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Italian PhD students at the borders: the relationship between family background and international mobility

Valentina Tocchioni*  and Alessandra Petrucci

* Correspondence: valentina.tocchioni@unifi.it
University of Florence, viale Morgagni 59, 50134 Florence, Italy

Abstract

Previous literature has suggested that PhD students' mobility has become a fundamental step during doctoral studies, both for training purposes and for creating transnational research networks. In recent years, there has been a significant increase in migration of highly educated and highly skilled Italians. Most studies concentrate on employment-related characteristics of researchers' and scientists' mobility, largely neglecting other topics, such as family background characteristics of those who decide to study and go abroad. Using the Istat Survey on occupational conditions of PhD holders conducted in 2014 and 2018 in Italy, along with modelling using multinomial logistic regression analyses, we aim to investigate the relationship between family background characteristics and mobility during PhD studies according to different types of international stay. Our results show that both parental education and mother's economic activity are related to the propensity for studying abroad among PhD candidates, whereas father's social class seems to have a lower impact on this decision. The gap in doctoral mobility among PhD students with respect to socio-economic status seems also to vary according to the different types of stay abroad. Overall, our findings intend to shed light on potential disparities related to studying abroad among PhD students and their links to family background, which may have future repercussions on students' occupational prospects.

Keywords: PhD students, International mobility, Family background, Higher education, Multinomial logistic regression, Italy

Introduction

Mobility involves the movement of people willing to improve their chances in education, occupational opportunities and quality of life (Michalos, 1997). In recent years, international academic mobility has been increasing among undergraduate, graduate and PhD students, as well as researchers and scientists around the world.

At the macro level, highly educated young people represent several short- and long-term gains for institutions and countries, which are increasingly seeking to recruit international students and retain them after graduation (Avveduto, 2012). At the micro



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level, empirical evidence in academic mobility has suggested that the international migration of educated and skilled people can have positive effects on their future employment prospects and careers, leading to higher salaries and better roles (Ermini et al., 2019). As a consequence, occupational prospects and careers may differ between those who have pursued an experience abroad and those who studied only in their home country. In this respect, international mobility has become a fundamental step in curriculums for PhD students, with implied impacts on the quality of the doctoral project and significance for the long-term investment in an academic career (Avveduto, 2001; Kim, 2010, 2017).

In Italy, the number of PhDs awarded has increased more than the demand for PhD holders, because the country lacks the economic and financial resources to fully employ researchers' and scientists' skills and knowledge. The job supply for highly skilled workers is scant amid the myriad of small-scale enterprises in the private sector, for which a PhD qualification offers few—in some cases, zero—advantages. In this context, mobility of PhD holders may be even more important, given the growing competition for finding a job related to their training and acquiring access within academia (Ballarino & Colombo, 2010). Despite the rising importance of doctoral mobility, international mobility *during* PhD studies is an under-studied phenomenon, as most studies tend to concentrate on graduates' and PhD holders' mobility (Ermini et al., 2019; Panichella, 2013).

Another shortcoming in the literature concerns *family background* of those who study abroad, which is frequently overlooked among the possible characteristics that affect mobility. Nevertheless, it is well acknowledged that family background characteristics—particularly parental education—affect children's school performances and occupational prospects (Boudon, 1974; Breen & Müller, 2020; Jackson, 2013). Similarly, the expansion of PhD programmes in Italy has not been accompanied by an "equalisation", that is, by a decrease in inequalities among educational opportunities for students belonging to different social strata (Argentin et al., 2015). In this respect, highly educated parents, having specific educational resources to help their children with informed guidance through the education system (Boudon, 1974), may support PhD students' mobility and thus have a positive impact on their future professions.

In this paper, using data on the professional conditions of PhD holders who obtained their qualification in an Italian athenaeum from 2008 to 2014, we shed light on potential disparities in *credit mobility* during PhD studies, namely sojourns abroad shorter than the full PhD programme. Concentrating on the propensity to study or to do research abroad for a visiting period during PhD studies, we verify if parental SES, which is operationalised with parental education, mother's economic condition and father's social class, is associated with a higher or lower mobility of Italian PhD students after controlling for possible confounders. Furthermore, we investigate if and how the relationship between PhD students' family background characteristics and the propensity for international mobility varies according to the different types of stay planned in their PhD programmes.

To our knowledge, scarce information is available about the relationship between PhD students' family background characteristics and their mobility; this paper intends to bridge this gap and shed light on if and how higher parental socio-economic status

may favour students at the top of the higher educational system in their international mobility.

Background

Highly educated people's mobility in a globalised world

International academic mobility has grown increasingly importance in the global higher education landscape (Verbik & Lasanowski, 2007), because of its recognised positive effects both at the macro and micro levels. According to human capital theory (Becker, 2009; Schultz, 1971), the prosperity of a country is strongly affected by its citizens' education and skills, as well as its quality of human resources. In light of this, an increase in skilled demand creates an incentive for improvements in higher education and, broadly speaking, for a country's economy. Following this line, governments around the world have begun to adopt specific policies to attract foreign talents whilst also retaining local workers. In the *brain-gain* process (Boeri et al., 2012; Straubhaar, 2000), international students bring potential for several short- and long-term gains for their hosting institutions and countries. In the short term, with public funding for higher education decreasing in many countries, universities are looking to diversify their generated income, aspiring towards the revenue earned from foreign students. In the long term, and in the wider socio-economic context, developed countries are looking to attract foreign skilled labour to supplement their rapidly decreasing and ageing populations (Verbik & Lasanowski, 2007). However, some countries suffer by their scant ability to attract or retain highly educated individuals, leading to the loss of highly educated and highly skilled people (Morano-Foadi, 2005; OECD, 2001). This *brain-drain* process is even harder for sending countries with publicly funded education systems, which invest in PhD programmes with the purpose of improving human capital and promoting the economic and social development within the country.

At the micro level, the international migration of educated and skilled people can be driven by several factors, where both personal motivations and the characteristics of the economic environment of the host country play a key role. Highly educated people and students can be pushed to leave their home country to seek better career and life opportunities if there is a lack of prospects in their home country. They may aspire to higher wages, to better life conditions and quality of life, or to improve their human capital (Bartolini et al., 2017; Solimano, 2008). As a result of their movement, PhD holders and highly skilled workers have a wage premium, especially when pursuing careers not related to R&D or academia (Di Cintio & Grassi, 2017; Ermini et al., 2019; Marini, 2019).

For doctoral students, mobility becomes part of their curriculum; it is believed to have a direct impact on the quality of the doctoral project itself. This understanding can result from technical knowledge gain, whereby mobility provides access to different or better research facilities (Ackers et al., 2008; Avveduto, 2001), or from the early accrual of transnational academic capital, which includes transnational networks and modes of thinking (Kim, 2010, 2017). Funding for doctoral researchers to engage in international academic mobility is judged

also to have the indirect benefit of promoting future mobility (Netz & Jaksztat, 2014; Saint-Blancat, 2018). Thus, an investment in doctoral mobility is not just an investment in the quality of the doctoral research output; it is a long-term investment in the internationalisation of research and higher education.

