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IZA DP No. 11302

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Daniele Biancardi
IRVAPP

Massimiliano Bratti
European Commission JRC, DEMM, Universita degli Studi di Milano, IZA and LdA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Effect of the First Italian Research Evaluation Exercise on Student Enrolment Choices

This paper studies the impact of the first Italian Research Evaluation Exercise (VTR 2001-2003) on university undergraduate students' enrolment choices. A before-after estimator with differential treatment intensities is used to investigate whether subject-group higher education institutions (HEIs) that had a higher performance in the VTR also benefited from more student enrolments and enrolment of students with better entry qualifications after the VTR. Our analysis demonstrates that increasing the percentage of "excellent" research products by one standard deviation (19 percentage points) increases student enrolment by 5.8%. The effects are larger for high-quality students, namely those with better high school final marks (8.3%) or coming from the academic track (12.2%), and they are larger for subject-group HEIs in the top quartile of the VTR quality distribution. The effects are of similar magnitude across all macro-regions (North, Centre and South and Islands), but they are precisely estimated only for universities in the North. When HEIs are divided into new and old universities, only the former, which have less established reputations in teaching and research, appear to have gained from good performance in the VTR.

JEL Classification: I21 I23

Keywords: research evaluation exercise, student enrolment, student quality, Italy, VTR

Corresponding author:
Massimiliano Bratti
European Commission Joint Research Centre (JRC)
Via E. Fermi 2749, TP 361
21027 Ispra
Italy
E-mail: massimiliano.bratti@unimi.it

1 Introduction

The evaluation of academic research is relatively recent in Italy. The first Research Evaluation Exercise (REE, hereafter), concerning the period 2001-2003 (VTR 2001-2003),[1] was completed in 2006 and the results made public in the same year. The results of a second REE, covering the scientific production of the period 2004-2010 (VQR 2004-2010),[2] were publicly released in 2013, and those of the third REE (VQR 2011-2014) in 2017.

All Italian REEs have been followed by lively debates. Critics of REEs maintain that they are very expensive and excessively based on quantitative (e.g. bibliometric) indicators. Advocates of REEs counter that, in a period of shrinking public funding for higher education, it is more important than ever to allocate resources in an effective and efficient way.

The VTR represented the first adoption of a performance-based research funding system (PRFS) in Italy and, along with the subsequent REEs, attracted considerable attention from researchers (Rebora and Turri, 2013; Geuna and Piolatto, 2016). However, following a well-established stream of research (see, among others, Jiménez-Contreras et al., 2003; Auranen and Nieminen, 2010), only the effect of the VTR on the supply side of higher education, namely on universities' research productivity, has been assessed (Cattaneo et al., 2016). Surprisingly, to the best of our knowledge, there are no studies of the effect of the VTR on the demand side, i.e. on students. In the current paper, we aim to fill this gap by investigating whether the results obtained in the REE had any consequence for Italian higher education institutions (HEIs, hereafter) in terms of the numbers and the quality of enrolled students.

Our paper is related to the literature that, especially in the USA, has investigated the effects on student application and matriculation decisions of ratings and rankings of HEIs produced by private intermediaries (e.g. the *US News & World Report College Rankings*). In general, these studies do find that improving institutional rankings has a positive effect on student applications (see the literature review in Tutterow and Evans, 2016); however, the size of the effect is not very large, and it is generally smaller in studies using time-series that control for prior rank (Sauder and Lancaster, 2006). Moreover, the effect of rankings on the number of applications and matriculations is larger for top institutions (Bowman and Bastedo, 2009). The way information is presented also matters. A better performance is more effective at raising applications when HEIs are listed in rank rather than in alphabetical order, although this effect is smaller for top institutions, which already have well-established reputations (Luca and Jonathan, 2013). A higher rank

[1] *Valutazione Triennale della Ricerca* (three-year research evaluation).

[2] *Valutazione della Qualità della Ricerca* (research quality evaluation).

is also associated with more selectivity in admissions, lower acceptance rates (Monks and Ehrenberg, 1999; Meredith, 2004) and higher student quality (Monks and Ehrenberg, 1999; Griffith and Rask, 2007).[3] Evidence also exists for the UK, where researchers have assessed the responsiveness of applications to the rankings produced by popular newspapers, such as *The Guardian* or *The Times*. The results are aligned with the US literature. A better ranking is associated with more applications, and the effect is stronger for the institutions in the top quantiles of the quality distribution and for overseas students, who pay higher fees and are more sensitive to quality (Chevalier and Jia, 2016). Papers that pool all subjects and analyse the effect of ranking on applications at the university level rather than at the subject-group (i.e. study-field) level generally find smaller effects (Soo, 2013; Broecke, 2015). This is partly because the quality of subject groups varies considerably within an institution (Chevalier and Jia, 2016; Gibbons et al., 2015). Interestingly, UK studies also confirm that the salience of information matters. Information on student satisfaction affects applications only when it is incorporated in league tables, and ranking scores are more relevant when there is a high level of competition among departments and institutions (Gibbons et al., 2015).

Despite the existence of abundant evidence on the effects of league tables, none of the studies just mentioned has looked into the effect of "official" rankings, e.g. those produced by national REEs, on student choices. On this issue the evidence is, to the best of our knowledge, almost non-existent. We are only aware of two papers, which provide evidence on the Excellence Initiative that was run by the German government in 2006 and 2007. This nationwide competition awarded extra funding to the universities with the best future concept for research. In the first study, using administrative data on student applications, Horstschräer (2012) demonstrates that medical schools in universities that were awarded excellence status significantly increased the number of applications. In the second study, Fischer and Kampkötter (2017) show using survey data that winning the competition allowed universities to enroll significantly better high-school graduates in terms of GPA in three subsequent admission terms. The label of "excellence university" improved students' ratings of a university's educational quality and their labour market expectations immediately after the award. However, these expectations quickly returned to the baseline level three years later, in spite of the persistence of excellence status. Two major differences between the Italian VTR and the German Excellence Initiative are (i) the absence in the latter of an overall university ranking (excellence status was awarded to the universities winning the competition without any possibility to differentiate quality among the non-winning HEIs), which makes it different from REEs; (ii) excellence status was awarded to universities and not to HEIs' subject-groups.

[3] However, Meredith (2004) does not find an effect on the SAT score.

In this paper, we seek to contribute to this still scant literature by focusing on the effects of the first Italian REE on university students' enrolment choices.[4] Italy is an interesting case study. Italy has always been characterised by the so-called *legal value* of university degrees. This grants formal equality among all degrees irrespective of the awarding institutions, e.g. in access to public sector jobs. However, the progressive reduction in the universities' public funding,[5] together with a decrease in student numbers,[6] has spurred increasing competition among HEIs, creating a quasi-market. In the absence of an official quality assessment of HEIs, students had little guidance when choosing which institution to enrol in. Popular newspapers such as *La Repubblica* or *Il Sole 24 Ore* have exploited this lack of information by starting to produce specialised publications containing HEIs' league tables. On the one hand, in this context, the setting of an official REE by the Ministry of Education, Universities and Research is likely to have made a reliable source of information available to students and to have had an impact on their choices. On the other hand, as the object of the evaluation was only research, it is not at all obvious that such information was deemed relevant by students when choosing HEIs. The main goal of this paper is to assess whether or not this was the case.

