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THE STRANGE CASE OF MATTHEW EFFECT AND BEAUTY CONTEST: RESEARCH EVALUATION AND SPECIALISATION IN THE ITALIAN UNIVERSITIES

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The Strange Case of Matthew Effect and Beauty Contest: Research Evaluation and Specialisation in the Italian Universities

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Abstract

The paper aims to examine whether the distribution of funds that prizes relatively more the most performing institutions has the effect of replicating the Matthew effect within them in terms of personnel policies and allocate proportionally more resources to the best departments to strengthen their output in the prospect of future assessments. Data from the Italian public university system between 2011 and 2017 as well as outcomes of the national evaluation of research produced between 2004 and 2010 and between 2011 and 2014 in 14 disciplinary research areas have been used. The empirical evidence shows that the Italian universities tended to increase their specialisation in the research areas, where they ranked below or slightly above the national mean, revealing that the universities chose to the mean try strengthening the weak sectors, both through promotions and new recruitments. Results suggest the existence of a dual policy. When the Ministry of Education, University and Research tries to foster a Matthew-effect mechanism, allocating more resources to the best-performing universities, these last seem opting to implement a beauty-contest strategy to make their weak areas to converge towards the national mean. When the effects of the recruiting strategies following the national evaluation of research, have been considered, results indicate the existence of some Matthew's effects showing that increasing specialization is more fruitful for the best than for the worst universities.

Keywords: Matthew effect; Academic research evaluation; Academic staff specialization; Distribution of scientific funding.

Jel-codes: I23; I28; H52

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1. Introduction

Since Merton's (1968) seminal work, the concept of "Matthew effect" has become familiar to many scholars in sciences and humanities. Matthew 25:29 reads: "For to every one who has will more be given, and he will have abundance; but from him who has not, even what he has will be taken away."[2] Scholars (mainly sociologists of science) have inquired the validity of this Gospel's rule in different fields, from citations to fund attraction. The idea is that authors who publish in journals with high impact factors or who are particularly renowned are cited more often (and therefore cumulatively more) than the others (Tol, 2009, 2013; Birkmaier and Wohlrabe, 2014 and Wang, 2014). Also firms and universities seem to attract research funds following a sort of "Matthew rule" (Rossi, 2009), which – for research institutions – may depend on their productivity in terms of published research output (Auranen and Nieminen, 2010). What emerges from the extant literature is the existence of Merton's Matthew effect: the more citation an author (paper) has, the more s/he (it) will have in the future in comparison with similar colleagues (papers); the same seems to hold for firms and research institutions in attracting both private and public research funds.

The described phenomenon is relevant for several reasons. On the one hand, the career of scholars and their capacity of attracting funds depends also on their visibility in terms of citations received. On the other hand, as Hicks (2012) shows, more and more the research institutions are evaluated by national agencies on the basis of research output, which includes citations in many cases. These evaluations are then used to distribute (part of) the public funds to universities, which receive more or less money according to their position in rankings so obtained. Whether such policies are effective to promote the production of high-level research and whether they are efficient is an open question (Antonelli and Crespi, 2013). Some criticise such systems, as they do not allow institutions with low ranks to climb positions, relegating them in a grey zone, with few funds available to improve their research output. Some claim that market rules are the best to promote efficiency and high-quality production, as competition is a stimulus in this sense. These latter thus justify the existence of the Matthew effect and describe it as positive outcome, while the former would attenuate when not eliminate such an effect.

The present work does not enter the debate about what is good for promoting high-quality research. Rather, the paper aims at shading some light on how the institutions respond to incentive schemes that engender the Matthew effect. The performance of universities, in particular, is generally evaluated considering separately the production and the quality of research in the

[2] *Holy Bible*, revised standard version.

different fields in which the specific university is involved. The most of the universities comprise different departments, each specialised in a particular domain (e.g. chemistry, biology, neurosciences, economics, mathematics, oriental languages, etc.). As these are too heterogeneous to be evaluated as a whole, the evaluation process of universities generally includes two steps: the first is the assessment of each single department (or homogeneous research area), and the second is the evaluation of the university through some synthetic indicator that includes the performance of the departments (areas).

The present article aims to contribute to the earlier empirical literature in two ways. The first research question of the paper is whether a distribution of funds that prizes relatively more the most performing institutions has the effect of replicating the Matthew effect within them in terms of personnel policies. In particular, there are two possible strategies in this sense: the first is to apply the same rules used by the evaluation agency and to allocate proportionally more resources to the best departments to strengthen their output in the prospect of future assessments. The second possible strategy is to allocate proportionally more resources to the weakest departments to strengthen their position in the prospect of successive evaluations. The first case reproduces the Matthew effect within the institutions; the second attenuates it. Indeed, the decision about how many new positions opening and in which departments (research areas) is generally a matter discussed at central level by each university, and depends on how many funds this last received. Furthermore, given the relevance of the results obtained in the research evaluation, universities may react differently in term of recruitment and specialization, the second contribution of the paper is to assess the successfulness of these strategies in specialization on following evaluations of research products.

To answer these questions, the analysis presented in this paper uses data from the Italian university system, which is composed mainly of public universities, funded by the national government. Indeed, the data of the MIUR (Ministero dell'Istruzione, Università e Ricerca – Ministry of Education, University and Research) report that the number of professors in the public system (50,673 units) is more than 13 times as big as that in the private universities (3,800)[3]. These data suggest that focusing on the public universities only, so to have comparable data (for the institutions considered are all subject to the same national legislation of fund allocation), returns a comprehensive picture of the Italian university system. The analysis considers the personnel in the Italian public universities between 2011 and 2017 and the two national evaluations (VQRs) that are relevant for the purposes on this paper in the specific interval of time: that for the period 2004-

[3] Source: MIUR. Data updated on April 12th 2018.

2010 (results published in 2013) and that for 2011-2014 (results released in 2016)[4]. An additional good reason to use Italian data is that about two thirds of the country's universities are ranked between the top 500 in the world (Regini and Colombo, 2013).

The main results of the analysis show an inverted U-shaped correlation between high evaluations and concentration of associate and full professors in the best scientific areas, suggesting the Italian higher education institutions tended to increase their specialisation in the research areas, where they ranked below or slightly above the national mean. This reveals that the universities chose to try strengthening the weak sectors, both through promotions and new recruitments. In terms of the effects of specialisation, universities with a national average or better score in previous research evaluation have gained from specialising and high-perform in the successive research evaluation.

The rest of the paper is organized as follows. Section 2 presents a literature review and Section 3 illustrates the institutional background of the Italian university system. Section 4 presents the data and variables and Section 5 discusses the econometric approach and the estimation results. Section 6 present robustness checks and finally, Section 7 concludes and discusses some policy implications.

2. Related literature

To the authors' knowledge, the extant literature does not provide any evidence about the university personnel policies and strategies in universities as a consequence of how funds are distributed between universities and between departments and research areas within each institution. The following review of the literature will therefore present the available results in two streams of literature that are crucial for the analysis presented in this paper. On the one hand, we will present and discuss the evidence about the Matthew effect in academia; on the other hand we will analyse and discuss the main rules used to allocate funds and vacancies between universities and departments. The aim of this twofold review is to show that there may be some strong relationship between resource allocation and personnel policies, and that these last may follow one of the two strategies outlined in the Introduction: concentration on the research areas with the best results to foster them, or relative overinvestments in the weakest areas to better off their results.

[4] Further details on the VQR will be given in section 3 of the paper. Full information and full reports for the two VQRs are freely available on the website of the Italian National Agency for the Assessment of Research (ANVUR): www.anvur.org.

The number of books and research articles that have followed Merton (1968) is very big. However, some are of particular relevance for the purposes of the present analysis. Geuna (2001) highlights that during the last decades the European governments have substantially changed the rules of allocation of public funds to public universities. In particular, while in the past (i.e. immediately after the Second World War), the governments had aimed at distributing resources uniformly between universities, new rules have been applied during time, especially as responses to the economic crises faced by the European countries. In addition, the transformation of states from producers of goods and services to market regulators (especially as a consequence of the *Washington Consensus*), has changed also the rules behind the mechanisms of public funding of tertiary education. The current orientation is thus to allocate (part of) the public funds, according to mechanisms that prize performance also in terms of quality of the research produced. As Gasparri (2008), Hicks (2012) and Muscio et al. (2013) highlight, the European governments have adopted different rules and mechanisms to distribute resources between universities, however, most of them include the quality of the research in the mechanism. Empirical evidence shows that this type of policy transition has happened also outside Europe, for example in China (Wu, 2015), and Cattaneo et al. (2016) highlight that research evaluations have increased the performance of the Italian universities in terms of research output.

Of course, each ranking that is based on composite criteria entails some degree of arbitrariness, and this is true also in the case of universities (Goglio, 2016). In the specific case of research assessment, the main problem is the heterogeneity between how different disciplines evaluate the research products. While the use of bibliometric indicators is spreading more and more (although some critiques have been raised – see Erne, 2007 and Hammerfelt et al., 2016), some disciplines prefer to resort to peer review. However, Abramo et al. (2009) show that, in spite of the increase in heterogeneity caused by the use of different evaluation methodologies, in the areas classifiable as “science and technology” (S&T) the results of an assessment based on bibliometric indicators and of another based on peer review are statistically equivalent. Nevertheless, there are advantages in using bibliometric indicators, for they decrease the time of the process and are cheaper, at least in terms of time of the reviewers (Abramo and D’Angelo, 2011).

