the international level, considerable R&D on the use of flora and of natural raw materials in the chemical (cosmetics, pharmaceutical) and food industries, and consumer interest in the gastronomic use of aromatic plants, has affected a rise the demand for natural products (Prasad, 2017); and the global polyphenols market is expected to grow at a c*ompound annual growth rate of* 7.2% by 2025. (Grand View Research, 2019). In this, China is the world leader; India, Canada, the USA and Germany have important roles; while the extracts of citrus fruits account for 30.5% (28.6%) of all such exports (imports) (Ministry of Rural Development and Food, 2017).

The therapeutic effects that polyphenols have on the prevention and cure of diseases are well attested in reducing the risk of cardiovascular disease (Karatzi et. al., 2008; Hertog et. al., 1995; Fernantez-Jarne et. al., 2002; Psaltopoulou et. al., 2005; Togna et. al., 2003; Martins et. al., 2007) and of liver disease (Assy et. al., 2009), in reducing oxidative stress and providing DNA protection (Visioli and Galli, 1998), in protecting from cancer (Fini et. al., 2008), metabolic Syndrome conditions (Camargo et. al., 2010), Alzheimer's disease (Pasinetti and Eberstein, 2008), leukemia and diabetes (Thomsen et. al., 2003; Fabiani et. al., 2006).

Currently, the price for high purity polyphenols ranges from 10-30 €/kg.

5. EXTRACTING POLYPHENOLS AND GENERATING ENERGY FROM THREE PHASE OLIVE MILL BYPRODUCTS

5.1. Processing olive leaves

5.1.1. Microwave Assisted Extraction (MAE)

The application of microwave technology is proposed as a method to isolate-refine polyphenolic components from olive leaves, in the form of liquid extract and high value-added powder, with the use of which (microwave technology) there has been a significant reduction in the extraction time and volume of the natural material, solvent (Laura Rinaldi, 2015).

Imagine a system with a large cavity containing a rotating basket, in which the leaves are placed, the desired amount of reverse osmosis water is added from a hole at the top of the system (the quantities are fixed: 17% olive leaves, 83% water),

the basket is sealed with a valve, and four Magnetrons create microwaves, each of which has a power of 1,500 Watt (i.e., 6,000 Watt total). The rotation of the reel on which the basket is placed is strong in order to achieve better extraction performance. An external liquid ring pump creates a vacuum of 330 milbar (the pressure under vacuum is 75 kpaskal). Temperature is set at 70 ^{0}C for 30 min, and the cooling time at 5min. A useful feature in this device is the development of impellers bearing pressure vessels, that are resistant to simultaneous multisample radiation. That is an important tool used both in the absorption of the extracted material and in the organic synthesis.

The chemical analysis of the pure powder that is produced, is provided in Table 4:

Table 4: Chemical composition of the pure powder (via the HPLC method)

Composition	**mg/kg**
Total Polyphenols	25,910
Hydroxy-tyrosol (3,4 DHPEA)	902
Tyrosol (p, HPEA)	134
Dialdehydic form of decarboxymethyl oleuropein aglycon (3,4 DHPEH-EDA)	715
Dialdehydic form of decarboxymethyl ligstroside aglycon (p, HPEA-EDA)	419
Lignans	1,433
Oleuropein aglycon (3,4 DHPEA- EA)	87
Ligstroside aglycon (p, HPEA-EA)	111

Source: Lampronikou, 2016.

5.2. Processing olive mill's liquid waste

The process for the completed management of the olive mills liquid waste with recovery of natural antioxidants and production of soil conditioners is achieved via a system using membranes and resins. This system is described in the following stages, which is a consecutive filtering of the olive mill liquid waste -Decanter, Ultra Filtration (UF), Nano Filtration (NF), Resins Columns (Resins), Reverse Osmosis (RO), Composting the mud, which is produced during the filtering stages of the olive mill liquid waste and olive leaves, that are discarded as solid waste or processed olive leaves – (D.P. Zagklis, C.A. Paraskeva, Membrane filtration of agro-industrial wastewaters and isolation of organic compounds with high added values, Water Science and Technology, 69 (2014) 202-207).

5.3. Cogenerating heat and electric energy

In this day and age, the generation of biogas from agricultural residues (e.g., olive leaves, olive mill, farm waste), via the anaerobic digestion of biodegradable organic materials, and its conversion to heat and electric energy is technically feasible and reliable. In Greece, its sustainability depends on the price of conventional fuels, and on the installation and operation costs of the energy-production unit.