Family background and academic mobility in Italy

In the literature, it is acknowledged that highly educated and highly skilled people are more prone towards mobility compared to unskilled people (Fratesi & Percoco, 2014) and that they receive material and immaterial benefits from this mobility (Bartolini et al., 2017; Ermini et al., 2019). But among highly educated students, which are most likely to pursue mobility? The literature identifies both individual resources and family background as features related to students' mobility at different levels of education. Whilst individual resources are universally accepted in influencing students' mobility (Tosi et al., 2019), agreement on the relationship between family background and students' mobility is less straightforward. Highly educated parents have specific educational resources to help their children with informed guidance through the education system (Boudon, 1974), which could suggest a positive association between parental education and mobility. Upper-class families are also well informed about university education and have access to better-quality information concerning the labour market; students from these families are, therefore, in a better position to select the most rewarding educational options (Morgan, 2005; Usher, 2005).

On the other hand, some studies posit that mobility may act as means of social upward especially for those with low family resources (Mariani, 2006; Scarlato, 2007). In the Italian context, a family's social networks are usually a resource for their children's occupational prospects, with parental education playing a decisive role in children's earnings, especially in the southern part of the country (Checchi & Peragine, 2005). As a consequence, young people with high educational attainment and strong individual resources may have greater chances to migrate from a patronage context (Mariani, 2006; Scarlato, 2007) than those young people who can count on parental resources.

Empirical studies on the topic have found that parental education plays a key role in shaping the propensity for interregional migration among high school graduates (Tosi et al., 2019), college graduates (Impicciatore & Tuorto, 2011) and PhD holders (Ruiu et al., 2019). Conversely, Capuano (2012) found no association between parental education and college students' mobility; she also uncovered a lower propensity towards mobility among students whose parents are highly successful whilst self-employed. College students with higher-grade professional parents, instead, have a higher propensity to pursue interregional opportunities (Impicciatore & Tuorto, 2011). Additionally, social class has an impact on college graduates' interregional migration (e.g. Impicciatore & Tuorto, 2011; Panichella, 2013).

With respect to PhD students' mobility, to the best of our knowledge, no systematic study has investigated Italian doctoral students' mobility during PhD programmes, whereas a handful of empirical studies have concentrated on graduates' mobility (e.g. Assirelli et al., 2019; D'Agostino et al., 2019; Panichella, 2013) and PhD holders' interregional mobility (see e.g. Ermini et al., 2019; Ruiu et al., 2019). The majority of studies deal with wage penalties and economic and financial consequences of highly educated

and highly skilled people's mobility and tend to ignore family background characteristics of those who study abroad and those who remain in Italy (Ghosh & Grassi, 2020). In a recent article, Assirelli et al. (2019) show how graduates benefit from international mobility in terms of wages, unemployment risks, access to skilled employment and career satisfaction. In this study, it emerges that higher parental occupational class is associated with a higher mobility of graduates; nevertheless, parental class is introduced as a control variable and does not represent the main objective of this work.

Furthermore, social origin and education have been investigated deeply in Western countries, but most concentrate on other aspects of this relationship, such as students' performance, access to tertiary education, school dropout rates and fields of study (e.g. Argentin & Triventi, 2011; Triventi et al., 2017). In our paper, we posit that family background may have an impact on PhD students' mobility, which may in turn cause better or worse occupational prospects. In this respect, concentrating on the relationship between PhD students' mobility and their earnings may be considered a further step. Before proceeding to analyse the association between PhDs' mobility and their incomes, the relationship between family background and PhD students' mobility should be accounted for. Nowadays, doctoral mobility is framed as an imperative for future career success (Henderson, 2019), which tends to improve occupational prospects of those involved in international academic mobility and, conversely, to penalise those who do not move abroad, even for short, time-limited periods. Even more, PhD students' international mobility is *expected* by academic senior colleagues (Henderson, 2019). Being aware of that expectation is fundamental for future career success of those who reach the highest level of education.

The Italian higher education system

In Italy, the higher educational system is mainly public; university reputation is less important in Italy than in other countries with more differentiated university systems, but it also has a few prestigious private institutions. Qualifications have the same "legal value", regardless of the institution delivering the degree (Agasisti, 2009; Cattaneo et al., 2017). Since the implementation of the EU's "Bologna process" in 2001, students attend a 3-year bachelor's programme followed by a 2-year master's programme, excluding a few highly technical programmes, such as pharmaceutical and medical schools, that still last 5 or 6 years. Students choose a field of study and have limited possibilities for personalising their course load. Except for private institutions, which set their own fees, tuition costs are relatively low and depend on per-capita household income with limited variation across institutions (Cattaneo et al., 2017), which is designed to favour enrolment for students from all social strata.

PhD studies were introduced in Italy in the 1980s, but they received increased incentive through the Bologna process in the 2000s, resulting in an increased number of positions and PhD programmes offered (Ballarino & Colombo, 2010). Whilst only 4078 PhD students defended their dissertation in 2000, the number was 9803 in 2016, and the highest year on record was 11,459 in 2014 (Istat, 2018). Although this increases in recent years, the number of PhD students enrolled in Italy is still lower than that in other European countries such as in Germany and in the UK (see Table 1). Most of PhDs awarded are in Medicine (15.6% of all PhDs awarded) and in Industrial and Information Engineering (12.5%: see Fig. 1).

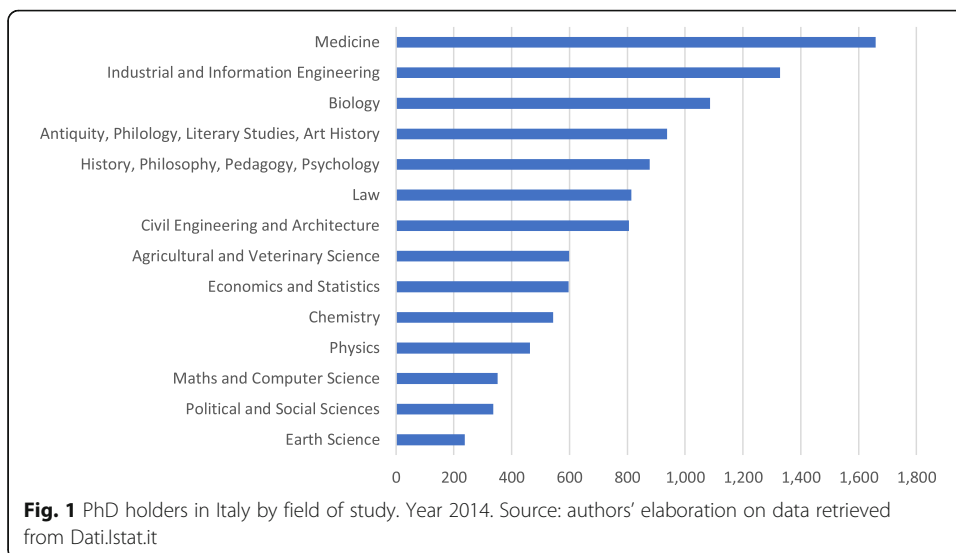
Table 1 Number of students enrolled in ISCED level 8 programmes (namely, doctoral or equivalent level) in selected European countries. Years 2014–2018

	2014	2015	2016	2017	2018
France	68,938	68,607	67,679	66,855	66,096
Germany	214,700	196,200	197,000	198,300	200,400
Italy	33,512	32,775	32,947	27,729	28,338
Spain	24,317	32,062	55,628	71,548	85,480
UK	111,395	112,800	113,003	112,289	111,257
Poland	43,358	43,399	43,177	43,181	41,318

