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Patterns of Cooperation in the European Defence Sector – A Network-Approach-Based Investigation of EU Projects

Péter BALOGH
University of Szeged, Department of Sociology, Szeged, Hungary
email: baloghp@socio.u-szeged.hu

Abstract. In this paper, we introduce research results from our network-approach-based investigation of the European Union defence cooperation projects. After brief remarks on the background, the research problem, the conceptual and methodological issues, we focus on the structure of the cooperation network and introduce the territorial, institutional, and (sub)regional patterns of partnerships. The data analyses illustrate that an integrated but fragmented cooperation network could be explored, and in several aspects remarkable differences can be measured on country-, regional, and sub-regional levels implying that territorial and institutional factors might have an important role in this specific area as well.

Keywords: European Union, defence projects, territorial differences, network analysis, embeddedness

1. Introduction and Background

Europe witnessed several events in the middle of the second decade of the new millennium that spectacularly illustrated the importance and necessity of adequate defence capabilities. The illegal annexation of the Crimea by the Russian Federation in 2014 and the culmination of the refugee crisis in 2015 highlighted some potential vulnerabilities of the region and the fragility of the neighbouring areas. These developments might have played an important role in paving the way for a (re)starting and intensifying process of defence capacity building. These processes can be observed on the one hand in the case of the increasing share of budget spent on defence issues by several European NATO member countries ('D.E.N.C.' 2021) and the direct investments into security infrastructure by purchasing different products.[1] On the other hand, a more subtle dimension of investment into security also started to evolve: certain states of the European Union initiated cooperation

1 See, for example: https://www.sipri.org/yearbook/2021/08.

projects in different spheres of defence issues. Besides that these projects might highly contribute to the integration and development of a common strategy and repository of relevant assets, the cooperation has the potential to facilitate and take advantage of partnership, social capital, and embeddedness (Granovetter 1985).

In our investigation, we wish to empirically explore the different structures and potential relations between the European Union members in partnership and network embeddedness through defence investments.

2. Research Problem and Conceptual Remarks

Cooperation and social capital and connections as a general means can promote development and increasing standards of living conditions (see Orbán–Szántó 2006, Putnam 2006), as the resources of the networks can provide novel resources for the community concerned (Coleman 2006.). In this sense, European integration can also be interpreted as a process of building partnership and trust among the European countries[2] in order to better realize common objectives and manage or prevent undesirable processes arising as potential threats for the countries involved and for the community as a whole. However, the evolution and development of integration might lead to a higher level of cooperation, a convergence of certain countries or regions, and clusters of Member States characterized with less deepened partnership relations or smaller sub-regions or subgroups with specific areas of cooperation. That is, a differentiated integration pattern might evolve (Brunazzo 2022) with a segmented structure of partnership, which could also be explored in specific areas, including defence initiations (see Blockmans–Crosson 2019).

Accordingly, the general research problem of this paper is whether a pattern and relationship between the network embeddedness and defence investments can be explored in the recent European context. Among the possible research topics, the following ones can be differentiated: (1) can stable patterns of fragmentation be measured in the European defence partnership network? It might be interesting to investigate (2) the level of inequalities and concentration of defence cooperations among the participating European Member States, and also (3) it could be worth looking into whether the possible role of the time factor has any impact on the embeddedness in the cooperation network of this specific context of defence projects. Last but not least, (4) the regional differentiation and territorial disproportionalities and inequalities of the partnership relations could be in the focus of the investigation.

Some outcomes of the research might have some policy implications worth considering as well, and regarding the methodological background the investigation

2 In this context, certain scholars also introduce the concept of European Social Capital (Praprotnik–Perlot 2021) while investigating the issue of the possible directions of the development of the European Union's future.

might promise a complex design and could facilitate the profound examination and comprehension of the topic.

3. Methodological Background

Our research is based on publicly available data sources of defence cooperation partnerships (PESCO), and in the course of data analysis a basically quantitative approach would be applied. In order to empirically investigate the patterns and differences of the *defence cooperation* partnerships and explore regional clusters and distinctive hubs of defence collaborations, we assembled a complex database from available online information. Several articles and studies (Blockmans–Crosson 2019, Varga 2019, Nádudvari–Etl–Bereczky 2020, Molnár–Szabolcs 2020) have already mapped the overall structure and some deeper characteristics of the cooperation, which results can be utilized for further investigation. In this respect, it might be worth investigating the structure as a *directed asymmetric network* in order to find out whether some kind of difference in the evolving structure can be measured. The calculation of network-specific measures might also be fruitful when trying to describe the territorial and regional differences.