The proposed coproduction unit discussed hereinafter requires 70.5 tn of animal waste and 3.5 tn of olive leaves and corn silage daily, and features:

- A digestion tank (diameter 30.00 m, height 8.00 m, flow separator 6-9 m^3/h, width 4.20 m, length 7.00 m, height 2.50 m).
- A pre-tank storage unit for the liquid raw material (diameter 6.70 m, height 5.00 m).
- Two storage ponds for the residue (the one pond 66.90 m x 34.90 m, the other 53.80 m x 28.40 m).
- A cogeneration unit of electric energy to run the unit, and of heat (width 2.50 m, length 4.00 m, height 2.50 m).
- An emergency torch capable of biogas combustion (100 m^3/h, diameter 0.50 m, height 1.00 m).
- Electrical efficiency: 300 kw.
- Full load hours: 8,000 / yr.
- Daily production: 3,169 m^3 of biogas, 6,600 KWh of electric energy, 7,250 kWh of thermal energy.
- Annual production: 2,400 MWh.

6. ASSESMENT OF SUSTAINABILITY

In this section we consider a scenario of setting up the olive mill byproduct processing unit in the industrial site of Patras (in the notional center of most olive mills in the district of Achaia), featuring available land and infrastructures, low transport and maintenance cost (about 0.35 €/km), and allowing for future collaboration with other industries.[2]

If Achaia produces about 37,461 tn/yr of liquid waste (see Point B), then it might be reasonable for the waste processing unit to have a capacity to process 33% more, i.e., about 50,000 tn/yr. Let us call this Point D. And if the harvest takes

[2] In our view the establishment of multiple processing units (for instance, in each or in every other olive mill) is not economically viable.

place in the course of five months every year (the olives are taken to the mills immediately), then Achaia may be averaging 333 tn of liquid waste per day.

To the extent (a) the purchase and installation of the electromechanical equipment for the suggested quantities, costs about 2,600,000 €, as per the pricelists provided by manufacturers; (b) the land and buildings (offices, laboratory, building equipment, fences) needed are estimated to about 400,000 € (the buildings are expected to have a useful life of 25 years); (c) the purchase of an environmental protection system, maintenance equipment, quality control lab equipment, lorries, sales vehicles, clothing, auxiliary equipment etc. are estimated to about 600,000 € (the equipment is expected to have a useful life of 10 years); the overall fixed cost (FC) is estimated to about 3,600,000 € or ((2,600,000+600,000)/10 + 400,000/25 =) 336,000 € per annum for the first ten years. Let us call this Point E.

If labor costs (15 people for 5 months, 4 people for 12 months, at a rather generous monthly wage) amount to 360,000 € per annum,[3] administrative expenses amount to (one half of labor costs, i.e.,) 180,000 € per annum, energy costs (290 KW) to 93,960 € per annum, the cost of chemical inputs to 30,000 € per annum, maintenance costs to (5% of FC, i.e.,) 180,000 € per annum, the annual cost of capital to 1,8% of the fixed cost (Kyriazis and Papadakis, 2009), i.e., 64,800 €, then –given point D– the total cost amounts to 1,244,760 €, taxes aside. Let us call this Point F. (The liquid waste and olives leaves are taken to be provided for free.)

The mass balances of the processing that are in accordance with Paraskeva et al. (2006) indicate, that the production of 50,000 tn of liquid waste per annum (see Point D) yields:

- 250 tn of polyphenols. At the modest price of 15,000 €/tn, they bring in 3,750,000 €. (Prices range between 10.0 and 30.0 €/kg.) Let us call this Point G.
- 2,500 tn of fertilizer (soil compost) with a minimum value of 100 €/tn. Along with 2,600 tn of fertilizer from the cogenerating heat and electric energy unit, that is a revenue of 510.000 € or more. Let us call this Point H.
- 40,000 tn of clean water to recycle (consume in facility), use for irrigation or dispose in natural (surface or underground) water receivers.

Insofar as the annual incomings exceed the annual outgoings (see Points (G+H)-F) by (4,260,000 – 1,244,760 =) 3,015,240 €, and taxes amount to 40%, then the net profit ought to be around 1,809,144 € ─ allowing even for a small payment (incentive) to olive mill owners. That said, the payment time would be about three years.

[3] A good number of the staff ought to have a very specialized scientific background.

7. CONCLUSIONS

Overall, there is a way to process the residue produced in olive mills in order to (a) reduce underground and soil pollution, (b) turn the residue into a soil conditioner, "green" electric energy and heat, as well as polyphenols in forms that may be used by other industries in the manufacture of medicines, nutritional supplements, cosmetics; thus, create cross-sectoral linkages, substitute (preserve) energy resources as required by the UN convention on climate change and the agenda for sustainable development, generate jobs (contribute to the demand for skilled and specialized jobs), and raise the value added in the regional economy. It is a way that introduces new, advanced technologies, adds to the prospects of further research in the region, and generates profits in post-recession Greece.