The focus on Italy is also important in the light of the heated debate on the fact that REEs may exacerbate the brain drain phenomenon in southern regions and the islands (Fondazione RES, 2016). Indeed, northern regions have been historically characterised by a net inflow of university students, thanks to their labour markets, which offer students better employment prospects. However, the geographical gap between northern and southern HEIs seems to have widened since 2006, which is the year the VTR results were released (see Section 5). It is then important to assess whether poor performance in REEs might have been an important factor in accelerating the haemorrhage of students that southern HEIs are suffering.

We provide a first assessment of the impact of the VTR on student choices using a

[4] The results of the VTR have already been used in some individual-level studies of Italian students' geographical mobility and labour market outcomes. Ciriaci (2014), using cross-section data, reports that the probability that a student *graduates* from a university outside his or her region of residence increases with the VTR score of the university of destination and decreases as the average score of the universities in the region of residence increases. We add to that paper by providing evidence from panel data, which allow us to deal with university time-invariant or very persistent unobserved heterogeneity (e.g. university reputation) and providing evidence on student enrolment instead of graduation. Sylos Labini and Zinovyeva (2011) demonstrates that research quality, measured by the VTR score, raises the probability that an individual enrols in a PhD course.

[5] The *Fondo di Finanziamento Ordinario* (FFO), which is the main source of public funding for Italian HEIs, decreased from almost 7.5 billion euros in 2009 to less than 6.4 billion euros in 2015.

[6] The total number of students enrolled decreased from a peak of 338 000 in the academic year 2003/2004, after the "Bologna reform" of 2001, to 255 000 in 2014/2015.

before-after estimator that exploits differential treatment intensities across HEIs. The score obtained in the VTR is the "dose" of the treatment administered to HEIs. In our analysis we compare HEIs' outcomes (total enrolments and student quality) before and after the VTR, and we look at whether in the post-VTR period there were significant (positive) changes associated with the results obtained in the VTR. The main identification assumption is that there are no contextual omitted variables which may be responsible for these changes. Such unobservable factors must have two features to threaten our identification strategy: (1) they must have the same timing as the release of the VTR results; and (2) they must be correlated with the VTR outcomes. This makes clear the importance of exploiting differences in VTR outcomes (i.e. treatment intensities) for identification. When making a simple before-after comparison, i.e. by simply comparing outcomes between the pre- and post-VTR periods, the effect of the VTR may be confounded, for instance, with that of the recession starting in 2008. By contrast, by also exploiting for identification purposes differences in treatment intensities between HEIs and scientific areas, we are able to control for year-specific or even province-year-specific fixed effects absorbing *inter-alia* the impact of the recession, even if it was different across the provinces where HEIs are located. Our identification strategy also enables us to control for time-invariant subject group by HEI heterogeneity (through subject-group HEIs fixed effects), which may simultaneously affect the VTR results and the number of enrolments. In our preferred specification, we also control for subject-group-HEI trends, which might pre-date the implementation of the VTR.

This paper contributes to the extant literature in at least two ways. First, as we mentioned, our study is the first to systematically examine the effect of an official REE on students' choices. Unlike the previous literature on privately produced league tables, we compare the period in which an official REE was not in place with a period in which an REE was functioning. Thus, unlike the extant research, our paper is not concerned with the effects of increasing HEIs' rankings but with how HEIs' enrolments changed over time as a consequence of having performed well (or badly) in the first REE.[7] In this sense, our estimates can be roughly interpreted as the effect on student choices of establishing an REE. This is of interest not only to stakeholders in Italy but also to readers and policy makers in countries that are thinking of implementing similar REEs. Second, in line with the most recent literature (Chevalier and Jia, 2016; Gibbons et al., 2015), we frame the analysis at the level of subject groups within HEIs. This is important because, as for newspapers' league tables, REE rankings are also very likely to differ across disciplines. We show that this is the case for the VTR evaluation exercise, in which differences in the evaluation

[7] This is also the reason why we focus only on the first REE. Moreover, pooling all REEs together poses some comparability issues, as the rules of the REEs changed over time.

between subject groups in the same university were often huge.[8] Thus aggregating the analysis at the HEI level is likely to wash out most of the variation across subject groups and hide the true effect of the research quality assessment on student choice.

The main findings of our paper can be summarised as follows. First, we show that while the VTR score (an indicator of average HEIs' quality) did not affect student demand the subject-group within HEI level, the percentage of excellent products was positively associated with the number of undergraduate student enrolments. This is partly because the second research quality indicator is better able to discriminate between subject groups within HEIs. Second, the VTR had a larger effect on the enrolment of high-quality students, i.e. those with better entry qualifications. Those are the students who are likely to care most about the quality of HEIs. Third, the positive effect of the VTR — both the final score and the proportion of excellent products in this case — on enrolment is stronger in the top quartile of the quality distribution. This is consistent with the effect of REEs, and of PBRF systems in general, to increase competition among those HEIs that have some chance of winning the "race for quality". Fourth, the effect of the VTR appears to be very similar across geographical areas, although it is precisely estimated only for northern Italy. Fifth, and last, statistically significant effects of the percentage of excellent products on student enrolments and student quality are found only for new universities (i.e. created after 1970), which have less of a tradition in teaching and research and for which the information released by the VTR might have contributed to partly filling the reputation gap compared with older institutions.

The paper proceeds as follows. Section 2 describes the context in which the first Italian REE was introduced and its main characteristics. In Section 3 we explain our empirical strategy. Section 4 describes the data used in the empirical analysis, whose results are commented on in Section 5. A brief discussion of the main mechanisms through which the VTR could have affected student choices is presented in Section 6. Finally, Section 7 summarises the main findings and concludes the paper.

2 The Italian system of higher education and the first Research Evaluation Exercise

The Italian higher education system has always been characterised by a high degree of centralisation. Law no 382 11/7/1980 provided that any variation in the existing university supply had to be included in a development plan to be approved by the Minister of Educa-

[8] It is important to notice that within the same *alma mater* researchers in different subject groups can be affiliated to the same department, and researchers in the same subject groups can be affiliated to different departments.

tion every three years. Moreover, openings of new universities required a specific law to be passed by Parliament. University degrees had to meet some criteria fixed centrally by the Ministry of Education, Universities and Research, concerning, among other things, their curriculum content. The fact that the system was (and still is) almost entirely public and directly managed by the central government, together with the very little differentiation between the degrees supplied by the different HEIs, led to the legal recognition of degrees in the same field as identical (*valore legale*, i.e. legal value).

