LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

MESTRADO

GESTÃO E ESTRATÉGIA INDUSTRIAL

TRABALHO FINAL DE MESTRADO

DISSERTAÇÃO

THE PARTNERSHIP BETWEEN CARNEGIE MELLON UNIVERSITY AND PORTUGAL: A CASE STUDY IN THE INTERNATIONAL PARTNERSHIPS PROGRAM

JOANA MARIA LEITÃO PEREIRA

NOVEMBRO - 2020

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

MESTRADO EM
GESTÃO E ESTRATÉGIA INDUSTRIAL

TRABALHO FINAL DE MESTRADO
DISSERTAÇÃO

THE PARTNERSHIP BETWEEN CARNEGIE MELLON UNIVERSITY AND PORTUGAL: A CASE STUDY IN THE INTERNATIONAL PARTNERSHIPS PROGRAM

JOANA MARIA LEITÃO PEREIRA

ORIENTAÇÃO:

PROF.ª ANA CORREIA MOUTINHO

CO-ORIENTAÇÃO:

PROF. TIAGO SANTOS PEREIRA (UNIVERSIDADE DE COIMBRA)

NOVEMBRO - 2020

Agradecimentos

Aos Professores Ana Correia Moutinho e Tiago Santos Pereira, pela orientação, aprendizagem e disponibilidade.

Aos entrevistados - Alumni, Diretores e Coordenadores Executivos - pela disponibilidade e pela valiosa contribuição que fez com que este estudo fosse possível.

À minha Mãe, o meu exemplo académico, a economista de quem herdei a mesma expressão e humor.

Ao meu Pai, o meu exemplo de resiliência e disciplina, quem persistiu e acreditou para que entregasse a minha tese.

Ao João, o meu companheiro, sempre do meu lado, que aconselhou, aturou e ajudou.

À minha Avó Laurinda, e aos meus Avós Noémio e Manuela, "*onde quer que estejam."*

Abstract

In 2006 the International Partnerships Program was first established between the Portuguese Government and three prestigious North American Universities, namely, *Massachusetts Institute of Technology* (MIT), *Carnegie Mellon University* (CMU) and *University of Texas at Austin* (UTA). This program was one of the measures of the Technological Plan (TP), aiming to positively impact the development of Portugal in the field of Science, Technology and Innovation (ST&I) through Research and Development (R&D).

This thesis aims to contribute as a complementary exploratory analysis of the *Carnegie Mellon University – Portugal* (CMU-PT) partnership in the format of Dual Degrees, as a case study. Through eight interviews conducted to Program Directors, Coordinating Team and Alumni, it strives to answer vital questions as to the known repercussions of what it takes to establish a Dual Degree between two foreign partners, and if this particular case met its proposed targets, as well as national goals and expectations set by other institutions of reference, such as the Organization for Economic Cooperation and Development (OECD).

As it happens, it takes a multitude of factors in order to achieve an efficient structure between all players, one which allows the much-needed results for the economic development of Portugal, building a strong ST&I basis through Higher Education, Research and Innovation (HERI).

Keywords: Public Policies; Science, Technology & Innovation; International Partnerships Program; Ph.D.; Dual Degrees; Case Study

Resumo

Em 2006 foi estabelecido o Programa de Parcerias Internacionais, entre o Governo Português e três universidades Norte Americanas de prestígio, nomeadamente, *Massachusetts Institute of Technology* (MIT), *Carnegie Mellon University* (CMU) e *University of Texas at Austin* (UTA). Este programa foi uma das medidas integradas no Plano Tecnológico (PT), com o objetivo de impactar positivamente o desenvolvimento de Portugal, no campo da Ciência, Tecnologia e Inovação (CT&I) através de Investigação e Desenvolvimento (I&D).

Este ensaio tem como finalidade contribuir como uma análise exploratória tendo como caso de estudo a parceria *Carnegie Mellon University – Portugal* (CMU-PT) em formato de Grau Dual. Através de oito entrevistas conduzidas a Diretores do programa, Equipa de Coordenação e Alumni, o estudo empenha-se em responder a questões vitais acerca das repercussões reconhecidas, o que é necessário para estabelecer um programa de Grau Dual entre parceiros estrangeiros, e se consegue atingir os objetivos propostos, as metas nacionais e expectativas estabelecidas por instituições de referência, como a Organização para a Cooperação e Desenvolvimento Económico (OCDE).

Como verificado, são necessários múltiplos fatores para atingir uma estrutura eficiente entre todos os atores, que permita atingir os resultados necessários para o desenvolvimento económico de Portugal, construindo uma base de CT&I forte através do Ensino Superior, Investigação e Inovação (ESII).

Palavras-Chave: Políticas Publicas; Ciência, Tecnologia e Inovação; Programa de Parcerias Internacionais; Ph.D.; Graus Duais; Estudo de Caso.

Index

List of Figures

List of Appendixes

List of Abbreviations

CMU – Carnegie Mellon University

CMU-PT – Carnegie Mellon University - Portugal Partnership

EU – European Union

DGEEC – Direção-geral de Estatísticas da Educação e Ciência

FCT – Fundação para a Ciência e a Tecnologia

GDP – Gross Domestic Product

HERI – Higher Education, Research and Innovation

HMS – Harvard Medical School

IPP – International Partnership Program

ICT – Information and Communication Technologies

MIT – Massachusetts Institute of Technology

MIT-PT – Massachusetts Institute of Technology – Portugal Partnership

OECD – Organization for Economic Cooperation and Development

Ph.D. – Doctorate

R&D – Research & Development

ST&I – Science, Technology and Innovation

TP – Technological Plan

USA – United States of America

UTA – University of Texas at Austin

UTA-PT – University of Texas at Austin – Portugal partnership

UTEN – University Technology Enterprise Network

1. Introduction

There is no question regarding the significance public policies of Science, Technology and Innovation (ST&I) have to nowadays social and economic development. This field includes a magnitude of measures and implications, for which a concerted public intervention can be decisive to the evolution and growth of a country. The path to ST&I progress does not stand only on the shoulders of industrial players, but also in hands of students and researchers who commit to invest in Higher Education and wish to conduct meaningful research work in the hope of making a difference in their country or even at a global level.

Out of the different public measures known in the Portuguese context, with the intent to impact the ST&I field, one can distinguish for its particular features the *International Partnership Program* (IPP) between North American top universities and the Portuguese Government. In these partnerships, each has its own traits and conducts itself under a distinctive coordination team. Reviewing these characteristics, the *Carnegie Mellon University* (CMU) partnership with Portugal contemplates the singular feature of its degrees being conducted in a Dual Degree format, meaning the students have the possibility of concluding a degree recognized and attributed from both universities, CMU and the Portuguese university.

This study aims to answer questions such as: 1) What were the fundamental factors in creating the partnership, and within a Dual Degree format?; 2) Knowing the structural changes faced by the other partnerships, how was it possible for CMU-PT to maintain its Ph.D. offer under Dual Degree format?; 3) What it is the importance of Dual Degrees for the future of CMU-PT and what could be its main impacts?; and 4) in which terms does the CMU-PT program benefit from the requirements of a strategic investment in HERI?

In order to analyze the complexity of how the establishment of an international Dual Degree is managed and its implications, this dissertation is essentially composed of three parts. First, a bibliographic review, which will give a historical context to the origin of the IPP: to see where Portugal stood before in terms of ST&I; the reasons to implement such measure; knowing each partnership; and analyzing the current assessments of the IPP and the Higher Education, Research and Innovation (HERI). Secondly, a methodological justification, for which a set of interviews were conducted to a specific group of actors within the *Carnegie Mellon University-Portugal* (CMU-PT) partnership.

Thirdly, the interview analysis, where can be seen how and why the Dual Degrees were established, tracing a link to the assessments already performed and the results of the last Annual Report performed by the CMU-PT coordinating team.

Lastly, following the analysis of the obtained data and the known impacts of this partnership through Dual Degrees, the conclusions of this study are discussed and presented.

2. Bibliographic Review

2.1 The importance of ST&I policies and their analysis

The Science, Technology, and Innovation (ST&I) area has a transversal impact in all other political action fields. It addresses various social-economic concerns (OECD, 2012), such as Environmental, Health, or Information and Communication Technologies, and a growing focus for Sustainable Development (Giovannini et al., 2015). The relevance of ST&I is unquestionable. Considering the public investment made, it is expected to develop the long-term national economy (Audretsch et al. 2002, OECD 2003). Hence, is safe to say that, in times of budget constraints and scarcity resource, the evaluation and analysis of ST&I and Research and Development (R&D) policies have become fundamental to understand if the planned investment is justified (Georghiou, 1997). In 2000, Georghiou and Roessner identified two main reasons for the growth of interest and concern for implementation for this kind of measures: firstly, it is influenced by the eagerness to comprehend which quantitative and qualitative impacts are a result of the implementation; secondly, the increasing tendency to associate science with the national competitive performance, so it should exist efficient approaches towards this connection and ways to evaluate it.

Georghiou et al. (2002) indicate the government intervention, by means of public policies, to rectify economic failures (Neoclassic Perspective). In the R&D an ST&I scope, these interventions aim towards the following goals: the improvement of information network between participants and information and knowledge providers so that the lack of decreases; publicly act upon the market to decrease risk and costs for economic players engaged in this area; promote processes which improve players relationship, in various degrees of collaboration and partnership.

As history comes to prove, it is fundamental to assess such measures: to distinguish the bad, the good, and even to capture the knowledge of how and what resources can be applied more efficiently, regarding future issues.

2.2 Science, Technology and Innovation in Portugal: A Historical Approach

2.2.1 Portugal and the national context

To introduce the International Partnerships Program study, it is essential to give a historical context that led the Portuguese Government to fully commit to the ST&I national progress.