Source: UNESCO

However, in recent years, the number of PhDs awarded has exceeded the demand for PhD holders in Italy. Finding work in universities has become more difficult amid a contraction in the number of open academic positions (Di Cintio & Grassi, 2017). Both processes have produced growing competition for PhD holders to find a job related to their training and to access academia (Ballarino & Colombo, 2010), thus incentivising both interregional and international mobility of PhD holders. Among PhD holders who defended their dissertation in 2004 or 2006, 7% resided abroad in 2009–2010; in 2018, this percentage increased to 17.2% among those who defended their dissertation in 2012 or 2014. In addition, a third of these PhD holders who defended in 2012 and 2014 had a stay abroad also before completing their PhD studies. Foreigners who chose an Italian PhD programme also increased over a similar period: 2.2% of PhD students who defended their dissertation in Italy in 2004 were international students, which climbed to 10.1% in 2014 (Istat, 2018).

Added to the scarcity of high-skilled jobs in Italy, another incentive for international mobility among PhD holders is the training experiences available during PhD studies abroad. Training abroad during the doctoral years has increasingly become a key element in both academic and professional development (Avveduto, 2001; Guth & Gill, 2008). Nowadays, the importance of international experience within PhD programmes has been explicitly recognised by the National Research Program 2015–2020 for



strengthening the integration of research in the international context. In this respect, some PhD programmes consider training abroad as a mandatory experience during PhD studies; others award an additional scholarship to incentivise a study term at a foreign university. International training has been increasing over the last decade: whereas 27.9% of PhD students studied abroad during their PhD work among those who defended in 2004, this percentage increased to 44.6% a decade after. Among those who had an experience abroad and defended in 2012 or 2014, one out of five lived abroad in 2018, whereas just one out of ten lived abroad among those who did not study abroad during their PhD work (Istat, 2018).

Research objectives

There is growing concern that mobility during PhD studies is a crucial and fundamental step in PhD students' education and training. Nevertheless, not all PhD programmes have the same approach towards mobility during doctoral studies. Whereas a period spent abroad is mandatory in some programmes, in others, it may be on a voluntary basis; in the latter case, PhD students who study abroad may receive additional funding. In this respect, it is crucial to acknowledge any association between family background characteristics and PhD students' mobility according to the type of mobility proposed by the PhD programme.

Our work intends to investigate whether and how family background characteristics and PhD students' mobility are associated, distinguishing between facultative and financed stays and facultative and non-financed. Indeed, highly educated parents might be more concerned about the importance of having an experience abroad for future occupational prospects compared to less educated parents; thus, they could encourage their adult children to study abroad for a facultative and financed period. Greater financial resources of parents in higher social classes could be more crucial for facultative and non-financed studies abroad. Thus, we may suppose a different propensity in PhD students' mobility with respect to family background characteristics and the type of stay proposed by PhD programmes. Whilst no difference may be hypothesised among PhD students completing a mandatory period abroad¹, a higher propensity to take on facultative and financed stays may be associated with PhD students who have highly educated parents or who belong to a higher social class, and this relationship may even be more marked for facultative and non-financed stays.

In our context, highly educated parents' and upper-class families' "information advantage" could be translated into their awareness of the importance of international mobility, thus supposing a *direct effect* of family background on mobility through better-quality information. Even more, those families are also the ones with higher financial resources; thus, they can easily support economically their children during their stay abroad, thus outlining a second, *direct effect* of family background on mobility through higher financial resources. Finally, upper-class families with adequate financial resources could opt for enrolling their children in the most prestigious universities; this choice might trigger an *indirect effect*, according to which their children might be more prone towards international mobility thanks to the importance given to

¹Given our objectives, we excluded those PhD students who went abroad for a mandatory stay from the sample.

internationalisation by their universities. Unfortunately, the information collected does not permit us to distinguish the various direct and indirect effects that may play in influencing the relationship between family background characteristics and PhD students' mobility, but only to advance some hypotheses.

Hence, concentrating on family background characteristics as a source of guidance through the education system and the different types to stays abroad during PhD studies, we create four profiles of PhD students differing for their family background characteristics and ranging from a low SES profile to a high SES profile and verify the relationship between the four profiles of family SES and the probability of studying abroad for a financed or non-financed stay.

Data and methods

Data

This study draws on retrospective micro-data. Namely, our source of information on socio-demographic characteristics and academic mobility is the "PhD graduates vocational integration" survey conducted by Istat². The first edition of these surveys was conducted in 2009–2010 by contacting all PhD holders who had obtained their qualification from an Italian academic institute in 2004 and 2006. The subsequent version of the survey contacted all PhD holders that achieved their Italian doctoral degree in 2008 and 2010. Finally, PhD holders who obtained their Italian qualification in 2012 and 2014 were surveyed in 2018. Response rates of these three surveys were around 70%: over a population of 18,568 PhD holders in 2004 and 2006, 69.8% (12,964) participated in the survey; 72.6% (16,322) of over 22,469 PhD holders in 2008 and 2010 responded in 2014; and among 22,099 PhD holders in 2012 and 2014, 72.7% (16,057) completed the interview in 2018. All editions of the survey have not interviewed those who decided to obtain a PhD qualification in a foreign athenaeum; for this reason, we focused only on *credit mobility*, lacking information about Italian PhD students who pursued a *degree mobility*.

Our sample included respondents who were interviewed in the two most recent editions of the survey, because the response variable about a period spent abroad during PhD studies was collected differently in the 2009–2010 edition.³ Then, we excluded foreign PhD students, because they were too few to allow for a separate analysis.⁴ After merging the two data sources, the final sample was constituted by 28,496 PhD holders who defended their dissertation between 2008 and 2014, of which 14,687 were interviewed in 2014 and 13,809 were interviewed in 2018.⁵ Among them, 10,073 (35.4%) spent a facultative period abroad during their PhD studies⁶. This percentage slightly increased over time, from 34.2% among PhD holders who defended their dissertation in 2008 to 36.8% among those who defended their dissertation in 2014. When considering the different types of stays, 7564 (75.1% of all PhD students who went abroad) pursued a facultative and financed stay; and 2509 (24.9%) went abroad for a facultative and non-

²The original name of the survey (in Italian) is "Indagine sull'inserimento professionale dei dottori di ricerca".

³In the 2009–2010 survey, the question about spending time abroad stipulated a minimum length of 4 weeks. In the two subsequent surveys, no temporal limitation was imposed.

⁴Interviewed foreign PhD students numbered only 388 (2.4%) in 2014 and 625 (3.9%) in 2018.

⁵We excluded 25 PhD students who did not report their university.

⁶We excluded 2845 PhD students who completed a mandatory stay abroad, because international mobility could not be considered as an individual choice for them.

financed stay. The preferred destination was the USA, where 1 out of 5 PhD students spent their stay (20.5%), followed by the UK (16.4%). Overall, more than 6 out of 10 PhD students studied in a country within the European Union (64.0%).