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CHAPTER 12

A START-UP INNOVATION DEVELOPMENT FRAMEWORK: THE BUSINESS MODEL CANVAS AND BLUE OCEAN STRATEGY

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ABSTRACT | Intense competition is forcing companies to identify innovative ways to capture and enhance market share while reducing costs. In this context, traditional planning and management control systems are insufficient to create value for companies and to allow them to be competitive in today's global market. Start-ups need to develop new systems for innovation evaluation and improvement. The present study proposes a new framework based on the Business Model Canvas and the Blue Ocean Strategy with a view to helping the integration of new technological business intelligence tools and human insights for companies. The objective is to provide an effective and efficient method to assist start-ups in solving typical problems, to grow rapidly, and to develop innovation, creating new market spaces to defeat the competition. The model was applied, through a preliminary case study, to the "PIN Initiative" of the Puglia Region with the aims at supporting young people in carrying out innovative entrepreneurial projects with a high potential for local development.

1. INTRODUCTION

In a knowledge-based society, innovation is the driving force of the economy on all levels and in all types of firms. The high risk connected with the introduction of new products usually pushes innovations to be commercialized through new and specific entities: start-up companies. Several studies have shown that one third of countries' economic growth is attributed to start-ups (Shabangu 2014). A start-up company is an entrepreneurial venture that is typically a newly emergent, fast-growing business that aims to meet a marketplace need by developing a viable business model around innovative products, services, processes, or platforms (*Startup Manual* 2017). Start-ups constitute an important instrument through which new ideas are brought to life, especially those that require an alternative response to that of already established companies in the field. Start-ups are innovative by their very nature. Several studies have suggested a positive link between innovation and start-up growth. Innovation can enhance market power (Schumpeter 2008), improve the ability to beat competitors (Porter 1990), reduce production costs (Cohen and Klepper 1996), support dynamic capabilities, and enhance absorptive capacity (Zahra and George 2002). It can lead to either fewer linear start-up processes (Samuelsson and Daviddson 2009) or more skewed returns (Scherer and Harhoff 2000).

The purpose of this study is to present an innovative framework for start-ups based on the Business Model Canvas (BMC) and the Blue Ocean Strategy (BOS) providing an organic and schematic view of the most significant elements and describing how they interact with each other.

The Business Model Canvas, together with the Blue Ocean Strategy concept, can represent a strategic framework for questioning incumbent business models and creating more competitive strategies for start-ups (Osterwalder and Pigneur, 2010).

Through the implementation of strategic choices based on this value concept, companies should be able to create new value propositions, generating loyalty amongst customers and employees, accessing new areas of demand, and reducing the level of competition (Furnari 2018). In addition, the use of Information and Communication Technologies (ICTs) is crucial in collecting and managing data in the most appropriate way. For example, data warehousing enables companies to store large volumes of business data in an appropriate way and artificial intelligence (AI) and machine learning allow the automatization of several activities the correct interpretation of data from heterogeneous sources (Bose and Mahapatra 2001).

The present study proposes an operative model, consisting of different phases, to support stat-ups in innovation development and growth. It is structured as

follows. A section on the theoretical introduces and explains the four main components of the study: the Italian innovative start-ups; the BMC (which is used to point out innovative elements); the BOS and innovative value; and the topic of the integration of the human mind with decision support systems (DSSs) for the purpose of implementing business strategies. In the second section, the methodology is explained, and the studies that have led to the proposed model are cited; the operative model—the innovation development framework for start-ups—is explained in detail. A preliminary case study is developed applied to the "PIN Initiative" of the Puglia Region: a financial instrument for young people who intend to carry out projects with an entrepreneurial vocation, with a high potential for local development, in the fields of cultural innovation, technological innovation and social innovation. The study ends with a conclusion and follow-up and suggestions for future research.

2. THEORETICAL BACKGROUND

1.1 Innovative Italian Start-ups

The term start-up, despite being used traditionally to indicate the period immediately following the beginning of an entrepreneurial activity, has lost its temporal meaning. It now describes a specific type of business. A start-up is a business model aimed at creating innovative products and services; it is the result of a creative idea and a business model configured for rapid growth, according to a scalable and repeatable scheme. The term has not an official definition, though, according to Rohbehmed: "the key attribute of a start-up is its ability to grow […] A start-up is a company designed to scale very quickly. This focus on growth unconstrained by geography differentiates start-ups from small businesses" (Rohbehmed, 2013). The concept involves a concentration of dynamics that each have their own identity and importance, but together they are the embodiment of the real meaning of the term. Planning the start-up process clearly makes it possible to achieve several objectives simultaneously, accelerating the maturation of the business idea and guiding the process of the intended innovation (Liao and Gartner 2007). All these actions are aimed at creating a strategic path that will help the company to develop (Van Gelderen et al. 2006).