On the demand side, until a few decades ago, the student body used to come almost entirely from families in relatively high socio-economic brackets. Indeed, educational mobility has historically been lower in Italy than in other developed countries. For example, Checchi et al. (1999) report that less than 2% of people whose father did not complete compulsory schooling end up having a college degree in Italy, while the corresponding figure for the USA is 12%. The evolution from an elite to a mass university system started in 1969, when access to university was liberalised and enrolment in any field became possible for students holding all types of upper secondary school degrees (Law 11 December 1969, no 910).[9]

On the supply side, the increased demand for higher education led to the foundation of many new HEIs, new faculties and new local branches. Reforms between the late 1980s and the early 1990s granted an unprecedented level of autonomy to universities regarding the management of teaching and financial resources. The requirement for parliamentary approval was abandoned in 1990 (Law no 341 19/12/1990), whereas the requirement for inclusion in a university development plan was retained. However, universities gained the autonomy to advance proposals for new initiatives to the Ministry. Many institutions used this new autonomy to open branches in smaller cities and to dramatically increase the number of degrees offered (Bratti et al., 2008; Oppedisano, 2011). The entry of new actors into the higher education market and the increasing fragmentation of educational provision contributed to enlarging the gap, in terms of quality, between HEIs. However, the Italian university system remains characterised by a much larger variation in research quality within departments than between departments in the same field of study (see Bonaccorsi and Cicero, 2016, for a within-between analysis of research quality).

A major step towards a mass tertiary education system was taken in Italy with the completion of the Bologna process and the so-called "3+2" reform (Ministerial Decree no 509/99).[10] The older long (mostly four- or five-year) degrees were replaced with two

[9] Before this law only individuals graduating from a specific academic upper secondary school track (*liceo classico*, i.e. classical lyceum) could enrol in all types of tertiary education.

[10] For a brief description of the "3+2" university reform, see Di Pietro and Cutillo (2008) and Cappellari and Lucifora (2009).

levels of degrees: three-year first-level degrees and two-year second-level degrees.[11] The large increase in the supply of degrees offered made it difficult for high school graduates to choose the best possible option given their preferences and constraints. This made prospective students increasingly interested in knowing the relative quality of institutions and degrees. For this reason, two of the main Italian newspapers (*Il Sole 24 Ore* and *La Repubblica*) started, about 15 years ago, publishing yearly rankings of Italian universities and faculties.[12]

With a similar purpose, i.e. to evaluate the quality of universities and other research institutions receiving public funds and to diffuse this information among stakeholders, the Steering Committee for Research Evaluation (CIVR) initiated the first REE (the VTR 2001-2003) in December 2003. The REE assessed the research produced by 102 Italian institutions (77 universities and 25 research agencies) for the period 2001-2003. The products evaluated were divided into 20 disciplinary areas, the 14 CUN areas plus 6 interdisciplinary sectors.[13] Each university had to send one (of its own choosing) product per four researchers, while research agencies were required to submit one product per two researchers. The first REE was entirely based on peer review. A total of 17 329 products were evaluated by 6 661 experts (Franceschet and Costantini, 2011). Each product evaluation, by at least two referees, led to four possible outcomes: excellent, good, passable and of limited value. Furthermore, universities shared data on human resources, international mobility and research funding in order to make a complete and informed assessment possible. The total cost of the REE was around 3.55 million euros. In contrast to what happened in the UK with the Research Assessment Exercise (RAE), initially very limited funding was linked to the results of the REE (see, for details Rebora and Turri, 2013).

The final results of the evaluation were released in February 2006, potentially affecting university enrolments beginning in the 2006-2007 academic year. The assessment of each single research product has not been published, but it has been disclosed only to rectors (i.e. chancellors). The final VTR ranking score was built as a weighted average, with the number of "excellent" (E) products multiplied by 1, "good" (G) products by 0.8, "passable" (P) products by 0.6 and "limited value" (L) products by 0.2. The formula is:

$$\text{final VTR score} = \frac{1 \cdot E + 0.8 \cdot G + 0.6 \cdot P + 0.2 \cdot L}{\text{total products evaluated}}. \tag{1}$$

This indicator can vary between 0.2, if all products are judged as of "limited value", and 1, if all products are "excellent". For the purpose of the current study we will be using two main

[11] Other courses were also introduced, such as first-level masters degrees and second-level masters degrees, but most students enrolled in the first two types of degrees.

[12] Faculties are the equivalent of schools in the international context.

[13] CUN stands for *Consiglio Universitario Nazionale* (National University Council). CUN's members are elected to advise the Ministry of Education, Universities and Research on matters related to HEIs.

indicators of quality. The first is the final VTR score, computed as described above, and the second is the percentage of excellent products (i.e. those evaluated as "excellent"). To make the results of the estimated regressions easier to read, both indicators are included in the econometric models as standardised variables with zero mean and unit standard deviation (σ, hereafter), so that their coefficients correspond to the percentage increase (as the dependent variable is measured as a logarithm) in the dependent variable produced by a 1σ increase in the indicator.[14]

3 Empirical strategy

We are primarily interested in the impact of VTR on the number of university enrolments and the quality of students. We use two measures of student quality. The first is the number of students coming from the upper secondary school academic track (*liceo*) and the second is the number of students with grades above 90 in the upper secondary school final examination (grades vary from 60 to 100).[15] We use data on enrolment from 2002 to 2011, that is, before the second and third REEs started. We base our identification strategy on a before-after estimator with differential treatment intensities.[16] The main idea is to look at whether subject-group HEIs that performed well in the evaluation exercise attracted a higher number of students and better students after the VTR than in the past relative to those subject-group HEIs that did not perform satisfactorily in the research assessment. Our empirical specification is described by the following equation:

$$Y_{ijt} = \alpha_0 + \alpha_{1i} D_i + \alpha_{2jt} D_{jt} + \alpha_3 (V_i \cdot POST_{2005}) + \epsilon_{ijt} \tag{2}$$

where i, j and t are subject-group HEI, province and time subscripts, respectively. D_i is an indicator variable defined at the HEI (a) $\times$ subject-group (k) level; D_{jt} are province-year

[14] The final VTR score for research quality has been used by the Ministry of Education, Universities and Research to build official rankings of universities in each of the 20 areas. For the purpose of the current study, we focus on the VTR score and not on the official rankings, as the latter were produced by university size groups (large, medium, small). We do not think that such classification is particularly useful for students who are interested in enrolling in high-quality HEIs, although it may be for the Ministry, which has to allocate public resources.

[15] Italy has a tracked upper secondary school system. Schools can be divided into three main tracks. The first is represented by the academic track, and we will refer to these schools as the academic high schools. The second is the technical track and the third the vocational track. Students who choose the academic track generally go on to tertiary education.

[16] Since all HEIs were subject to the VTR exactly at the same time, it is not possible to use a difference-in-differences (DID) strategy (see, for instance, Duflo, 2001).

fixed effects;[17] V_i a (time-invariant) continuous variable reflecting the score obtained in the VTR and $POST_{2005}$ a post-VTR dummy. In particular, the first academic year affected by the reform was 2006/2007, and starting from this academic year the $POST_{2005}$ indicator takes on the value 1. ϵ_{ijt} is an error term. In this baseline specification, α_3 captures a higher or lower *level* of the outcome variable (e.g. student enrolments or student quality) after 2005 for subject-group HEIs that obtained a higher score in the VTR. Subject-group HEIs' time-invariant factors are captured by α_{1i} and local factors (e.g. cost of housing, local unemployment) by α_{2jt}.