As for the methods applied, besides the quantitative approach in our research project, we rely on the network analysis perspective, which enables us to explore the inner patterns of the graphs and also to quantify the positions of the states and regions involved. Furthermore, we find it to be illustrative to utilize some measures and indices of inequalities and concentration – primarily the Lorenz curve and the Hoover index – from the field of geography and spatial analysis, which help to express and compare in one single number the level of disproportionality.

3.1. Limitations

The following analyses thus will be based on a quantitative approach that enables us to draw a complex picture of the investigated phenomenon and examine it form various aspects, but it has potential shortcomings as well. Accordingly, it is necessary to consider that certain outcomes regarding the patterns of cooperation, network positions, and relations might be – at least partially – explained with further, essentially qualitative argumentations. These background connections cannot be fully investigated in the analyses, as these would exceed both the formal length and content limitations of this paper. However, we select certain cases when we refer to the potential background and context of the quantitative patterns. Similarly, it needs to be added that the relationships between certain variables investigated in the analyses can be connected to other alternative explanations which, as cannot be quantified, cannot be included formally in the statistical analysis.

In spite of the considerations mentioned above, the author finds worth and potentially fruitful investigating the differences and regional patterns of EU defence cooperations with a quantitative approach.

4. Data Analyses

4.1. Introducing the PESCO Projects

The four waves of the PESCO projects contain an overall number of 60 defence initiations among 25 European Union Member States. The most active participant of the defence programme is France with its fourteen coordinated projects (see *Figure 1*). With a kind of gradual decrease, Italy and Germany follow the most active country with eleven and nine initiated projects respectively, and then Greece, Spain, Estonia, and Portugal can be found with a minimum of three projects. There seem to be an essentially negative relation between the activity level and the number of partners in the cooperative defence initiations. This rather unclear pattern can be illustrated with the correlation coefficient (–0,097) as well and might be explained, at least partially, with the notable outliers among the less active project coordinator countries. Lithuania, Hungary, and Bulgaria each have only one project coordination; however, they have a relatively higher number of partners/ties directed towards other EU countries. This inverse pattern is the most visible in the case of Belgium and the Netherlands, in the latter case 23 partners being involved in a single coordinated project.

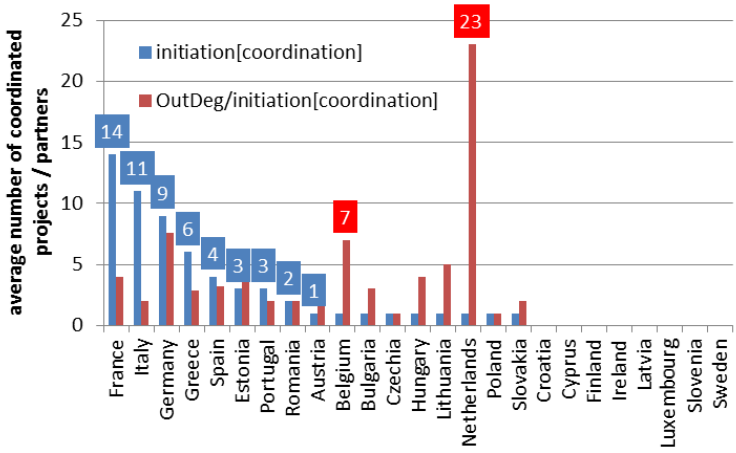
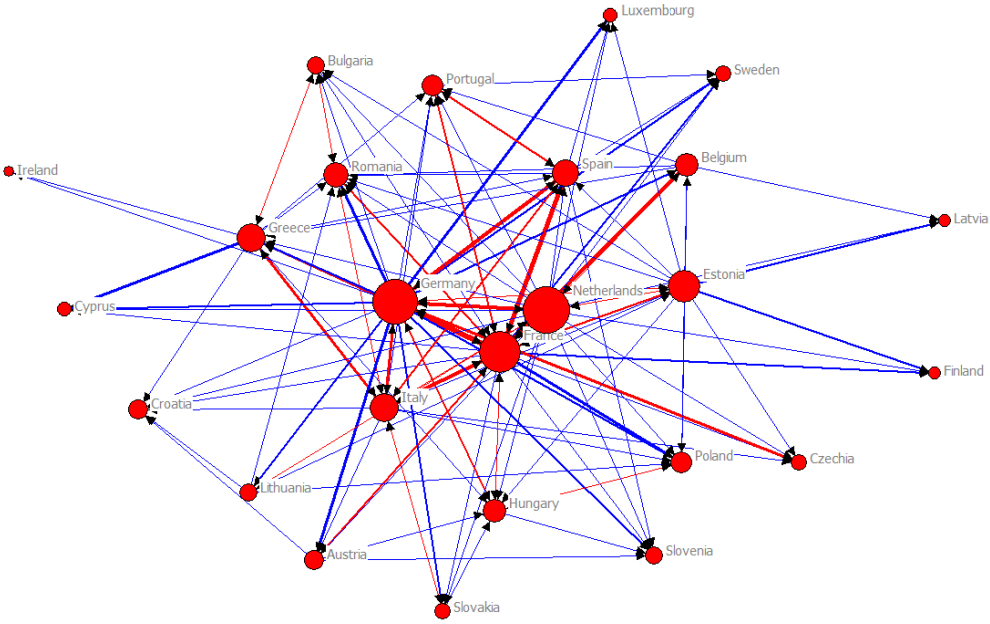