Key variables and descriptive statistics

Table 2 shows descriptive statistics about the PhD students. The framework is categorised into three modalities: (1) the student did not study abroad (namely, s/he remained in Italy); (2) the student spent a facultative stay abroad, financed by the university; and (3) the student spent a facultative stay abroad, not financed by the university.

The key explanatory variables include three variables that describe PhD students' SES, namely, parental educational attainment, mother's economic activity and father's social class.⁷ Education is divided into four categories which represent the highest educational attainment between the two parents: primary or lower, lower secondary, upper secondary and tertiary/post-tertiary.⁸ Many PhD students had at least one parent with a tertiary education (41.1%), but at least one parent with upper secondary education is also common in the sample (35.9%). Students whose parents were both primary educated are overrepresented among those who did not complete studies abroad (75.2% of students). On the other hand, PhD students whose mother and/or father was tertiary educated were more likely to spend a period abroad (overall, 37.9%), even if not financed (9.7%). Between the two possibilities of doctoral mobility, most students who studied abroad completed a facultative and financed stay. However, students whose parents were both primary educated still had this opportunity to a lower extent (17.3%) than other PhD students.

Mother's economic activity considers if she was an employee/self-employed, a homemaker, retired or in another condition. Most PhD students had a mother who worked (56.0%), or who was a homemaker (32.5%). Lower mobility was identified among PhD students whose mothers were homemakers (68.2% of them did not study abroad), whereas PhD students whose mothers worked or were retired were more prone to study abroad.

Finally, father's social class is classified according to EGP-class typology aggregated in a five-category classification (Goldthorpe & Erikson, 1992): higher-grade professionals, lower-grade professionals, routine non-manuals, self-employed and working class (skilled/unskilled), with a residual sixth category for those whose social class is unknown.⁹ PhD students showed high percentages among better socio-economic positions, namely, fathers who were lower-grade professionals (36.8%), followed by self-employed (21.4%) and higher-grade professionals (20.0%). According to these findings, PhD students whose fathers were higher-grade professionals had the highest probability

⁷These variables were collected when students first enrolled in university. We opted to merge mother's and father's education into one variable because they were correlated (Spearman correlation coefficient was equal to 0.64). Correlations between the other variables were lower: correlation between parental education and father's social class (mother's economic activity) was -0.43 (-0.23), and correlation between father's social class and mother's economic activity was 0.15.

⁸When mother's (father's) education was not reported, we categorised parental education according to the other parent's education; overall, 175 PhD students (0.61% of the total sample) did not report either mother's or father's education and were categorised with an unknown category.

⁹The question about father's social class included answers from respondents whose father did not work (because of retirement, unemployment or inactivity) at the interview date.

Table 2 PhD students by their type of stay and individual and contextual characteristics. Absolute and raw percentage values

	Remained in Italy		Study abroad				Total
			Facultative and financed stay		Facultative and non-financed stay		
Parental education							
<i>Primary</i>	1412	(75.2)	325	(17.3)	141	(7.5)	1878
<i>Lower secondary</i>	3076	(66.4)	1166	(25.2)	391	(8.4)	4633
<i>Upper secondary</i>	6553	(64.5)	2766	(27.2)	837	(8.2)	10,156
<i>Tertiary/post-tertiary</i>	7242	(62.1)	3283	(28.2)	1129	(9.7)	11,654
<i>Unknown</i>	140		24		11		175
Mother's economic activity							
<i>Employed/self-employed</i>	9977	(62.5)	4547	(28.5)	1426	(8.9)	15,950
<i>Homemaker</i>	6318	(68.2)	2180	(23.5)	769	(8.3)	9267
<i>Retired</i>	1363	(63.4)	578	(26.9)	209	(9.7)	2150
<i>Other conditions</i>	765	(67.8)	259	(22.9)	105	(9.3)	1129
Father's social class							
<i>Higher-grade professional</i>	3369	(63.8)	1345	(25.5)	571	(10.8)	5285
<i>Lower-grade professional</i>	6137	(63.3)	2729	(28.1)	836	(8.6)	9702
<i>Routine non-manual</i>	1229	(66.2)	488	(26.3)	139	(7.5)	1856
<i>Self-employed</i>	3657	(64.9)	1481	(26.3)	498	(8.8)	5636
<i>Working class (skilled/unskilled worker)</i>	2570	(65.8)	1038	(26.6)	299	(7.7)	3907
<i>Unknown social class</i>	1461		483		166		2110
Gender							
<i>Male</i>	8286	(61.8)	3870	(28.9)	1245	(9.3)	13,401
<i>Female</i>	10,137	(67.2)	3694	(24.5)	1264	(8.4)	15,095
Student's main source of earnings							
<i>Full scholarship</i>	10,505	(58.5)	6293	(35.0)	1176	(6.5)	17,974
<i>Partial scholarship</i>	1031	(67.5)	351	(23.0)	145	(9.5)	1527
<i>Research grant</i>	906	(69.4)	241	(18.5)	158	(12.1)	1305
<i>Other grants from the same university</i>	712	(70.9)	170	(16.9)	123	(12.2)	1005
<i>Earnings outside university</i>	4306	(80.0)	367	(6.8)	709	(13.2)	5382
<i>No source of earning</i>	963	(73.9)	142	(10.9)	198	(15.2)	1303
Macro-area of athenaeum							
<i>North</i>	6906	(59.9)	3628	(31.5)	1000	(8.7)	11,534
<i>Centre</i>	5665	(66.8)	2020	(23.8)	794	(9.4)	8479
<i>South/Islands</i>	5852	(69.0)	1916	(22.6)	715	(8.4)	8483
Interregional move for PhD studies							
<i>No</i>	14,274	(65.9)	5716	(26.4)	1686	(7.8)	21,676
<i>Yes</i>	4149	(60.8)	1848	(27.1)	823	(12.1)	6820
Year of PhD dissertation							
<i>2008</i>	4740	(65.9)	1865	(25.9)	593	(8.2)	7198
<i>2010</i>	4905	(65.5)	1991	(26.6)	593	(7.9)	7489
<i>2012</i>	4587	(63.9)	1906	(26.6)	684	(9.5)	7177
<i>2014</i>	4191	(63.2)	1802	(27.2)	639	(9.6)	6632
Field of study							
<i>Science and Engineering</i>	5715	(59.2)	3326	(34.4)	617	(6.4)	9658

Table 2 PhD students by their type of stay and individual and contextual characteristics. Absolute and raw percentage values (*Continued*)

	Remained in Italy		Study abroad				Total
			Facultative and financed stay		Facultative and non-financed stay		
<i>Life Science</i>	6643	(72.5)	1882	(20.5)	641	(7.0)	9166
<i>Social Science and Humanities</i>	6065	(62.7)	2356	(24.4)	1251	(12.9)	9672
Total	18,423	(64.7)	7564	(26.5)	2509	(8.8)	28,496

Authors' elaboration on the Istat Survey on occupational conditions of PhD holders. Years 2014 and 2018

of a facultative and non-financed stay among the four groups (10.8%), whereas PhD students whose fathers were routine non-manuals or working class had the highest probability of remaining in Italy (66.2 and 65.8%, respectively). The differences were modest among the various social classes (only 2.9%).

