Exploring the Gender Gap in Erasmus Student Mobility Flows

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Abstract The present contribution aims at exploring the Erasmus student mobility flows across European countries given the relevant role played by the internationalisation process in the implementation of university policies. In particular, the main purpose is to confirm the presence of a gender gap across countries in the Erasmus programme according to the related literature. Mobility data and socio-demographic indicators are collected from the European Union Open Data Portal and the Eurostat website. Information on student flows are then considered to define network data structures in which the nodes are the countries and the incoming and outgoing links represent the number of students exchanged between countries. Results show that the number of females involved in Erasmus programme is greater than the number of males, even if the position of countries in terms of centrality scores in the network structure remains similar.

Keywords Gender gap · Erasmus student mobility · European open data · Network measures · Clustering

1 Introduction

The internationalisation could be defined as "the process of integrating an international, intercultural or global dimension into the purpose, functions or delivery of post-secondary education" [12]. Among others, the degree of internationalisation in higher education is measured by the reception of foreign students and the sending of students abroad. In fact, universities consider the number of foreign students

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they attract as an indicator of the attractiveness and the reputation of their education provisions.

The most famous mobility programme developed by the European Union (EU) to promote the exchange of cultural, professional and personal experiences within EU countries is the European Region Action Scheme for the Mobility of University Student, that is the Erasmus programme. The participation in this programme has increased from 3,000 participants in 1987 to 272,497 in 2013–2014, and within the new Erasmus+ for the period 2014–2020, the number of participants has increased to 796,761 for Key Action 1 in 2017.

The benefits of participating in study abroad programme are mainly related to the personal and professional growth of students. The development of learning experience with intercultural and linguistic improvement skills and the enhancement of job prospects and opportunities after graduation are the main factors explored for students involving in this international experience [1, 11, 13–15].

Within this scenario, the analysis of how gender might relate to the international student mobility trajectories is taken up by some authors, showing as female students are often overrepresented in Erasmus [2, 5]. This tendency of a "strong gender bias in favour of female students" is discussed in the recent contribution of De Benedictis and Leoni [see [9] and references therein].

The present contribution aims at analysing the gender (in)equality in Erasmus mobility by investigating if there exists any differences in incoming–outgoing flows of students between European countries in six academic years, from 2008–2009 to 2013–2014. To capture the structural features and patterns of Erasmus mobility flows by gender, the adoption of network measures [3, 4, 8] along with clustering techniques is able to identify groups of good importers and good exporters countries involved in this process.

The data under study are gathered from the European Union Open Data Portal, and network data structures are defined in order to analyse and describe relationships among countries. Moreover, educational indicators are collected from the Eurostat website to describe the investments of European countries in higher education in the period under analysis and to better clarify the role of each country in the internationalisation process of higher education system.

The contribution is organised as follows. Section 2 briefly describes the data and the methodological approach for exploring international student mobility data and country indicators. Section 3 reports the main findings and some suggestions for further developments.

2 Data and Methods

The data on Erasmus student mobility flows are downloaded by the official European Commission website on Erasmus-Statistics[1] for six academic years, from 2008–2009

[1] For details see https://data.europa.eu/euodp/en/data/publisher/eac.

Table 1 List of indicators gathered from the Eurostat website

Index
Enrolment in tertiary education
Expenditure on tertiary as a percentage of government expenditure on education
Net flow ratio of internationally mobile students (inbound - outbound)
School-age population, tertiary education
Government expenditure on education as a percentage of GDP
Gross enrolment ratio, tertiary education
Graduates from tertiary education
Expenditure on education as a percentage of total government expenditure
Government expenditure on tertiary education as a percentage of GDP
Teachers in tertiary education programmes
Inbound mobility rate
Expenditure on tertiary as a percentage of total government expenditure
Total outbound internationally mobile tertiary students studying abroad
Total inbound internationally mobile students
Outbound mobility ratio
Gross outbound enrolment ratio

to 2013–2014. Two types of Erasmus mobility of students enrolled at higher education institutions are collected: the *Student Mobility for Studies* (SMS) that enables students to spend a study period in another country, and the *Student Mobility for Placement* (SMP) that enables students to spend a placement period (traineeship or internship) in an enterprise/organisation in another country. The information available in the datasets are ID of sending and hosting Partner Erasmus; sending and hosting countries; students' gender; subject area code; type of mobility (SMS or SMP); level of study (first cycle, second cycle, third cycle and short cycle); duration of mobility in months.