In September 2019 there were 10,630 Italian start-ups registered on the Business Register, with a total production value of €1.2 billion. Of these, 2,576 were launched thanks to the digital and free constitutionalism method, a growth of 169 units over the previous survey in June 2019 (Infodata 2019). The definition of innovative start-ups is based on Article 25 of the Legislative Decree 179/2012, which

introduced into the Italian legal system a specific notion of "new technological enterprise," that is, the innovative start-up. Only new capital companies which respect specific requirements are considered to belong to this category

In the face of the challenges of market globalisation, the economies that are showing greater dynamism and resistance to shocks deriving from devaluations and market crises are those that maintain high technological and innovative profiles over time. For this reason, the economic policies of governments are aimed increasingly at encouraging the development of industrial sectors and companies that work innovation, research and development (R&D), and cutting-edge technologies. In Italy, the business ecosystem (small to medium sized enterprises [SMEs], large corporations, specialised service providers such as incubators and accelerators, the universities and research centres, and so on) is growing every year as it helps innovative start-ups to grow rapidly. Being able to count on successful innovative start-ups guarantees economies wealth and employment. The ideas of the few can generate benefits for the many.

2.2 The use of the Business Model Canvas to Highlight Innovation

There are many ways of pointing out the innovative values of new enterprises. The present study identifies these within the nine areas of the BMC, which was first presented in the book *Business Model Generation* by Alexander Osterwalder and Yves Pigneur (2010). The BMC is a strategic business design tool that uses visual language to create and develop innovative, high-value business models. It allows the graphic presentation of the way a company creates, distributes, and captures value for its customers. Its logic is based on nine business building blocks: customer segments; customer relationships; channels; value proposition; key resources; key activities; key partners; cost structure; and revenue streams. The blocks can be grouped into four main business areas: customer; offerings; infrastructure; and financial variability. It is through these that the start-up generates value. The final objective is to have a synthetic and schematic view of all variables that have impact on the value creation in the business model. The nine building areas represent a set of elements that describe how a company organises its resources and activities to achieve a specific objective.

Whether the entrepreneur is in start-up mode or already gaining traction, they need true clarity in their business model to plan for success. The concept of the BMC was to provide a simple, intuitive, and flexible tool that can be developed rapidly and applied on an ongoing basis to iterate and refresh a business's strategy. Business model innovation is a matter of creating value for companies, customers, and society, and replacing outdated models. Osterwalder and Pigneur were

not the only ones to believe that the business model could be represented as a set of several elements, and that it could be expressed through a series of dimensions. Johnson, Christensen and Kagermann (2008) present a model comprising the union of four interconnected elements, which together create and provide value: the value proposition for the customer; the profit formula; key resources; and key processes. Baden-Fuller and Haefliger (2013) regard the business model as a system for solving the problem of identifying customers; attracting them; satisfying their needs; and monetising the value offered. Lindgardt, Reeves, Stalk and Deinler (2009) suggest a model that is divided into value proposition and an operating model, and Itami and Nishino (2010) distinguish the two constitutive dimensions of the business system and the profit model.

2.3 The Blue Ocean Strategy's Innovative Value

The BMC can be blended with the BOS concept, which was introduced by Kim and Mauborgne (2004). The BMC is a perfect extension of the analytical tools presented by Kim and Mauborgne. It provides a base model for the analysis of all the main elements of a business to which the innovative and competitive principles of the BOS can be applied. Therefore, these two approaches provide a powerful framework for questioning incumbent business models and for creating new, more competitive ones. The BOS involves the simultaneous pursuit of differentiation and low cost for the purposes of opening up a new market space and creating new demand (Osterwalder and Pygneur 2010). It is "a consistent pattern of strategic thinking behind the creation of new markets and industries where demand is created rather than fought for and the rule of competition is irrelevant" (Kim and Mauborgne, 2005). The strategy provides companies guidelines on how to escape from intense competition in the same market space, where there are limited customers with an increasing number of competitors, by creating a new market space (Kim et al. 2008; Kim and Mauborgne 2015). It challenges companies to break out of the red ocean of bloody competition by creating new uncontested blue oceans that render the competition irrelevant. Drawing on more than a decade of new strategies, and after analysing the birth, growth, and in some cases death of companies, Osterwalder and Pigneur, (2010) showed how going beyond the competition, inspiring the trust of people, and seizing new growth opportunities allows businesses to move from a crowded red ocean to a blue ocean, an undisputed market space. Red oceans are occupied by all existing industries; they are known marketplaces in which industry boundaries are defined and accepted, and the competitive rules of the game are well established. Companies try to outperform their rivals to grab a greater share of existing demand. As the market space becomes increasingly

crowded, profits and growth are reduced; over time, products become commodities, leading to cut-throat or *bloody* competition - hence the term red oceans. Blue oceans, in contrast, grant all industries not presently in existence an unknown market space untainted by competition. In blue oceans, demand is created rather than fought over, so there are more opportunities for rapid and profitable growth. Competition is irrelevant, because the rules of the game are waiting to be written. The term symbolises the wider, deeper potential to be found in unexplored marketplaces. Instead of segmenting existing demand and benchmarking competitors, the BOS is about growing demand and breaking away from the competition (Kim and Mauborgne, 2015).