Figure 1. *Number of defence initiations among 25 European Union Member States*

The pattern of the cooperation network based on the PESCO projects can be described as a structured and differentiated network containing more or less clearly distinguishable segments (see *Graph 1*). These segments can be interpreted to some extent even as an arrangement of concentric circles. In the centre of the network, we can primarily find Germany, France, the Netherlands, and Italy is well – although the latter is located more distant from the other three most active countries. This pattern could imply a progress of concentration – which would be a comprehensible process considering certain models of network evolution – if we consider that the analyses based on earlier waves of PESCO projects[3] identified more numerous leading countries.

The next segment of the network could be interpreted as an intermediary ring located around the core with the most active countries. In this section, Estonia and Greece seem to be more significant countries with a relatively higher number of connections, but Spain and Romania could also be considered as such.



Graph 1. *Pattern of the cooperation network based on the PESCO projects*

On the periphery of the network, we can find the third, outer ring with the least integrated states of the PESCO cooperation network – namely Ireland, Latvia, and

3 See, for example, Nádudvari–Etl–Bereczky 2020.

Finland. Hungary is positioned around the border area between the intermediary and the outer segments, in a sub-graph with Austria, Slovakia, and Slovenia.[4]

A further characteristic of the directed graph worth mentioning is the frequent and dense presence of mutual links – although obviously, in the light of the nature of the cooperation projects (fixed participants), this is understandable: France possesses eleven partners with reciprocal links, Germany and the Netherlands have seven and six respectively. These mutual relations contribute to the evolvement of a more embedded network structure.

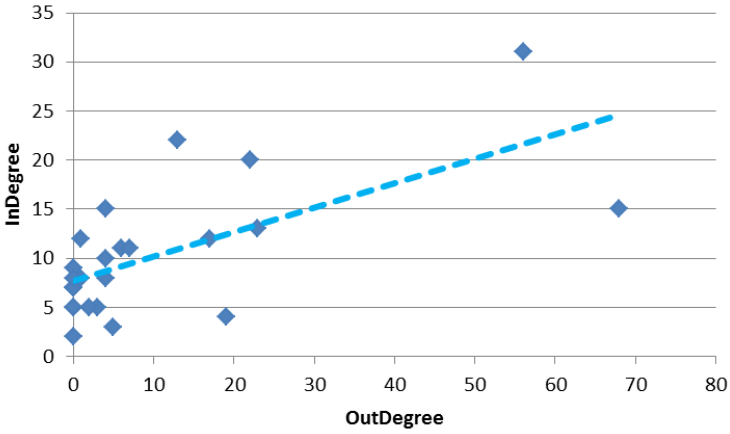


Figure 2A. *Distribution of initiations, ties pointing to other countries and partnerships*

The positions of the countries in the graph of the cooperation network proves to be structured in a different way: based on the figures of the distribution of initiations – or ties directing towards other countries (out-degree)[5] and partnerships –, ties

4 It should be noted that the pattern of defence cooperations explored in this part of the analyses might emerge as an intersection of various different factors not ready to be measured quantitatively. On the one hand, regarding the central players of the network, the presence of a traditionally strong, developed, functional, and many-sided defence sector has the potential to invite others to cooperate in several different fields of defence, that is, these actors can necessarily have a greater and wider room for building collaborative relations. In this sense, we encounter a mechanism widely known in the social sciences which describes that the more one has, the more will be given to him/her – referred to as the Matthew effect in sociology (see Merton 1968.).