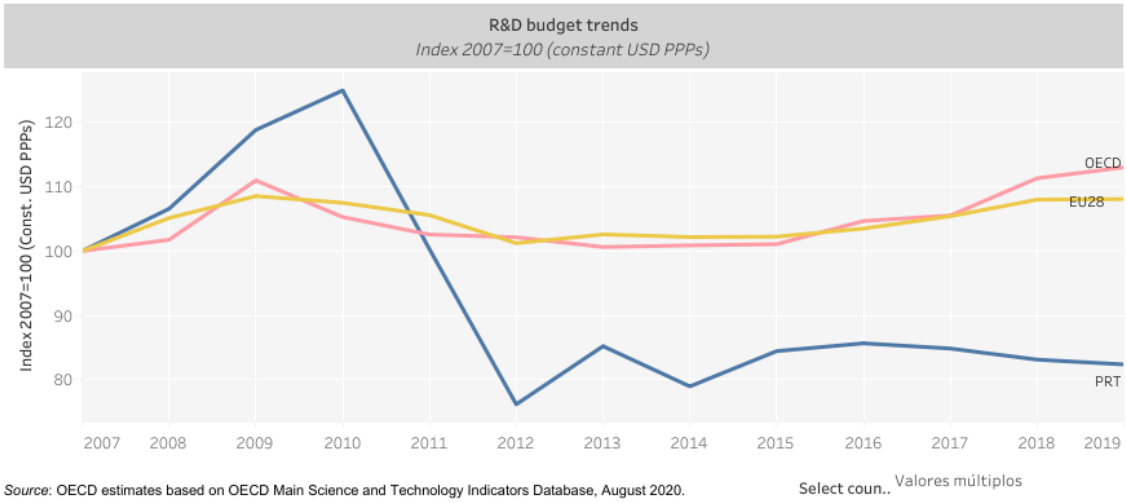
Portugal is one of the European Union (EU) and OECD countries, which is still well below the Gross Domestic Expenditures on R&D, compared to the OECD and EU annual average (see Appendix I - Gross Domestic Expenditures on R&D by performing Sector and R&D intensity). Portugal has taken a decade to elevate this expenditure to be at least 1,5% of the Gross Domestic Product (OECD, 2020), and verifying this rate in 2017, it still dwells at this same level (OECD, 2017b, Corado Simões et al., 2017). This expenditure is primarily done by the Higher Education sector, secondly by the Business sector, and lastly by the Government. It is possible to state, the Higher Education - being its main objectives: to provide a post-secondary education, with a duration of three or more years, "*designed to provide sufficient qualifications for entry to advanced research programs and professions with high skill requirements"*[1], and to develop advanced research – is the principal investor in R&D, at a national level.

At the beginning of the XXI century, the backward in ST&I in Portugal was considered not just due to an aggravated national economic context but was also due to structural problems (Academy of Finland, 2011). In 2005, Portugal was facing many challenges regarding ST&I, as it was identified by the OECD Portugal's tertiary education system evolution and the RIO Country Report 2017 (OECD 2007, Corado Simões et al. 2017). Some of the challenges identified were: there was no long-term planning towards the Tertiary Higher education to reflect an R&D growth and consequently ST&I, Portugal had to "*build excellence*"; the firms with the capacity to invest in higher R&D intensity were found absent in the scientific development network. Additionally, there was no integration of higher education input in industry, being the human capital unsuitable to follow the international environment, making this a vicious cycle. Portugal was facing challenges that positioned the country well behind its EU peers since it was not creating a rightful competition in terms of ST&I. The country had no correlative mechanism

[1] See https://stats.oecd.org/glossary/detail.asp?ID=5440 , accessed on October 15th 2020.

between education, human resources, and industry. This fact would translate into the human resources' unsuitability to adapt and stand up to the international advancements and was not translating into high technology and other high-value-added goods. Besides these challenges, Portugal faced an economic crisis which compromised the budgetary means to investment towards R&D starting 2010, placing Portugal below the OECD and EU average, and with repercussions in the following decade:

FIGURE 1 – PORTUGAL'S R&D BUDGET TRENDS, BY INDEX 2007=100



Source: OECD 2020

Regarding to the tradition of ST&I public policy evaluation, studies indicate Portugal fits into a group of countries characterized by a culture of limited evaluation (Jang and Vonortas, 2002); however, it shows an increase in the concern for the internal development of new systems for assessment, being that Portugal accepted and recognized this importance (Gomes and Telha, 2010). In a diagnostic study of the Research and Innovation System done by the *Fundação para a Ciência e a Tecnologia* (FCT) in 2013, it was identified as a weakness (FCT 2013, p. 37): "*Scarce evaluation activity (Ex-ante, interim, Ex-post) of national policies and programs*." With this, it was also indicated how important to execute these evaluations (FCT 2013, p. 291):

> "*…must also stress the importance of the execution of international evaluation to the policies and programs and the participation in learning mutual exercises or by other specialized entities, which would*

allow for an independent reflection and with quality as a complement to the running activities."

In order to rise above, Portugal would have not only to invest but also change the very fabric of its organization.

Nowadays, Portugal has come a long way, and it has been making significant efforts in order to improve this position. The first step into this progress was to unify two of the ministries that contribute the most to the ST&I area: The Ministry of Science and Technology and the Ministry of Education, for which in 2005, the 25th Constitutional Government of Portugal has set the Ministry of Science, Technology and Higher Education. In organizational and budget terms, this has proven beneficial since one would not be disregarded for the other (Fiolhais, 2011). Although it faced organizational changes and had different designations, nowadays the Ministry is settled as Ministry of Science, Technology and Higher Education[2].

In 2005, the Portuguese Government presented the Technological Plan (TP) as a clear framework and set of targets to boost ST&I national standards. In 2007, the Ministry for Science, Technology, and Higher Education communicated a set of goals, with a "*matter of urgency, for the overcoming of our scientific and technological delay,"* defined as a "*Compromise with Science for Portugal's future."* In 2018, the Minister for Science, Technology and Higher Education, Manuel Heitor, issued a document contemplating the perspectives for Higher Education, Research and Innovation for 2030, with three main goals: 1) meet a share of 3% of GDP in GERD (Gross Expenditure in R&D), setting one third as public expenditure and the remaining business expenditure; 2) having 60% of tertiary education graduates aged twenty years old enrolled in higher education; and 3) Achieve European Leadership level of digital skills. These goals are certainly ambitious for a time frame of ten years (Pereira, 2019), knowing the country's past, but it is a compromise and a step towards improvement.

It has been seen the importance of Higher Education as a pivotal sector for ST&I progress, and investing in Higher Education to provide a path for ST&I development and, ultimately, economic growth. One example for which the Portuguese Government implemented a constructive measure to invest in Higher Education – and consequently in

[2] See https://www.portugal.gov.pt/pt/gc21/area-de-governo/ciencia-tecnologia-e-ensino-superior/acerca , accessed on November 14th 2020.

R&D, was the International Partnerships Program, which was one of the programs derived from the TP.

2.2.2 The Technological Plan

Framed in the PNACE – *Programa Nacional de Ação para o Crescimento e o Emprego 2005-2008* or National Program of actions for Growth and Employment -, the TP is part of Competitiveness and Economic growth for Portugal. It is defined as: *"… a plan of action to put in practice an articulated group of politics which aim to stimulate the creation, diffusion, absorption and use of knowledge…*" (XVII Governo Constitucional, 2005). With the implementation of this plan, it was intended to respond to a group of needs and flaws identified in the areas covered in the competitiveness scope by taking action directly in the Science, Technology, and Innovation perimeter. The enforcement of this type of politics has as its primary goal the growth of national competitive edge and to create economically sustainable growth, since the TP is settled in a range of intertwined measures, with different purposes, but with a common goal.

The TP splits into three actions axes: 1) the Knowledge Axis, which essentially intents to qualify the Portuguese population through measures which have as main purpose of raising the level of qualification, being in terms of national qualification or lifelong training; 2) the Technology Axis, which includes measures to fight the scientific and technological gap, and act on the creation of scientific and technological skills and in the qualification of Research and Development (R&D) activities; 3) the Innovation Axis, which is related to the previous one, having as its primary goal giving response to the challenges of globalization.

As can be seen, each axis has different targets, and for each different measures apply. Nonetheless, it is essential to refer each measure can be a response to different targets within the same axis. This way, the main measures for each axis can be listed: 1) for the Knowledge Axis there was the *Novas Oportunidades* initiative, which "*has as its main goal to attract youth and adults which left the educative system prematurely*" (XVII Governo Constitucional, 2005), and there is the *Vale Ensino Ciência e Tecnologia* which is defined by the possibility of assignment of bank loans to students, which part of it is secured by public funds; 2) in the Technology Axis, lie measures such as the

implementation of a fiscal incentives system to support corporate R&D, which enables 20% of Corporate Income Tax deduction, or Grants for employment in science as way to encourage the recruitment of individuals with Ph.D. and Master's degrees in order to strengthen internal skills; for the Innovation Axis, two relevant measures focused in qualified youth where implemented, namely, the INOVJOVEM program to facilitate the inclusion in small and medium-sized enterprises in various areas, and the *INOV Contacto* program which gives the possibility of professional experiences in international territory.

Although each axis has its own features, the Portuguese Government also intended to intervene in three transversal dimensions to the TP Axes, to promote a sustainable growth: 1) Promote the development of institutions which articulate the markets, since they are the ones which govern the incentives system; 2) Explore network economies, and stimulate connections between the leading players in the Portuguese Research and Innovation system; 3) Create alternative financing mechanisms, to use as instruments. The transversal dimensions indicated were considered for each measure to face multiple targets defined for each axis simultaneously.

2.2.3 International Partnerships Program

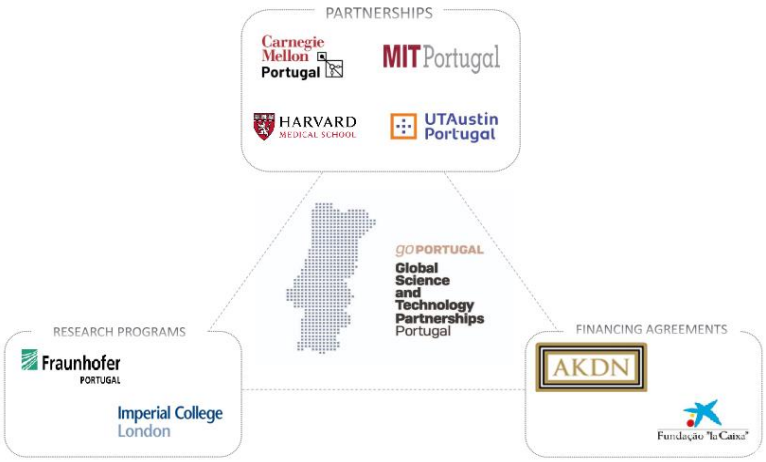
Having previously defined the TP's importance and structure, there is one measure that strongly distinguishes itself. This measure was incorporated into the Technology Axis in consideration of the transversal dimension of establishing networks between the main ST&I market players, being the International Partnerships Program between the Portuguese Government and four North American Universities of great international prestige, namely: *Massachusetts Institute of Technology* (MIT), *Carnegie Mellon University* (CMU), the *University of Texas at Austin* (UTA), and *Harvard Medical School* (HMS).