Method: the multinomial logistic regression

When the response variable is nominal, ad hoc models, which are the extension of logistic regression models with more than two categories, have been developed. In particular, if the response variable is nominal, such a variable with J categories has a multinomial distribution, $\Pr(Y = y_j) = \pi_j$, of $J-1$ dimension, because there is one redundant probability ($\pi_1 + \pi_2 + \dots + \pi_J = 1$). For models of this kind, the order of the categories is irrelevant, because they are unordered (Agresti, 2003).

The multinomial logistic regression model is formed by $J-1$ equations, with separate parameters for each; the last J th category is considered as the baseline category and is used for pairing each of the remaining $J-1$ categories to it. In this way, each equation has the form:

$$\log\left(\frac{\pi_j}{\pi_J}\right) = \alpha_j + \beta_j X$$

where:

- π_j is the probability of the j th category and π_J is the probability of the last, J th category
- α_j is the intercept for the j th equation (namely, for the j th category)
- X is the vector of covariates for the j th equation
- β_j is the vector of regression coefficients for the j th equation

Usually, estimates of the model parameters are fitted simultaneously for all equations (Agresti, 2003).

Analytical strategy

We studied PhD students' propensity to study abroad using a multinomial logistic regression model, with standard errors clustered at the field of study. The response variable is a nominal variable that indicates whether the student remained in Italy during doctoral studies (1), which is the reference category, or if s/he went, whether the stay abroad was financed (2) or non-financed (3).

Following a stepwise procedure, first, we estimated the probability of remaining in Italy or studying abroad in one of the two different situations according to parental educational attainment (Model 1); second, we included mother's economic activity (Model 2) and, third, father's social class (Model 3) verifying with goodness-of-fit measures if the models improved with the inclusion of these explanatory variables; and fourth, we added all control variables in our model (Model 4). In particular, we included several controls about PhD student's individual characteristics, such as his/her gender (because men tend to move more frequently than women: Tosi et al., 2019); his/her main source of earnings, which could play a fundamental role in moving abroad (with the following categories: full scholarship for the whole PhD programme; partial scholarship—for a shorter period of the PhD programme; research grant; other grants from the same university; earnings outside the university; no source of earnings); and if the student completed his/her PhD studies at a university outside of his/her region of residence, as mobility increases mobility (Assirelli et al., 2019). Moreover, we added some controls about PhD programme, such as the macro-area where the athenaeum was located (North; Centre; South/Islands), the calendar year of his/her PhD dissertation (2008; 2010; 2012; 2014) and PhD student's field of study¹⁰ (distinguishing among Science and Engineering; Life Science; Social Science and Humanities), given that mobility tends to be higher in fields with more easily transferable skills (e.g. scientific fields) than in others (Assirelli et al., 2019).

Results

To aid interpretation, we estimate predicted probabilities of mobility during PhD studies and present them graphically. Full model results are presented in [Appendix Table 4](#). [Figure 2](#) shows the confidence intervals at 83% of predicted probabilities of not moving abroad during PhD studies (hence, of remaining in Italy for the whole PhD programme) according to family background characteristics from Model 4 (see Goldstein & Healy, 1995, for details on the graphical representation of confidence intervals). Predicted probabilities of remaining in Italy decrease with parental educational attainment, passing from 65.6% for PhD students with tertiary educated parents to 78.7% among PhD students with primary educated parents, and the confidence intervals do not overlap. Whilst the difference in predicted probabilities of remaining in Italy between PhD candidates with tertiary educated parents and at most lower secondary educated parents is restrained (4.3%), it becomes very high when comparing PhD students with primary educated parents against all other PhD candidates (the gap goes from 8.7% with students with at most lower secondary educated parents to 13.1% with students with at least one tertiary educated parent).

According to mother's economic activity, the predicted probability of remaining in Italy is lowest for students whose mother was employed or retired (65.9% and 67.2%, respectively), whereas it is highest for students whose mother was a homemaker (71.8%). Despite the difference in predicted probabilities is quite small (5.9% at most), confidence intervals of predicted probability of remaining in Italy do not overlap except

¹⁰Unfortunately, the survey did not collect other information about the features of PhD programme, as well as we did not know the athenaeum where the PhD student was enrolled.

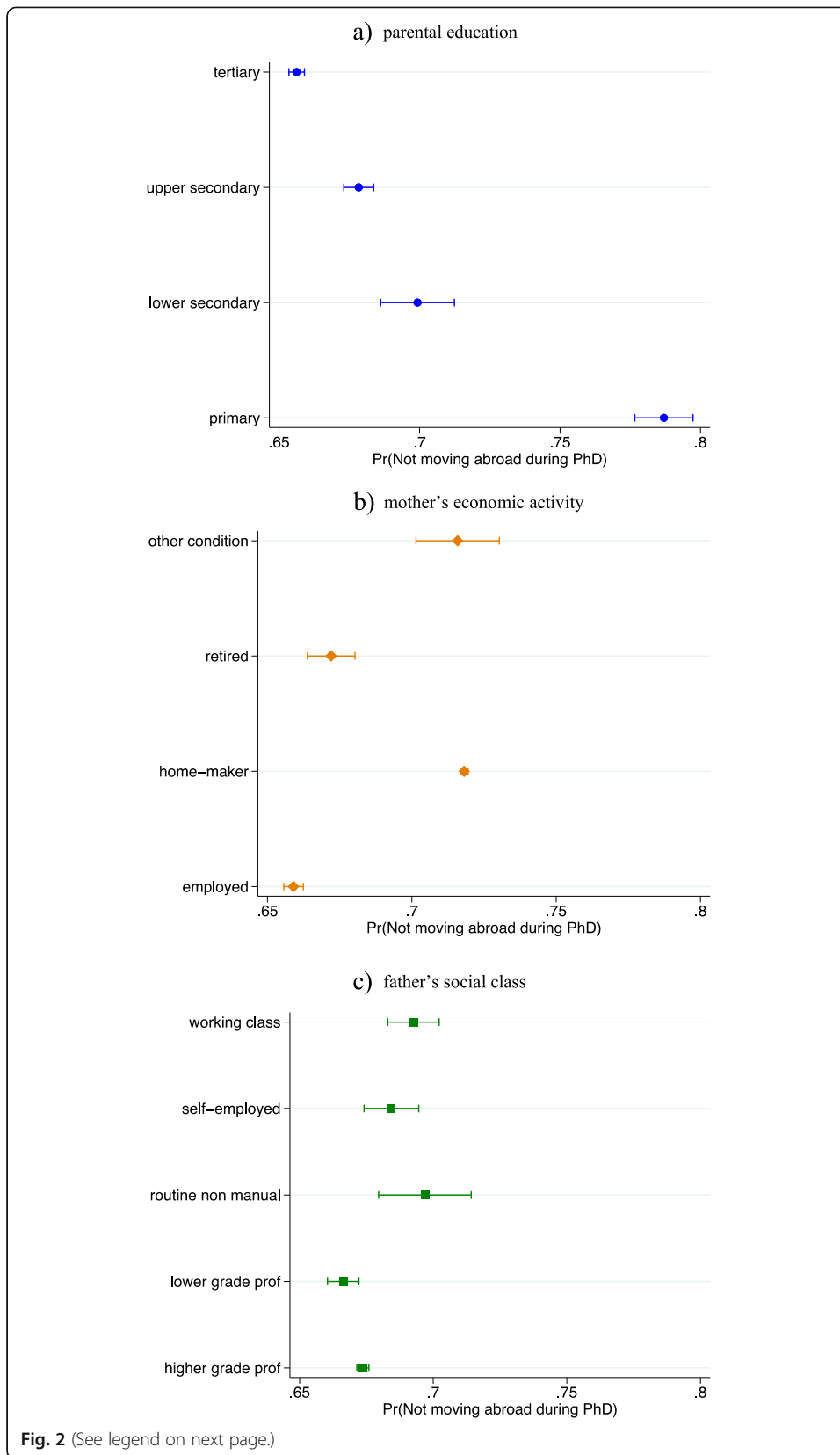


Fig. 2 (See legend on next page.)