The allocation of public funds to universities is based on research performances worldwide (Geuna and Martin, 2003). Human resource policies strictly depend on the funds received; therefore, the results of research productivity affect also academicians’ promotions. Lissoni et al. (2011) analyse a large sample of French and Italian physicists, and find that academic promotions are mainly due to research productivity and seniority, this last having become important especially as a consequence of the recent cuts to the French and Italian university budgets. Countries such as Italy, Sweden and the

U.K. use national research evaluation to divide (a part of) the public funds between universities, prizing those that perform better (Bennera and Sandströmb, 2000 and Abramo and D'Angelo, 2011). With specific reference to Italy, Rossi (2009) finds clear evidence that public funds allocated to universities and their performance in terms of national evaluation of the research (2004-2010 wave) are positively and highly correlated. Also Franceschini and Maisano (2017), using the data of the last available Italian national evaluation of university research highlight the correlation between its results and the allocation of public funds. This evidence is not surprising, as the law itself establishes that a share – that is growing over time – of the total public budget allocated to the universities depends on the quality of the produced research, as assessed by the national evaluation procedure. This mechanism would be *per se* sufficient to affect universities' human resource policies, as one may reasonably assume that each of them aims at maximising the funds received by the national government. Therefore, universities should hire academics that publish in the journals evaluated as "excellent" by the evaluation agency.

Always with reference to Italy, Cattaneo et al. (2016) find that the introduction of the national evaluation of research and the distribution of funds conditional on the results of such an evaluation have increased the research productivity. In addition, this improvements are concentrated in the most reputed universities. This result may be led by an increase in the productivity of the incumbent staff, by having hired new staff whose productivity was better than that of the incumbents, or by a combination of these two phenomena. In this framework, promotions may be seen as incentives for productivity: if the most productive scholars are promoted before the less productive (or these last are not promoted at all), then scholars are incentivised to produce more and better. This type of incentive has two components: monetary (in terms of higher wages) and hedonic (in terms of pure utility deriving from career advancement – see Hall and Chandler, 2005). Nonetheless, Abramo et al. (2015) highlight that sometimes seniority of candidates plays a major role in promotions, rather than scientific productivity. However, this phenomenon is likely to affect the decision about whom to promote rather than the allocation of resources between scientific areas.

3. The Italian university system: a brief overview of the main characteristics

This section offers a brief description of two main aspects of the Italian university system that are central for this paper. First, the process of research evaluation is presented; then the mechanisms behind vacancy openings, promotions and selection criteria are outlined.

The national evaluation of research was introduced in Italy in 2003 and assessed the research produced between 2001 and 2003 (Baccini et al., 2013). In the subsequent years two other assessments followed, in 2011 for the research produced between 2004 and 2010 and in 2016 for the period 2011-2014. As it can be noticed, the period over which the evaluation is conducted have always changed, and so did the rules. However, the two last rounds benefitted from the institution of the Italian national agency for the evaluation of the research (Agenzia Nazionale per la Valutazione delle Università e della Ricerca – ANVUR), which established the rules of the evaluations, and carried them out. Besides the different time spans covered, the principles of the evaluation did not change from one round to the other. The so-called scientific products (research articles published in journals or books and research books) were classified in four (VQR 2004-10) or five (VQR 2011-14) tiers for each of the 14 disciplinary areas individuated by the MIUR. The ANVUR classified these areas into two categories: bibliometric and non-bibliometric. The first group gathers the scientific areas, for which the national scientific community generally agrees that the quality of a publication depends on bibliometric parameters (impact factor, article influence score, SJR, etc. of the journal where an article is published and number of citations received by an article). The areas, where bibliometric parameters are not generally accepted as an index of quality were classified as non-bibliometric. This choice was also largely determined by the fact that in non-bibliometric areas a large share of publications is represented by books, for which bibliometric indices are not available.

For the bibliometric areas, the scientific products were attributed a tier (between A – excellent quality – and E – limited quality), according to the value of the bibliometric indices for each product[5]. The classification of the scientific products depended thus on their bibliometric values in the bibliometric areas; in these cases the attribution of the tier to each specific scientific product was automatic. The same did not happen for the non-bibliometric areas. In these cases all the research products underwent a peer evaluation process, i.e. each product was sent for evaluation to an expert in the same research filed as that of the product, and the expert assigned the product to one of the four merit classes. Although the procedure was inhomogeneous between research areas, it was homogeneous within each of them.

The opening of vacancies and the promotions of incumbent scholars in Italy depend on the number of "punti organico" (literally "personnel points" PPs henceforth) assigned by the MIUR to each university each year. This number depends on mainly three factors: 1) the total number of students enrolled in the university; 2) the value of the separations of professors in the previous year and 3) the results globally obtained by the university in the previous VQR. More in details: each of

[5] In particular, the top 10% of journals in terms of at least one of the bibliometric indicators used (5-year IF, AIS, SNIP, SJR) were classified in tier A, those in the second and third decile as tier B; journals falling in the fourth and fifth deciles were classified as tier C. the sixth and seventh deciles individuated tier-D journals. The last three deciles were attributed tier E.

the three ranks in which Italian academics are divided (i.e. assistant, associate and full professors) has a precise value in terms of PPs: a full professor is worth 1 PP, an associate professor is worth 0.7 PP and an assistant professor (tenure track) is worth 0.5 PP. To give an example, a university that is allocated 14 PPs may hire either 14 full professors, or 20 associate professors or 28 assistant professors, or any combination of the three ranks, provided that the total cost of the recruitments does not exceed the assigned PPs. The same rules establish that if a professor is hired and she was previously in service at another university, the hiring university pays her full cost in terms of PPs. For instance, if the University of Bologna hires as associate professor somebody already working at the University of Venice, the University of Bologna "consumes" 0.7 PP, independently of whether the hired professor was assistant or associate professor in Venice. Instead, if the University of Bologna promotes an assistant professor, already working in the same university, to associate professor, this university "consumes" only the difference between the PPs already spent to hire the promoted person as assistant professor (i.e. 0.5 PP) and the value of the position to which she is promoted (i.e. 0.7). Thus, in such a case, the cost of the promotion is 0.2 PP.

The allocation of vacancies between the departments of a given university is not ruled at national level. Rather, for the sake of governance independency granted by the law, each university freely establishes the rules of allocation (Capano, 2008), given the maximum number of vacancies yearly allowed by the MIUR. Once a university receives the yearly endowment of PPs, the distribution of them between the different departments (and hence between the different research areas) is a decision of the board of each university and depends on the strategic valuations of the board in terms of teaching and research needs and planning. In this sense, each university is responsible of how many PPs are to be allocated to each research area. The board of each department then decides the division of the PPs received between the different ranks. In conclusion, this process grants some degrees of autonomy in deciding whether universities (in particular) and departments want to invest more in some research areas than in others. To induce the departments to hire the best candidates and to promote their best scholars in terms of research output, the evaluation attributed a prize of 27% to the publications submitted for the VQR by the scholars recruited or promoted during the years under evaluation. To give an example: a tier-A publication of a professor either hired or promoted from an inferior to a superior rank during the years under evaluation was given 1.27 times the points of a tier-A publication submitted by another scholar who had not been recruited nor promoted during the same period. Such a system had the aim of incentivise universities to hire and/or to promote scholars with top-tier publications instead of scholars with research products of lower quality.

In the end, the process is the result of a bargaining process within each university and is not observable from outside. However, the results of this process in terms of number of promotions and vacancies opened by each university in each disciplinary area is visible and constitutes part of the core data used in this paper.

4. Data and variables

Two are the main sources of data. We collect the number of Full professors, Associate professors and Assistant professors from the Ministry of Education, University and Research (http://cercauniversita.cineca.it/php5/docenti/cerca.php) in the time span 2011-2017 from 65 Italian public universities[6], disaggregated in 14 main scientific and disciplinary research areas[7]. Data on the Italian Research Evaluation assessment for the period 2004–10 (VQR 2004–10) and 2011-2014 (VQR 2011-14) have been, instead, collected from Italian national agency for the evaluation of the research (ANVUR - http://www.anvur.it/). On the basis of the evaluation results, we consider to main indicators of research quality.

To make the research assessment fully comprehensive, it has to be specified that in the research evaluation assessment taken in 2011-2014 (VQR 2011-14), each research outcome was evaluated to be excellent (E), good (G), acceptable (A), or limited (L). According to the adopted definition, missing (M) outcomes, refused (R) products as well as cases of plagiarism and fraud (PF) have been also taken into account. Given this classification, the overall research quality of a University i operating in area j presenting a number n of outcomes, is defined as follows:

$$v^{8}{}_{i,j} = n_{i,j,E} + 0.8\, n_{i,j,G} + 0.5\, n_{i,j,A} + 0\, n_{i,j,L} - 0.5\, n_{i,j,M} - n_{i,j,R} - 2\, n_{i,j,PF} \quad 1)$$

The $v_{i,j}$ indicator is a function of the quality and quantity of the research produced in a given University. From equation (1), it is possible to derive the two main indicators of research quality used in the paper. The first indicator is called R-index and gives a relative assessment of the

[6] We cover 65 out of the 67 public universities accredited by the Italian Ministry of Education, University and Research (http://www.miur.gov.it/web/guest/istituzioni-universitarie-accreditate).