The Erasmus data are used to defined network structures over time represented by a weighted digraph $\mathscr{G}(\mathscr{V}, \mathscr{L}, \mathscr{W})$, where $\mathscr{V}$ is the set of countries (vertices), $\mathscr{L} \subseteq \mathscr{V} \times \mathscr{V}$ is the set of arcs (directed lines) and $\mathscr{W}$ is the set of weights, $w : \mathscr{L} \to \Re$, i.e. the number of students exchanged between pairs of countries. The corresponding adjacency matrix $\mathbf{A}$ is both not symmetric, with a directed link from the origin country to the destination country, and weighted, with elements $a_{ij} = w(v_i, v_j) = w_{ij}$ greater than 0 if there is a link between country v_i and country v_j, and $a_{ij} = 0$ otherwise.

In addition, to inspect the attractiveness of universities, several indicators downloaded from the Eurostat website and related to specific features of the Tertiary Education System[2] are added as further information in the analysis (Table 1).

Social Network Analysis (SNA) tools and exploratory data analysis methods are then considered as a strategy of analysis to capture the structural characteristics and

[2]For details see https://ec.europa.eu/eurostat/statistics-explained/index.php.

patterns of student mobility flows in the Erasmus programme in order to confirm whether a gender gap exists. First, to study the temporal changes and the networks' characteristics for the six academic years under analysis, weighted directed adjacency matrices are defined. Each matrix describes the student's flows among countries involved in the Erasmus programme for each academic year by type of Erasmus programme and by gender. Then, to identify countries who play a central role, the hub and authority centrality scores [10] are adopted to determine which countries are good exporters (i.e. countries with good hub points to many other countries) and/or good importers (i.e. countries with a high authority score is linked by many different hubs). The peculiar structure of student mobility flows by gender is considered to discover potential differences in the Erasmus country destinations of males and females. Second, the network results are enriched by considering exploratory data analysis methods (i.e. principal component analysis and hierarchical clustering) applied to both higher educational indicators and network measures, to reveal connections between the roles played by countries in the student mobility network and their investments in education as a key element of institutions' attractiveness.

In Sect. 3, we report the main findings showing the trend of the Erasmus mobility, and the temporal changes and the networks' characteristics to underline the differences in Erasmus country destinations of males and females.[3]

3 Results

The Erasmus mobility networks have mainly changed in terms of number of students involved in the programme over time. In general, the number of males and females students who joined the Erasmus programme increased. A remarkable difference between the networks of SMS and SMP for males and females is observed. The number of students who moved for study is greater than the number of students who moved for placement. Moreover, the number of females who go abroad for study and for placement is greater than that of men. These results are shown in Table 2, where the distribution of Erasmus students by gender for SMS and SMP and over time is displayed.

In particular, the number of students goes up from 168,193 in 2008–2009 to 212,208 in 2013–2014 for the SMS network (+26.2%) and from 30,330 in 2008–2009 to 60,289 in 2013–2014 for the SMP (+98.8%) (Table 2). The number of women increases from 101,982 in 2008–2009 to 127,782 in 2013–2014 in SMS (+25.3%) and from 18,609 in 2008–2009 to 37,107 in 2013–2014 for the SMP (+99.4%). Then, the number of men becomes larger from 66,211 in 2008–2009 to 84,426 in 2013–2014 in SMS (+27.5%) and from 11,721 in 2008–2009 to 23,182 in 2013–2014 for the SMP (+97.8%) (Table 3).