This measure comprises several objectives that are transversal to the four partnerships (MEC 2007, Academy of Finland 2011): a) Improve teaching and training capacity; b) Increase the number of national consortiums; c) Promote the internationalization of national universities and research organisms; d) Improve the recruitment of teachers; e) Promote economic growth through scientific innovations; f) Make Portugal more attractive in terms of new talents and valued activities; g) Allow Portuguese enterprises

to have better access to the international markets. Each partnership has its singularities, which should be considered separately since each one addresses different thematic according to each partner's expertise areas.

These partnerships began in 2006 as a five-year program, being renewed in 2012 and again in 2018 for another five years (See Appendix II – International Partnerships Program: Chronological View), and these are now in Phase III. Today the international program is designated as *GoPortugal – Global Science and Technology Partnerships*, wherefore another 64 Million Euros investment has already been approved, until 2023 (Resolução de Conselho de Ministros n. º 24/2018 de 8 de março).

FIGURE 2 – GOPORTUGAL: INTERNATIONAL PARTNERSHIP PROGRAM STRUCTURE 2020



Source: FCT 2020a, FCT 2020b, FCT 2020c, FCT 2020d, FCT 2020e, FCT 2020f, FCT 2020g, FCT 2020h FCT 2020i.

Besides the so-called "*Partnerships"*, within the IPP also enabled the association with actors in the research area, like the Fraunhofer Center in Portugal – which is considered one of the largest organizations for applied research in Europe -, and the Imperial College of London. There was also the connection with actors who contribute at a financial level like "La Caixa" Foundation and the Aga Khan Development Network.

Within the reports issued for each remaining partnership, it is possible to have a global vision of what each one comprises:

FIGURE 3 - GOPORTUGAL INTERNATIONAL PARTNERSHIPS PROGRAM DETAILS 2006 – 2019

	MIT Portugal	CMU Portugal	UTAustin Portugal
Education & Research Areas	PhD Degrees: Bioengineering Systems Engineering Desing and Advanced Manufacturing Sustainable Energy Systems Transportation Systems Masters Degrees: Bioengineering Technology Management Enterprise Sustainable Energy Systems Transporte Infrastructure Systems Research Areas: Climate Science & Climate Change Earth Systems: Oceans to Near Space Digital Transformation in Manufacturing Sustainable Cities	Dual PhD Degrees: Computer Science Electrical and Computer Engineering Engineering and Public Policy Human-Computer Interaction Language Technology Robotics Software Engineering Dual Master Degrees: Entertainment Technology Human-Computer interaction Science in Informantion Networking Information Tecnology - Information Security Software Engineering ECE & MBA Double Degree Advanced Training Programs: Data Science & Machine Learning User Experience Design	PhD Degrees: Digital Media Advanced Computing Applies Mathematics Master Degree: Multimedia Advanced Training Programs: Advanced Computing Medical Physics Nanotechnologies Space-Earth Interactions Technology Innovation and Entrepreneurship
Students Admitted (2007-2019)	1069	370	281
Portuguese Universities	Universidade de Coimbra Universidade de Lisboa Universidade do Porto Universidade Nova de Lisboa Universidade do Minho	Universidade de Aveiro Universidade da Madeira Universidade do Minho Universidade do Porto (FCUP/FEUP) Universidade de Lisboa (FCUL/IST) Universidade Nova de Lisboa (FCTUNL) Universidade de Coimbra (FCTUC) Universidade do Porto (Porto Business School)	Universidade do Porto (FEUP/FBAUP/FCUP/FEP) Universidade Nova de Lisboa (FCTUNL/FCSHUNL) Universidade do Minho Universidade de Lisboa (IST) Universidade de Coimbra
Public Investment (Portugal, M€)	72,60 M€	67,87 M€	38,25 M€
Faculty Exchange	340	79	72
Research Projects Funded	34	58	36
Known Industry Investment (M€)	2,25 M€	2,57 M€	0,58 M€
Industry Affiliates	63	146	10
Start-ups / Spinoffs	117 Ventures	11 Start-ups	5 Spinoffs

Source: MIT Portugal 2012, MIT Portugal 2016, MIT Portugal 2017, CMU Portugal 2012, CMU Portugal 2019, Resolução de Conselho de Ministros n.º 132/2006 de 13 de outubro, Resolução de Conselho de Ministros n.º 16/2013, Resolução de Conselho de Ministros n.º 6/2014 de 18 de novembro, Resolução de Conselho de Ministros n.º 80/2014 de 29 de dezembro, Resolução de Conselho de Ministros n. º 24/2018 de 8 de março, UTAustin Portugal 2016, UTAustin Portugal 2019.

Massachusetts Institute of Technology – Portugal

When first launched, the Massachusetts Institute of Technology – Portugal (MIT-PT) partnership focused on five areas of expertise: System Engineering, Systems of Bioengineering, Design Engineering and Advanced Production, Renewable Energy Systems, and Transportation. The partnership, which is based predominantly upon training in the Systems Engineering area, aims to: Adopt emerging and complex concepts

of engineering; Promote the materialization of new products by design, test, and implementation levels; Train and shape new engineering leader; Facilitate the introduction of Portuguese research groups in international networks; Promote the training and opportunities for interinstitutional postgraduate programs; Develop a board of Innovation and Entrepreneurship leaders.

From this partnership, four Ph.D. programs and four Master degrees resulted, being considered as the biggest of the four partnerships in number of students (1069 enrolled students), involved entities (27 universities, 36 Research Centers, and 63 Industry Affiliates), and associated budget (72,6 Million Euros, approved between 2006 and 2018, just regarding Portugal Public Investment).

Today, this partnership has changed its paradigm, and starting from 2019, Ph.D. and Master programs are no longer active and the program concentrates its resources solely on research projects. Although still focusing on Systems Engineering, the MIT-PT has turned its attention towards other emerging areas: Climate Science and Climate Change, Earth Systems – Oceans to Near Space -, Digital Transformation in Manufacturing, and Sustainable Cities.

Carnegie-Mellon University – Portugal

This Partnership was created with a focus on Communication and Information Technologies and on an entrepreneurship component, which offers as studying areas: Critical Infrastructures of Protection and Security, Future Technologies and Services in the Internet, Services, and Technologies of Interactive Media, and Software Engineering.

The Carnegie-Mellon University – Portugal (CMU-PT) resulted in seven Ph.D. programs - Computer Science, Electrical and Computer Engineering, Engineering and Public Policy, Human-Computer Interaction, Language Technology, Robotics, and Software Engineering -, and six Masters in similar subjects. In quantitative terms, this is the second biggest partnership, with an estimated budget of 67,87 Million Euros approved until 2023 and 370 enrolled students.

The combination of entrepreneurship and the more technological areas translates into specific goals, such as the creation of programs of intensive training and research internationally recognized, in the level of the areas covered by CMU-PT; Strengthen relationships between Universities and Research organisms, with High-Tech Enterprises

and Start-Ups; Support and promote the recruitment of Highly skills Human Resources; Best Practices Exchange to promote an Entrepreneurship Environment.

This partnership is the only one in the *GoPortugal* program which offers Dual Degrees, meaning the students receive a degree from both universities: the Portuguese institution enrolled in and Carnegie-Mellon University. Nowadays, the Dual Master's degrees are no longer active. The partnership kept the research funding for projects, and has created two advanced training programs: Data Science and Machine Learning and User Experience Design.

University of Texas at Austin – Portugal

Also renewed in 2018, the University of Texas at Austin – Portugal partnership (UTA-PT) is considered by all indicators the smallest, with a budget of 38,25 Million Euros approved until 2023, and focuses on Digital Media and Mathematics, such as Dynamic Systems, Financial Mathematics, Game Theory, Optimum Control, Solutions, Number Theory, and Cryptography.

Through these areas, the UTA-PT intends to achieve the following goals: expansion of the presence of Advanced Digital Media in Portugal, through exchanges in research and education; promotion of interactions between Universities and Companies; and promotion as well of interinstitutional postgraduate programs. UTA-PT offered three Ph.D. in Digital Media, Advanced Computing and Applied Mathematics, and one Master's degree in Multimedia. These degrees are no longer active and, similar to CMU-PT, remains focused upon research project funding and has established five new Advanced Training Programs: Advanced Computing, Medical Physics, Nanotechnologies, Space-Earth Interactions, and Technology Innovation and Entrepreneurship.

This partnership has the specificity of including the University Technology Enterprise Network (UTEN), being defined as a business network established in UTA in 2009. It encourages technological global development and infrastructure trading. This organism encompasses goals as the setting of Internships in an international degree, Technology Transfer promotion, and competitivity growth between technological basis companies.

Harvard Medical School – Portugal

Unlike the other partnerships, the Harvard Medical School – Portugal (HMS-PT) partnership did not endure. Since its inception in 2009, the partnership was dissolved and has changed towards an intensive training program referred to as *Portugal Clinical Scholars Research Training*. It focused on giving training to future medical researchers, providing the tools necessary to perform clinical research. FCT ensures total tuition to the students accepted, meaning the Portuguese Government fully funded the training.

2.3 Assessments of the International Partnerships Program

As the IPP evolved and prevailed, although not in its original format, it was considered a worthy subject for evaluation: how partnerships between the three highly qualified North American universities and a country in the far southeast of Europe could remain since 2006 until today? Being a program that encompasses many areas that can impact the most critical domains for ST&I and national economic growth is vital to realize if it is a measure worthwhile the investment and an example for other public policies.

