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Which benefits and limits derive from ESA membership for European Countries owning "medium-sized" space agencies?

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ABSTRACT

This study investigates the benefits and limits deriving from membership with ESA of six medium-sized space agencies in terms of strengthening and development (or not) of space technologies, as well as their contribution to the growth of productive activities and to the increase of services for citizens. This research contributes to the more general issue of the usefulness of space activities, not only for scientific or military-political purposes but also for economic and social development. Results show that, on the one hand, the membership with ESA has allowed smaller Countries to access space programs, to develop advanced technologies and to support the growth of their firms in some significant markets, but, on the other hand, the membership has also limited the access to space to few companies, without encouraging the broad dissemination of technological knowledge.

1. Introduction

The analysis of the benefits deriving from the involvement of Countries in space programs is prompted for two main reasons [1–3]. As first, the space industry needs to justify its high consumption of public resources [4–6]; second, it provides a significant source of technological spillovers, which can make an important contribution to the economic development of a nation [3,7,8]. The integration of sophisticated technologies with advanced materials and components leads the space sector to exploit a wide range of support industries, thus spreading its technology and enhancing the economy. Such high-technology level requires massive Research and Development (R&D) investments [9]. The size and risks of such investments, and the strategic relevance of space technologies for economic and military purposes, have lead nations to support the demands of the industry, both by carrying out R&D within public organizations and by funding and directing private research [3].

As far as Europe is concerned, the space segment is a particularly interesting and dynamic field, including several players with varying priorities across the 22 countries that are member states of the European Space Agency (ESA). In the past decade, there has been increasing affiliations to ESA and the European Union (EU). In 2015, the 20 ESA member states were joined by two new member states: Estonia and Hungary [10]. It is possible to group these 22 countries in three main clusters in terms of contribution to the ESA budget. The first cluster is composed by big contributors (for example, Germany and France), the second one by medium contributors (for example, Sweden and Switzerland) and the latter by minor contributors. In the past, scholars focused their attention toward strategies and policies of agencies belonging to big contributors [11–13], due to their relevance in the ESA context and their opportunity to develop autonomous initiatives. Conversely, in the scientific literature no studies are available investigating the advantages and limits of being small or medium sized space agencies in the European context. Our study tries to address this gap focusing in particular on the medium sized space agencies. Specifically, we are interested in understanding the "hybrid" position of European Countries owning space agencies that are neither big nor small. The term hybrid indicates their strong dependence from ESA programs, even if with a sufficient potential autonomy to develop their own space related industrial strategies. Thus, smaller agencies are not considered. We aim at answering the following research questions (RQs):

RQ1. *Which advantages derive from being ESA members by Countries owning medium-sized space agencies?*

RQ2. *Which limits emerge from being ESA members if compared with other successful cases?*

In the following, we start by presenting as first the European space environment and an overview on ESA, and then we briefly introduce the international space context, with particular reference to the emblematic

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case of Japan. Then, we explain in detail our objectives, methodology and the sample investigated. Results of our study follow. Finally, we conclude the paper by answering the above mentioned research questions and discussing the main implications of our findings.

2. The ESA context

2.1. The European space environment

Main customers of space-related products and services are still Governments, involved in a wide range of space activities due to the strategic value of space for economic goals and national prestige. Public investment is the main source of financing for technological development related to major space projects. Space manufacturing is, thus, dependent on institutional civil and military investment. The traditional massive involvement of public actors in space activities derives from the features of this sector. Indeed, its complexity and economic parameters may discourage the private sector: while a profit-maximizing firm often decide to invest and establish an efficient, cost-effective business model targeting a profitable segment of the market, a Government may also address to results that do not necessarily depend only on profitability.

According to a recent study based on the ESA context [10], it is possible to identify a number of motivations that encourage the involvement of Countries in space activities, namely: to boost industrial competitiveness, to engage in international cooperation, technology development and transfer, job creation, European non-dependence, and societal benefits. Specifically, it was found that social benefits score relatively low if compared to other motivations. The main motivation to invest in space activities is to strengthen industrial competitiveness followed by the engagement in international cooperation. ESA members clearly perceive that investments in space can enhance the competitiveness of their space (and space-related) industry, as well as of high-tech industries in general. They also believe that space-related activities are closely linked to the objective of industrial competitiveness (e.g., technology development and its transfer from space to earth applications for commercial purposes), and to job creation issues. Moreover, space is an ideal area for international cooperation, mainly because it is expensive for a single state to engage in space activities. Finally, also European non-dependence from other global space actors is an important rationale determining public investments in space.