[3]The analysis is performed by the open-source R packages "sna", "igraph" and "blockmodeling" [6, 7, 16].

Table 2 Distribution of Erasmus Student Mobility networks for Studies (SMS) and for Placement (SMP) by gender from 2008–2009 to 2013–2014

Year	Total number	#. of exchanges		% of females	
	of exchanges	SMS	SMP	SMS	SMP
2008–2009	198,523	168,193	30,330	60.6	61.4
2009–2010	213,266	177,705	35,561	61.1	60.9
2010–2011	231,408	190,495	40,913	60.9	61.8
2011–2012	252,827	204,744	48,083	60.6	61.1
2012–2013	268,143	212,522	55,621	60.6	61.9
2013–2014	272,497	212,208	60,289	60.2	61.6

Our elaboration based on *Erasmus Facts, Figures and Trends*, European Commission website

The structure of the temporal networks shows in the six academic years under analysis a little increase in terms of involved countries and links among them (Table 3). Specifically, the number of countries for the SMS and SMP networks increases from 31 in 2008–2009 to 33 and 34 in 2013–2014 for males and females. Moreover, for females the number of links goes up from 769 links in 2008–2009 to 896 links in 2013–2014 in the SMS network and from 591 links in 2008–2009 to 796 links in 2013–2014 for the SMP network. Then, for males the number of links goes up from 760 links in 2008–2009 to 874 links in 2013–2014 in the SMS network and from 569 links in 2008–2009 to 761 links in 2013–2014 for the SMP network.

Looking at the number of outgoing and incoming students, countries are classified as good exporters and/or good importers by means of the hub and authority network centrality indexes. These classifications are drawn up for males and females and for SMS and SMP. We note that the ranking for SMS network is stable across the years. In particular, Spain, France, United Kingdom, Italy and Germany are always the most favourite destinations. The other five positions (from 6 to 10) show a little change between males and females. For example, Denmark is a destination chosen by men in the first two years. The women prefer Belgium. This difference should be related to the fields of study. In fact, looking at the raw data for these two countries, it emerges that the males studied Economics and Engineering in Denmark, while the females went to Belgium to study Political Sciences, Foreign Languages and Health. This result is in line with those showed in [9], where the authors analysed the gender bias in Erasmus mobility by looking at the fields of study. For SMP network the ranking is stable over the period, also if we look at the gender level.

Then, for the SMS network, the best importing countries obtaining high values for authority scores are Spain, France and United Kingdom; while Germany and France show the highest hub scores. Looking at the gender level, it emerges that the best importing countries are different between females and males. In particular, for females Spain and France are always in the first two positions for all years, while for males only Spain confirms its first position, and the second position changes over the time. For almost all the years, Spain is both the best authority and hub country in the SMS network. In both rankings, Italy is always in the top five positions. In particular,

Table 3 Number of countries involved in the Erasmus Student Mobility networks for Studies (SMS) and for Placement (SMP) by gender from 2008–2009 to 2013–2014

	Female						Male					
Academic	Erasmus SMS			Erasmus SMP			Erasmus SMS			Erasmus SMP		
years	Countries	Links	Students	Countries	Links	Students	Countries	Links	Students	Countries	Links	Students
2008–2009	31	769	101,982	31	591	18,609	31	760	66,211	31	569	11,721
2009–2010	32	713	108,148	31	651	22,082	32	761	69,557	31	597	13,479
2010–2011	33	804	115,934	33	665	25,267	33	785	74,561	33	616	15,646
2011–2012	33	884	124,103	33	740	29,365	33	866	80,641	33	712	18,718
2012–2013	33	882	128,562	33	777	34,399	33	858	83,433	34	740	21,150
2013–2014	34	896	127,782	33	796	37,107	34	874	84,426	34	761	23,182

it is in a better position in the hub score rankings, showing a better exporting than importing behavior in the SMS network. Poland appears to be a good exporting country for both females and males. Moreover, in the last three years also Turkey enters in the top five positions.

