

## Chapter 49

# A Comparison between International Trade and R&D Collaboration Networks in the European Aerospace Sector

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### **ABSTRACT**

*Do trading countries also collaborate in R&D? This is the question that, facing with a number of methodological problems, here it is dealt with. Studying and comparing the international trade network and the R&D collaboration network of European countries in the aerospace sector, social network analysis offers a wide spectrum of methods and criteria either to make them comparable or to evaluate its similarity. International trade is a 1-mode directed and valued network, while the EU-subsidized R&D collaboration is an affiliation (2-mode) undirected and unvalued network, and the elementary units of this latter are organizations and not countries. Therefore, to the aim to make these two networks comparable, this paper shows and discusses a number of methodological problems and solutions offered to solve them, and provides a multi-faceted comparison in terms of various statistical and topological indicators. A comparative analysis of the two networks structures is made at aggregate and disaggregate level, and it is shown that the common centralization index is definitively inappropriate and misleading when applied to multi-centered networks like these, and especially to the R&D collaboration network. The final conclusion is that the two networks resemble in some important aspects, but differ in some minor traits. In particular, they are both shaped in a core-periphery structure, and in both cases important countries tend to exchange or collaborate more with marginal countries than between themselves.*

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## INTRODUCTION

This paper deals with an interesting scientific issue, whose analysis requires to face with difficult methodological problems. The scientific issue is understanding if – and to what extent – international trade relationships are distributed in a similar way to international R&D collaborations. More specifically, the question is the following: is there a significant similarity between the structure of trade exchanges and of R&D collaborations? Clearly, this question is more meaningful when the scope is restricted to a specific sector, and especially if that sector is high-tech, because it is reasonable to expect that in this case R&D efforts and exchanges are more necessary than in low-tech sectors. Therefore, we have chosen the European aerospace sector. A positive answer would tell us that firms and research institutions (university and research centers) tend to collaborate in international R&D with the same countries with which they trade, and vice versa. Our work seems to confirm this outcome, and thus, it opens the road to possible explanations.

The aim of comparing the network of international trade and that of R&D collaboration networks is rather challenging from a methodological point of view, because it implies to make two sets of data manipulation and other methodological choices. Firstly, these two networks have a different nature, and so they should be “prepared” to be compared. Secondly, their comparison addresses to the classical problem of comparing complex systems: similar in terms of what? To say, in terms of structure is not enough, because this can mean a lot of different things and have a lot of aspects.

The paper proceeds as follows: in the next section is reviewed theoretical background on both international trade networks and R&D collaboration networks, even though such review is generic, because unfortunately our work has no predecessors with which directly contrast our results. Due to the considerable methodological problems raised by the comparison between trade

and collaboration networks, the third section is quite long. Indeed, the secondary aim of this paper is just giving a methodological contribute to face with this kind of problems. Then, in the fourth section, results are articulated between aggregate and synthetic indexes, followed by strict topological analyses, like simple matching, assortativity, and core-periphery analysis. In the final section are discussed the main implications of this work and possible further developments.

## THEORETICAL BACKGROUND

It is unlikely that a country is self-sufficient in any industry, because an industry is diversified in many different products, and a country’s industry can hardly produce all of them, no matter how developed or specialized that country is. Moreover, it’s practically impossible that a country can produce all the components and raw materials for a given industry, and in the required amount. International trade theory made these points clear since long (Bowen *et al.*, 2012; Ethier *et al.*, 1995; Feenstra, 2003; Feenstra & Taylor, 2010; Milberg & Winkler, 2013). More recently, evolutionary economic geography (Boschma & Frenken, 2006; Boschma & Lambooy, 1999; Boschma & Martin, 2007; Essletzbichler & Rigby, 2007; Frenken & Boschma, 2007; Martin & Sunley, 2007), and more particularly the theoretical perspectives of global value chain (Gereffi, 1999; Gereffi *et al.*, 2005; Humphrey, 1995; Humphrey & Schmitz, 2002), and of international knowledge networks (Cappellin & Wink, 2009; Gross Stein *et al.*, 2001; Lundan, 2002; Maxwell & Stone, 2007) have underlined that industry’s trade patterns depend not only on trade barriers, transportation costs, labor costs and other traditional variables investigated by international economics. They depend also – and in some cases, like high-tech industries, primarily – on the dynamics of international innovation diffusion, technological trajectories, and the like. Hence, it could be reasonably wondered to what

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