2.2. An overview on ESA

To be thorough, a general background on ESA is provided in this section [14–16]. ESA is an international organization that was founded in 1975 by 10 states (Belgium, Germany, Denmark, France, United Kingdom, Italy, the Netherlands, Sweden, Switzerland and Spain), merging two organizations: the European Launch Development Organization (ELDO) and the European Space Research Organization (ESRO). It operates as Europe's gateway to space and is composed by 22 Member States, as depicted in Fig. 1. As shown in the figure, 20 member states belong to the EU. Six other EU states have cooperating agreements with ESA, thus participating indirectly in all ESA procurements and activities, in addition to Canada, that takes part in some programs under a long-standing cooperation agreements. Finally, Slovenia is an Associate member.

It currently employees about 2300 people, with 5.75 billion euro budget in 2017 [16]. The agencies belonging to each member states contribute differently to ESA budget. In the case of Switzerland and Austria, for example, more than the 80% of the budgets of the respective agencies is paid to ESA. This implies a *de facto* identification of the space programs of both countries with those put in place by ESA. This choice seems to be imposed by the large use of ESA structures and instruments by the two agencies, to achieve the development of their industrial apparatus. In addition, the operating power and a strong influence exerted on strategic choices, is held by the major member states (Germany, France, Italy and the United Kingdom), which account for over 67% of ESA budget. For the “equitable return” rule, agencies belonging to the major member state get, in favor of their countries' enterprises, the largest slice of ESA funding. This represents a strong limit for the development of the industrial competition of each member state, even if the “system engineer” nature of missions and space tools often allows the creation of strong relationships and thus cooperation between companies belonging to different countries.

By coordinating the resources (both financial and intellectual) of its members, ESA can undertake programs and activities far beyond the scope of any single European country. The activities carried out refer to nearly all space-related areas. Specifically, “space science” is a

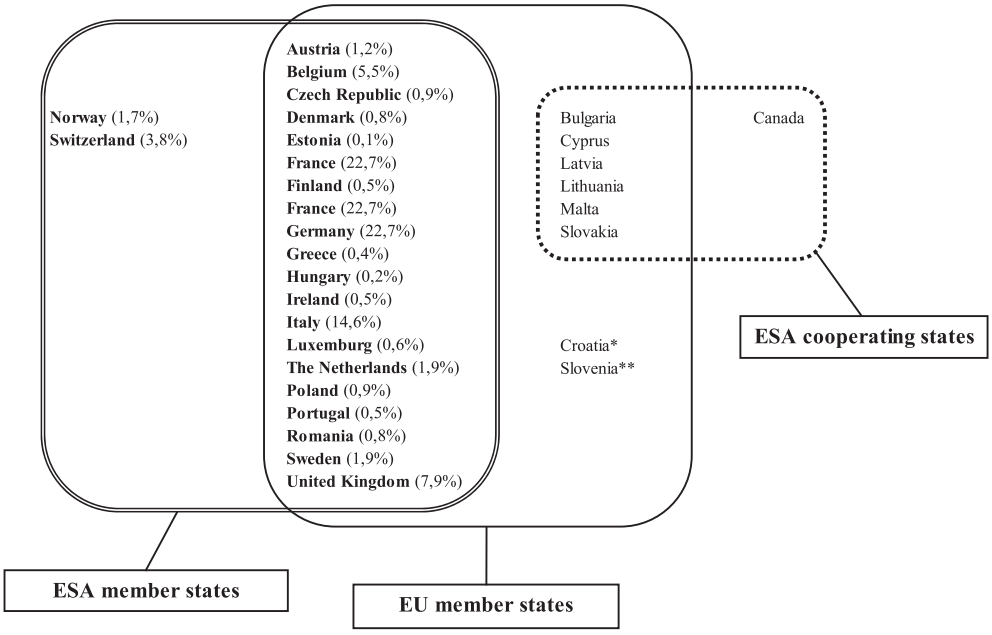

Fig. 1. ESA member states and ESA cooperating states (in brackets, the contribution, in percentage, of each member state to the ESA budget).