The specification in (2) controls for subject-group-HEI fixed effects, i.e. subject-group HEIs are allowed to start from different intercepts as far as enrolments and student quality are concerned. These fixed effects control for time-invariant unobserved heterogeneity that might affect the number of enrolments and student quality. However, we also estimate a more demanding specification including both subject-group HEI-specific intercepts and subject-group HEI-specific trends, which allow subject-group HEIs to follow different pre-VTR trends in the outcome variables. This may address the concern that subject-group HEIs that saw an increase in enrolment or in student quality after the VTR may have already been on a steeper upward trend before the research assessment. The corresponding specification is:

$$Y_{ijt} = \alpha_0 + \alpha_{1i} D_i + \gamma_i (D_i \cdot f(t)) + \alpha_{2jt} D_{jt} + \alpha_3 (V_i \cdot POST_{2005}) + \epsilon_{ijt} \tag{3}$$

where the γ_is are the coefficients of the subject-group HEI-specific trends $D_i \cdot f(t)$, and $f(t)$ is a function of time (t). Although our preferred specification uses a linear trend, we also check the robustness of our main results using a quadratic trend.

Some of the existing literature mentioned in the introduction has demonstrated that league tables may be more important for the top institutions, while average- or low-quality institutions may be less sensitive to rankings. To test this hypothesis we divide the VTR score into two quartile dummies, one for the fourth quartile of the quality indicator (Q4), meaning higher quality, and the other for the lower quartiles (Q1-Q3). Then V_i is replaced with the fourth quartile dummy in all specifications above.[18] The coefficient on the $Q4 \cdot POST_{2005}$ has to be interpreted as the differential effect with respect to lower quartiles of quality.

The VTR produced several indicators. In this study we use the overall VTR score and the proportion of excellent products (see data description). The first is an indicator of

[17] In Italy, a province (*provincia*) is an administrative division of intermediate level between a municipality (*comune*) and a region (*regione*).

[18] Only one of the two interactions between quartile dummies and the post-VTR period can be included in the regression, as when both are included the two dummies are collinear with the province-year fixed effects.

the average research quality of a subject-group HEI, while the second is more suitable to capture research excellence.

4 Data

Our analysis is based on data from two main sources. Information about the number of students enrolled in each year and degree course (including a code on the detailed field of study) comes from the website of the Ministry of Education, Universities and Research (MIUR). This dataset also provides the number of enrolled students by upper secondary school final grade and track. We focus our analysis on students enrolled in first-level (i.e. undergraduate) degrees. This choice is dictated by the fact that second-level degrees were introduced by universities in the 2004/2005 academic year, and there are not enough years before 2006 to estimate the effect of the VTR on student enrolment.[19] Student enrolment data for each first-level degree course were aggregated in HEI-province-subject group-year cells, where HEI-province cells define university branches, as Italian universities often have branches located in different provinces.

The second data source is the report released by the Steering Committee for Research Evaluation in February 2006. The document contains information on research quality divided by scientific area for 77 universities. We decided to focus our attention on two measures of research quality, the final VTR score described in equation (1) and the percentage of excellent products.

Before running the analysis the two sources of data had to be merged. In the Italian higher education system, first-level and second-level degrees are classified into "degree classes" (*classi di laurea*), i.e. groups that have similar training objectives and a minimum number of credits in given — narrowly defined — subject-groups. The latter are defined in terms of scientific sectors (*settori scientifico-disciplinari*). Scientific sectors are

[19] There are other reasons why it could be preferable to focus on first-level degrees. First of all, while many second-level degrees had a fixed number of slots per year, the same is not true for first-level degrees, where access was unconstrained almost everywhere in Italy in the period that we consider. Since we are interested in the effect of research quality on student enrolment, restrictions on the number of slots (for which we do not have data) would be a potential confounding factor in our analysis. We expect in particular that HEIs with a better score in the REE would tend to rely more on selective admissions for second-level degrees, leading to a potential negative bias in our estimates of the effect on total enrolments. Secondly, the two indicators for the quality of enrolled students that we use are likely to be better proxies of student quality before starting first-level degrees, while, for second-level degrees, the final grade in the first-level degree is a better proxy of student ability. Unfortunately, the latter is not available in the data. Third, in the first period of implementation the curricula of second-level degrees were designed to be a natural continuation of first-level degrees provided by the same institution, and there was little mobility of students across HEIs.

subject groups in which academic personnel are placed for career purposes. For instance, researchers can participate in public hiring or promotion competitions only if the latter match their (or a very similar, i.e. "affine") scientific sector .[20] Moreover, a course belonging to a given scientific sector can generally be taught only by academic staff (assistant professors, associate professors or full professors) belonging to the same or to an "affine" sector.

To carry out our analysis, we have to map the results of the VTR, which are available at the level of scientific sector, with student enrolments, which are available at the "degree class" level. We proceed as follows: (1) VTR results are aggregated into broad scientific areas according to the National Council of University (CUN) classification areas; (2) "degree classes" are aggregated into broad teaching subject groups according to the prevailing scientific sectors; (3) the two sets of subject groups are matched lexicographically. The linking table is reported in Appendix A. We manage to obtain complete information about enrolment and research quality for 518 subject-group HEI groups. We deem this match sufficiently precise for our purposes. The match is mapping the prevailing content of a group of degrees, in terms of a subject group, into the research performance of academic staff in the same group. Researcher-level information on the VTR results was never publicly disclosed and results were only released in aggregated form (at the scientific sector or department level). It was therefore impossible for students to know the quality of each researcher who was teaching in a specific degree and consequently the quality of each degree. Hence, students could know at best that researchers in a given subject group were performing better than researchers of another subject group in a given HEI or how researchers in the same subject group in different HEIs were performing in comparative terms.

In Figure 1 we plot the variation between and within institutions in the final VTR score. The graph presents the lowest, the average and the highest scores obtained by each institution. A large majority of universities have quite similar average scores, while there is much larger variation between fields of study within the same institution. Just to take an example, the University of Catanzaro obtained a maximum score of 0.87 and a minimum score of 0.2 , with an average score of 0.66. This makes clear the advantage of carrying out the analysis at the subject-group level, since averaging enrolments and REE scores at the HEI level would wash out most of the variation. The relatively low amount of variation in the final VTR score is partly due to the design of the REE, as the number of products to be sent for the evaluation was quite low, one per every four researchers.[21] Figure 2 presents the same information as Figure 1 for the percentage of

[20] For instance, a researcher in political economy (*Economia Politica*) can participate in a competition for political economy or economic policy (*Politica Economica*).