[7] Mathematics and Informatics; Physics; Chemistry; Earth Sciences; Biology; Medicine; Agricultural and Veterinary Sciences; Civil Engineering and Architecture; Industrial and Information Engineering; Antiquities, Philology, Literary Studies, Art History; History, Philosophy, Pedagogy, Psychology; Law Studies; Economics and Statistics; Political and Social Sciences.

[8] In the research assessment taken in 2004-2010 (VQR 2004-10) a slightly different evaluation has been taken into account. More specifically, each research outcome was evaluated to be excellent (E), good (G), decent (D), acceptable (A), or limited (L). According to the adopted definition, missing (M) outcomes and refused (R) products have been also taken into account. Given this classification, the overall research quality of a University i operating in area j presenting a number n of outcomes, is defined as follows: $v_{i,j} = n_{i,j,E} + 0.7\, n_{i,j,G} + 0.4\, n_{i,j,D} + 0.1\, n_{i,j,A} + 0\, (n_{i,j,L} + n_{i,j,M} + n_{i,j,R})$.

quality of research for University i with respect to that of the area j; it is calculated as the ratio among the average score for University i and the average score of the area j as follows:

$$R_{i,j} = \frac{I_{i,j}}{V_j / N_j} \qquad 2)$$

where, $V_j = \sum_{i=1}^{k} v_{i,j}$ and $N_j = \sum_{i=1}^{k} n_{i,j}$ are respectively the total score and the total number of outcomes in each area j and $I_{i,j} = \frac{v_{i,j}}{n_{i,j}}$ is the simple average score of the University i in a given area j. R is greater than one if the research quality in the University is higher than in the area average, and vice versa.

The second indicator is called X-index and gives the share of excellent outcomes of a University i in an area j with respect to share of excellent outcomes in the area and it is calculated as follows:

$$X_{i,j} = \frac{\frac{n_{i,j,E} + n_{i,j,G}}{n_{i,j}}}{\frac{\sum_{i=1}^{k}(n_{i,j,E} + n_{i,j,G})}{\sum_{i=1}^{k} n_{i,j}}} \qquad 3)$$

also in this case, X is greater than one if the share of excellent outcomes is higher in the University than in the area.

In order to capture the universities' human resource policies and therefore measure the specialization of the academic staff within each university as well as within research areas, we take advantage of the Revealed Comparative Advantage measures, among which one of the most commonly used is the Balassa index (refined and popularized by Béla Balassa, 1965; 1989) as follows:

$$Balassa\ Specialization\ Index_{ijt}\ (BSI) = \frac{academic\ staff_{ijt} / academic\ staff_{it}}{academic\ staff_{jt} / academic\ staff_{t}} \qquad 4)$$

Where i, j and t refer to university, area of research and time respectively. We calculate four specialization indexes when the whole academic staff is taken into account ($BSI_{ACADEMIC\ STAFF}$) as well as when, instead, full professors ($BSI_{FULL\ PROFESSORS}$), associate professors ($BSI_{ASSOCIATE\ PROFESSORS}$) and Assistant professors ($BSI_{ASSISTANT\ PROFESSORS}$) are separately considered. The Balassa index measures the degree of specialisation of university academic staff. If the Balassa index is more than 1, it means that higher specialisation has been reached. If it is less than 1 it means that no specialisation is involved.

The empirical analysis is divided into two steps. In the first, the impact of the 2004-10 evaluation of the Balassa specialisation index is calculated; in the second, the effect of the changes in specialisations on the 2011-14 evaluation is estimated. Table 1 reports the summary statistics of the main variable of interest, i.e. the Balassa index for each research area at national level. The figures shown in the table are the arithmetic means of the index, and, for this reason, the figures are different from 1[9]. Nevertheless, they reveal interesting information. Almost all the figures are larger than 1, meaning that there are some universities, which present very high levels of specialisation in some research areas, while "under specialisation" (i.e. BSI > 1) is generally low. In other words there are cases with BSI much larger than 1, indicating high specialisation in an area, while BSIs lower than 1 on average are never much far from 1.

[Table 1 around here]

5. Empirical analysis

5.1. Effects of the 2004-2010 VQR on the specialization of universities

To recover the effects of the results of the 2004-10 VQR on the specialisation of the academic staff, we rely on the OLS estimate of the following equation

$$\Delta BSI_{2016-2011_{i,j,\tau}} = \alpha + \gamma VQR_{2004-2010_{i,j}} + \delta VQR_{200-2010_{i,j}}^{2} + \beta BSI_{2011_{i,j,\tau}} + \varepsilon_{i,j} \qquad 5)$$

where $\Delta BSI_{2016-2011,i,j,\tau}$ is the Balassa Specialization Index for university i, research area j and academic career specification τ (whole academic staff, full, associate and assistant professors) measured as the difference between 2016 and 2011; $VQR_{2004-2010_{i,j}}$ is the Italian Research Evaluation assessment index for the period 2004–10 - (the R and X indices are used alternatively) for university i and research area j , and finally $BSI_{2011i,j}$ controls for the level of academic specialization in 2011 for university i and research area j. $\varepsilon_{i,j}$ is the i.i.d. error term.

[9] They would indeed equal one if they were weighed means instead of the arithmetic means.

Tables 2 and 3 present the effect of the results of the 2004-10 VQR on the specialisation of the academic staff for the full sample, i.e. including all the Italian public universities and all the scientific areas, as defined by the MIUR. The results of the evaluation are introduced using the two main indices calculated by the MIUR: index R and index X. The first represents the relative position of each institutions with respect to the national situation when all the research products are taken into consideration; index X, instead, represents the same as index R, but when only the products classified as "excellent" or "of high quality" are considered. In other words, index X weighs excellence more and quantity less than index R does. For all the outcomes of interest, we report two estimates for standard errors. Columns (1) and (3) in Table 2 and Columns (1), (2), (3), (7), (8) and (9) in Table 3 report standard errors robust to heteroscedasticity; whereas, Columns (2) and (4) in Table 2 and Columns (4), (5), (6), (10), (11) and (12) in Table 3 report standard errors clustered at university level.

Table 2 shows an inverted U-shaped correlation between high evaluations and concentration of the academic staff both when the R index (Columns 1 and 2) and when the X index (Columns 3 and 4) have been considered. In other words, for some universities the specialisation in the most prized areas is an increasing function of the results obtained in the VQR, while, for others, the function is decreasing. Indeed, looking at the evolution of the BSI between 2011 and 2016, we notice that it decreased (in non-statistically significant way) for assistant professors in those areas and universities with an R index higher than 1 in 2010, while it increased when R was lower than 1 (and this decrease is statistically significant at 5% level). Similar, but non-significant from a statistical point of view, results are observable for full professors[10]. A different story is observable for associate and professors: in this case, the BSI remains substantially unchanged in those areas that scored higher than the mean in the 2004-2010 VQR, while a relatively large decrease is detected when the R index was below the national mean. This outcome is likely to be explained mainly by the promotions of assistant professors to the rank of associate professors (see further for a more detailed discussion).

The figures in the Table 3, when the components of academic staff have been separately considered, confirm an inverted U-shaped correlation between high evaluations and concentration of full, associate and assistant professors in the best scientific areas. Such effects are significant in all the three models featuring different structure of the error terms. The maximum of the second degree function is always around 1 for the full sample and for the sub-samples of assistant, associate and full professors. This means that, when the evaluation received in the VQR by a specific area of a given university is below the national mean, resources are concentrated in the

[10] Tests not reported in the paper but available on request.

best areas (i.e. those, whose evaluation is closest to the national mean, although below that threshold). Instead, when the evaluation is above the mean, the resources are concentrated on the areas that are closer to the national mean (i.e. with low relative evaluations), than on those that are far from the mean (i.e. the excellent areas). Such an outcome suggests the existence of a dual policy: apparently universities prefer to strengthen the areas that are close to the national mean, either below or above the threshold, while they tend to specialise less in the worst and in the best areas. The reason why the specialisation does not grow in the worst areas may be intuitive: given the few resources available, it is preferable to concentrate them in performing rather than in non-performing disciplines. This will not help bettering off the evaluation of the weak areas, but the areas with an evaluation close to the national mean are probably more likely to improve their performance more than those with very low evaluations, which would likely require massive investments. Less clear is the reason why, between the areas above the mean, specialisation increases more in those closest to it than in the others. A possible explanation is that universities wish to push the good – but not excellent – areas towards excellence; for this reason, they concentrate human resources there. After all, returns of investments are decreasing, as the national evaluation system imposes a cap represented by the maximum number of research product that each scholar can submit for the evaluation. Investing in areas where all (or the large majority) of the scholars already submit only excellent products will not increase the evaluation of a university in that specific area. Instead, investing resources in areas where margins of improvement are possible will likely improve the result in the next evaluation. The dual policy, thus, seems to be induced by how the mechanism works, rather than by other factors.