Furthermore, for the SMP network, the rankings of countries obtained by the authorities scores show that the best importing countries for Erasmus placement are United Kingdom and Spain. Looking at the ranking with respect to gender, we see that the best two importing countries for females are United Kingdom and Spain, while for males the first two importing countries change in 2011–2012. In fact, United Kingdom is replaced by Germany. At the same time, the best exporting countries are France and Germany, showing the highest values of the hubs score. Italy has a marginal role in the SMP network, since it is between the fifth and -sixth position. Considering the ranking for females, we note that the best three exporting countries are France, Germany and United Kingdom, even if the order changes over the period considered. The three best countries for males are Denmark, Germany and Spain, except in last year when Italy ascends the ranking getting the third position.

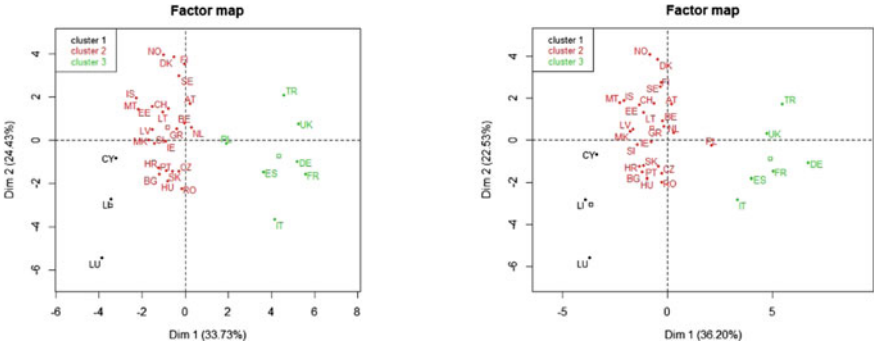
To better describe the structure of student mobility flows, Principal Component Analysis (PCA) and Hierarchical Clustering are performed on Erasmus data collected in the academic year 2013–14 by considering the hub and authority centrality measures and some indicators of Tertiary Education System described in Table 3. The analysis considers separately the type of Erasmus programme and the gender. Starting from the PCA results,[4] the agglomerative hierarchical clustering with Ward's criterion is performed to identify the presence of groups of countries. For all cases, *three clusters* have been identified (see Figs. 1 and 2).

The 34 countries joining the Erasmus programme for studies and for placement, considering males, are grouped as follows:

- *cluster 1* (7 countries): Germany, Spain, France, Italy, Poland, Turkey and the United Kingdom;
- *cluster 2* (24 countries): Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, Greece, Croatia, Hungary, Ireland, Iceland, Lithuania, Latvia, Macedonia, Malta, The Netherlands, Norway, Portugal, Romania, Sweden, Slovenia, Slovakia and Switzerland;
- *cluster 3* (3 countries): Cyprus, Liechtenstein and Luxembourg.