[21] This changed in the following REEs. Each university research staff member had to submit three

products that were evaluated as excellent in each subject-group HEI. For this indicator the variance is larger, with many subject-group HEIs presenting no excellent products and some others for which all the research output sent was judged excellent. Figure 3 presents the variation in the two measures of research quality (the VTR score and the percentage of excellent products) between provinces. They correspond to Nomenclature of Territorial Units for Statistics 3 (NUTS-3) in Eurostat's classification. A clear geographical divide emerges, with most institutions in the top 20 positions located in the North of Italy and the majority of institutions with low scores located in the South and Islands.

Figure 4 by plotting the raw data visualises the kind of empirical exercise that we do in this paper. The figure plots the average number of students enrolled per year in subject-group HEIs that got a low (first quartile) versus a high (fourth quartile) score in the VTR. The number of students enrolled per subject-group HEI decreased significantly during the period in both groups. However, the reduction was larger for subject-group HEIs that received a bad evaluation, i.e. with a score in the first quartile, and a large proportion of the divergence took place immediately after the publication of the results. Thus the effect of a better VTR rating on enrolment appears to be positive in the raw data. The falling trend for the whole period is also evident for students graduating from high school with a high mark,[22], while for students from academic high schools the initial decrease in enrolment is compensated for by a similar increase between 2007 and 2011 for both high and low research quality subject-group HEIs.

5 Results

5.1 Main results

Table 1 consists of three panels. In each panel we use a different dependent variable. Panel A uses the number of total enrolments, panel B the number of students enrolled that graduated from upper secondary school with a high mark (90 or more out of 100) and panel C the number of students enrolled coming from the academic track. In columns (1)-(3) we focus on the effect of the VTR score and in columns (4)-(6) on the effect of the proportion of excellent products. Columns (1) and (4) represent our baseline specifications, while in the other columns we report robustness checks on including differential subject-group-HEI trends (linear or quadratic). The baseline specifications control for subject-group-HEI fixed effects and province-year fixed effects. Column (1) demonstrates that only enrolments of

research products in the VQR 2004-2010 and two products in the VQR 2011-2014.

[22] Since students in southern Italy have on average higher marks in the high school final examination (see Montanaro, 2008) this trend may just reflect a more sustained negative trend for HEIs located in the South of the country.

students achieving high marks seem to be affected by the VTR score (a 6.5% increase for a 1σ increase in the score). The results change remarkably when we consider the proportion of excellent products. Our baseline estimates show that a 1σ increase in the proportion of excellent products raises total student enrolments and the numbers of high-mark students and academic-track students by 6.2%, 10.2% and 7.4%, respectively.[23]

In columns (2) and (5) subject-group-HEI linear trends are added in. Inclusion of these differential time trends allows us to remove the assumption that all subject-group HEIs had similar trends in student enrolment before the VTR irrespective of their research quality. For this reason we consider this specification our preferred model. Column (2) shows that inclusion of these additional controls sweeps out all the positive effects of the VTR score on enrolment of high-mark students found in the previous column. By contrast, the effects of the percentage of excellent products remain all positive and statistically significant. Increasing this indicator by 1σ raises total, high-mark and academic-track student enrolments by 5.8%, 8.3% and 12.2%, respectively. In columns (3) and (6) quadratic trends are included, which, however, have only a negligible effect on the estimated coefficients.

To gain an idea of the magnitude of the effects, a 1σ increase in the VTR score is equivalent to a 0.1 increase in the score and corresponds to the difference in performance between the economics subject group in Bocconi University — scoring 0.89 in the VTR and ranking in first position (together with the university of Reggio Emilia) — and the same subject-group in universities such as Sassari, Siena or Bolzano (see Figure B1 in Appendix B). Similarly, a 1σ increase in the proportion of excellent products is equivalent to a 19 percentage point increase, which roughly corresponds to the difference between the performance of economics in Bocconi University — with 50% of excellent products — and in the University of Bologna (see Figure B2 in Appendix B).

A possible explanation for the difference in results between columns (1)-(3) and (4)-(6) is that, given the limited number of research products submitted, the VTR score was probably less able to determine quality than the proportion of excellent products , which exhibits larger variation both between and within HEIs (see Figure 3). The larger effects of research quality on the enrolment of high-quality students is consistent with the latter's being more responsive to the release of new information concerning research quality than students with low entry qualifications.

5.2 Non-parametric specification

A possible concern with our identification strategy is that a high percentage of excellent products in the VTR may pick up university reputation, for which we are not able to con-

[23] In panels B and C, 48 observations for which data on student quality are not available are dropped from the sample.

trol in the regressions. To test this hypothesis, in Table C1 in Appendix C we report the estimates of a less parametric specification in which each pre- and post-VTR year dichotomous indicator is interacted with the proportion of excellent products. The interaction with 2002 is omitted and represents the reference group. Ideally, the pre-VTR interactions should be close to zero and statistically insignificant, and the interactions should be positive and statistically significant in the post-VTR period if the REE really did have an effect. This is what is observed in coefficients shown in Table C1, which are also plotted in Figure 6. Moreover, the effect is quite constant over time in the post-VTR period, confirming the adequacy of the linear specification of equation (2).[24]

5.3 Heterogeneous effects

In this section, we explore some potential heterogeneities in the effect of the first REE. A robust finding in the past literature is that rankings especially affect student enrolment in HEIs in the top part of the quality distribution, while lower ranking institutions are less sensitive to the release of research quality information. We investigate this hypothesis including indicator variables for the fourth quartile (Q4) of the VTR scores and proportions of excellent VTR products, using interaction terms as described in Section 3. Interestingly, panel A of Table 2 shows that the effect of ranking in the fourth quartile of the VTR score on total enrolment becomes statistically significant at the 1% level and points to a 17.8% increase in student enrolments compared with HEIs in lower research quality quartiles (column 4). Similarly, being in the fourth quartile of the proportion of excellent products produces a 17.4% increase in total enrolment, which is significant at the 1% level. After including linear trends, in columns (2) and (4), the estimated effects are a bit smaller but still remain substantial and statistically highly significant.

The effects of being in the top quartile of the VTR score on enrolment of high-quality students are even larger. Panel B of Table 2 shows that being in the top quartile of the VTR score (or proportion of excellent products) increases the number of enrolments of high-mark students by 23.9% (20.9%). Effects of a similar magnitude are found in panel C on enrolments of students coming from the academic high school track. The magnitude of the effect of having the VTR score (or proportion of excellent products) in the fourth quartile is 19.6% (18.6%). The point estimates are generally robust to the inclusion of subject-group-HEI linear trends, and they become even larger on the number students coming from the academic school track (30.1% and 28.7%, for the VTR score and the proportion of excellent products, respectively).