The same quantitative results hold for assistant professors; one may therefore reach conclusions analogous to those for associate professors. However, the most of associate and full professors in 2016 were already part of the academic staffs before. Many (at least 23% of the total) of the assistant professors in 2016 were hired between 2012 and 2016; apparently this new positions were distributed according to the same criteria accounting for the results of the VQR. However, more in-depth analysis of the figures may suggest a different conclusion. Indeed, the most of the new associate professorships created between 2012 and 2016 were promotions of assistant professors to associate professors. Therefore, as the concentration of these last in the most-prizing areas has increased as a response to the results of the VQR, in absence of new assistant professorships, the concentration of the assistant professors would be negatively correlated with the results of the VQR. However, this is not the case, as the correlation has an inverted-U shape, which suggests that universities hired proportionally more assistant professors also in the most-prizing areas.

The positive effect on the concentration of associate professors is explicable also through three additional mechanisms, which, however, do not hinder the previous interpretation. On the one hand, the same promotion mechanism described for assistant professors may have worked for promotions of associate professors to full professors. However, the new full professorships were a fraction (about 44%) of the new associate professorships in the period 2012-2016. This means that, if the new associate professorships were concentrated in the most-prizing areas, the concentration of associate professors in these areas had to increase, as the figures in the Table 3 show. One may now wonder whether this result was the consequence of constrained or of unconstrained decisions of the universities. Indeed, on the one hand it is likely that the number of assistant professors qualified as associate professors was relatively larger in the best than in the worse areas in terms of VQR. Therefore, universities had proportionally more qualified assistant professors in the most-prized areas and this drove the choice of how to allocate new associate professorships between the different areas. Indeed, the concentration index would not depend on the results of the VQR only if the allocation of new associate professorships had been inversely proportional to the results of the VQR. In particular, the allocation would have had to follow a linear law of inverse proportionality so that the relative penalty for the each area above the mean was equal to the relative advantage of that area in terms of VQR with respect to the other areas in the same university. While this cannot be excluded a priori, the systematic implementation of such a mechanism is extremely unlikely, and the figures in the table suggest to exclude it.

The increase in the concentration index of associate professors may therefore have been driven by the relatively larger shares of assistant professors qualified as associate professors together with policies of resource allocation. At the level of each university, these allowed opening more positions in the areas that received the best evaluations and had the larger shares of qualified assistant professors. However, this interpretation does not exclude that the policies of promotions were inspired also by the will of increasing the concentration of the resources in the most-prized areas more than a simple distribution of the resources proportional to the shares of qualified would have done.

An additional result is the negative sign of the concentration index in 2011 (although significant only for associate professors). This sign means that resources were invested proportionally more in those sectors that were characterised by lower concentration, than in those where the investments had already been large in the past. This phenomenon may be the result of some willingness to re-equilibrate the distribution of resources with respect to the past, or the consequence that the area on which universities concentrated more resources in the past were not the winners in the evaluation process.

Overall, the results presented reveal two different strategies pursued by the Italian universities in terms of recruitments and specialisation as a consequence of the results obtained in the VQR. On the one hand, universities tended to overinvest in the research areas characterised by VQR scores that were below or slightly above the mean. On the other hand, this pattern seems to hold especially for senior ranks, which depend not only on new recruitments, but also on promotions of junior scholars already working at the same university.

[Tables 2 and 3 around here]

5.2. Effects of the specialization in 2011-2014 on the 2011-2014 VQR

The second part of the analysis concerns the effects of the recruiting strategies on the VQR 2011-2014. In particular, as we have seen, the Italian universities have pursued different strategies of recruiting in terms of increasing or decreasing their specialisation in the different scientific areas. The aim of this second part of the paper is to evaluate the successfulness of these strategies in terms of the VQR carried out on the period 2011-2014. In other words, the impact of the variation in specialisation between 2011 and 2014 on the same-period VQR is evaluated. A caveat is important here: given the budget constraints of Italian universities, the turnover had been limited in the period considered; therefore, the changes in the Balassa index between 2011 and 2014 are small in absolute terms.

To recover the effects of the specialization in 2011-2014 on the 2011-2014 VQR, we rely on the OLS estimate of the following equation

$$\Delta VQR_{(11-2014)-(04-2010)_{i,j}} = \varphi + \vartheta \Delta BSI_{2014-2011_{i,j,\tau}} + \\ + \rho \Delta BSI^2_{2014-2011\, i,j,\tau} + \omega \Delta BSI_{2014-2011_{i,j,\tau}} * \beta VQR_{04-2010\, i,j} + \beta VQR_{04-2010_{i,j}} + \varepsilon_{i,j} \qquad 6)$$

where $\Delta VQR_{(11-2014)-(04-2010)_{i,j}}$ is the variation of results in the VQR research evaluation produced between 2011 and 2014 (VQR 2011-14) and between 2004 and 2010 (VQR 2004-2010) for university i and research area j (again the R and X index are used alternatively), $\Delta BSI_{2014-2011_{i,j,\tau}}$ is the Balassa Specification Index for university i, research area j and academic career specification τ , measured as the difference between 2014 and 2011, and finally

$VQR_{04-2010_{i,j}}$ controls for the level of research evaluation produced between 2004 and 2010 (VQR 2004-10) for university i and research area j. $\varepsilon_{i,j}$ is the i.i.d. error term.

Table 4 and Table 5 show the results for the whole sample, when the R index and the X index have been respectively considered; the dependent variable is expressed in terms of variation the result obtained from a VQR to the other. Again, for all the outcomes of interest, we report two estimates for standard errors. Columns (1), (3), (5) and (7) report standard errors robust to heteroscedasticity while Columns (2), (4), (6) and (8) report standard errors clustered at university level. A first remark is about the negative sign of the evaluation received in the 2004-2010 VQR: it shows that the higher the score in 2010, the lower its growth between the two evaluation periods. Such a result is not surprising and is consistent with decreasing returns of research: universities that were already producing high-quality research improved this quality relatively less than universities that scored worse, as there is less room for improvements near to the top than far from it.

The empirical evidence shows that the effect of the specialisation is clearly positive; considering these effects more in details, we can observe that the specialisation in all the three ranks (i.e. full, associate and assistant professors) had a positive effect in terms of R index (Table 4), while the effect is statistically significant only for associate professors when the X index is considered (Table 5). While the relationship suggested by the analysis between $R_{VQR,2010\text{-}2014}$ and the BSI is quadratic, almost all the universities are positioned in the increasing branch of the parabola. The results indeed suggest that the minimum of the parabola is around 0.085 for institutions for which $R_{VQR,2004\text{-}2010}$ was equal to 1 (i.e. for the institutions that scored exactly as the Italian average). This minimum shifts leftwards as the value of $R_{VQR,2004\text{-}2010}$ decreases (it is equal to 0.492 when $R_{VQR,2004\text{-}2010} = 0.5$), while it shifts rightwards when the R index increases. This result leads to the conclusion that all the institutions that scored as the national average or better have gained from specialising, while the worst universities (those with a value of $R_{VQR,2004\text{-}2010}$ particularly low) performed worse than the others if they chose to specialise. A possible explanation for this may be a reputation effect: bad institutions attract low-quality scholars, while prestigious universities attract high-quality researchers. Stated a bit differently, we may say that high-performing scholars apply for positions in top universities and are hired, while low-performing scholars are unable to enter these universities and end to be hired by low-quality institutions. This difference suggests that the effect of specialisation in terms of top-quality publications is weaker than on the average quality of research products. However, the data indicate that the increase in top-quality publications was produced in particular by the associate professors. Given the rules of academic promotions in Italy, this same result suggests also that likely assistant professors with top-quality research products were promoted to associate professors in the four years considered for the VQR.

Overall the results of the empirical analysis presented show that, on the one hand, some universities implemented strategies aimed at catching-up the best others, by over-investing in the scientific areas, where they were strong, while the universities that obtained above-the-means evaluations in 2010, aimed at strengthening the research areas where they were less performing. On the other hand, increases in specialisation were more fruitful for the best than for the worst universities. This may indicate the existence of some Matthew's effect: the best scholars go to the best universities.

[Tables 4 and 5 around here]

6. Further analyses

As a further step, we divide the full sample into two sub-samples, one for research areas in the filed of Science and Technology (S&T), and the other for research areas in the field of humanities and social sciences (H&SS).

We first estimate equation (5) in order to recover the effects of the results of the 2004-10 VQR on the specialization of the academic staff. Results for the whole academic staff are presented in Table 6 while Table 7 shows the empirical evidence when full, associate and assistant professors are taken into account, both for S&T research areas. In particular, results show that none of the coefficients for the R or for the X index is statistically significant. This outcome means that the Italian universities decided not to change their specialisations in the science and technology research areas, according to the results of the VQR. In other words neutrality of investments in S&T research personnel with respect to the VQR is found.