(See figure on previous page.)

Fig. 2 Results from Model 4: predicted probabilities of not moving abroad during PhD studies according to parental education, mother's economic activity and father's social class. CI 83%. Source: Istat Survey on occupational conditions of Italian PhD holders. Years 2014 and 2018. Note: To estimate predicted probabilities, the family background covariate under control is allowed to vary, whilst the remaining family background covariates, as well as controls (student gender, scholarship availability, year of PhD defence, macro-area of athenaeum, if the university is outside student's region of residence, field of study), are kept at the mean value

for PhD students with mothers who were homemakers or in another economic condition.

Finally, predicted probabilities of remaining in Italy vary only slightly with respect to father's social class, moving from the lowest for PhD students whose father was a lower-grade professional (66.6%) to the highest for those whose father belonged to the working class (69.2%). Overlapping confidence intervals divide the predicted probabilities of remaining in Italy for PhD students in two macro-categories of father's social class: fathers who were a higher- or a lower-grade professional and fathers who were self-employed, a routine non-manual or working class.

Figure 3 shows confidence intervals at 83% of predicted probabilities of studying abroad for (a) a facultative and financed stay or (b) a facultative and non-financed stay (from Model 4) according to four profiles differing for their SES, presented in Table 3 with their numerosity (see also Appendix Table 4 for full model results).

Generally speaking, predicted probabilities of studying abroad increase as the parental status of the PhD student increases. However, some differences remain between the two types of stay. Predicted probabilities of studying abroad for a facultative and financed stay (see Fig. 3a) vary from 17.4% for the low SES profile (profile A) to 24.5% for the medium-high SES profile (profile C). Apart from the low SES profile whose confidence intervals do not overlap with the others, the remaining three profiles—from medium-low to high SES—have a similar propensity towards international mobility for a facultative and financed stay (with paired confidence intervals). Figure 3b displays predicted probabilities of going abroad for a facultative and non-financed stay, which range from 6.5% among the low-status profile (profile A) to 10.3% for the high-status profile (profile D). In this case, confidence intervals overlap between adjacent profiles in all except the highest socio-economic status, which appears isolated in the graph.

The stepwise procedure reveals that all three family background covariates improved the model fitting (see AIC and BIC measures reported in Table 4 in the Appendix). For parental education, both PhD students with tertiary educated or primary educated parents significantly differ from the reference category (namely, PhD students with upper secondary educated parents); even if the estimates change once introduced all controls (Model 4), the significance of the estimated coefficients remains the same both for a financed stay and a non-financed stay.

When looking at the economic aspects of the family of origin (represented by mother's economic activity and father's social class), a few coefficients are significant, once controlled for parental education, and in particular when estimating the

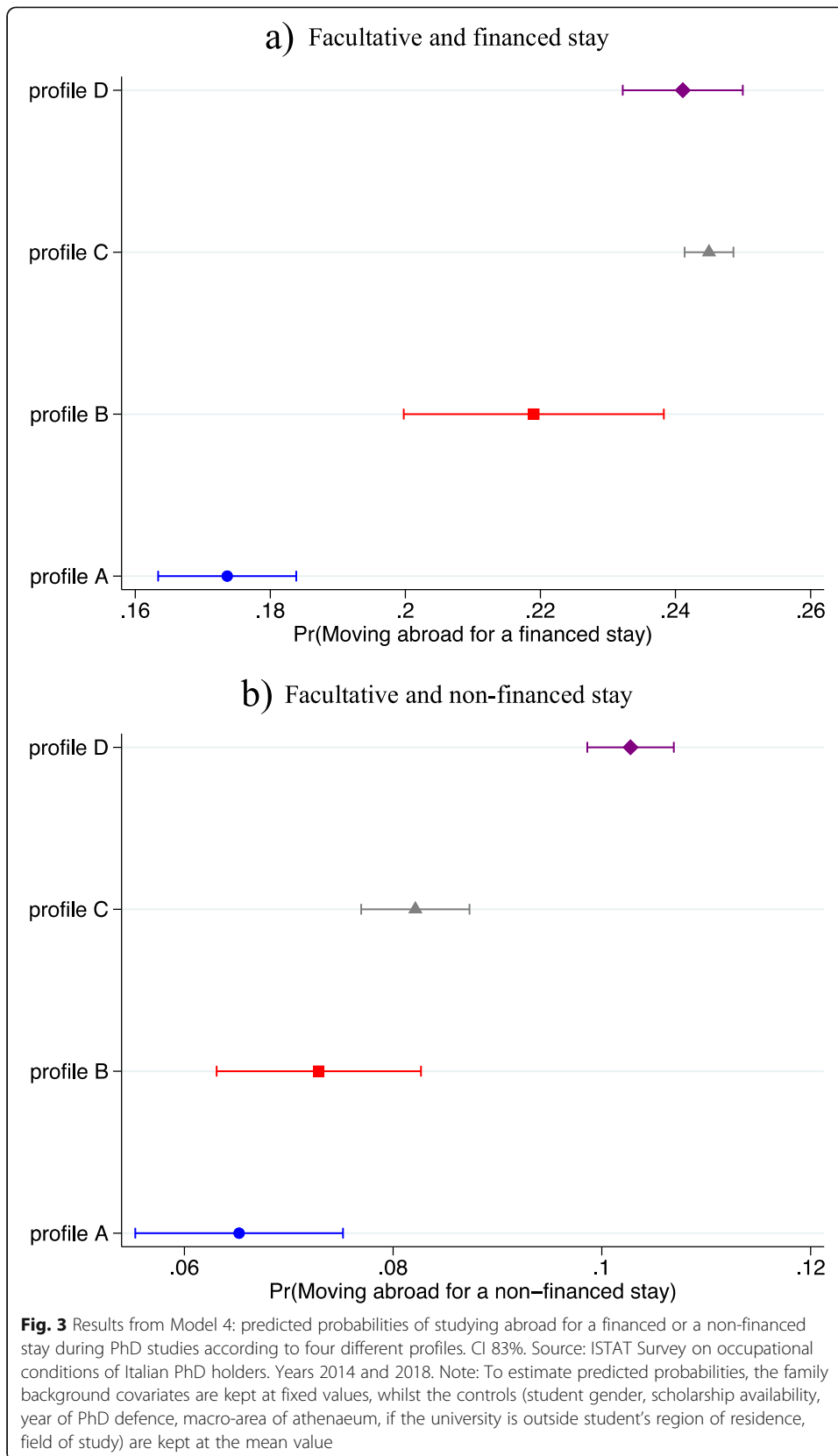


Table 3 Profiles of PhD students by family background characteristics. Absolute values and raw percentage values