Since the direct impact of VTR on public funding of HEIs was initially very limited, we

[24] In these estimates subject-group-HEI time trends are omitted because of multicollinearity.

expect the effect of the VTR results on student enrolment, if any, to be the result of changes in HEIs' reputations. Given that student mobility increased in Italy over the last decade (De Angelis et al., 2016)[25] it is important to investigate whether this phenomenon is due to a better awareness of differences in quality between HEIs or, as the trend accelerated dramatically after 2008, it can simply be explained by the fact that students increasingly prefer to enrol in universities located in more attractive labour markets. Indeed, the search for quality is not the only, and probably not even the most important, factor motivating students' geographical mobility, and the state of the labour market, both at origin and at destination, plays an important role (Dotti et al., 2013). However, there are concerns that bad performances by southern Italy's universities in REEs may exacerbate the brain drain and increase South-North migrations of university students. Figure 5 shows that, notwithstanding the clear trend towards a decrease in student numbers in all macro-regions, the drop is more sustained for the South in the post-VTR period. One could expect especially northern universities to gain from a good result in the VTR because they are likely to enjoy a "double dividend" from a high ranking in REEs by attracting not only more local students but also more external students (i.e. students from other regions). Southern students who have decided to move out of their regions may, for instance, change their enrolment choices compared with the past in favour of destinations ranking highly in the VTR . By contrast, southern universities are more likely to compete in local catchment areas and to enjoy much lower gains from a good rankings in REEs. Table 3 explores this hypothesis, by reporting estimates split by geographical macro-region (North, Centre, South and Islands). Splitting the sample removes a great deal of the variation in the VTR results, and not surprisingly the estimates are much less precise. The first three columns show no significant association between total enrolments and quality of enrolments and the VTR score for all geographical areas. When considering the percentage of excellent VTR products, we find more variable results. Indeed, while the effects are generally positive and significant for the North (6.1%, 11.5% and 16.4% on total enrolments, high-mark students and academic-track students, respectively), the effects are generally lower and statistically insignificant for the Centre and of similar magnitude but statistically insignificant for the South (with the exception of panel C, column (6)).

In Table 4 we report further analysis to throw light on the main channels through which performance in the VTR might have affected student choices. In particular, we suggest that, if the estimated VTR effect is mainly explained by an increase in the supply

[25] Mobility of high school students to HEIs in other areas of the country increased everywhere but the North-West. The area experiencing the largest growth was the South and Islands, whereas the proportion of high school students enrolling in the Centre and northern Italy increased from 16.5% in 2008 to 22.3% in 2014.

of information on the quality of universities provided to students, it should be larger for newly created universities, which do not have a well-established reputation compared with universities that have long traditions of teaching and research. To test this hypothesis, HEIs are divided into old and new universities: respectively, those founded before and after 1970.[26] The results suggest that the VTR had statistically significant effects only on new universities, for which positive effects are found for all outcomes (total enrolments, high-mark students and academic-track students) when we consider the effect of the percentage of excellent products. A 1σ increase in the percentage of excellent products increases total enrolments by 10.3% and the number of high-mark and academic-track students by 12.6% and 16.5%, respectively. The effects are generally statistically significant at the 5% level. From this evidence, it is recently created universities in particular that have more to gain from official REEs in terms of increasing the numbers and quality of students enrolled. Good performance in REEs could be a way of quickly filling the reputation gaps that these HEIs have compared with old universities. These results contrast with those of Gibbons et al. (2015), who do not find significant differences in the effect of the *Times Good Universities Guide* ranking between the most prestigious institutions, which form the so-called "Russell group", and the rest of HEIs.

6 Discussion

This section provides a brief discussion of the potential channels through which the VTR might have affected student choices. For new information to have had an impact on students, they must have had access to it. To have an idea of the diffusion of the VTR results, we searched the historical archive of the Italian newspaper *La Repubblica* for the keyword "Comitato di Indirizzo per la Valutazione del Sistema Universitario" (Steering Committee for Research Evaluation, CIVR), which is the committee that was in charge of managing the VTR. We limited the search to 2006, i.e. the year when the VTR's final results were released. The search delivered 13 results, 8 of which are related to the VTR (Table D1 in Appendix D). Apart from an article that comments in general on the performance of the whole Italian university system in the VTR, the others are focused on specific universities and compare their performance with other HEIs. The press coverage concerns both North and Centre Italy's institutions (University of Turin, University of Bologna) and South Italy's universities (University of Palermo, University of Basilicata, University of Naples

[26] There are 26 "new" universities in the sample: Piemonte orientale, Valle d'Aosta, Carlo Cattaneo, Insubria, San Raffaele, Milano-Bicocca, Brescia, Bolzano, Verona, Udine, Tuscia, Roma Tor Vergata, Roma LUISS, Roma Tre, Roma Campus Bio-Medico, Cassino, Sannio, Seconda Università degli studi di Napoli, Teramo, Molise, Foggia, Politecnico di Bari, Libera Università Mediterranea Jean Monnet, Basilicata, Calabria, Catanzaro – Magna Grecia.

Federico II). The articles are not limited to good performance in the VTR, but they also cover cases of poor performance (e.g. medicine at the University of Palermo). The press coverage of the VTR was therefore fairly good. Even if not all universities were covered by articles in national newspapers, we believe that readers (students and their parents) were made aware of the existence of a national REE and of the university rankings produced by CIVR, which were publicly and freely available. The public's interest in the VTR is indeed demonstrated by the high traffic and the large increase in the number of visits to the CIVR website, when the final results were made available (February 2006). Indeed, the CIVR website was visited 460 000 times in the few weeks after the release of the results (Rebora and Turri, 2013). Figure D1 in Appendix D depicts the trend in internet searches for the abbreviation "CIVR" in Italy, and it clearly shows a peak in interest that coincides with the publication of the VTR results and the appearance of the first articles in the national press (February 2006).

We might wonder, however, if the new information provided by the VTR was indeed new, or if it just provided similar information to what was already available to students through rankings produced by newspapers.[27] Although this seems to be excluded by the results of Section 5.2, to further test this hypothesis, we focus on the Censis-Repubblica University Guides, which build rankings at the subject-group level, and gather a dataset from the paper editions of the annual guides, covering the whole period of our analysis. The guides provide different indicators and rankings, and we focus here on the final score[28] that was used by Censis-Repubblica to compile the rankings of subject-group HEIs in a given field of study. This indicator is included as an additional covariate in the different models, and the results of the estimation for the specification including interaction terms between the VTR score and the post-VTR period are reported in Table E1 in Appendix E. The estimates on the VTR score and the percentage of excellent products turn out to be very robust to the inclusion of the Censis-Repubblica quality indicator and very close to those reported in Table 1, suggesting that the VTR had an additional effect over and above the league tables already available to the public. The effect of the Censis-Repubblica score is positive but statistically significant only in the specifications omitting subject-group-HEI trends.

[27] Pigini and Staffolani (2016), for instance, using a cross-section of Italian secondary school graduates show that more talented students' enroment choices are affected by university quality — proxied by the Censis-Repubblica scores — irrespective of family socio-economic status.

[28] The final score is constructed as the average of standardised scores in four areas: productivity, teaching, research and internationalisation.