[Tables 6 and 7 around here]

Data for H&SS tell instead a different story. Tables 8 and 9 summarize the results, for academic staff and for full, associate and assistant professors respectively, when the analysis is restricted to H&SS. The empirical evidence shows a statistically significant inverted-U relationship between the R index and the BSI for the whole academic staff (Table 8) and for all the professor ranks (Table 9). As before, the maximum of this inverted-U is around 1 for full and associate professors, while it is around 0.9 for assistant professors. These figures suggest that – in H&SS – only the universities that ranked much below the national mean decided to increase their specialisation in H&SS over-hiring assistant professors. The effects on recruitments in and promotions to the other two ranks are instead similar to those detected for the full sample. The use of the X instead of the R index does not change this conclusion. The only difference is a shift to the right of the maximum of the second-degree function, which is now always larger than 1 for all the ranks.

[Tables 8 and 9 around here]

We finally estimate equation (6) to recover the effects of the specialization in 2011-2014 on the 2011-2014 VQR. Tables 10 and 11 show the results for S&T and for the H&SS research areas, when the R index is taken into account. Tables 12 and 13, instead, report the estimates for S&T and for the H&SS research areas, when the X index is considered. For S&T, the general results are overall confirmed, although increasing the specialisation for associate professors has a positive payoff only for the universities that already scored well above the national mean in terms of R index; no effect is detected for assistant professors. Turning to H&SS, it is possible to notice that increases in the specialisation at both associate and assistant professor levels have a positive impact on the VQR 2010-2014 measured through the R index. In particular, the effect of assistant professors is strong and always positive, indicating that the assistant professors hired between 2010 and 2014 in H&SS on average were of relatively high quality in terms of research output.

[Tables 10 and 11 around here]

Considering instead the X index, we may observe positive effects due to the choice of increasing the specialisation at the full-professor level in S&T, and at associate-professor level in H&SS. This outcome suggests that in the first group of research areas, top publications were produced by full professors, while associate professors are the producers of top publications in H&SS. If we assume that the increases in the Balassa index are mostly due to new recruitments, and that these are in the most of cases promotions from the rank immediately below, then we can conclude that top scholars were concentrated among associate and assistant professors in S&T and in H&SS respectively at the beginning of 2010 and that in the two groups of disciplines the best of them were promoted to the immediately higher rank in the period 2010-2014.

[Tables 12 and 13 around here]

7. Conclusions

National evaluations of university research are an important tool for assessing the quality of the research produced in a country and for monitoring its evolution over time. The results produced by the national agencies charged of these evaluations are used also to allocate public funds between the universities. After a series of reforms, also Italy undertook this way some years ago; the MIUR allocates funds also according to the results of the periodic research evaluations, carried out by the national agency for the evaluation of research quality.

This paper aims at understanding whether universities use the results of these evaluations when planning new recruitments and promotions of already hired scholars. The rationale behind this is to maximise the resource intake: if the results in terms of quality of the research increase, also the resources transferred from the Ministry to the single institution do. However, the result comes from a comparative rather than from an absolute comparison: at the end of each evaluation period, all the public universities are ranked according to their performance in research, and prized according to their position in the ranking. To improve such a position, universities may follow (at least) two strategies: invest especially in the research areas where they obtained the best results, to further strengthen them, or spend resources mainly to increase the performance of the weakest research areas. In both cases, investments are in particular in terms of human capital, through new recruitments of strong scholars and the promotion of the best of those already working in the same university.

The empirical evidence provided in this paper shows that the Italian universities tended to increase their specialisation in the research areas, where they ranked below or slightly above the national mean, revealing that the universities chose to try strengthening the weak sectors, both through promotions and new recruitments. This outcome suggests the existence of a dual policy: on the one hand the MIUR tries to foster a Matthew-effect mechanism, allocating more resources to the best-performing universities; on the other hand, these last seem opting to implement a beauty-contest strategy to make their weak areas to converge towards the national mean. Whether the two faces of this duality are at odds with each other (i.e. whether the second decreases the effectiveness of the first) should be the object of further research.

In terms of the effects of specialisation, we may see that it increased the university's performance for those universities that already scored high in the 2004-2010 evaluation, while the effect becomes lesser and lesser positive, as the quality of the past research output decreases. The outcomes presented in this paper seem to result from the combination of the effects of policies engendered by the results of the 2004-2010 VQR and national habitations and related promotions of scholars. Future research will address this issue, trying to disentangle the two processes. The data available for the present analysis are indeed not sufficient for inquiring this aspect, as the new system of national qualification started in 2012.

This study has two main limitations. The first is that each research evaluation system has its own rules, and these rules have never absolute value. In other words, different methods of evaluation may lead to different results and each country uses specific criteria, which render hard any comparison between countries. The second limitation is that – as our results show – the definition of different indices based on the same macro-rules lead to (partially) different results. Therefore, some universities may have based their decision on an indicator, and some others on another, increasing the heterogeneity of policies within the same country. While we believe that no method of evaluation may have absolute validity, efforts should be made both at EU and at international level for harmonising the evaluation systems for at least two reasons: academic research is more and more globalised, and the mobility of scholars between countries and within the EU is increasing over time.

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TABLES

Table 1 – Descriptive statistics - Balassa specialization index for academic staff, full, associate and assistant professors by research areas (years 2011 and 2016) – R and X indices for research evaluation by research areas (VQR 2004-10)

Area	Obs	BSI academic staff	BSI full professors	BSI associate professors	BSI assistant professors	BSI academic staff	BSI full professors	BSI associate professors	BSI assistant professors	R Index	X Index
		2011				2016				VQR 2004-10	
01	54	1.077	1.069	0.978	1.103	1.091	1.062	0.996	1.174	1.017	0.994
02	49	1.317	1.280	1.585	1.331	1.288	1.259	1.307	1.315	1.016	1.014
03	51	1.020	1.010	0.968	1.056	1.022	1.025	1.005	1.043	0.991	0.973
04	43	1.302	1.350	1.262	1.316	1.290	1.295	1.243	1.309	0.966	0.990
05	54	1.135	1.140	1.101	1.121	1.102	1.090	1.113	1.080	1.036	1.045
06	46	1.048	1.159	1.067	0.994	1.063	1.149	1.111	0.994	1.130	1.081
07	32	1.949	2.049	1.895	1.971	1.924	1.983	1.984	1.837	0.967	0.934
08	43	1.646	1.650	1.592	1.666	1.615	1.637	1.541	1.690	1.010	1.043
09	51	1.232	1.191	1.203	1.289	1.207	1.174	1.152	1.297	0.981	0.988
10	52	1.575	1.549	1.503	1.612	1.611	1.629	1.530	1.645	1.000	0.996
11	54	1.209	1.109	1.272	1.217	1.224	1.227	1.227	1.227	0.985	0.973
12	55	1.229	1.194	1.409	1.153	1.233	1.224	1.297	1.189	1.007	0.934
13	58	1.301	1.263	1.414	1.302	1.231	1.155	1.283	1.250	0.999	0.973
14	51	1.229	1.088	1.287	1.273	1.224	1.188	1.165	1.308	0.988	1.076
Total	693	1.283	1.266	1.306	1.292	1.273	1.267	1.260	1.292	1.007	1.001

Table 2 – Effects of the 2004-10 national evaluation research on the Balassa specialization index for academic staff – All research areas – Dep. Variable: ΔBSI $_{\text{ACADEMIC STAFF 2016-2011}}$

VARIABLES	(1) Academic Staff	(2) Academic Staff	(3) Academic Staff	(4) Academic Staff
BSI $_{\text{ACADEMIC STAFF 2011}}$	-0.059*	-0.059	-0.059	-0.059
	(0.035)	(0.040)	(0.038)	(0.043)
R index $_{\text{VQR 2004-10}}$	0.774**	0.774**		
	(0.322)	(0.327)		
R index $_{\text{VQR 2004-10}}{}^{2}$	-0.408**	-0.408**		
	(0.170)	(0.173)		
X index $_{\text{VQR 2004-10}}$			0.215**	0.215**
			(0.099)	(0.102)
X index $_{\text{VQR 2004-10}}{}^{2}$			-0.104**	-0.104**
			(0.048)	(0.049)
Constant	-0.337**	-0.337**	-0.085	-0.085
	(0.142)	(0.143)	(0.041)	(0.042)
Observations	693	693	693	693
R-squared	0.533	0.533	0.512	0.512

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3 - Effects of the 2004-10 national evaluation research on the Balassa specialization index for full, associate and assistant professors – All research areas - Dep. Variable (1), (4), (7), (10): ΔBSI $_{\text{FULL PROFESSORS 2016-2011}}$; Dep. Variable (2), (6), (9), (11): ΔBSI $_{\text{ASSOCIATE PROFESSORS 2016-2011}}$; Dep. Variable (3), (7), (10), (12): ΔBSI $_{\text{ASSISTANT PROFESSORS 2016-2011}}$