Kim and Mauborgne (2015) expanded their concept in response to the change engendered by digitisation. They revised and improved the first book to give it a more modern vision. This resulted in *Blue Ocean Shift: Beyond Competing* (2017). Combining the insights of human psychology with practical tools, they provided a new guide for shifting the entrepreneur, the team, or the entire company towards the idea of trust and the creation of a new market (Furnari, 2018). In keeping with the original concept, creating a new market space means being innovative, but innovation is not limited to products and technology; different case studies have shown that companies achieve high growth through value pioneership as well as technological pioneership. They also create blue oceans by constantly developing and optimising their own processes and offering them as a service, such as e-commerce, customer care services, in-store technologies, telephone ordering, website management, and warehousing. Innovation is also independent of company size; both large and small companies can achieve high growth by creating new market spaces (Lindic et al. 2012; Shilling, 2013). Sheehan (2009) suggests that one way to generate Blue Ocean strategies is to use the fundamental building blocks of value creation. He proposes three types of value: lower prices using an industrial efficiency logic; greater user connectivity with a network services logic; and better offerings that fit with the user's needs using a knowledge intensive logic. By combining these value creation logics, managers may achieve innovation (Sheehan, 2009). In the BMC we can identify two main dimensions: on the right side is the creation of value and on the left side is the efficiency with which it is created. Using this model we can analyse step by step all aspects of process logic. Value innovation in the BOS involves providing new features and services while simultaneously reducing costs through the elimination of less valuable ones. This approach rejects the traditionally accepted trade-off between differentiation and low costs (Osterwalder and Pigneur, 2010).

2.4 Integrating the Human Mind with Decision Support Systems

Growing and intense competition is forcing companies (including start-ups) to identify innovative ways to capture and enhance market share while reducing costs. A better appreciation of the buying behaviour of customers can enhance the effectiveness of target marketing practices. Data warehousing technology has enabled companies to organise and store large volumes of business data in a form that can be analysed, while advances in AI and machine learning have automated the recognition of patterns in databases. These developments have changed the way business data are analysed. They have given rise to data mining, which combines machine learning, statistical analysis, and visualisation techniques with the intuition and knowledge of the business analyst (Bose and Mahapatra 2001). Through the introduction of these technological tools and progress in business intelligence, DSSs have become increasingly important for enterprises. A DSS is a computerised programme used to support determinations, judgements, and courses of action in an organisation or a business. It analyses massive amounts of data, compiling comprehensive information that can be used to solve problems and to make decisions (Segal 2019). All these tools are the new business differential. Gains in speed and precision and the execution by algorithms of the most repetitive tasks mean that company staff are freed from having to carry out routine and low-value jobs and are able to focus on more creative, strategic, and value-added activities (Zanotti 2018). The key to a winning business strategy is the integration of people and machines. It is important that companies exploit all the opportunities and advantages technologies offer, and that they integrate them with the knowledge, experience, creativity, and insights that only humans can provide.

3. METHODOLOGY

Innovation is strongly associated with growth. New business is created by new ideas, which in turn leads to competitive advantage (Tidd and Bessant 2018). It is essential that start-ups find an innovative development strategy. We therefore decided to design a new model for innovative value analysis and improvement, based on an extended version of the BMC and BOS.

Phase 1: Theoretical Study and Examination of the Best Models

The methodological approach of the present study was based on an extensive analysis of the BMC and BOS through the research project *Knowledge and Innovation in, to and from Emerging Markets* (KITFEM), which was established in 2016 with-

in the Marie Skłodowska-Curie Actions Research and Innovation Staff Exchange (RISE). We also examined other models for innovative values analysis and the improvement approach to innovation used by the Knowledge Foundation *madrid* in Madrid.[1]

- IMP^{3}rove is a benchmarking tool for innovation management that allows for national and international comparisons. The competitive assessment is based on the A. T. Kearney House of Innovation. IMP^{3}rove uses an online system for the collection of qualitative and quantitative data, which is facilitated by a certified expert who is able to quickly generate analysis reports. The model is designed to innovate large enterprises.
- The Innovation Health Check (IHC) is organised to guide a structured conversation with companies concerning the key areas that influence the success of innovation management. It uses a questionnaire expressed in direct language to obtain formal and informal information. This model is more appropriate for SMEs and start-ups because their structures are usually more elementary.

Phase 2: Preliminary Definition of the Framework

The model framework was then developed. We classified the most relevant components of innovation in accordance with the nine areas of the BMC. By combining the three value creation logics proposed by Sheehan (2009) and the Four Actions Framework of Osterwalder and Pigneur (2010), we identified ways to generate and implement a BOS. There were a number of problems with the first iteration of the model, which needed to be tested on real cases.

Phase 3: Model Improvement and Completion

To test and refine the model, we interviewed representatives of 15 Italian and 15 Spanish companies (spin-off companies and start-ups), with the aim of understanding the most relevant issues they faced, and how they were approaching innovation. We organised questions and answers in in line with the BMC building blocks to compare the strengths and weaknesses for enterprise and to improve the model. The results of the interviews showed that most new companies had a confused idea of the innovative value they wanted to offer, and that they found it difficult to outline distinctive traits to differentiate them from their competitors. The analysis gave us a more solid basis on which to design the operative model.