An OECD assessment of Portugal's Higher Education, Research, and Innovation (HERI) performance in 2019 emphasizes the country's importance in investing through coordinated measures (OECD, 2019). An approved global investment is made in graduating Ph.D. holders and simultaneously in research programs, with an inclusive business sector. In a report from 2013 regarding a diagnostical review over the Research and Innovation system in Portugal (FCT, 2013), FCT made the goal towards financing doctorates, Portuguese universities, and research units as a whole: not only is able to find synergies as it encourages to construct networking between all parties. The OECD's study (OECD, 2019) finds that most research activity in OECD countries occurs in the business and industry sector, but in Portugal, this indicator is lower. So, it is imperative to establish a cohesive connection between the two worlds: the pool of Ph.D. holders and the business sector. To ensure a stronger link between research and business, in Portugal, future measures regarding Doctoral Training must be created in harmony with the strategic areas where they are most needed. This reinforced link also fosters interest and adaptative capacity for firms to persist on research and innovative approaches. Conclusively, the OECD review (OECD, 2019) mentions the IPP as an example in which FCT was

"*…successful in encouraging the creation or development of interesting national and international partnerships for doctoral training, in potentially strategic fields for Portugal."*

A separate study by Carnegie Mellon (Cohen et al., 2002), emphasizes public research's importance for innovation at a national and global rate, which is mostly done by these Ph.D. Holders. This fact stresses even more, the importance of developing the investment in this training and establishing a bridge between Ph.D. Holder and Business Sector. The survey done by DGEEC in 2017 (DGEEC, 2017), which indicates a very high employment rate regarding Doctoral Degrees Holders, also shows 83,00% work in the academic sector from 1970 till 2015. Nonetheless, these figures have been declining over time, with the Doctoral Degree Holders going progressively more into the business and public sectors.

In 2011, the XIX Constitutional Government of Portugal requested an independent assessment performed by the Academy of Finland, being a governmental organism specialized in Scientific Research funding. This assessment would become determinant for the extension of the IPP and its funding (Resolução de Conselho de Ministros n. º 16/2013 de 21 de março). Although departing from few visible results, since Ph.D. students were still in training and projects ongoing, the Finnish organization considered the assessment to have positive feedback and significant results (Academy of Finland 2011, p.54).

The Academy of Finland conducted a thorough, in-depth survey targeting the considered "*relevant stakeholders*," such as students, faculty, researchers, program managers, including the high-level experts, and looking upon the results, the application and structure of this program as its unique features. It was considered a significant effort towards improving the four key goals in Portugal R&D and ST&I: Cultural change, Internationalisation, Increasing cooperation, and access to equipment and infrastructure. This effort meant an increase in FCT's budget, meaning Portugal kept being the major investor. Overall, it was concluded that given the unparalleled traits, it was a well-constructed program with significant outputs, however it was too soon to conclude the extent of its full effects, since the first call Ph.D. degrees and research projects were still ongoing. To offset the positive statements, some cautionary remarks were also made: given that the weight of this substantial investment falls mainly upon the Portuguese

partner, the initial structure can prove to be unsustainable in the future, and remodeling of the partnerships can be required, pointing to strategic management.

As Pfotenhauer et al. (2012) stated, besides all motives and main goals, this program would allow Portugal to catch-up by means of learning with the best. This would fuel a rapid evolution to a highly resistant education sector, and inspire the business sector. The IPP has positioned itself in the main trends for economic growth: internationalization and networking, critical-mass building, and a shift to high technology industry (Heitor and Bravo 2010, Pfotenhauer et al. 2012, Hird and Pfotenhauer 2017, OECD 2019, Horta and Patricio, 2015).

Essentially, it is strongly advised for Portugal to invest harmonized with the current global trends in a strategic manner, reaching to the most important actors for the HERI advancement: Ph.D. holders, research activities, and the business sector.

Most of the articles that review the partnerships integrated into the IPP, feature their main attention in the MIT-PT as the biggest in quantitative terms among the three partnerships, and as previously seen in point 2.2.3 of this study. However, and following the advice by the Academy of Finland, the partnerships have been rearranged throughout since its beginning, adjusting its offers, and thriving upon what worked the best between different institutions. One crucial feature remains the same since 2006: the CMU-PT was the only partnership to successfully establish Dual Degrees Ph.Ds. and sustain the same graduating structure. Looking at the main criteria identified as relevant to invest public funding in doctoral training, we can also verify that the CMU-PT Partnership ticks all relevant points towards being considered a strategic measure.

3. Methodology

3.1 Analysis basis

This work proposes a complementary analysis to the assessments previously indicated in point 2.3, mainly two studies: the last Annual Report Released by CMU-PT Office for 2018/2019, which reflects a quantified vision of the CMU-PT initiatives so far; and the study performed by Horta and Patricio (2015) in regards to the interviews conducted to the actors in IPP universe.

In the most recent Annual Report of CMU-PT, released in September 2020 and data from 2018 and 2019, the coordination team was able to gather relevant information regarding its Ph.D. students, such as: how many students enrolled; how many alumni have concluded the degrees so far; and in what countries are the alumni working and in which job positions, compartmentalizing in four main areas - Government, University, Industry, and Non-Governmental. This data was relevant to understand some aspects of the CMU-PT in quantitative terms and to be able to analyze questions such as: 1) what was the success rate of Ph.D. in terms of enrolled versus Alumni; 2) after the conclusion of the degree, in what countries the Alumni were employed, and particularly how many decided to be employed in Portugal; 3) by country, what kind of job positions are held by the Alumni, i.e., where are they giving their upmost contribute considering the experience provided by the Dual Degree. To at least some of these questions, we can try to establish a correspondence between the goals proposed for the partnership and its achievements.

The study conducted by Horta and Patricio (2015) aims to identify the necessary conditions to create the IPP's partnerships. The article broadly describes the IPP's establishment through interviews conducted with a roll of pivotal actors, from policy actors to program directors and other key figures involved in the decision-making process. The authors concluded by identifying five critical factors for the creation of the partnerships: 1) "*Direct political engagement by the government at the highest level"*, meaning there was an active role from high ranking politicians, as the prime minister himself and ministers, to make this happen making the budgetary necessary means available; 2)"*The expert nature of the policymakers",* since the policymakers involved had academic backgrounds, which helped to assert the importance for this public investment for the R&D and ST&I national development; 3) "*The contribution of publicly funded science policies promoting brain-circulation"*, since the inherent mobility factor

highly contributes for brain-circulation and creating meaningful possibly lasting links between intervenients; 4)"*Portuguese 'mediators' at US universities"*, since there was a top-down/bottom-up dynamic which allowed to design the partnership, due to important Portuguese mediators, and was specially seen in the CMU-PT; 5)"*The US faculty and their motivations for collaborating"*, since most faculties saw these as an opportunity to recruit top researchers from in a global basis. This analysis allowed us to have a glimpse into the complexity in the creation of this kind of international partnerships and what it takes to begin. It is a contributing study for future partnerships, even if applied to different institutions or countries in the R&D and ST&I area.

Giving the previously reviewed study basis, this thesis serves as an exploratory analysis of the CMU-PT partnership, being the only one within the IPP with a Dual Degree opportunity. This study aims to answer questions such as: 1) What were the fundamental factors in creating the partnership, and within a Dual Degree format?; 2) Knowing the structural changes faced by the other partnerships, how was it possible for CMU-PT to maintain its Ph.D. offer under Dual Degree format?; 3) What it is the importance of Dual Degrees for the future of CMU-PT and what could be its main impacts?; and 4) in which terms does the CMU-PT program benefit from the requirements of a strategic investment in HERI?

3.2 Interviews

To better understand the processes and address the questions proposed, the chosen method was to conduct specific interviews. Considering the perspective of Georghiou and Roessner (2000, p. 662):

> *"…the collective arrangements and their attendant dynamics, not the accumulated innovation products, that should more properly be considered the main asset when assessing the value of research…*".

This view reveals the importance of considering ST&I policies' assessments as a social phenomenon, whereby the quantitative methods must be backed with qualitative methods, namely taking advantage of surveys (Simmonds et al. 2009, Salles-Filho et al. 2011, Yin 1994) and interviews (Salles-Filho et al. 2011, Georghiou and Roessner 2000, Bozeman and Rogers 1999). In studies executed on the MIT-PT by Pfotenhauer et al. (2012),

Pfotenhauer et al. (2016) and Hird and Pfotenhauer (2017) reaffirm the usefulness of complementary qualitative methods as the use of interviews, like Horta and Patricio (2015), and Patricio et al. (2017).

Following the trail, a set of interviews were conducted to the CMU-PT program Directors, Coordination officers, and Ph.D. Alumni, to analyze how their experience on setting up a Dual Degree in an international partnership strongly impacted its sustainability and the outcomes generated by this Alumni.

A set of eight in-depth individual interviews were conducted with two specific groups: first, the CMU-PT program directors (two interviews) and Coordination Office elements (two interviews), and secondly, to Ph.D. Alumni Students (four interviews). The purpose was to put forward questions that would allow each group to describe its experience, have a full view of what is needed to establish a Dual Degrees between countries of different continents, and how these processes unfold (See Appendix IV – Interviews Script). The first group elements were asked to describe how the possibility of a Dual Degree was created, as well as the work dynamics between partners, and the restructuring the program faced. The second group was requested to outline the experience since joining the Ph.D. and any other component of the partnership - until its conclusion -, and identify its impacts. Both groups were also asked the question as to how the CMU-PT differs from any other similar partnerships.

4. Results

4.1 Setting-up an international Dual Degree and investment dynamics

Upon liaising with the first group, the way and the process through which the Dual Degrees were established was clear: since one of the elements was a well-regarded faculty in CMU, the connection was possible. As indicated by one of the Program Directors, both parties had already expressed the interest to collaborate in some way, and after a tour, by a representative team of CMU, to some of Portugal's Universities both parties signed a Memorandum of Understanding, and Portugal challenged CMU to present a partnership proposal. The director described the construction of a thorough model with each university, in order for all academic components to be dully recognized by each institution. To reach an agreement towards the necessary requirements to establish the Dual Degrees, a detailed process of communication with each representative was established, which was very politically demanding and time-consuming.

This 'leap of faith', also corroborated by Horta & Patricio (2015) interviews, was considered by some academics and policymakers as a doubtful move. CMU, was at some point the more reluctant party to this format, since it did not have the experience of establishing such an affiliation with a foreign country. However, it was indeed possible to build a partnership in many levels, allowing both partners to have a more consistent structure and develop a more meaningful relationship degree between all players (Directors, Students, Researchers, Faculty, and Industrial Affiliates), as is expected of a Dual Degree. The decision was later proven right, and the initial bias was dissipated after the students' success: "*The quality of the partnership arises from the students' success"*, stated one of the directors. The demand level and intricacy of the process were met by the students right from the application process, which is similar to the application for a CMU Ph.D. student in the USA and is considered as an important step for commitment. The same process appeals to synchronization between the two entities: although the approval must be granted primarily by CMU, the application faces a second approval stage by a Portuguese committee.