VARIABLES	(1) Full Professors	(2) Associate Professors	(3) Assistant Professors	(4) Full Professors	(5) Associate Professors	(6) Assistant Professors	(7) Full Professors	(8) Associate Professors	(9) Assistant Professors	(10) Full Professors	(11) Associate Professors	(12) Assistant Professors
BSI $_{\text{FULL PROFESSORS 2011}}$	-0.016			-0.016			-0.033			-0.033		
	(0.079)			(0.079)			(0.090)			(0.089)		
BSI $_{\text{ASSOCIATE PROFESSORS 2011}}$		-0.332***			-0.332***			-0.332***			-0.332***	
		(0.077)			(0.077)			(0.082)			(0.085)	
BSI $_{\text{ASSISTANT PROFESSORS 2011}}$			-0.045			-0.045			-0.044			-0.044
			(0.042)			(0.042)			(0.043)			(0.042)
R index $_{\text{VQR 2004-10}}$	1.243**	1.129***	0.524**	1.243**	1.129**	0.524*						
	(0.544)	(0.436)	(0.262)	(0.492)	(0.440)	(0.266)						
R index $_{\text{VQR 2004-10}}{}^2$	-0.653**	-0.590**	-0.283**	-0.653**	-0.590**	-0.283**						
	(0.255)	(0.231)	(0.138)	(0.259)	(0.232)	(0.142)						
X index $_{\text{VQR 2004-10}}$							0.314*	0.331**	0.138*	0.314*	0.331**	0.138
							(0.163)	(0.133)	(0.083)	(0.166)	(0.139)	(0.084)
X index $_{\text{VQR 2004-10}}{}^2$							-0.152**	-0.154**	-0.071*	-0.152*	-0.154**	-0.071*
							(0.077)	(0.064)	(0.038)	(0.079)	(0.068)	(0.039)
Constant	-0.549**	-0.467**	-0.217*	-0.549**	-0.467**	-0.217*	-0.127*	-0.110*	-0.044	-0.127*	-0.110*	-0.044
	(0.216)	(0.194)	(0.117)	(0.220)	(0.195)	(0.117)	(0.073)	(0.057)	(0.039)	(0.074)	(0.060)	(0.038)
Observations	693	693	693	693	693	693	693	693	693	693	693	693
R-squared	0.413	0.756	0.253	0.413	0.756	0.253	0.351	0.750	0.248	0.351	0.750	0.248

Columns (1)-(2)-(3)-(7)-(8) and (9) standard errors robust to heteroscedasticity; Columns (4)-(5)-(6)-(10)-(11) and (12) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4 – Effects of the Balassa specialization index for academic staff, full, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (R index) - All research areas – Dep. Var.: ΔR index $_{VQR\ (11\text{-}2014)\text{-}VQR\ (04\text{-}2010)}$

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R index $_{VQR\ 2004\text{-}2010}$	-0.477***	-0.477***	-0.477***	-0.477***	-0.470***	-0.470***	-0.478***	-0.478***
	(0.0302)	(0.0301)	(0.0294)	(0.0295)	(0.0302)	(0.0303)	(0.0304)	(0.0303)
ΔBSI $_{ACADEMIC\ STAFF\ 2014\text{-}2011}$	-0.973	-0.973						
	(0.854)	(0.965)						
BSI $_{ACADEMIC\ STAFF\ 2014\text{-}2011}^2$	1.704**	1.704**						
	(0.781)	(0.701)						
BSI $_{ACADEMIC\ STAFF\ 2014\text{-}2011}$ * R index $_{VQR\_2004\text{-}2010}$	0.904*	0.904						
	(0.526)	(0.543)						
BSI $_{FULL\ PROFESSORS\ 2014\text{-}2011}$			0.0756	0.0756				
			(0.260)	(0.232)				
BSI $_{FULL\ PROFESSORS\ 2014\text{-}2011}^2$			0.215***	0.215***				
			(0.0570)	(0.0485)				
BSI $_{FULL\ PROFESSORS\ 2014\text{-}2011}$ * R index $_{VQR\_2004\text{-}2010}$			-0.137	-0.137				
			(0.228)	(0.196)				
BSI $_{ASSOCIATE\ PROFESSORS\ 2014\text{-}2011}$					-0.499***	-0.499***		
					(0.0924)	(0.0798)		
BSI $_{ASSOCIATE\ PROFESSORS\ 2014\text{-}2011}^2$					0.145**	0.145**		
					(0.0645)	(0.0668)		
BSI $_{ASSOCIATE\ PROFESSORS\ 2014\text{-}2011}$ * R index $_{VQR\_2004\text{-}2010}$					0.475***	0.475***		
					(0.160)	(0.157)		
BSI $_{ASSISTANT\ PROFESSORS\ 2014\text{-}2011}$							-0.112	-0.112
							(0.221)	(0.234)
BSI $_{ASSISTANT\ PROFESSORS\ 2014\text{-}2011}^2$							0.0928***	0.0928***
							(0.0289)	(0.0260)
BSI $_{ASSISTANT\ PROFESSORS\ 2014\text{-}2011}$ * R index $_{VQR\_2004\text{-}2010}$							0.0704	0.0704
							(0.0992)	(0.103)
Constant	0.468***	0.468***	0.467***	0.467***	0.461***	0.461***	0.470***	0.470***
	(0.0306)	(0.0295)	(0.0299)	(0.0289)	(0.0307)	(0.0297)	(0.0309)	(0.0298)
Observations	693	693	693	693	693	693	693	693
R-squared	0.426	0.426	0.426	0.426	0.428	0.428	0.425	0.425

Columns (1)-(3)-(5)-(7) standard errors robust to heteroscedasticity; Columns (2)-(4)-(6)-(8) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5 – Effects of the Balassa specialization index for academic staff, full, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (X index) - All research areas - Dep. Var.: ΔX index $_{\text{VQR (11-2014)-VQR (04-2010)}}$

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X index $_{\text{VQR 2004-2010}}$	-0.640***	-0.640***	-0.645***	-0.645***	-0.634***	-0.634***	-0.642***	-0.642***
	(0.0251)	(0.0252)	(0.0253)	(0.0246)	(0.0250)	(0.0256)	(0.0254)	(0.0254)
BSI $_{\text{ACADEMIC STAFF 2014-2011}}$	0.217	0.217						
	(0.996)	(1.020)						
BSI $_{\text{ACADEMIC STAFF 2014-2011}}^2$	0.879	0.879						
	(1.505)	(1.495)						
BSI $_{\text{ACADEMIC STAFF 2014-2011}}$ * X index $_{\text{VQR 2004-2010}}$	0.190	0.190						
	(0.493)	(0.497)						
BSI $_{\text{FULL PROFESSORS 2014-2011}}$			-0.182	-0.182				
			(0.244)	(0.248)				
BSI $_{\text{FULL PROFESSORS 2014-2011}}^2$			0.177	0.177*				
			(0.109)	(0.103)				
BSI $_{\text{FULL PROFESSORS 2014-2011}}$ * X index $_{\text{VQR 2004-2010}}$			0.101	0.101				
			(0.228)	(0.221)				
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}$					-0.222***	-0.222***		
					(0.0704)	(0.0797)		
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}^2$					0.248***	0.248***		
					(0.0695)	(0.0721)		
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}$ * X index $_{\text{VQR 2004-2010}}$					0.371***	0.371***		
					(0.0839)	(0.0852)		
BSI $_{\text{ASSISTANT PROFESSORS 2014-2011}}$							0.00553	0.00553
							(0.294)	(0.295)
BSI $_{\text{ASSISTANT PROFESSORS 2014-2011}}^2$							0.00258	0.00258
							(0.0649)	(0.0424)
BSI $_{\text{ASSISTANT PROFESSORS 2014-2011}}$ * X index $_{\text{VQR 2004-2010}}$							0.0284	0.0284
							(0.0889)	(0.0850)
Constant	0.631***	0.631***	0.636***	0.636***	0.625***	0.625***	0.633***	0.633***
	(0.0252)	(0.0247)	(0.0254)	(0.0244)	(0.0252)	(0.0250)	(0.0255)	(0.0249)
Observations	693	693	693	693	693	693	693	693
R-squared	0.719	0.719	0.718	0.718	0.722	0.722	0.718	0.718

Columns (1)-(3)-(5)-(7) standard errors robust to heteroscedasticity; Columns (2)-(4)-(6)-(8) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6 - Effects of the 2004-10 national evaluation research on the Balassa specialization index for academic staff – Science and Technology research areas - Dep. Variable: ΔBSI $_{\text{ACADEMIC STAFF 2016-2011}}$

VARIABLES	(1) Academic Staff	(2) Academic Staff	(3) Academic Staff	(4) Academic Staff
BSI $_{\text{ACADEMIC STAFF 2011}}$	-0.051***	-0.051***	-0.052***	-0.052***
	(0.017)	(0.017)	(0.015)	(0.005)
R index $_{\text{VQR 2004-10}}$	-0.043	-0.043		
	(0.058)	(0.044)		
R index $_{\text{VQR 2004-10}}{}^2$	0.027	0.027		
	(0.033)	(0.025)		
X index $_{\text{VQR 2004-10}}$			-0.023	-0.023
			(0.044)	(0.041)
X index $_{\text{VQR 2004-10}}{}^2$			0.015	0.015
			(0.024)	(0.022)
Constant	0.019	0.019	0.010	0.010
	(0.022)	(0.018)	(0.016)	(0.017)
Observations	423	423	423	423
R-squared	0.221	0.221	0.228	0.228