On the other hand, similarly, the less significant countries of the cooperation network could have smaller and less diverse defence sectors which prevent them from participating in several dimensions of the development projects. However, it should be emphasized in this regard that specialization can play an important role, and in some cases we might again discover the process linked to the Matthew effect: when a state acquires a specific, strategically important element of the European Union defence sector – as in the case of Estonia regarding cyber defence (centre) or the Czech Republic and space developments –, it also gets an advantage to accumulate further development projects and collaborative relations.

5 Degree – or number of ties – is the most important characteristic of a node (Barabási 2016: 63–65).

point towards an arbitrary state – a positive relation can be explored (see *Figure 2A*). That is to say, the more active a country is in the PESCO initiations, the more numerous partners it can achieve in the cooperation network (correlation coefficient; R = 0.657). Certainly, France and Germany seem to be some kind of outliers in this sense; however, if we exclude them from the analysis (see *Figure 2B*), the pattern proves to be essentially the same (R = 0.537).

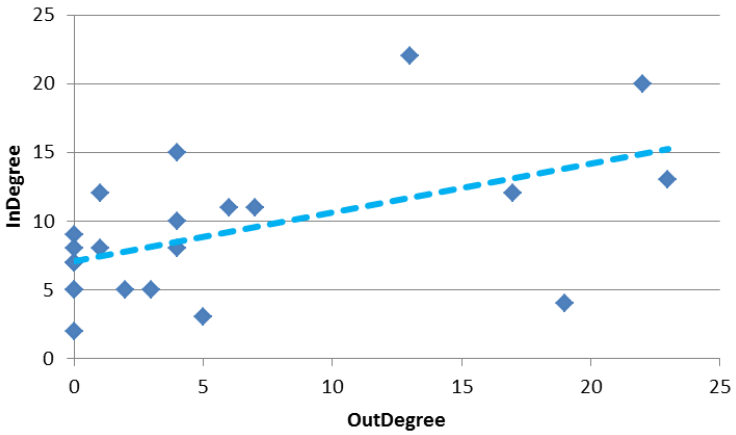


Figure 2B. *Distribution – excluding outliers (France, Germany)*

4.2. Country-Level Inequalities

If we investigate the differences among the countries participating in the sixty-one different European Union defence cooperation projects applying certain measures of territorial inequalities, a moderate level of concentration emerges. On the one hand, the inequalities of the distribution of the projects can be illustrated with the Lorenz curves (Németh 2005: 11–12) – illustrating a single-variable expression of the cumulative distribution –, which imply (see *Figure 3*) that the pattern of project initiation and the externally directed ties of the countries in the cooperation network prove to be rather unequal (see Németh 2005: 12), as the curves – similarly or even identically – run parallel with the X axis in the first segment of the distribution, which can be understood if we consider that the correlation coefficients between the relative distribution of the external ties and the project initiation shares is: R = 0.969. A slight difference can be seen in the initial phase of the growth of the curve where in the case of the project initiation values a somewhat flatter pattern can be explored, while the case of the network ties pointing outwards the distribution implies a more consistent cumulative pattern. However, both of the aforementioned variables exhibit a greater level of inequality compared to the values of inward or

partnership ties of the countries in the network structure. This less curved pattern can be explained by the fact that – contrary to the initiation distribution and outward network ties[6] – every EU Member State is involved in one or more defence projects, that is, they all have several partnerships.