	Remained in Italy	Study abroad		Total	abs.v. (% over total obs)
		Financed stay	Non- financed stay		
Profile A: low SES	387 (76.0)	90 (17.7)	32 (6.3)	509	(1.8)
Parental education: <i>Primary</i>					
Mother's economic activity: <i>Homemaker</i>					
Father's social class: <i>Working class (skilled/unskilled worker)</i>					
Profile B: medium-low SES	238 (71.3)	70 (21.0)	26 (7.8)	334	(1.2)
Parental education: <i>Lower secondary</i>					
Mother's economic activity: <i>Homemaker</i>					
Father's social class: <i>Routine non-manuals</i>					
Profile C: medium-high SES	1639 (64.1)	712 (27.9)	205 (8.0)	2556	(9.0)
Parental education: <i>Upper secondary</i>					
Mother's economic activity: <i>Employed/self-employed</i>					
Father's social class: <i>Lower-grade professionals</i>					
Profile D: high SES	1706 (62.9)	715 (26.4)	291 (10.7)	2712	(9.5)
Parental education: <i>Tertiary/post-tertiary</i>					
Mother's economic activity: <i>Employed/self-employed</i>					
Father's social class: <i>Higher-grade professionals</i>					

Authors' elaboration on the Istat Survey on occupational conditions of PhD holders. Years 2014 and 2018

propensity to move for a non-financed stay; nevertheless, full model results (Model 4) show how having a mother who was a homemaker or retired significantly lowers the propensity of moving abroad for a financed stay. Finally, father's social class shows a different behaviour with respect to the type of stay; whilst having a father that was a higher-grade professional increases the propensity of moving abroad for a non-financed stay, the opposite is true for the propensity of moving abroad for a financed stay (with respect to those PhD students whose father was a lower-grade professional).

Finally, all control coefficients from Model 4 (Appendix Table 4) are in line with expectations from the published literature.

Concluding discussion

This paper addresses the relationship between PhD students' family background characteristics and their international mobility during PhD studies, aiming to bridge the gap in the literature and shedding light on if and how higher parental socio-economic

status may favour mobility for students at the top of the higher education system. International mobility is largely recognised in the literature as favourable for future employment prospects; in this respect, lower international mobility during PhD studies may negatively impact PhD holders' academic careers. Our study suggests a relationship between family background characteristics—mainly parental education and mother's economic activity—and the propensity for studying abroad. High parental education is associated with a higher propensity for studying abroad during PhD studies, whereas the opposite is true for low parental education. In particular, the gap in international mobility between PhD students with primary educated parents and other parental education is remarkable. Of note, the former group is residual among all PhD students; information barriers may still play a role in shaping their decisions on the profitability of international mobility (Morgan, 2005; Usher, 2005). On the other hand, parental social class seems to play a more moderated role compared to parents' education, despite a significant (but small) divide between low-medium and high social classes may be identified. To sum up, the family of origin's social and economic characteristics appear relevant in shaping the propensity for studying abroad (e.g. Assirelli et al., 2019).

Looking at the two types of stays, on one hand, when the stay is facultative and financed, the family of origin's socio-economic profiles have a limited impact on PhD students' propensity to study abroad, except for those who have a low SES. In this case, we may speculate that, once accounted for individual characteristics and PhD student's income, when the stay is financed both information barriers and parental economic resources could play a (moderate) role: PhD students from upper statuses could be more informed by their parents and networks about the profitability of international mobility during PhD programmes, whilst their lower status counterparts may not have access to similar insights from their networks (Morgan, 2005; Usher, 2005; Abbiati & Barone, 2017). Nevertheless, economic reasons could condition the lower mobility of PhD students with parental low SES, too; although financed, the scholarship might not be enough to fully cover all the expenses of a study period abroad.

On the other hand, when the stay is facultative and non-financed, the gap is shifted: even if only a limited proportion of PhD students opt for this kind of stay, overall, PhD students with parental high socio-economic profile and both parents working have a considerably higher mobility than their counterparts with parental low or medium SES. In this respect, we may hypothesise that, once controlled for individual characteristics and PhD student's earnings, when the stay is not financed parental economic resources seem to play a (sizable) role: without any additional funds, parental economic support might be decisive for spending a period abroad. Instead, information barriers do not seem to be at play: whereas facultative and financed stays are common among PhD students from families with low-medium SES and medium-high SES, the opposite is true for facultative and non-financed stays. In sum, the key element that differentiates the propensity to go abroad between these two intermediate socio-economic profiles seems to be the availability of economic funds from universities. Finally, the idea that information barriers may play a (marginal) role in international, financed stays, whereas economic resources may be more relevant for international, non-financed stays is endorsed by the reversed sign of the relationship between PhD students whose fathers were higher-grade professionals and international mobility for financed or non-financed stays.

Moreover, it is worth noting that universities—as well as different fields of study—could assign a different importance to international mobility; thus, information knowledge could differ not only for the family of origin, but also for the university itself. Moreover, additional funds assigned to international mobility might differ from university to university, as well as the amount of the scholarship. Unfortunately, our analyses do not permit us to disentangle this effect, given that we do not have accurate information in this respect. Nevertheless, a remark should be done. University characteristics may be seen—at least partly—as a mediator of family background characteristics on international mobility: upper-class families are also those who enrol their children in more prestigious universities, which in turn could be associated with higher international mobility and higher funds and scholarships. Unfortunately, we could not test this effect in our analyses and disentangle the direct effect of family background on international mobility from the indirect effect passing through university prestige.

Finally, it is important to remark that PhD students are a selected group of individuals, because they have reached the highest level of education in a country. Those belonging to lower social strata have endured an even more marked process of selection in comparison with students from higher social classes (Argentin et al., 2015). PhD programmes are highly selective about access, favouring adults with high parental SES, and during students' studies, given that higher participation results in highly educational experiences such as international mobility. Nevertheless, the selection process could continue also during PhD studies, favouring those students from higher social classes that have greater economic resources for spending a period abroad, for example, even if funds from university are scarce or absent. In this respect, we posit that greater funds from the university could reduce this gap between PhD students with high parental SES and low parental SES, guaranteeing to the latter enough funds for experiencing international mobility as well as their counterparts.

This study has some limitations, including the lack of information on life events (e.g. child's birth) during participants' PhD studies and on their family ties, which may have influenced study abroad decisions (see e.g. Henderson, 2019; Jöns, 2011). Other variables from the Istat Survey could not be used because of differences in collection methods and categories between the surveys (e.g. the final score obtained in master's degree, age at PhD qualification). Regarding the period spent abroad, the length is unknown in the two surveys considered for this study. In the first edition of the survey, nearly 30% of PhD students spent at least 4 weeks abroad. Thus, we may suppose that at least the same percentage of PhD students spent a period of 1 month or a longer one abroad, which would account for most of the PhD students who studied abroad in our sample. Despite this knowledge gap, even shorter study periods may be fruitful for creating international networks (Avveduto, 2001; Henderson, 2019).

Based on our work, we speculate that parental socio-economic status influences international mobility for studying abroad during PhD studies, especially facultative and non-financed stays. Given that international mobility might have direct or indirect consequences on academic and occupational outcomes of those students at the highest level of education (e.g. Ermini et al., 2019), further research should investigate whether Italian PhD students' international mobility have future repercussions on their occupational prospects, and the potential mediating role of parental SES.