The final version fused the BMC and the BOS to create a new method for help-

[1] https://www.madrimasd.org

ing start-ups to innovate and build competitive advantage. In addition, technological tools can support innovative element analysis and comparison and the intuition of analysts can be applied to the BMC and the concepts of the BOS.

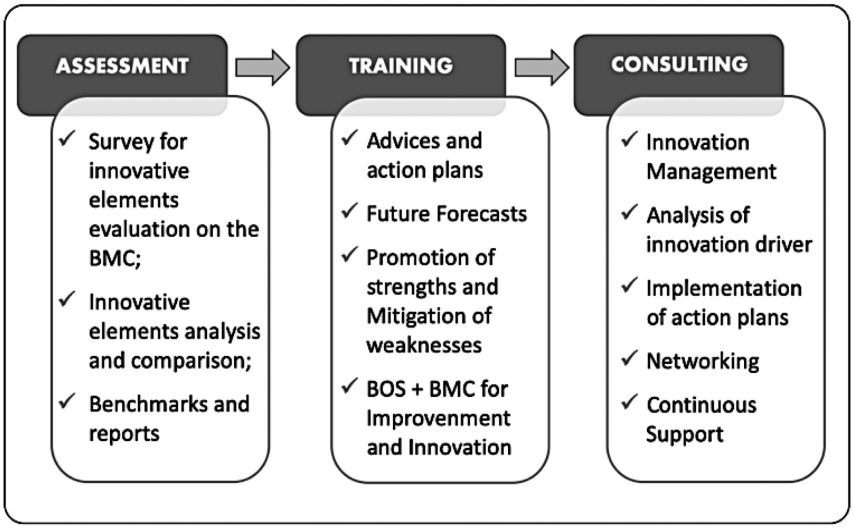
4. THE OPERATIVE MODEL

The operative model (Fig. 1) has three main phases: assessment, training, and consulting. These could also be cyclical for the purpose of continuous improvement.

In the assessment phase, surveys for innovative element evaluation based on the BMC will be submitted to start-ups. Exploiting data analysis and technological tools, these elements can be analysed and compared, generating detailed benchmarking reports that show strengths and weaknesses relative to competitors.

The training phase starts with advice and action plans aimed at the promotion of strengths and the mitigation of weaknesses. Future forecasts are carried out to understand how the positive and negative aspects may evolve. These could be automated using innovative DSSs. The analyst can begin to evaluate how the integration between the BMC framework and the BOS might be applied to the companies to help them find new market spaces.

Figure 1: The Operative Model



In the consulting phase, all analyses and evaluations take the form of plans for the management of innovation. The innovation drivers are examined and action plans implemented thereafter. Analysts can help start-ups to start networks that could be used to mix the strengths of one company and the weaknesses of another to create new forms of collaboration and exchange. Finally, the implemented strategies and subsequent modifications have to be monitored and tested; once a company starts on its innovation path, continuous support is necessary to maximise growth and innovation.

5. A PRELIMINARY CASE STUDY

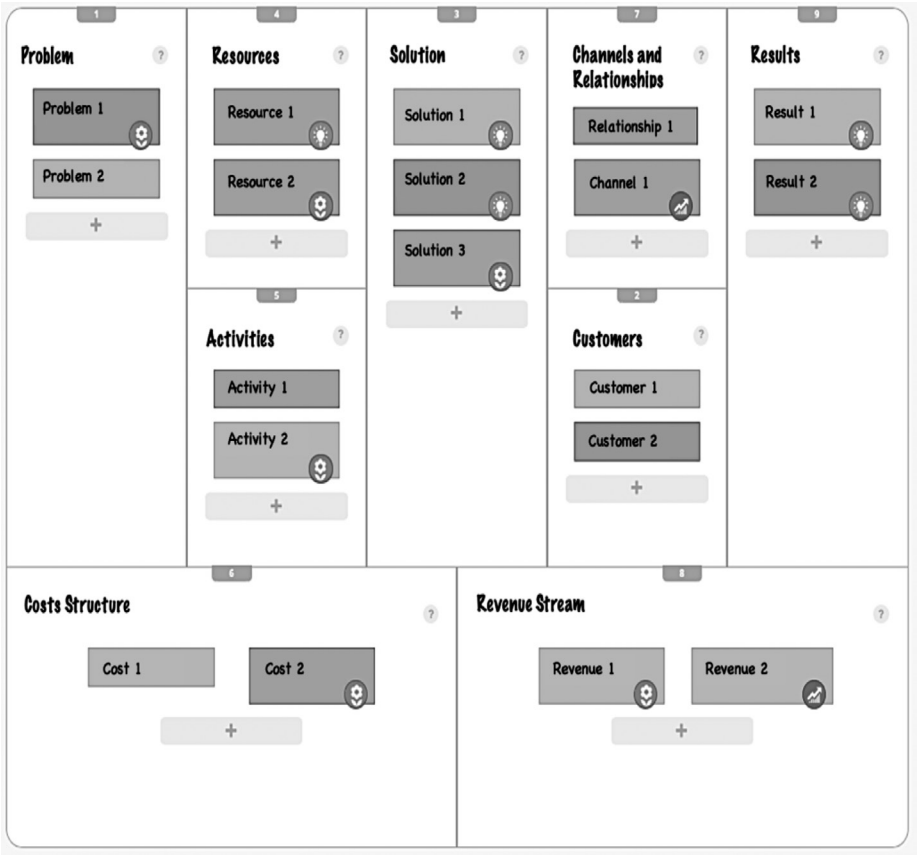
The proposed model was applied to the PIN Programme, an initiative for financing innovative ideas that was introduced in the Apulia region in 2016. It was designed to support the entrepreneurial ideas of people under 36. It supports the implementation of entrepreneurial projects in the fields of cultural, technological, and social innovation. Young entrepreneurs who wish to compete have to participate in a public competition that comprises several stages. One of these includes the compilation of a variant of the BMC. The PIN commission evaluates submissions on the basis of innovation, follow-up, and the ability to have a positive impact on the region. We studied the current PIN application template and analysed the demonstration model, which was supplied by Arti Puglia after a formal request.