7 Concluding remarks

The Italian higher education system has always been characterised by the so-called "legal value" of university degrees. The degree content being strongly regulated centrally by the Ministry of Education, Universities and Research, all university degrees in the same field were (and still are) considered formally equivalent. However, the progressive transition to mass tertiary education has been accompanied by a very rapid increase in the number of HEIs and degrees supplied, often leaving students with little guidance on the real value of the educational programmes offered. This lack of information has been exploited by private intermediaries — in Italy by newspapers — that have published universities' league tables annually. Although the impact of unofficial university rankings on student choice has already been the subject of several studies in the USA and the UK, and to a smaller extent also in Italy, the same cannot be said for official ranking exercises.

This paper focuses on the first REE (the VTR), which was completed in Italy in 2006, and it features the first assessment of its impact on student choice, namely on the total number of university enrolments and on enrolments of high-quality students, proxied by high school final examination mark and provenance from the academic high school track. To the best of our knowledge, our paper also represents the first study investigating the effect on student enrolment choices of establishing a REE.

We relate the number of enrolments at the subject-group-HEI level to VTR ratings using a "differential intensity" before-after estimator. In particular, we investigate whether subject-group HEIs with a better VTR performance in 2006 also had better student enrolment outcomes after 2006.

Our analysis shows that the final VTR score did not affect the number and quality of students enrolled, while our second indicator of research quality, the percentage of excellent products, had a positive and significant effect on student enrolment. In our preferred specification with subject-group-HEI linear trends, a 1σ increase in the proportion of excellent research products (i.e. 19 percent points) leads to a 5.8% increase in total enrolments, a 8.3% increase in enrolments of students graduating from upper secondary school with a high mark (at least 90 out of 100) and a 12.2% increase in students coming from the academic high school track. We find, in line with the earlier literature, that the coefficients are highly non-linear, with most of the effect occurring in the fourth quartile of the research quality distribution. In fact, the total number of students enrolled is 12.8% and 13.3% higher for HEIs in the fourth quartile compared with HEIs in lower quartiles of quality for the first and second indicators of research quality, respectively. The size of the effect is larger when we focus on high-quality students. For high school graduates with a high mark, the HEIs in the fourth quartile experience an increase in enrolment of 21% and

18.8% for the VTR score and the percentage of excellent products, respectively, while for students coming from an academic track the effect is even larger at 30.1% and 28.7% for the first and the second indicators, respectively.

Finally, we find that the effect of the VTR appears to be very similar in the North and in the South of the country, although it is precisely estimated only in the former, and it is larger in new universities, which are more likely to suffer from a reputation gap than old universities.

The positive effect of VTR on student enrolment and student quality can be explained by student access to new information on the quality of universities, as shown by the high volume of traffic and the peak in visits to the Steering Committee for Research Evaluation (CIVR) website just around the time of the release of the VTR results and the first press coverage of the VTR (February 2016).

Some cautionary notes are in order. First, unlike the following REEs, the VTR did not initially link the research performance to the relevant amount of public funding received by institutions. The average proportion of total universities' public resources distributed on the basis of the first REE exercise was very low in 2006-2011, about 1.4%. In this respect, we interpret the VTR effect as being mainly reputational, while we do not think that such a small proportion of performance-related funding might have changed student choices on the basis of financial concerns. However, the effect of the following REEs could be much stronger, as a larger proportion of universities' public resources were distributed on the basis of their results. Within a few years 30% of the total public budget for university funding will be allocated on the basis of quality indicators, and research quality, with a weight of 65% in the determination of the total score, will be the main determinant of these funds (Decree Law no 69/2013).

Second, as a similar evaluation of university teaching was not in place during the same period, a possible reading of our results is that, in the absence of reliable information on teaching quality, students were using research performance in the REE as a proxy for the quality of teaching. However, little is known about the complementarity between teaching and research activities (Hattie and Marsh, 1996; Becker and Kennedy, 2005). The two may be substitutes, in which case, once students realise that, outcomes in REEs may even turn out to be negatively correlated with the enrolment of those students who mostly care about teaching.

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References

Auranen, O. and M. Nieminen (2010). University research funding and publication performance–An international comparison. *Research Policy 39*(6), 822–834.

Becker, W. E. and P. E. Kennedy (2005). Does Teaching Enhance Research in Economics? *American Economic Review 95*(2), 172–176.

Bonaccorsi, A. and T. Cicero (2016). Distributed or concentrated research excellence? Evidence from a large-scale research assessment exercise. *Journal of the Association for Information Science and Technology 67*(2), 2976–2992.

Bowman, N. A. and M. N. Bastedo (2009). Getting on the front page: Organizational reputation, status signals, and the impact of U.S. News and World Report on student decisions. *Research in Higher Education 50*(5), 415–436.

Bratti, M., D. Checchi, and G. de Blasio (2008). Does the expansion of Higher Education Increase the equality of educational opportunities? Evidence from Italy. *LABOUR 22*(s1), 53–88.

Broecke, S. (2015). University rankings: Do they matter in the UK? *Education Economics 23*(2), 137–161.

Cappellari, L. and C. Lucifora (2009). The "Bologna Process" and college enrollment decisions. *Labour Economics 16*(6), 638–647.

Cattaneo, M., M. Meoli, and A. Signori (2016). Performance-based funding and university research productivity: the moderating effect of university legitimacy. *The Journal of Technology Transfer 41*(1), 85–104.

Checchi, D., A. Ichino, and A. Rustichini (1999). More equal but less mobile?: Education financing and intergenerational mobility in italy and in the us. *Journal of Public Economics 74*(3), 351–393.

Chevalier, A. and X. Jia (2016). Subject-specific league tables and students' application decisions. *Manchester School 84*(5), 600–620.

Ciriaci, D. (2014, October). Does University Quality Influence the Interregional Mobility of Students and Graduates? The Case of Italy. *Regional Studies 48*(10), 1592–1608.

De Angelis, I., V. Mariani, F. Modena, P. Montanaro, et al. (2016). Academic enrolment, careers and student mobility in italy. Technical report, Bank of Italy, Economic Research and International Relations Area.

Di Pietro, G. and A. Cutillo (2008). Degree flexibility and university drop-out: The Italian experience. *Economics of Education Review 27*(5), 546–555.

Dotti, N. F., U. Fratesi, C. Lenzi, and M. Percoco (2013, March). Local Labour Markets and the Interregional Mobility of Italian University Students. *Spatial Economic Analysis 8*(4), 443–468.

Duflo, E. (2001). Schooling and labor market consequences of school construction in indonesia: Evidence from an unusual policy experiment. *The American Economic Review 91*(4), 795–813.

Fischer, M. and P. Kampkötter (2017). Effects of german universities' excellence initiative on ability sorting of students and perceptions of educational quality. *Journal of Institutional and Theoretical Economics (JITE) 173*(4), 662–687.

Fondazione RES (2016). *Università in declino. Un'indagine sugli atenei da Nord a Sud.* Rome: Donzelli Editore.

Franceschet, M. and A. Costantini (2011). The first Italian research assessment exercise: A bibliometric perspective. *Journal of Informetrics 5*(2), 275 – 291.