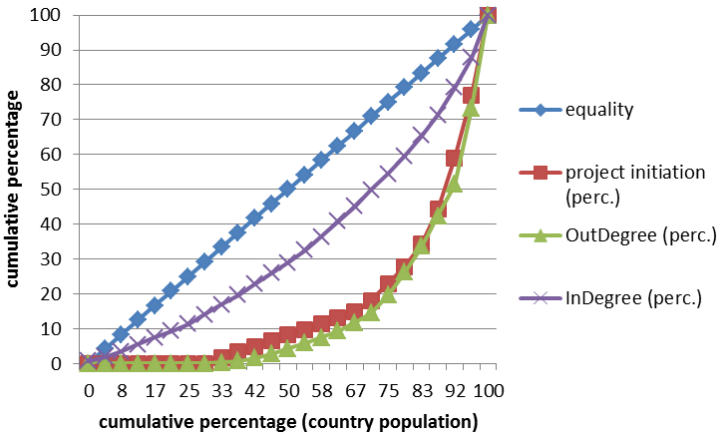


Figure 3. *Lorenz curves illustrating the inequalities of the distribution of the projects*

The distributional differences of the defence project variables – besides the graphical single-variable illustration – might also be fruitful to be investigated with a quasi-comparative approach, applying the formula of the Hoover index (Németh 2005: 8). In the light of the values of the Hoover indices (see *Figure 4*) based on the calculation with a comparison to the population[7] distribution of the EU members involved in the projects, a moderate level of inequality can be observed. In this context, a different similarity pair can be identified: the level of concentration of the project initiations in the light of the population shares of the countries is identical with the distribution of inward ties of the countries compared to the population data. That is, a slightly more than one fourth (28%) of the initiated projects and the partnership ties should be reallocated among the participating countries in order to be in line with the population distribution of the investigated countries. However, in the case of the ties representing outward relations in the cooperation network, an even higher rate of inequality can be measured: nearly one third (32%) of this kind of partnership ties prove to be unevenly distributed compared to the population data.

6 Where an overall number of eight countries have 0 values; see *Figure 1*.

7 In this comparison, we calculated the average number of population for each country based on the Eurostat population data for 2018–2021, as this period is relevant for the time span of the cooperative defence projects.

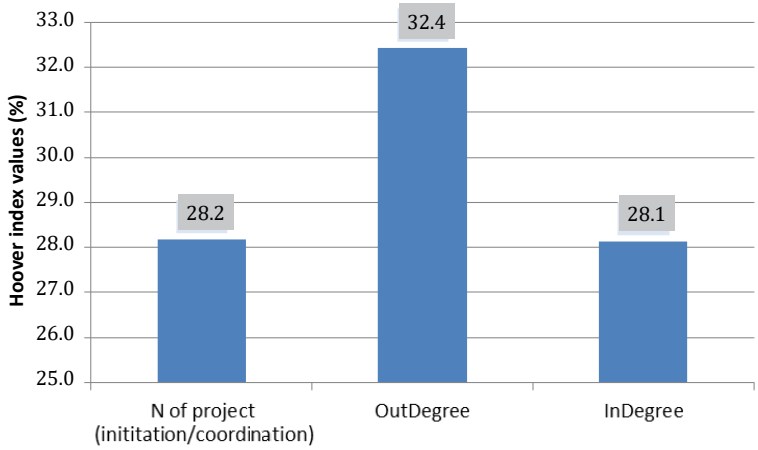


Figure 4. *Hoover indices*

Based on these findings, it can be generally stated that project initiation and positions or integration in the cooperation network of the PESCO defence projects prove to be unequal to a certain extent based on both the graphical and numerical investigation methods of territorial analysis.

4.3. EU and NATO Differences

Since all PESCO countries are European Union members, only inner comparisons can be carried out. One aspect can be the time spent in the organization – accordingly, the first comparison reveals the differences of the network centrality values in the light of the date of accession.

As per the data explored, both the out-degree and in-degree mean values tend to decrease towards the EU members that joined the organization later (see *Figure 5*). This negative tendency is more notable in the case of the initiations, but in the case of the partnerships it is also visible. That is to say, the countries with longer memberships have higher volumes – as a tendency – of participative actions and community collaboration, which might imply a kind of institutional learning and the cultivation of cooperative norms and might illustrate the evolvement and possible role of trust and embeddedness.

A similar mechanism can be empirically explored if we distinguish between the founders of the EU and the rest of the countries. The average values of both the initiations and collaborations prove to be remarkably higher in the group of the six EU founders (see *Figure 6*). The project initiations seem to be polarized, as there can be measured values of out-degree more than seven times higher in the case of the

funding states compared to the other countries, and the average level of participation is also almost twice as high in the founding Member States.