Appendix

Table 4 Model coefficients for Model 1, Model 2, Model 3 and Model 4^a

	Model 1			Model 2			Model 3			Model 4		
	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value
a) Facultative and financed stay												
Parental education (ref. upper secondary)												
<i>Primary</i>	-0.606	0.057	0.000	-0.543	0.052	0.000	-0.577	0.048	0.000	-0.385	0.013	0.000
<i>Lower secondary</i>	-0.108	0.041	0.008	-0.064	0.043	0.131	-0.098	0.046	0.033	-0.026	0.052	0.612
<i>Tertiary/post-tertiary</i>	0.071	0.032	0.028	0.037	0.030	0.231	0.080	0.021	0.000	0.109	0.020	0.000
<i>Unknown</i>	-0.901	0.213	0.000	-0.826	0.241	0.001	-0.741	0.255	0.004	-0.863	0.230	0.000
Mother's economic activity (ref. employed/self-employed)												
<i>Homemaker</i>				-0.206	0.007	0.000	-0.202	0.009	0.000	-0.135	0.012	0.000
<i>Retired</i>				-0.060	0.014	0.000	-0.049	0.013	0.000	-0.043	0.014	0.002
<i>Other conditions</i>				-0.172	0.060	0.004	-0.140	0.063	0.026	-0.114	0.059	0.052
Father's social class (ref. lower-grade prof)												
<i>Higher-grade professionals</i>							-0.126	0.029	0.000	-0.099	0.039	0.010
<i>Routine non-manual</i>							-0.002	0.046	0.966	-0.001	0.049	0.977
<i>Self-employed</i>							0.003	0.024	0.892	-0.006	0.048	0.895
<i>Working class (skilled/unskilled)</i>							0.121	0.017	0.000	0.053	0.026	0.044
<i>Unknown social class</i>							-0.152	0.025	0.000	-0.069	0.017	0.000
Gender (ref. male)												
<i>Female</i>										-0.196	0.047	0.000
Scholarship (ref. full scholarship)												
<i>Partial scholarship</i>										-0.523	0.089	0.000
<i>Research grant</i>										-0.878	0.048	0.000
<i>Other grants from university</i>										-0.832	0.095	0.000
<i>Earnings outside university</i>										-1.915	0.037	0.000
<i>No source of earnings</i>										-1.348	0.082	0.000
Macro-area of athenaeum (ref. north)												
<i>Centre</i>										-0.347	0.048	0.000
<i>South/Islands</i>										-0.394	0.140	0.005
Interregional move for PhD studies (ref. no)												
<i>Yes</i>										0.151	0.094	0.107
Year of defence (ref. 2008)												
<i>2010</i>										0.049	0.078	0.528
<i>2012</i>										0.073	0.088	0.410

Table 4 Model coefficients for Model 1, Model 2, Model 3 and Model 4^a (Continued)

	Model 1			Model 2			Model 3			Model 4		
	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value
2014										0.138	0.099	0.162
Field of study (ref. Science and Engineering)												
<i>Life Science</i>										-0.560	0.010	0.000
<i>Social Science and Humanities</i>										-0.168	0.013	0.000
Constant	-0.863	0.191	0.000	-0.783	0.195	0.000	-0.781	0.192	0.000	0.169	0.112	0.132
b) Facultative and non-financed stay												
Parental education (ref. upper secondary)												
<i>Primary</i>	-0.246	0.040	0.000	-0.223	0.054	0.000	-0.199	0.076	0.009	-0.214	0.073	0.003
<i>Lower secondary</i>	-0.005	0.062	0.938	0.013	0.068	0.855	0.038	0.044	0.381	0.037	0.053	0.476
<i>Tertiary/post-tertiary</i>	0.199	0.043	0.000	0.183	0.051	0.000	0.114	0.039	0.003	0.079	0.034	0.019
<i>Unknown</i>	-0.486	0.480	0.311	-0.551	0.492	0.263	-0.473	0.491	0.336	-0.495	0.566	0.382
Mother's economic activity (ref. employed/self-employed)												
<i>Homemaker</i>				-0.083	0.058	0.147	-0.091	0.057	0.109	-0.084	0.050	0.091
<i>Retired</i>				0.077	0.013	0.000	0.074	0.015	0.000	0.020	0.037	0.593
<i>Other conditions</i>				0.070	0.023	0.003	0.100	0.008	0.000	0.096	0.011	0.000
Father's social class (ref. lower-grade prof)												
<i>Higher-grade professionals</i>							0.187	0.038	0.000	0.170	0.025	0.000
<i>Routine non-manual</i>							-0.129	0.122	0.289	-0.124	0.107	0.245
<i>Self-employed</i>							0.038	0.129	0.768	0.015	0.121	0.899
<i>Working class (skilled/unskilled)</i>							-0.062	0.102	0.546	-0.055	0.090	0.542
<i>Unknown social class</i>							-0.132	0.113	0.244	-0.174	0.104	0.096
Gender (ref. male)												
<i>Female</i>										-0.204	0.122	0.094
Scholarship (ref. full scholarship)												
<i>Partial scholarship</i>										0.240	0.027	0.000
<i>Research grant</i>										0.526	0.102	0.000
<i>Other grants from university</i>										0.521	0.037	0.000
<i>Earnings outside university</i>										0.253	0.227	0.265
<i>No source of earnings</i>										0.443	0.123	0.000
Macro-area of athenaeum (ref. north)												
<i>Centre</i>										-0.090	0.062	0.147
<i>South/Islands</i>										-0.144	0.061	0.018

Table 4 Model coefficients for Model 1, Model 2, Model 3 and Model 4^a (Continued)

	Model 1			Model 2			Model 3			Model 4		
	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value	Coeff.	std error	p value
Interregional move for PhD studies (ref. no)												
Yes										0.383	0.053	0.000
Year of defence (ref. 2008)												
2010										-0.023	0.043	0.583
2012										0.182	0.102	0.073
2014										0.184	0.096	0.055
Field of study (ref. Science and Engineering)												
Life Science										-0.089	0.019	0.000
Social Science and Humanities										0.610	0.039	0.000
Constant	-2.058	0.262	0.000	-2.037	0.279	0.000	-2.033	0.269	0.000	-2.199	0.197	0.000
Log-likelihood	-24,080.4			-24,057.7			-24,031.9			-22,411.6		
AIC	48,164.7			48,119.4			48,069.8			44,827.2		
BIC	48,181.2			48,135.9			48,094.6			44,843.7		

^aModel 1, Model 2, Model 3 and Model 4 are multinomial logistic models with random errors clustered at the field of study (the response variable is about international mobility during PhD studies with three categories—where the reference category is the student who remained in Italy), and they differ only for the control variables included in the four model specifications

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Authors' contributions

All the authors are responsible and cooperated for defining the research objects and the analytical strategy to be pursued in the development of the paper. VT is responsible for data preparation and statistical analyses and wrote the core of the paper. AP is responsible for the finalisation of the paper. All the authors declare that they read and approved the final manuscript.

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Declarations

Competing interests

The authors declare that they have no competing interests.

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