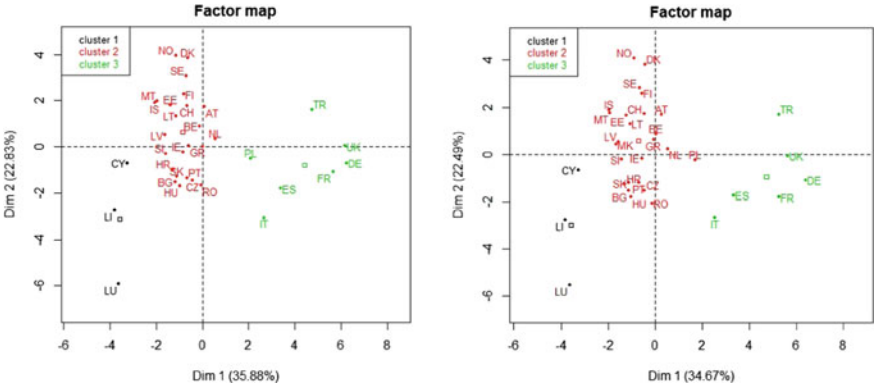
As for the females, there is a difference in the first and second cluster. For both -SMS and -SMP networks, Cluster 1 is made up of 6 countries, while cluster 2 of 25 countries. The country moving from cluster 1 to cluster 2 is Poland. However, the countries in *cluster 1* are the most central ones in the SMS and SMP networks for males and females, showing the highest hub and authority scores. The countries in *cluster 3* are the less central ones in the networks, showing the lowest scores. In *cluster 2* there are the less influential countries in the Erasmus programme, with hub and authority scores closer to 0.

[4]The results of PCA are available upon request.



(a) 2013-2014 - SMS - Female (b) 2013-2014 - SMS - Male

Fig. 1 Factorial map of the first two principal components on educational indicators in Erasmus student mobility for studies (SMS) for females and males. Countries are coloured according to the three clusters' solutions. AT = Austria; BE = Belgium; BG = Bulgaria; CH = Switzerland; CY = Cyprus; CZ = Czech Republic; DE = Germany; DK=Denmark; *EE* = Estonia; ES = Spain; FI = Finland; FR = France; GR = Greece; HR = Croatia; HU = Hungary; IE = Ireland; IS = Iceland; IT = Italy; LI = Liechtenstein; LT = Lithuania; LU = Luxembourg; LV = Latvia; MK = Macedonia; MT = Malta; NL = Netherlands; NO = Norway; PL = Poland; PT = Portugal; RO = Romania; SE = Sweden; SI = Slovenia; SK = Slovakia; TR = Turkey; UK = United Kingdom



(a) 2013-2014 - SMP - Female (b) 2013-2014 - SMP - Male

Fig. 2 Factorial map of the first two principal components on educational indicators in Erasmus Student Mobility for Studies (SMS) and for Placement (SMP) for females and males. Countries are coloured according to the three clusters' solutions. AT = Austria; BE = Belgium; BG = Bulgaria; CH = Switzerland; CY = Cyprus; CZ = Czech Republic; DE = Germany; DK = Denmark; *EE*=Estonia; ES = Spain; FI = Finland; FR = France; GR = Greece; HR = Croatia; HU = Hungary; IE = Ireland; IS = Iceland; IT = Italy; LI = Liechtenstein; LT = Lithuania; LU = Luxembourg; LV = Latvia; MK = Macedonia; MT = Malta; NL = Netherlands; NO = Norway; PL = Poland; PT = Portugal; RO = Romania; SE = Sweden; SI = Slovenia; SK = Slovakia; TR = Turkey; UK = United Kingdom

Summarising, even if the number of all students who joined the Erasmus programme increased from 2008–2009 to 2013–2014, we note that the number of females involved in the SMS and -SMP is greater than the number of males. This result is in line with the results reported in related literature. As a justification of this gender bias persisting over time across countries, we can consider the effect of the fields of study as discussed in De Benedictis and Leoni [9]. The authors using the same data of the EU open data portal but at university level justify the advantage of female participation over male in this programme given the denser network of connections involving female students. These latter prevail in fields such as Arts and Humanities, Education and Social Sciences, Journalism and Information; whereas the bias in favour of female students is strongly reduced in fields such as Information and Communication Technologies and Engineering, Manufacturing and Construction. The position of countries according to the hub and authority scores for SMS and SMP, instead, is similar at gender level.

As further lines of research, we are interested in analysing the configuration of Erasmus student network over time with respect to the attractiveness of each country to better investigate the gender gap in the internationalisation process, by adding some information on the tourism behavior in the European countries, such as number of trips, overnight stays, and the values for travel expenditures.

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