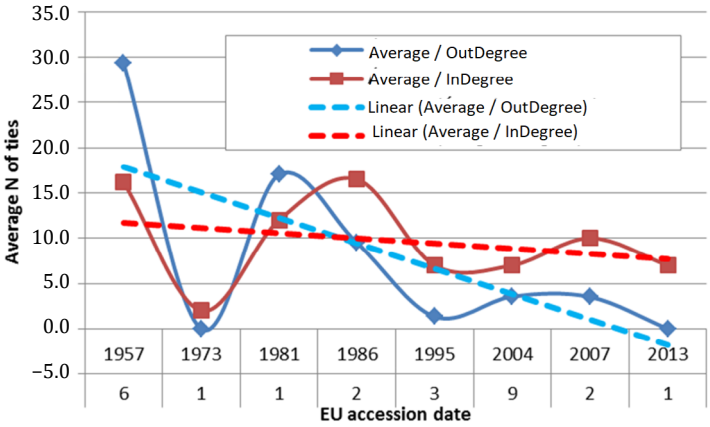


Figure 5. *Differences of the network centrality values in the light of accession dates*

So, the countries in the European Union seem to be different regarding their activity in both defence investment initiations and partnerships. The main pattern implies that the EU members with more experience have higher levels of collaborative activities, which might be explained with institutional learning, embeddedness, and trust.

However, several countries of the PESCO projects are also NATO member countries, so this differentiation offers a similar possibility for comparison.

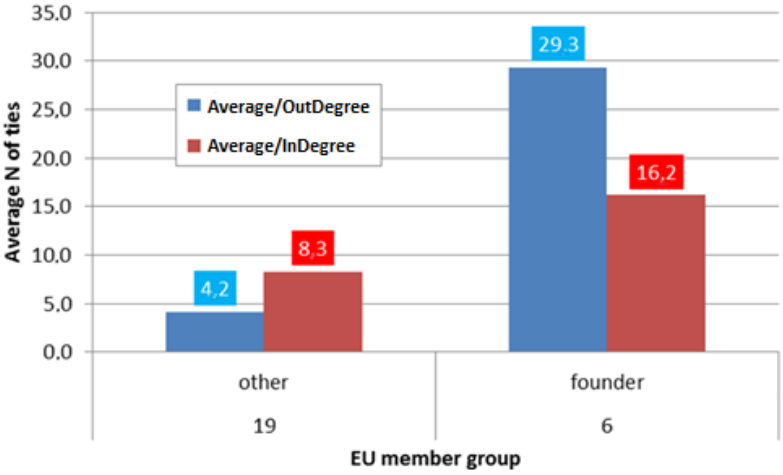


Figure 6. *Average values of both the initiations and collaborations in the group of the six EU founders and other member countries*

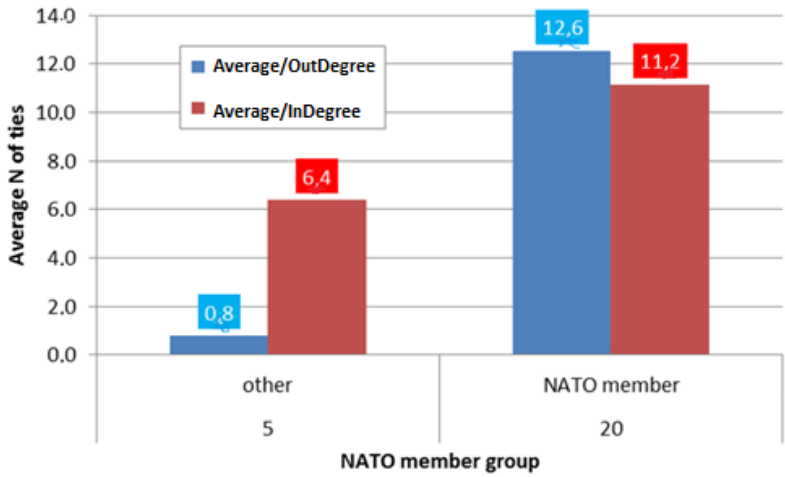


Figure 7. *Differences between NATO member countries and others regarding the average number of network ties (based on the initiated defence projects)*

The most notable difference can be seen – in this case again – in the context of the initiations. That is, the average number of network ties based on the initiated defence projects is more than fifteen times higher in the case of those EU members that are also NATO member countries (see *Figure 7*). Furthermore, states with NATO membership prove to be also more desirable or more frequently 'targeted' partners.