5.1 Case Study Analysis AS-IS

- In their application, the young entrepreneurs have to describe their idea according to the stages of the integrated telematic application.
- One of these is a business model that takes inspiration from the BMC and Ash Maurya's (2012) Lean Canvas, which was inspired by Eric Ries (2011). However, the PIN-specific model has many original elements designed specifically for the presentation of PIN projects.
- PIN has an application for presenting the business canvas; it is a synthetic visualisation tool to be completed by notes and details, and applicants can add tags to foreground the proposal's innovation, territory development, follow-up, and to make final comments.
- The BMC component comprises nine areas: problem, customers and beneficiaries, solution, resources, activities, cost structure, channels and relationships, revenue stream, and results.[2]

[2] http://pingiovani.regione.puglia.it/come-partecipare

Figure 2: Present Business Canvas Model (As-Is)

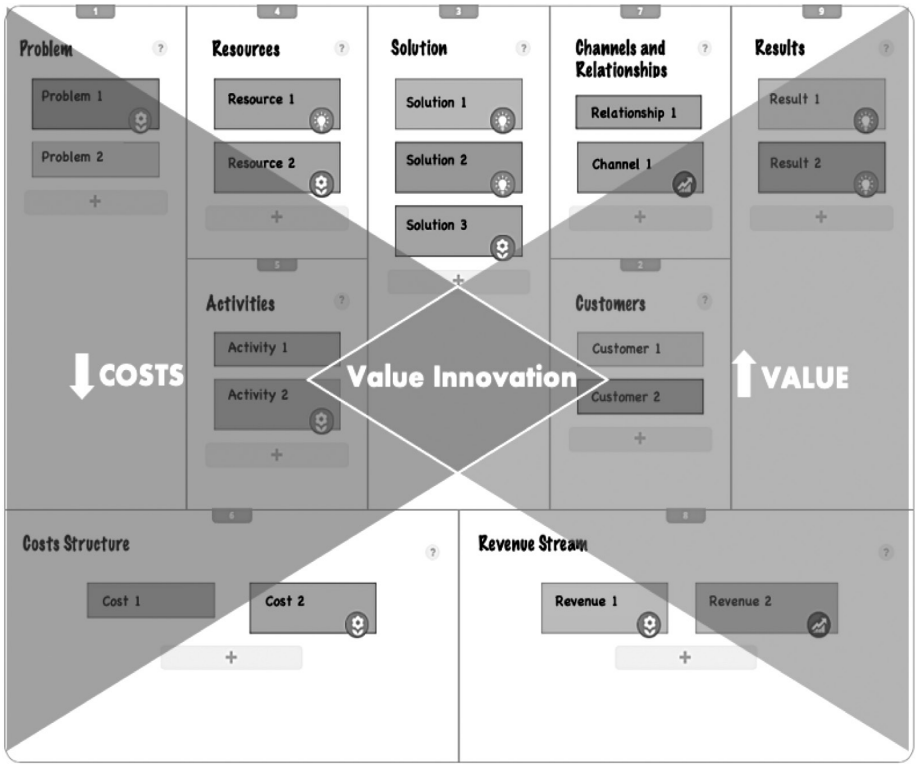


- Innovation is an important evaluation criterion, but it is highlighted only through poorly specified tags.
- The model does not provide a means of building networks or of combining the strengths and weaknesses of different projects.

5.2 Case Study Analysis (To-Be): Proposals for Improvement

The operative model proposed in the present study could be useful both upstream, as a support for start-ups who intend to present an application, and downstream, as a support for the PIN process during the evaluation and selection phases.