The CMU-PT Director said it was the first time CMU established an international partnership within this format and with this level of complexity. CMU has other educational partnerships at an international level - CMU Australia established in 2006, and CMU Africa established in 2011, in Rwanda. Nevertheless, when asked why these

partnerships were considered different, it was explained that in these other locations the partnership takes the form of a CMU center with CMU faculty, which grants only a CMU degree. In Portugal, it was created this model that permits to attribute of a degree in each institution, involving faculty from both sides, hence the mobility experience. This imposes yet another relevant question: why was Portugal considered for this type of partnership and not any other country? The CMU-PT Director replied CMU considered that the Portuguese faculty was at an equal level, i.e., the Portuguese faculty would be just as adequate as CMU faculty to lecture and mentor the partnership students. This parity is a determinant for compromise, both from the institutions – hence the intricate model with courses recognized by all -, and from students – hence the immersion in the CMU environment.

Being asked about the initial 2006 offer versus the present structure, without the Master's Dual Degrees and having a more vocational format, one of the Program Directors considered it as a positive change. The advanced training programs were an option adopted to meet the business needs, granting a training with much faster results and similar to an American format. However, the group considers that Portugal is still very much detached from this reality since the Master's Degrees in the country are still perceived as an extension to the first level academic training and a pipeline to Ph.D. Degrees, in contrast to the American reality, more aligned with the business under a fast-paced context, and also more expensive. The Advanced Training programs are also regarded as a way to recruit students from other disciplinary backgrounds and grant a prestigious qualification that can bring the student better professional opportunities. It is safe to state that, although the dual degrees for Master's Degrees did not flourish, the Master's and Ph.D. have very different commitment levels and goals as to the student perspective. Moreover, when questioned as to why the Ph.D. Dual Degrees were able to have such longevity, CMU-PT Director indicates that for the CMU Directors these degrees were an essential requirement to continue the partnership. So, without the Ph.D. Dual Degrees, there is no CMU-PT partnership.

At first glance, it would seem the investment was one-sided, supported by the Portuguese Government. However, when questioned about the investment dynamics of the partnership, it is agreed among the interviewees that there is a proportionate intervention between partners. It is important to note that in the US there is no grant-awarding process on the same scale as Portugal. Typically, there is no funding for Ph.D. students; instead,

students are financed by research projects, and for that reason, the Partnership students recruited in these projects are also covered by this system. The students have the possibility of having the tuition fee paid by the partnership grants, and also of being allocated into research projects in the CMU environment, for which they receive a salary:

> "*For instance, when a student is another year* [in the USA] *usually it is its Faculty advisor that pays. There is a usage dynamic of resources that comes in part from the Portuguese state, but many times also comes from a financed project. (…) The funding comes from Research Projects, and when the faculty accepts a student, they are also paying the costs of the student"* – CMU-PT Director.

The Faculty Advisor contribution could not be confirmed by the Alumni interviewed, although at least three Alumni confirmed their integration into research projects during their degrees, for which they were financed for.

From this investment dynamic emerges the question as to what is the extent of the benefit for both parties. When questioned about if the partners benefit from the partnership in equal terms, the CMU-PT Directors affirmed the partners benefit at different levels. As indicated, the Portuguese universities benefit because: 1) reinforce the internationalization by attracting highly-skilled students in a global level, with the opportunity to develop their investigation in a national context; 2) learn '*Best Practices'* in academic management; 3) develop excellence training in the Information and Communication Technologies (ICT); 4) foster research and promote entrepreneurship and innovation by connecting students and researchers to industrial affiliates. The CMU-PT Directors think CMU benefits more in terms of attracting high-quality students to CMU, by extending their international links, and being initially funded by the Portuguese Government.

4.2 The Ph.D. Dual Degree structure, International Experience, and Networking

Both interviewed groups, identified in point 3.2 in this study, were very consistent regarding the process the Ph.D. follows. With a mandatory international mobility experience of at least two years, the student usually proceeds to the USA in the first year,

where it has the autonomy to choose a faculty Advisor at CMU and the research plan that wishes to pursue. The student is co-advised by a faculty member in Portugal selected according to the project embraced, which can also be suggested by the directors. In the second year, beyond classes and research, the student will also perform a '*teaching requirement,'* which consists of the opportunity to be an Assistant Faculty in CMU and the Portuguese institution. This opportunity, a requirement by CMU, has proven to be quite successful. After the degree's conclusion, the interviewed alumni have kept the teaching in Portugal or CMU, depending on the chosen career path. This can also be seen in the last CMU-PT Annual Report (CMU Portugal, 2020), which shows that 39,18% of the Alumni are currently working in a university environment. In the third year, the student performs the '*Qualifier,'* by which it officially presents and proposes the research which pretends to conduct and should be approved to continue the degree. Over the remaining years, the student concludes the degree.

Despite well structured, there was a consensus among all interviewed alumni, to signal that the processes on the Portuguese side were much lengthier and bureaucratic, opposed to the North American side, which is more agile and dynamic in what refers to the student's administrative affairs inherent to the degree. The alumni consider CMU to be present in every step of the degree, having a better knowledge of the program and processes:

> "*Not only the people in the* [Portuguese university] *do not have familiarity with the program, the bureaucracies are much more difficult to navigate."* – Alumni

> "*The North American mentally refers to time as money, so they do not waste time in bureaucracy. The time they waste in bureaucracy is the time not spent working."* – Alumni

Directors and alumni see this immersion in the CMU environment as a vital point to the Ph.D.'s persistence as a Dual Degree. This structure for a Dual Degree is seen as a way to connected the areas of education, research, and innovation; i.e., is also a way to incentive the Ph.D. Students to eventually integrate other areas that the partnership also funds, such as a research project or/and a contract with an industrial affiliate, or even to create a start-up.

The situation gives the students the opportunity for exposure to a highly demanding academic reality. The students reported they had to rise to the challenge, and also felt recognized as top students and researchers. The experience is seen as very helpful to fully assimilate the procedures, and learning what the American institution has to offer. The full experience, which could only be provided by this unique experience under an international dual degree, establishes a propitious environment for close networking between students, faculty and industry affiliates.

4.3 CMU-PT: Present, Future and Drawbacks

Following the review of the assessments in point 2.3 of this study, both groups consider to be a well-aggregated program:

> "*It is always important to fund people at the same time funding ideas and projects, because people, with their enthusiasm and curiosity, and their competences, then end up to identify new areas and things that we were not expecting. When we fund only projects or just faculty, the faculty choose the students to do that specific work e; usually, there is not so much openness. (…) I think that it is very important to fund brilliant students and give them that opportunity regardless of the project, the company, the faculty, because it is them that choose the advisor,"* – CMU-PT Director.

A recent annual report by the CMU-PT coordinating team (CMU Portugal, 2020) sought to verify the outcome of the current 78 alumni – of the 125 enrolled students -, and concluded that 54% (40 alumni) of the 74 possible to inquire were currently working in the United States of America (USA), being: 7% (3 alumni) working for the Government, 38% (15 alumni) working in universities and 55% (22 alumni) working in the industry. Only 20% (15 alumni) of 74 alumni are working in Portugal: 40% (6 alumni) of those in universities, and 60% (9 alumni) in industry. The remaining 26% (20 alumni) of the 74 alumni worked in the rest of the EMEA area (Europe, Middle East, and Asia). It is safe to state that the majority of the alumni do not stay and work in Portugal, which does not positively contribute to one of the IPP's main goal to attract High-Skilled Human Resources.

When incorporating these figures into the FCT universe, considering that FCT granted 16198 Ph.D. fellowships between 2006 and 2018 (See Appendix III – Ph.D. Grants: Figure evolution of applications in individual contest 1998-2018) in the individual calls, 78 Alumni is a very small impact. Given that in twelve years FCT granted an average of 1350 fellowships per year, the partnership has granted 125 in fourteen years. The Impact is rather small compared to the fellowships already granted by FCT without the program. The main component of the program is education, and in that aspect does not contribute significantly (0,66%) to the increase of fellowships granted.

Another important aspect is the importance of the type of networking created. All interviewees felt that there was a deep connection between players, which helped greatly to find working opportunities, especially through the connection with the CMU-PT industrial affiliates. Also, the best practice learnings from the students help them to be able to improve Higher Education in Portugal; for example, one of the interviewed Alumni was able to create a series of seminars in the Portuguese university, which would also include CMU participants.

The CMU-PT program is regarded as a different and strategic approach, directing the research elite to critical business areas, like ICT. The interviewees identify the CMU-PT as the forefront of ST&I policies, where there is the humility position to learn with the best and generate "*critical mass"* in these areas, with considerable impacts to its students, universities, country, and companies:

> "*news got out that one of our industrial affiliates, Talkdesk, was assessed in 3 billion Euros, it was a 'unicorn.*[3]*' Portugal has four 'unicorn' companies, and all are industrial affiliates of CMU-PT, and all have some connection to the CMU program. There are only forty 'unicorns' in Europe, so Portugal as a very important market share, which is only possible with partnerships like this one. Unfortunately, we could ask the Portuguese universities to play in that market because are universities in a country which is still very late to this game in this area in particular."* – CMU-PT Director.

[3] By current definition, a company is considered as a "*Unicorn*" when it reaches a reported evaluation equal or over 1 billion dollars (Gornall and Strebulaev 2019)

In 2020, the indicated '*unicorns'* affiliated to the CMU-PT program are the companies OutSystems, Talkdesk and Fartfetch, being evaluated in 1 billion, 3 billion[4] and 2.4 billion[5] dollars. Although the company Feedzai, which also originated within the CMU-PT program, attracts high-valued investments and high-volume payments[6], it does not fulfill the requirements to consider a '*unicorn*'[7].

When questioned about what were the setbacks identified, the CMU-PT Directors referred to some negative aspects. When establishing the framework model between CMU and the Portuguese universities, there was not an Administrative Office in common to facilitate and coordinating the organization and communication. This was solely in the hands of the CMU-PT Director and an associate, which were CMU faculty. The coordination for a common-ground model was difficult, since each Portuguese university had its administrative procedures. The CMU-PT Director pointed out the process would be a lot more efficient if there had been a representative '*champion*' from Portugal, who would coordinate the processes for the Portuguese side. Adding to this fact, after the implementation of the Dual Degrees, and also referred by the students, there was an inherent bureaucracy to the Portuguese universities and a lack of internal communication which represented a delay between the conception of the instruments and its implementation. As an example, the administrative services of some universities, to add to the fact of not recognizing the Dual Degrees, also were not adapted to receive them.