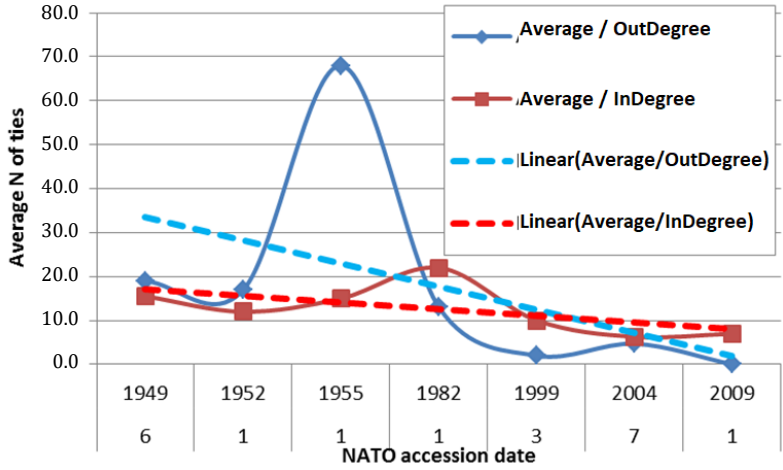


Figure 8. *Average number of ties depending on NATO accession date*

It can also be added that based on the data, an identical pattern can be seen regarding institutional learning (see *Figure 8*): the in-degree values are less notably related to membership duration, but the values tend to be higher with long-term membership, and defence partnership initiations show a more remarkably positive connection.

In this sense, both EU and NATO membership figures corroborate that a longer, more significant experience in a multi-player, cooperative institutional environment increases the activity and partnership potential in a rather specific domain of defence investments.

4.4. Regional Differences

Considering the regional patterns of participation in PESCO projects, notable differences arise (see *Figure 9*). The Western European region appears to include the most active countries regarding defence project coordination (17.2 ties on average), and the average rate of partnership is also the second highest (12.8 ties on average) in the region. Southern Europe is characterized with a similar value in initiation (13.7 ties on average), and the highest value of partnership relations (17.7 ties on average) can be measured among the regions in this area. The relatively higher values in the Central European region might be explained with Germany being part of the group, and the Northern European region proves to be the least integrated area in the defence cooperation.[8]

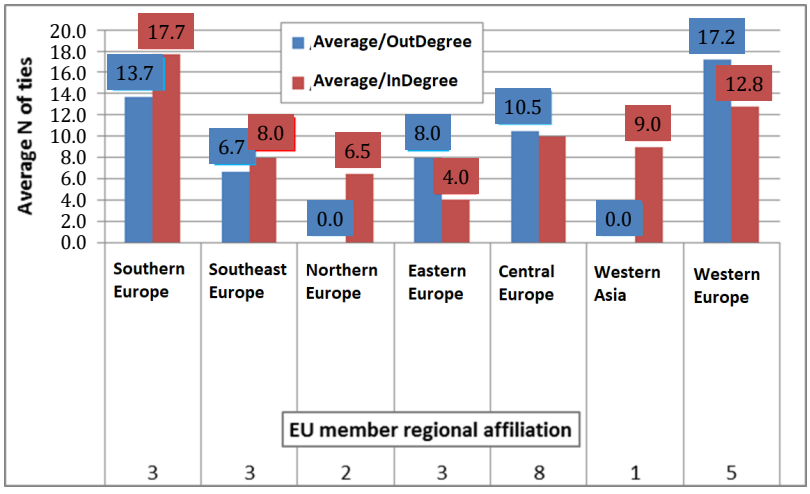


Figure 9. *Regional patterns of participation in PESCO projects*

8 To a certain extent, this pattern may be explained, at least partially, by the fact that Finland and Sweden are neutral, and also notable arms manufacturers on their own.

As a greater territorial unit with twelve countries, Central and Eastern Europe has lower values in both out-degree and in-degree measures (see *Figure 10*) although intra-regional differences show an opposite pattern: in the Central and Eastern European region, initiations are slightly higher than partnership values, while in the other remaining areas in-degree values are a bit higher.