Figure 3: Business Canvas Model Integrated Into the Blue Ocean Strategy



Upstream Improvement

- Entrepreneurs who intend to compete could develop the innovative values of their idea by following the blending of the BMC and the BOS proposed in the present study before applying. Start-ups could use this model to investigate new ways of decreasing costs and of increasing innovative values simultaneously, which would help to open up new market spaces and create new demand.
- Start-ups could use it to work on the three main evaluation criteria: innovation, impact on the territory, and follow-up.

Downstream Improvement

- Beginning from the as-is analysis, it would be possible to propose an evaluation criterion focused on innovation that could be integrated into the current evaluation process. This could offer an additional evaluation criterion and a means of encouraging networking.

- The current approach does not consider innovation in its broadest sense; a project may be innovative in the context of the territory in which it is being introduced, but it may be obsolete beyond it. The proposed model offers an effective tool by which to evaluate this, for example by generating benchmarks and reports.
- The current approach evaluates projects individually; it does not take into consideration possible collaborations and interchanges between them. The model proposed in the present study could support the PIN programme by opening up possibilities for networking and by recognising the strengths of one company and the weaknesses of another to create new forms of *open innovation*.

The PIN funding process is not the only possible field of application; the model could also be usefully applied to other similar public administration instruments.

6. CONCLUSION AND FOLLOW-UP

Today there are no completely integrated models or technologies able to support start-ups and entrepreneurs in their strategic choices. The proposed model is innovative because it seeks to improve the approach of the BMC with the use of new data mining technologies and to develop new innovative strategies based on the BOS. The idea of modelling innovative elements on the BMC has three important advantages:

- Focusing on the Whole

The model is designed to guide thinking through each of the building blocks. It allows companies to understand how each element is related to the others. It encourages them to think about their businesses in a more systematic and formal way. Its visual nature aids comprehension by presenting the overall picture and revealing how the sum of the innovation elements is more than the sum of the individual parts.

- Speed & Agility

The key principle is to concentrate on quality rather than quantity. Not every possible component has to be considered; the crucial issue is to determine the key inputs to each building block from an innovation perspective. Such a classification is simple and focused; the model can be used by start-up companies that ordinarily have basic structures, a small number of staff, and a limited cash flow.

- Common Language

The BMC creates a common language that can be used to articulate, share, and gather feedback and to compare each business model and their innovative values.

The model is immediate and easy to interpret and is appropriate for a start-up's basic and intuitive organisational structure. The BMC represents an efficient method for the innovative values evaluation by providing a visual *big picture* that can help companies to understand how changing one part of a business model impacts other parts. Our model can be integrated with the BOS concept to provide a powerful framework for upsetting existing current business models and for creating new, more competitive ones. To achieve value innovation, the BOS proposes an analytical tool called The Four Actions Framework. The following key questions challenge an industry's strategic logic and established business models:

1. Which factors that the industry takes for granted should be eliminated?
2. Which factors should be reduced well below the industry standard?
3. Which factors should be raised well above the industry standard?
4. Which factors should be created that the industry has never offered?

In addition to value innovation, the strategy proposes the exploration of non-customer groups to create blue oceans and to tap unchartered markets. Blending the BOS value innovation concept and the Four Actions Framework with the BMC has generated a powerful new tool for companies. The right-hand side of the BMC (value creation) and the left-hand side (costs) fit well with the BOS value innovation logic. The integration of these two approaches means that a business model innovation can be analysed in its entirety, while the Four Actions Framework elements (eliminate, create, reduce, and raise) can be applied to each building block of the model to ascertain the implications for the others (Osterwalder and Pigneur 2010).

To conclude, the application of the BOS principles to the BMC affords the opportunity to analyse systematically a business model innovation in its entirety. It is a potent means of examining value propositions and business models and of exploring new customer segments. The BMC complements the BOS by providing a visual holistic view that allows start-ups to understand how innovating one business model building block impacts other blocks. It can act as a blueprint for the implementation of a strategy through organisational structures, processes, and systems that would help firms to be more innovative and competitive.

A follow-up to this study might consist of integrating the right and customized technological tools for innovative elements evaluation, which can generate reports, benchmarks and forecasts. It includes all the new possibilities that machine learning, AI and decision support systems can offer in business field. In this way the

intuition of analysts can exploit the concepts of blue ocean and the insight of the business model canvas, to support companies in the best way for achieving innovation.

7. FUTURE RESEARCH

It should be possible to use technological tools for the analysis of all the start-ups in the PIN Database. Using appropriate and customised data mining tools, future researchers could discover significant patterns in the data collected, and to automatise certain parts of the evaluation process. Such tools could also be used to compare innovation outcomes in different countries and to discover ways of building networks amongst companies. Another idea would be to extend the PIN analysis to other government financing measures, so our model could be validated using a larger sample.

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CENTRE OF PLANNING
AND ECONOMIC RESEARCH

ISBN: 978-960-635-469-4

Printed in Greece