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level. Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 7 - Effects of the 2004-10 national evaluation research on the Balassa specialization index for full, associate and assistant professors – Science and Technology research areas - Dep. Variable (1), (4), (7), (10): $\Delta BSI_{\text{FULL PROFESSORS 2016-2011}}$; Dep. Variable (2), (6), (9), (11): $\Delta BSI_{\text{ASSOCIATE PROFESSORS 2016-2011}}$; Dep. Variable (3), (7), (10), (12): $\Delta BSI_{\text{ASSISTANT PROFESSORS 2016-2011}}$

VARIABLES	(1) Full Professors	(2) Associate Professors	(3) Assistant Professors	(4) Full Professors	(5) Associate Professors	(6) Assistant Professors	(7) Full Professors	(8) Associate Professors	(9) Assistant Professors	(10) Full Professors	(11) Associate Professors	(12) Assistant Professors
$BSI_{\text{FULL PROFESSORS 2011}}$	0.025			0.025			0.027			0.027		
	(0.086)			(0.072)			(0.086)			(0.074)		
$BSI_{\text{ASSOCIATE PROFESSORS 2011}}$		-0.255**	-0.088*		-0.255**	-0.088***		-0.254**			-0.254**	
		(0.110)	(0.051)		(0.112)	(0.028)		(0.110)			(0.112)	
$BSI_{\text{ASSISTANT PROFESSORS 2011}}$									-0.092*			-0.092***
									(0.047)			(0.030)
R index $_{\text{VQR 2004-10}}$	0.030	0.050	-0.198	0.030	0.050	-0.198						
	(0.048)	(0.050)	(0.190)	(0.065)	(0.047)	(0.172)						
R index $_{\text{VQR 2004-10}}^{2}$	-0.012	-0.017	0.108	-0.012	-0.017	0.108						
	(0.026)	(0.027)	(0.110)	(0.038)	(0.024)	(0.098)						
X index $_{\text{VQR 2004-10}}$							0.103*	0.012	-0.167	0.103	0.012	-0.167
							(0.054)	(0.044)	(0.143)	(0.067)	(0.037)	(0.139)
X index $_{\text{VQR 2004-10}}^{2}$							-0.042*	-0.005	0.089	-0.042	-0.005	0.089
							(0.023)	(0.022)	(0.080)	(0.032)	(0.018)	(0.076)
Constant	-0.023	-0.005	0.095	-0.023	-0.005	0.095	-0.062*	0.019	0.078	-0.062	0.019	0.078
	(0.024)	(0.026)	(0.075)	(0.033)	(0.023)	(0.074)	(0.033)	(0.027)	(0.054)	(0.038)	(0.023)	(0.058)
Observations	423	423	423	423	423	423	423	423	423	423	423	423
R-squared	0.011	0.470	0.119	0.011	0.470	0.119	0.033	0.469	0.162	0.033	0.469	0.162

Columns (1)-(2)-(3)-(7)-(8) and (9) standard errors robust to heteroscedasticity; Columns (4)-(5)-(6)-(10)-(11) and (12) standard errors clustered at university level. Standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8 - Effects of the 2004-10 national evaluation research on the Balassa specialization index for academic staff – Humanities and Social Sciences research areas - Dep. Variable: $\Delta BSI_{ACADEMIC\ STAFF\ 2016\text{-}2011}$

VARIABLES	(1) Academic Staff	(2) Academic Staff	(3) Academic Staff	(4) Academic Staff
$BSI_{ACADEMIC\ STAFF\ 2011}$	-0.028	-0.028	-0.058	-0.058
	(0.036)	(0.045)	(0.055)	(0.064)
R index $_{VQR\ 2004\text{-}10}$	1.043***	1.043***		
	(0.277)	(0.278)		
R index $_{VQR\ 2004\text{-}10}{}^{2}$	-0.554***	-0.554***		
	(0.150)	(0.152)		
X index $_{VQR\ 2004\text{-}10}$			0.248**	0.248**
			(0.101)	(0.103)
X index $_{VQR\ 2004\text{-}10}{}^{2}$			-0.117**	-0.117**
			(0.047)	(0.049)
Constant	-0.451***	-0.451***	-0.087**	-0.087**
	(0.122)	(0.121)	(0.040)	(0.040)
Observations	270	270	270	270
R-squared	0.688	0.688	0.571	0.571

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 9 - Effects of the 2004-10 national evaluation research on the Balassa specialization index for full, associate and assistant professors – Humanities and Social Sciences research areas - Dep. Variable (1), (4), (7), (10): ΔBSI $_{\text{FULL PROFESSORS 2016-2011}}$; Dep. Variable (2), (6), (9), (11): ΔBSI $_{\text{ASSOCIATE PROFESSORS 2016-2011}}$; Dep. Variable (3), (7), (10), (12): ΔBSI $_{\text{ASSISTANT PROFESSORS 2016-2011}}$

VARIABLES	(1) Full Professors	(2) Associate Professors	(3) Assistant Professors	(4) Full Professors	(5) Associate Professors	(6) Assistant Professors	(7) Full Professors	(8) Associate Professors	(9) Assistant Professors	(10) Full Professors	(11) Associate Professors	(12) Assistant Professors
BSI $_{\text{FULL PROFESSORS 2011}}$	0.020			0.020			-0.058			-0.058		
	(0.083)			(0.081)			(0.127)			(0.125)		
BSI $_{\text{ASSOCIATE PROFESSORS 2011}}$		-0.312***			-0.312***			-0.357***			-0.357***	
		(0.091)			(0.086)			(0.106)			(0.111)	
BSI $_{\text{ASSISTANT PROFESSORS 2011}}$			0.0128			0.0128			-0.006			-0.006
			(0.039)			(0.038)			(0.041)			(0.043)
R index $_{\text{VQR 2004-10}}$	1.658***	1.462***	0.789***	1.658***	1.462***	0.789***						
	(0.455)	(0.472)	(0.212)	(0.453)	(0.469)	(0.212)						
R index $_{\text{VQR 2004-10}}{}^2$	-0.874***	-0.776***	-0.430***	-0.874***	-0.776***	-0.430***						
	(0.240)	(0.259)	(0.114)	(0.241)	(0.257)	(0.114)						
X index $_{\text{VQR 2004-10}}$							0.326*	0.367***	0.172*	0.326*	0.367**	0.172*
							(0.177)	(0.135)	(0.088)	(0.176)	(0.146)	(0.088)
X index $_{\text{VQR 2004-10}}{}^2$							-0.159**	-0.163**	-0.090**	-0.159**	-0.163**	-0.090**
							(0.079)	(0.065)	(0.037)	(0.080)	(0.070)	(0.038)
Constant	-0.722***	-0.601***	-0.329***	-0.722***	-0.601***	-0.329***	-0.101	-0.110*	-0.050	-0.101	-0.110*	-0.050
	(0.211)	(0.210)	(0.094)	(0.208)	(0.206)	(0.094)	(0.085)	(0.058)	(0.041)	(0.085)	(0.064)	(0.041)
Observations	270	270	270	270	270	270	270	270	270	270	270	270
R-squared	0.573	0.839	0.485	0.573	0.839	0.485	0.415	0.806	0.397	0.415	0.806	0.397

Columns (1)-(2)-(3)-(7)-(8) and (9) standard errors robust to heteroscedasticity; Columns (4)-(5)-(6)-(10)-(11) and (12) standard errors clustered at university level. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 10 – Effects of the Balassa specialization index for academic staff, full, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (R index) - Science and Technology research areas - Dep. Var.: ΔR index $_{\text{VQR (11-2014)-VQR (04-2010)}}$

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R index $_{\text{VQR 2004-2010}}$	-0.478***	-0.478***	-0.478***	-0.478***	-0.469***	-0.469***	-0.477***	-0.477***
	(0.0387)	(0.0311)	(0.0376)	(0.0327)	(0.0381)	(0.0336)	(0.0374)	(0.0326)
BSI $_{\text{ACADEMIC STAFF 2014-2011}}$	0.960	0.960						
	(2.494)	(2.244)						
BSI $_{\text{ACADEMIC STAFF 2014-2011}}{}^2$	6.567*	6.567*						
	(3.887)	(3.409)						
BSI $_{\text{ACADEMIC STAFF 2014-2011}}$ * R index $_{\text{VQR 2004-2010}}$	-1.251	-1.251						
	(2.094)	(1.876)						
BSI $_{\text{FULL PROFESSORS 2014-2011}}$			0.335	0.335				
			(0.288)	(0.284)				
BSI $_{\text{FULL PROFESSORS 2014-2011}}{}^2$			0.270***	0.270***				
			(0.0540)	(0.0659)				
BSI $_{\text{FULL PROFESSORS 2014-2011}}$ * R index $_{\text{VQR 2004-2010}}$			-0.418	-0.418				
			(0.268)	(0.272)				
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}$					-1.275**	-1.275**		
					(0.526)	(0.486)		
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}{}^2$					-0.113	-0.113		
					(0.193)	(0.208)		
BSI $_{\text{ASSOCIATE PROFESSORS 2014-2011}}$ * R index $_{\text{VQR 2004-2010}}$					0.887*	0.887**		
					(0.456)	(0.422)		
BSI$_{\text{ASSISTANT PROFESSORS 2014-2011}}$							-1.828	-1.828
							(1.114)	(1.378)
BSI$_{\text{ASSISTANT PROFESSORS 2014-2011}}{}^2$							-0.152	-0.152
							(0.167)	(0.205)
BSI $_{\text{ASSISTANT PROFESSORS 2014-2011}}$ * R index $_{\text{VQR 2004-2010}}$							1.307	1.307
							(0.820)	(1.015)
Constant	0.466***	0.466***	0.466***	0.466***	0.457***	0.457***	0.466***	0.466***
	(0.0391)	(0.0324)	(0.0380)	(0.0337)	(0.0385)	(0.0343)	(0.0378)	(0.0337)
Observations	423	423	423	423	423	423	423	423
R-squared	0.409	0.409	0.406	0.406	0.404	0.404	0.405	0.405