Some concerns regarding the students' recruitment were also pointed out. Being done in two separate phases and committees, when it came to the selection by the committee in Portugal, there was some conflict and competition between Portuguese universities as to which one would receive the student. Although not related to the Dual Degrees, in the project funding evaluation, which is carried by a selection committee in Portugal in which the Partnership Directors have no intervention, it was referred that many project selections were made without proper consideration of CMU-PT research areas:

> "*The committee would select without knowledge of the focus areas."* – CMU-PT Director.

[4] See, http://www.cbinsights.com/research-unicorn-companies, accessed on October 11th, 2020.
[5] See, https://www.nasdaq.com/market-activity/ipos/overview?dealId=1062291-87686, accessed on October 17th, 2020.
[6] See, https://www.forbes.com/sites/tomgroenfeldt/2016/02/16/feedzai-stops-financial-fraud-with-machine-learning/#28f9c799599d , accessed on October 17th, 2020.
[7] See, https://www.forbes.com/companies/feedzai/#61c714a2180d, accessed on October 17th, 2020.

One of the CMU-PT Directors expressed a concern regarding the budget constraints to finance students an increase of applications to the program. This is viewed as a handicap to integrate more highly skilled students into the partnership, which alerts to the fact that it is necessary to consider other funding channels and/or other solutions to decrease costs.

5. Conclusions

CMU-PT is an international partnership with complex features, and it can be stated that it is as challenging to initiate it as to endure it. The interviewees had a very coordinated view of the program, for which they described the same outline of the proceedings inherent to the Ph.D. Dual Degree, as well similar perspectives in terms of its effectiveness. There is a visible ongoing mutual effort to uphold the Ph.D. in the Dual Degree format, where both partners benefit, although at different levels. As previously indicated, this type of measure can be an effective response to the goal for investment with coordinated efforts: is not only the attribution of students Ph.D. grants; it is also fostering meaningful and important institutional research and business connections, with a spillover to an international extent. However, in terms of investment dynamics, the Portuguese Government still holds a large share of total investment, and CMU certainly benefits from this. CMU does not have to make an initial contribution to integrate the students into the program or research projects. This fact, as it can be verified, does not guarantee talent attraction, since only 20% of Alumni are working in Portugal, versus the 54% who are working in the USA. If the Portuguese government would consider replicating the terms of this partnership or do it at a greater scale, that should be translated into an expansion of the results and greater retention of Alumni and researchers in the Portuguese context. This alerts to the fact that it can only be developed with a greater budget, for which the Portuguese government would have to rethink and restructure its budget framework, and consider the incorporation of other funding channels as well as attract private investment.

An imposing question arises: like students, who '*learn with the best'*, did also Portuguese university learn? A constant factor that surfaced during the interviews was the bureaucratic nature of Portuguese universities, which imposed a lot of setbacks since the constitution of the partnership itself. It would be an important feature to consider in what terms "*institutional learning*", is possible. This would allow the Portuguese universities to provide a top education to other students outside the partnership, streamline its educational processes, create a more R&D enabling environment and less bureaucratic administrative processes. In the long term, this would represent the capacity of universities to present themselves as top universities, to offer more competitive degrees, and pursue a more leveled partnership without such a major investment input. This would

also translate into an increase in the Portuguese universities' capacity to attract top students and researchers, and possibly external contributions of industrial affiliates, just by itself without reaching to international partnerships at an extensive level.

The importance of an immersive context is highly regarded by the students to fully develop their research and learn the necessary skills, incentivize their work, and have a '*ripple effect*' on others. The students consider to be recognized and appreciated as CMU's top students. There was a compromise between both counterparts: the American institution was demanding, and the students corresponded to those top demands. The interviewed alumni who returned to Portugal have since created opportunities allowing other students and researchers to have a chance to learn, contributing to their universities and the national context, in an effort to create an environment more suitable to R&D. With this experience, there was the creation of a tight and well-connected network, extending not only through students, researchers, faculty and the industry but also through countries.

Overall, and according to these discussed results, the CMU-PT partnership under a Dual Degree is considered a success in its longevity and students' success, and not only due to the '*vote of confidence*' by both parties. Although it is important to employ this kind of agreed measures, the program fails to retain most of the alumni by not ensuing the employment of such researchers in Portugal. This can be due to various economic and cultural factors; nonetheless, it would be recommended a complementing retaining measure to the program or a review of the current action plan.

6. Methodological Challenges

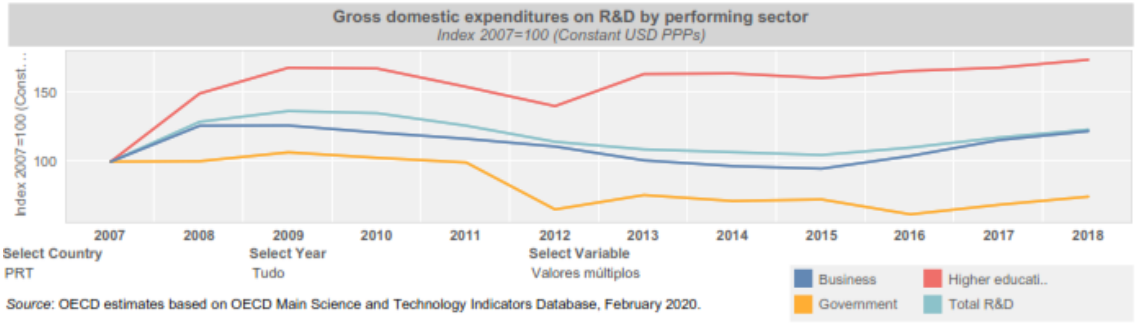
This study was limited in terms of the interview scope, by time constraints, which could have considered also the university's representatives, aiming to explore if there was also a learning caption in terms of institutional and administrative procedures.

The interviews could also be extended to faculty and mentors, from both parties, in order to incorporate their view upon the Dual Degrees structure and mechanisms, analyzing if they have the same success vision after they had direct contact with the students.

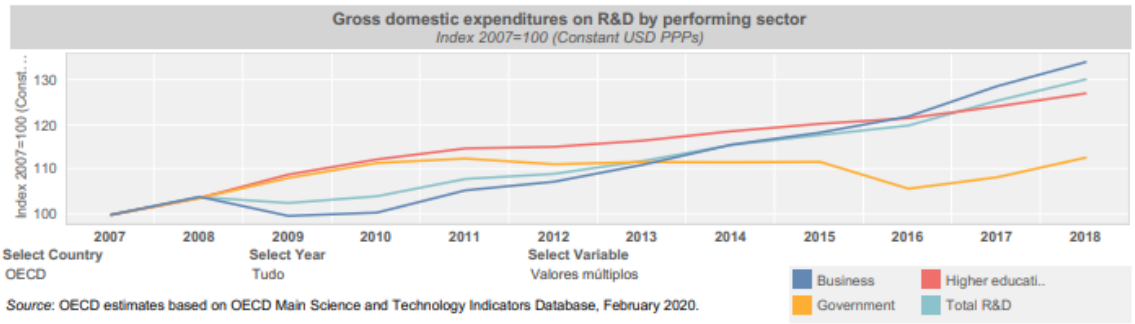
Due to the natural limited availability of the participant interviewees, there was not enough time to develop more in-depth interviews, namely more one-to-one interviewees, which would have been more beneficial as a contribution to this essay and permit to explore other important issues.

Appendixes

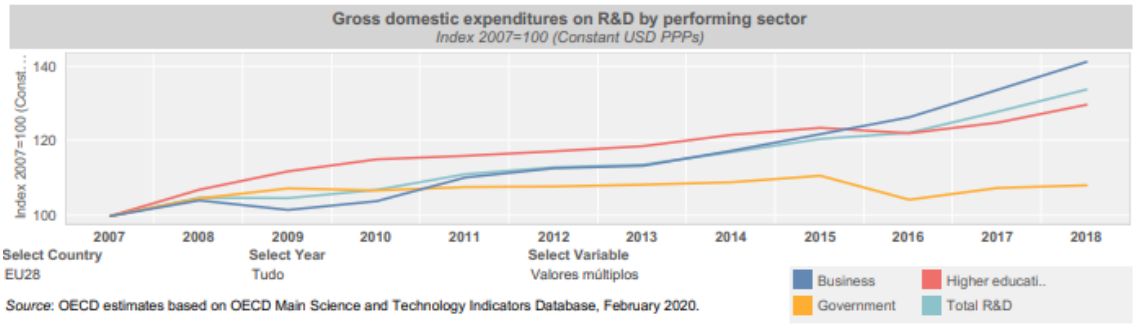
Appendix I – Gross Domestic Expenditures on R&D by performing Sector and R&D intensity



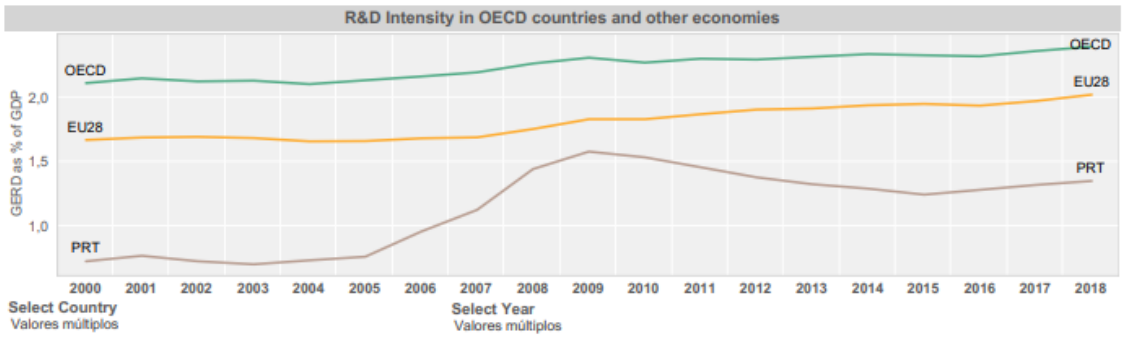
Source: OECD estimates based on OECD Main Science and Technology Indicators Database, February 2020.