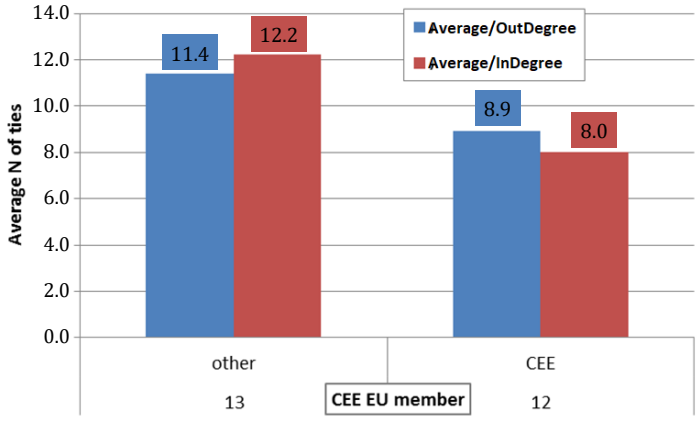


Figure 10. *Differences between the Central and Eastern European region and other EU members*

Finally, the comparison between the more limited area of the V4 countries and the other regions of the European Union illustrates notable differences primarily in the case of the PESCO project coordination (see *Figure 11*). The average number of defence project initiations is almost six times higher in the case of non-V4 countries although in the area of collaboration remarkably more moderate differences can be measured.

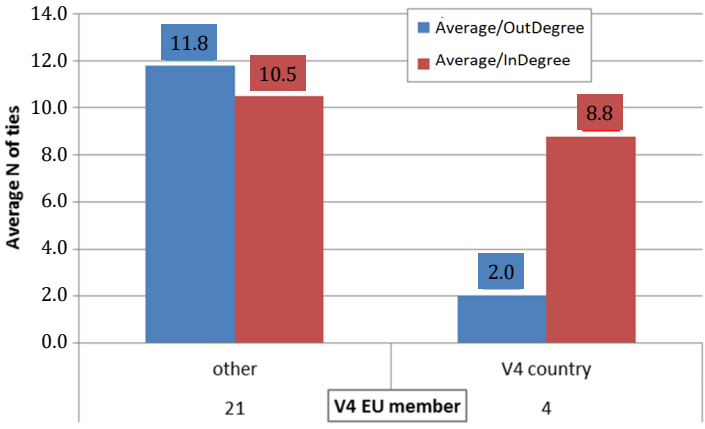


Figure 11. *Differences between the V4 countries and other regions of the EU*

Besides that the PESCO projects tend to be more frequent in countries with more institutional experience and the countries are arranged in a structured cooperation network, significant territorial differences can be explored from a regional and sub-regional perspective, which also corroborates the advantage of the core Member States.

5. Summary and Conclusions

Based on the research outcomes, it could be stated that (1) cooperative EU defence investment projects evolve into structured, dense, and embedded networks. Contrary to the initial presupposition, (2) a high degree of fragmentation could not have been explored – the relations among the investigated countries create a completely integrated network. However, (3) the states in the network have different inner positions, of course – based on their ties, they occupy more central or rather marginal status, but there cannot be found isolated segments or clusters. (4) The differences among the positions of the countries and the embeddedness of the networks could also have been illustrated by the reciprocal ties between certain states. As for further country-level investigations, (5) project initiation and positions or integration in the cooperation network of the PESCO defence projects also prove to be unequal to a certain extent. Institutional background – primarily the length of membership in the European Union and in the military alliance of NATO – has been (6) identified also as a differing factor in the PESCO projects, which might be explained, at least partially, with the potential to accumulate skills and experience in collaborative patterns of decision-making and in cooperative reaction to evolving challenges. As for the regional and sub-regional aspects, notable differences could be explored: (7) Western Europe proves to be the most active region if we investigate the outward ties of the cooperation network, and, on the other hand, South Europe has the highest values concerning the partnership roles of the cooperative defence projects. However, in both measures of network positions (9) the sub-region of Central and Eastern Europe has notably smaller values, similarly to the V4 group members, which exhibit a kind of asymmetric integration, as they have a rather low outward connectedness and a higher – however still relatively low from an overall perspective – partnership value.

It seems that the various forms of connections among the investigated countries and the differences illustrated in institutional and regional affiliations all imply the *emergence of a highly structured and embedded pattern of relations* among the studied segment of the European sphere. The differences indicate an inner central-periphery pattern with some long-term significant EU members in the core of the defence cooperation network and a remarkably lower level of integration of the countries form the central and eastern regions of the community.

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