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level.
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 11 – Effects of the Balassa specialization index for academic staff, full, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (R index) - Humanities and Social Sciences research areas - Dep. Var.: ΔR index VQR (11-2014)-VQR (04-2010)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R index VQR 2004-2010	-0.474***	-0.474***	-0.467***	-0.467***	-0.466***	-0.466***	-0.478***	-0.478***
	(0.0500)	(0.0509)	(0.0473)	(0.0495)	(0.0498)	(0.0518)	(0.0494)	(0.0524)
BSI ACADEMIC STAFF 2014-2011	-1.733	-1.733						
	(3.348)	(3.080)						
BSI ACADEMIC STAFF $2014\text{-}2011^2$	4.405	4.405						
	(5.285)	(4.579)						
BSI ACADEMIC STAFF 2014-2011 * R index VQR 2004-2010	2.096	2.096						
	(2.942)	(2.608)						
BSI FULL PROFESSORS 2014-2011			0.207	0.207				
			(0.647)	(0.594)				
BSI FULL PROFESSORS $2014\text{-}2011^2$			-0.318	-0.318				
			(0.513)	(0.404)				
BSI FULL PROFESSORS 2014-2011 * R index VQR 2004-2010			0.00703	0.00703				
			(0.391)	(0.390)				
BSI ASSOCIATE PROFESSORS 2014-2011					-0.597***	-0.597***		
					(0.165)	(0.116)		
BSI ASSOCIATE PROFESSORS $2014\text{-}2011^2$					0.310*	0.310**		
					(0.163)	(0.123)		
BSI ASSOCIATE PROFESSORS 2014-2011 * R index VQR 2004-2010					0.852**	0.852***		
					(0.391)	(0.285)		
BSI ASSISTANT PROFESSORS 2014-2011							-2.697	-2.697
							(1.654)	(2.069)
BSI ASSISTANT PROFESSORS $2014\text{-}2011^2$							2.538**	2.538
							(1.268)	(1.556)
BSI ASSISTANT PROFESSORS 2014-2011 * R index VQR 2004-2010							2.206*	2.206
							(1.210)	(1.496)
Constant	0.468***	0.468***	0.463***	0.463***	0.460***	0.460***	0.473***	0.473***
	(0.0505)	(0.0502)	(0.0482)	(0.0496)	(0.0508)	(0.0518)	(0.0507)	(0.0533)
Observations	270	270	270	270	270	270	270	270
R-squared	0.460	0.460	0.453	0.453	0.464	0.464	0.466	0.466

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level.
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 12 – Effects of the Balassa specialization index for academic staff, full, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (X index) - Science and Technology research areas - Dep. Var.: ΔX index $_{VQR\ (11-2014)-VQR\ (04-2010)}$

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X index $_{VQR\ 2004-2010}$	-0.578***	-0.578***	-0.576***	-0.576***	-0.579***	-0.579***	-0.579***	-0.579***
	(0.0285)	(0.0271)	(0.0275)	(0.0270)	(0.0263)	(0.0257)	(0.0274)	(0.0266)
BSI $_{ACADEMIC\ STAFF\ 2014-2011}$	-1.182	-1.182						
	(1.460)	(1.302)						
BSI $_{ACADEMIC\ STAFF\ 2014-2011}^2$	2.262	2.262						
	(4.066)	(3.458)						
BSI $_{ACADEMIC\ STAFF}$ * X index $_{VQR\ 2004-2010}$	0.264	0.264						
	(1.046)	(0.906)						
BSI $_{FULL\ PROFESSORS\ 2014-2011}$			-0.475***	-0.475***				
			(0.123)	(0.125)				
BSI $_{FULL\ PROFESSORS\ 2014-2011}^2$			0.133**	0.133**				
			(0.0540)	(0.0547)				
BSI $_{FULL\ PROFESSORS\ 2014-2011}$ * X index $_{VQR\ 2004-2010}$			0.335***	0.335***				
			(0.106)	(0.110)				
BSI $_{ASSOCIATE\ PROFESSORS\ 2014-2011}$					-0.817	-0.817		
					(0.599)	(0.600)		
BSI $_{ASSOCIATE\ PROFESSORS\ 2014-2011}^2$					-0.271*	-0.271		
					(0.158)	(0.171)		
BSI $_{ASSOCIATE\ PROFESSORS\ 2014-2011}$ * X index $_{VQR\ 2004-2010}$					0.369	0.369		
					(0.363)	(0.369)		
BSI $_{ASSISTANT\ PROFESSORS\ 2014-2011}$							-1.888	-1.888
							(1.355)	(1.615)
BSI $_{ASSISTANT\ PROFESSORS\ 2014-2011}^2$							-0.394	-0.394
							(0.322)	(0.379)
BSI $_{ASSISTANT\ PROFESSORS\ 2014-2011}$ * X index $_{VQR\ 2004-2010}$							1.074	1.074
							(0.809)	(0.963)
Constant	0.568***	0.568***	0.566***	0.566***	0.570***	0.570***	0.571***	0.571***
	(0.0304)	(0.0291)	(0.0295)	(0.0294)	(0.0285)	(0.0282)	(0.0295)	(0.0292)
Observations	423	423	423	423	423	423	423	423
R-squared	0.607	0.607	0.608	0.608	0.605	0.605	0.606	0.606

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level.
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 13 – Effects of the Balassa specialization index for full, academic staff, associate and assistant professors in 2011-2014 on the 2011-14 national evaluation research (X index) - Humanities and Social Sciences research areas - Dep. Var.: ΔX index VQR (11-2014)-VQR (04-2010)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X index VQR 2004-2010	-0.667***	-0.667***	-0.682***	-0.682***	-0.664***	-0.664***	-0.665***	-0.665***
	(0.0372)	(0.0376)	(0.0330)	(0.0330)	(0.0371)	(0.0383)	(0.0366)	(0.0382)
BSI ACADEMIC STAFF 2014-2011	1.607	1.607						
	(1.302)	(1.218)						
BSI ACADEMIC STAFF $2014\text{-}2011^2$	0.515	0.515						
	(3.705)	(3.828)						
BSI ACADEMIC STAFF 2014-2011 * X index VQR 2004-2010	-0.203	-0.203						
	(1.025)	(1.039)						
BSI FULL PROFESSORS 2014-2011			1.238	1.238				
			(0.849)	(0.801)				
BSI FULL PROFESSORS $2014\text{-}2011^2$			-1.440	-1.440				
			(0.913)	(0.867)				
BSI FULL PROFESSORS 2014-2011 * X index VQR 2004-2010			-0.427	-0.427				
			(0.377)	(0.382)				
BSI ASSOCIATE PROFESSORS 2014-2011					0.0490	0.0490		
					(0.101)	(0.0788)		
BSI ASSOCIATE PROFESSORS $2014\text{-}2011^2$					0.429***	0.429***		
					(0.0871)	(0.0702)		
BSI ASSOCIATE PROFESSORS 2014-2011 * X index VQR 2004-2010					0.537***	0.537***		
					(0.105)	(0.0909)		
BSI ASSISTANT PROFESSORS 2014-2011							-0.984	-0.984
							(0.904)	(1.050)
BSI ASSISTANT PROFESSORS $2014\text{-}2011^2$							2.459*	2.459
							(1.484)	(1.691)
BSI ASSISTANT PROFESSORS 2014-2011 * X index VQR 2004-2010							0.980	0.980
							(0.644)	(0.738)
Constant	0.655***	0.655***	0.671***	0.671***	0.655***	0.655***	0.655***	0.655***
	(0.0359)	(0.0333)	(0.0327)	(0.0303)	(0.0358)	(0.0340)	(0.0353)	(0.0339)
Observations	270	270	270	270	270	270	270	270
R-squared	0.788	0.788	0.785	0.785	0.792	0.792	0.787	0.787

Columns (1)-(3) standard errors robust to heteroscedasticity; Columns (2)-(4) standard errors clustered at university level.
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1