Source: OECD estimates based on OECD Main Science and Technology Indicators Database, February 2020.



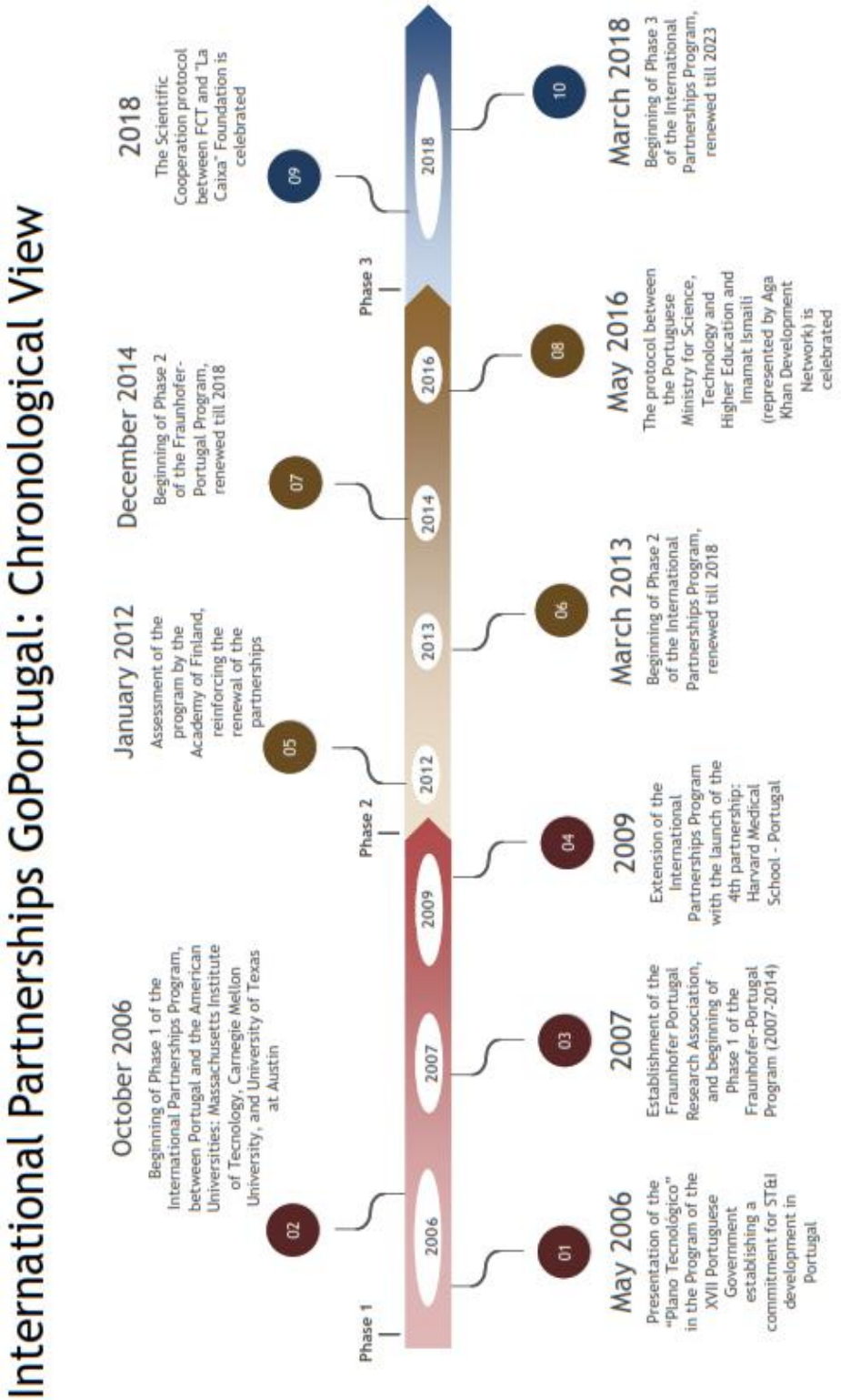
Source: OECD estimates based on OECD Main Science and Technology Indicators Database, February 2020.



Source: OECD estimates based on OECD Main Science and Technology Indicators Database, February 2020.

Source: OECD 2020

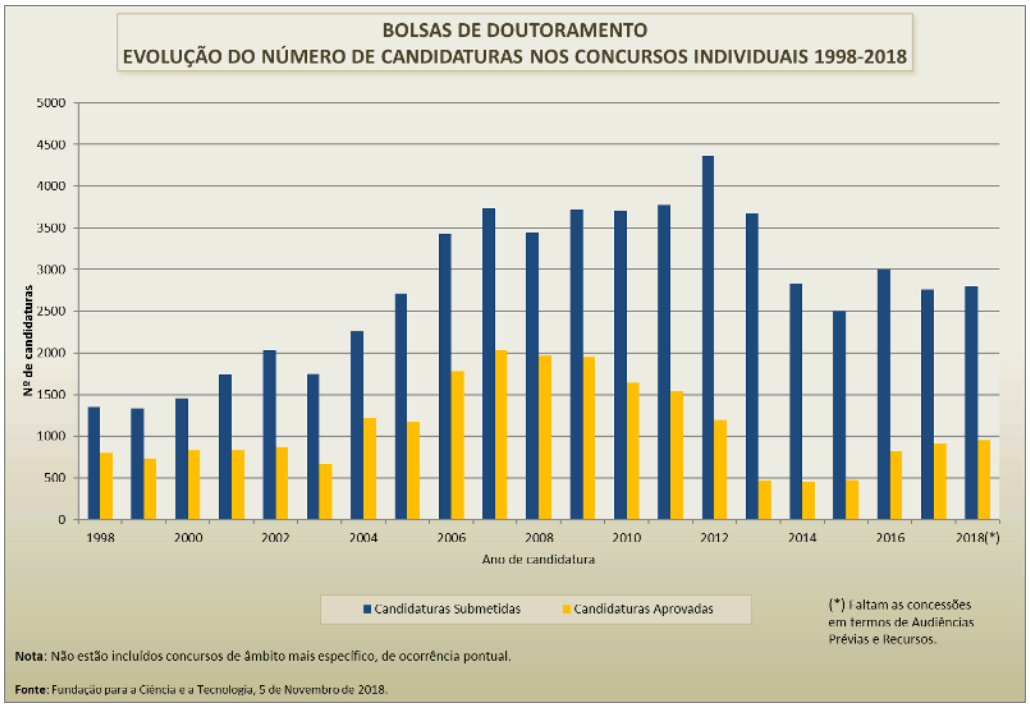
Appendix II – International Partnerships Program: Chronological View



Source: MIT Portugal 2012, MIT Portugal 2016, MIT Portugal 2017, CMU Portugal 2012, CMU Portugal 2019, Resolução de Conselho de Ministros n.º 132/2006 de 13 de outubro, Resolução de Conselho de Ministros n.º 16/2013, Resolução de Conselho de Ministros n.º 6/2014 de 18 de novembro, Resolução de Conselho de Ministros n.º 80/2014 de 29 de dezembro, Resolução de Conselho de Ministros n. º 24/2018 de 8 de março, UTAustin Portugal 2016, UTAustin Portugal 2019.

Appendix III – Ph.D. Grants: Figure evolution of applications in individual contest 1998-2018

BOLSAS DE DOUTORAMENTO EVOLUÇÃO DO NÚMERO DE CANDIDATURAS NOS CONCURSOS INDIVIDUAIS 1998-2018		
Ano	**Candidaturas submetidas**	**Candidaturas aprovadas**
1998	1347	800
1999	1334	733
2000	1454	828
2001	1736	831
2002	2033	872
2003	1751	670
2004	2261	1221
2005	2709	1172
2006	3424	1781
2007	3731	2031
2008	3443	1969
2009	3717	1951
2010	3702	1640
2011	3775	1548
2012	4367	1198
2013	3673	466
2014	2836	453
2015	2505	472
2016	3004	824
2017	2763	915
2018(*)	2797	950
Fonte: Fundação para a Ciência e a Tecnologia, à data de 5 de Novembro de 2018.		
(*) Faltam as concessões em termos de Audiências Prévias e Recursos.		



Source: FCT 2020j

Appendix IV – Interviews Script

Questions placed to CMU-PT program directors and Coordination Office elements

1) For how long have you been working in the International Partnerships Program?
2) How was created the possibility of implementing Dual Degrees in CMU-PT?
3) Which is the dynamic between the two universities?
    a. What is it like to work with CMU/PT universities? Can you describe positive and negative points?
    b. Can you describe the application process of students?
    c. After the enrolment of the students, how is the dynamic between the Portuguese and the American universities?
4) The CMU-PT went through a reorganization process. Do you think the implementation of a new educational model was adequate? Do you consider a positive transition?
5) Do you think that other areas of the program also need reorganization? If yes, why and which area(s)?
6) Can you identify something that should be improved related to the Dual Degrees?
7) Considering all that was addressed, to what extent do you think this FCT's instrument is different from all others?
8) Is there something that did not occur as expected?
9) Do you think both partners equally benefit from the partnership?
10) Do you think the partnership should have an end or another format in the future?

Questions placed to Ph.D. Alumni

1) Within the CMU-PT, which area and degree you were admitted to?
2) How you describe the application process to the program?
3) How you describe your mobility experience?
4) How is the dynamic between the Portuguese and the American universities?
    a. Can you describe any differences between the two?
5) After concluding the degree, you enrolled in any other program or activity related to the partnership?
    a. If yes:
        i. Which?
        ii. Why did you enroll?

iii. Can you describe the experience?

6) What you were able to develop with your research? Any impacts verified nowadays?
7) Considering all that was addressed, to what extent do you think this FCT's instrument is different from all others?

Bibliography

Academy of Finland. (2012). Independent Assessment of Portuguese Collaboration with US Universities in Research and Education, Helsinki: Academy of Finland.

Audretsch et al. (2002). The Economics of Science and Technology. Journal of Technology Transfer (27) 2002, pp. 155-203.

Bozeman, B., Rogers, J. (1999). ‘‘Use-and-Transformation’’: An Elementary Theory of Knowledge and Innovation. School of Public Policy, Georgia Institute of Technology, Atlanta, GA.

CMU Portugal. (2012). ICT Portugal: An Entrepreneurial Research Initiative. A Roadmap for the second phase of the Carnegie Mellon Portugal Partnership. Accessed in October 16th 2020, on the website of: CMU Portugal https://www.cmuportugal.org/documents-and-reports/ .

CMU Portugal. (2019). CMU Portugal: Exploring new research frontiers in ICT towards a global innovation ecosystem. Accessed in October 16th 2020, on the website of: CMU Portugal https://www.cmuportugal.org/documents-and-reports/ .

CMU Portugal. (2020). Annual Report 18 19. Accessed in October 16th 2020, on the website of: CMU Portugal https://www.cmuportugal.org/documents-and-reports/ .

Cohen, W., Nelson R., and Walsh J. (2002). “Links and Impacts: The Influence of Public Research on Industrial R&D”, Management Science (48) 2020, pp. 1-23.

Corado Simões, V., Mira Godinho, M., and Sanchez-Martinez, M. (2017) RIO Country Report 2017: Portugal, EUR 29160 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-81216-3, doi:10.2760/837712, JRC111275

DGEEC. (2017). Inquérito aos Doutorados (CDH – Careers of Doctorate Holders) – Sumários Estatísticos. Accessed in November 14th 2020, on the website of: DGEEC https://www.dgeec.mec.pt/np4/208/.

Resolução de Conselho de Ministros n.º 132/2006 de 13 de outubro. Diário da República n.º 198/2006 – Série I. Lisbon.

Resolução de Conselho de Ministros n.º 16/2013 de 21 de março. Diário da República n.º 57/2013 – Série I- Lisbon.

Resolução de Conselho de Ministros n.º 6/2014 de 18 de novembro. Diário da Républica n.º 223/2014 – Série I. Lisbon.

Resolução de Conselho de Ministros n.º 80/2014 de 29 de dezembro. Diário da Républica n.º 250/2014 – Série I. Lisbon.

Resolução de Conselho de Ministros n. º 24/2018 de 8 de março. Diário da República n.º 48/2018 – Série I. Lisbon.

FCT. (2013). Diagnóstico do Sistema de Investigação e Inovação: Desafios, forças e fraquezas rumo a 2020, Lisboa: FCT.

FCT. (2020a). Parcerias Internacionais. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/cooptrans/parcerias/index.phtml.pt .

FCT. (2020b). Cooperação Internacional: GoPORTUGAL - Parcerias Globais em Ciência e Tecnologia. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/cooptrans/goportugal/ .

FCT. (2020c). GoPORTUGAL - Global Science and Technology Partnership Portugal: Cooperação CMU — Portugal. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/tecnologia/parceriasinternacionais/cmu/ .

FCT. (2020d). GoPORTUGAL - Global Science and Technology Partnership Portugal: Programa MIT — Portugal. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/tecnologia/parceriasinternacionais/mit/ .

FCT. (2020e). GoPORTUGAL - Global Science and Technology Partnership Portugal: Programa UTAustin — Portugal. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/tecnologia/parceriasinternacionais/utaustin/ .

FCT. (2020f). GoPORTUGAL - Global Science and Technology Partnership Portugal: Programa Fraunhofer — Portugal. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/tecnologia/parceriasinternacionais/fraunhofer/ .

FCT. (2020g). GoPORTUGAL - Global Science and Technology Partnership Portugal: Cooperação Harvard Medical School — Portugal. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/tecnologia/parceriasinternacionais/harvard/ .

FCT. (2020h). GoPORTUGAL - Global Science and Technology Partnership Portugal: Iniciativas ibéricas de investigação e inovação. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/cooptrans/fundacaolacaixa/ .

FCT. (2020i). GoPORTUGAL - Global Science and Technology Partnership Portugal: Acordo de Cooperação Científica e Tecnológica entre o MCTES e o Imamat Ismaili. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/cooptrans/imamat_ismaili/ .

FCT. (2020j). Bolsas de Formação Avançada, Estatísticas: Bolsas de doutoramento. Evolução do número de candidaturas nos concursos individuais 1998-2018. Access in October 16th 2020, on the website of: FCT https://www.fct.pt/apoios/bolsas/estatisticas/index.phtml.pt .

Fiolhais, C. (2011). A Ciência em Portugal, 1ª Edição. Lisboa: Fundação Francisco Manuel dos Santos.

Georghiou, L. (1997). Issues in the evaluation of innovation and technology policy. In: OECD Proceedings, Policy Evaluation in Innovation and Technology – Towards best practices, OECD, Paris.

Georghiou, L., Roessner, D. (2000). Evaluating technology programs: tools and methods. Research Policy (29) 2000, pp. 657-678.

Georghiou, L. (2002). Evaluation of Research and Innovation Policy in Europe: new policies, new frameworks? In US-European Technology Forecasting and Assessment Conference. eScholarID:2b2646

Giovannini, E. et al. (2015). The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals: Report of the expert Group “Follow-up to Rio+20, notably the SDGs”, Brussels: European Commission

Gomes, H. and Telha, J. (2010). Expert Evaluation Network Delivering Policy Analysis on the Performance of Cohesion Policy 2007-2013: Task 1: Policy Paper on Innovation, A report to the European Commission, Lisbon: Centro de Estudos e Desenvolvimento Regional e Urbano.

Gornall, W. and Strebulaev, A. (2019). Squaring venture capital valuations with reality. Journal of Financial Economics 2019.

Heitor, M. and Bravo, M. (2010). Portugal at the crossroads of change, facing the shock of the new: People, knowledge and ideas fostering the social fabric to facilitate the concentration of knowledge integrated communities, Technological Forecasting and Social Change (77) 2010, pp. 218–247.

Hird, M. and Pfotenhauer, S. (2017). How Complex international partnerships shape domestic research clusters: Difference-in-difference network formation and research re-orientation in MIT Portugal Program. Research Policy (46) 2017, pp. 557-572.

Harvard Medical School. (2020). Portugal Clinical Scholars Research Training Program. Accessed in October 16th 2020, on the website of: Harvard Medical School Portugal Clinical Scholars Research Training https://postgraduateeducation.hms.harvard.edu/certificate-programs/custom programs/portugal-clinical-scholars-research-training .

Horta, H. and Patricio, M. (2015). Setting-up an international science partnership program: A Case study between Portuguese and US research universities. Technological Forecasting and Social Change 2015.

Jang, Y. Vonortas, N. (2002). Performance Measurement for Government R&D Programs: In search of Best Practice. Final Report to the Korea Institute of SandT Evaluation and Planning, Washington, D.C.: Center for International Science and Technology Policy.

Ministério da Ciência, Tecnologia e Ensino Superior. (2007). Um Compromisso com a Ciência para o futuro de Portugal: Vencer o atraso científico e tecnológico, Lisbon: MCTES.

Minister for Science, Technology and Higher Education (2018). Higher Education, Research and Innovation in Portugal: Perspectives for 2030, Lisbon: MCTES.

MIT Portugal (2012). MIT Portugal: Sharpening Portugal's Competitive Edge. Accessed in October 16th 2020, on the website of: MIT Portugal https://archive.mitportugal.org/about/strategic-report .

MIT Portugal (2016). MIT Portugal Yearbook 2016. Accessed in October 16th 2020, on the website of: MIT Portugal https://archive.mitportugal.org/about/strategic-report .

MIT Portugal (2017). MIT Portugal Brochure: its Students, world-class Research and Innovation & Entrepreneurship. Accessed in October 16th 2020, on the website of: MIT Portugal https://archive.mitportugal.org/about/strategic-report .

OECD. (2003). The Sources of Economic Growth in OECD Countries, Paris: OECD.

OECD. (2007). Tertiary Education in Portugal, Paris: OECD.

OECD. (2012). OECD Science, Technology and Industry Outlook 2012 Highlights, Paris: OECD.

OECD. (2017a). OECD Science, Technology and Industry Outlook 2012 Highlights, Paris: OECD.

OECD. (2017b). OECD Highlights from the OECD Science, Technology and Industry Scoreboard 2017 - The Digital Transformation: Portugal. Accessed in October 16th 2020, on the website of: OECD Science, Technology and Industry Scoreboard https://www.oecd.org/portugal/sti-scoreboard-2017-portugal.pdf .

OECD. (2019). OECD Review of Higher Education, Research and Innovation: Portugal, Paris: OECD Publishing

OECD. (2020). Main Science and Technology Indicators. Accessed in October 16th 2020, on the website of: OECD Main Science and Technology Indicators https://www.oecd.org/sti/msti.htm .

Patricio, M.T. et al. (2017). Faculty-exchange programs promoting change: motivations, experiences, and influence of participants in the Carnegie Mellon University-Portugal Faculty Exchange Program. Tertiary Education and Management 2017.

Pereira, T. S. (2019). Ciência e Tecnologia: O desafio do crescimento e do impacto da investigação, In: Mamede, R.P., Silva, P. A. (2019) O Estado da Nação e As Políticas Públicas 2019: Menos Reformas, Melhores Políticas. Lisbon: IPPS-ISCTE, pp. 24-29.

Pfotenhauer, et al. (2012). Seeding Changes through International University Partnerships: The MIT-Portugal Program as a Driver of Internationalization, Networking, and Innovation. Higher Education Policy 2012, pp. 1-26.

Pfotenhauer, et al. (2016). Architecting complex international science, technology and innovation partnerships (CISTIPs): A study of four global MIT collaborations. Technological Forecasting & Social Change (104) 2016, pp. 38-56.

Salles-Filho, S. et al. (2011). Evaluation of ST&I programs: a methodological approach to the Brazilian Small Business Program and some comparisons with the SBIR program. Research Evaluation 2011, pp. 159-171.

Simmonds, P.J. et al. (2009). An evaluation of the Cambridge–MIT Institute: Prepared for the Department of Innovation Universities and Skills. Technopolis Group 2009, pp. 1–110.

UTAustin Portugal. (2016). Colab 2016 Annual Report. Accessed in October 16th 2020, on the website of: UTAustin Portugal https://utaustinportugal.org/annual-reports/ .

UTAustin Portugal. (2019). UT Austin Portugal 2019 Annual Report. Accessed in October 16th 2020, on the website of: UTAustin Portugal https://utaustinportugal.org/annual-reports/ .

Yin, R. (1994). Case Study Research: Design and Methods (2nd Edition). Thousand Oaks: Sage Publications, 1994

XVII Governo Constitucional. (2005). Plano Tecnológico: Uma estratégia de crescimento com base no Conhecimento, Tecnologia e Inovação, Documento de Apresentação, Lisboa: XVII Governo Constitucional.