Geuna, A. and M. Piolatto (2016). Research assessment in the UK and Italy: Costly and difficult, but probably worth it (at least for a while). *Research Policy 45*(1), 260–271.

Gibbons, S., E. Neumayer, and R. Perkins (2015). Student satisfaction, league tables and university applications: Evidence from Britain. *Economics of Education Review 48*(C), 148–164.

Griffith, A. and K. Rask (2007). The influence of the U.S. News and World Report collegiate rankings on the matriculation decision of high-ability students: 1995-2004. *Economics of Education Review 26*(2), 244–255.

Hattie, J. and H. W. Marsh (1996). The relationship between research and teaching: A meta-analysis. *Review of Educational Research 66*(4), 507–542.

Horstschräer, J. (2012). University rankings in action? The importance of rankings and an excellence competition for university choice of high-ability students. *Economics of Education Review 31*(6), 1162–1176.

Jiménez-Contreras, E., F. de Moya Anegón, and E. D. López-Cózar (2003). The evolution of research activity in Spain: The impact of the National Commission for the Evaluation of Research Activity (CNEAI). *Research Policy 32*(1), 123–142.

Luca, M. and S. Jonathan (2013). Salience in quality disclosure: Evidence from the U.S. News College Rankings. *Journal of Economics & Management Strategy 22*(1), 58–77.

Meredith, M. (2004). Why do universities compete in the ratings game? An empirical analysis of the effects of the U.S. News and World Report College Rankings. *Research in Higher Education 45*(5), 443–461.

Monks, J. and R. G. Ehrenberg (1999). U.S. News and World Report's College Rankings: Why do they matter". *Change 31*(6), 42–51.

Montanaro, P. (2008). I divari territoriali nella preparazione degli studenti italiani: Evidenze dalle indagini nazionali e internazionali. *Questioni di Economia e Finanza. Occasional papers. Bank of Italy. 14*.

Oppedisano, V. (2011). The (adverse) effects of expanding higher education: Evidence from italy. *Economics of Education Review 30*(5), 997–1008.

Pigini, C. and S. Staffolani (2016). Beyond participation: Do the cost and quality of higher education shape the enrollment composition? The case of Italy. *Higher Education 71*(1), 119–142.

Rebora, G. and M. Turri (2013). The UK and Italian research assessment exercises face to face. *Research Policy 42*(9), 1657–1666.

Sauder, M. and R. Lancaster (2006). Do rankings matter? The effects of U.S. News & World Report rankings on the admissions process of law schools. *Law & Society Review 40*(1), 105–134.

Soo, K. T. (2013). Does anyone use information from university rankings? *Education Economics 21*(2), 176–190.

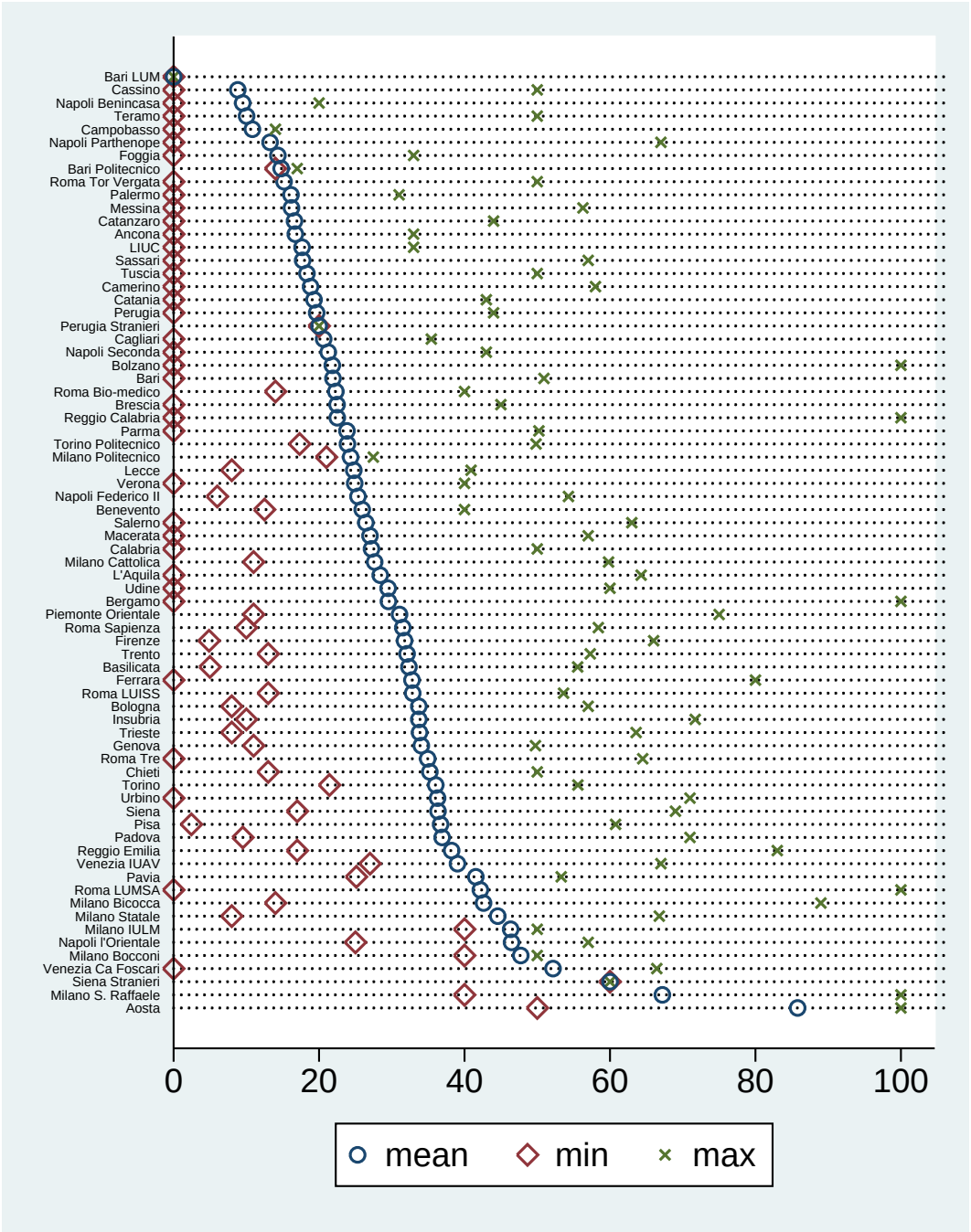
Sylos Labini, M. and N. Zinovyeva (2011). Stimulating graduates' research-oriented careers: does academic research matter? *Industrial and Corporate Change 20*(1), 337–365.

Tutterow, C. and J. A. Evans (2016). Reconciling the small effect of rankings on university performance with the transformational cost of conformity. In E. P. Berman and C. Paradeise (Eds.), *The University Under Pressure*, Volume 46 of *Research in the Sociology of Organizations*, pp. 265–301. Emerald.

Figure 1: VTR final score by university

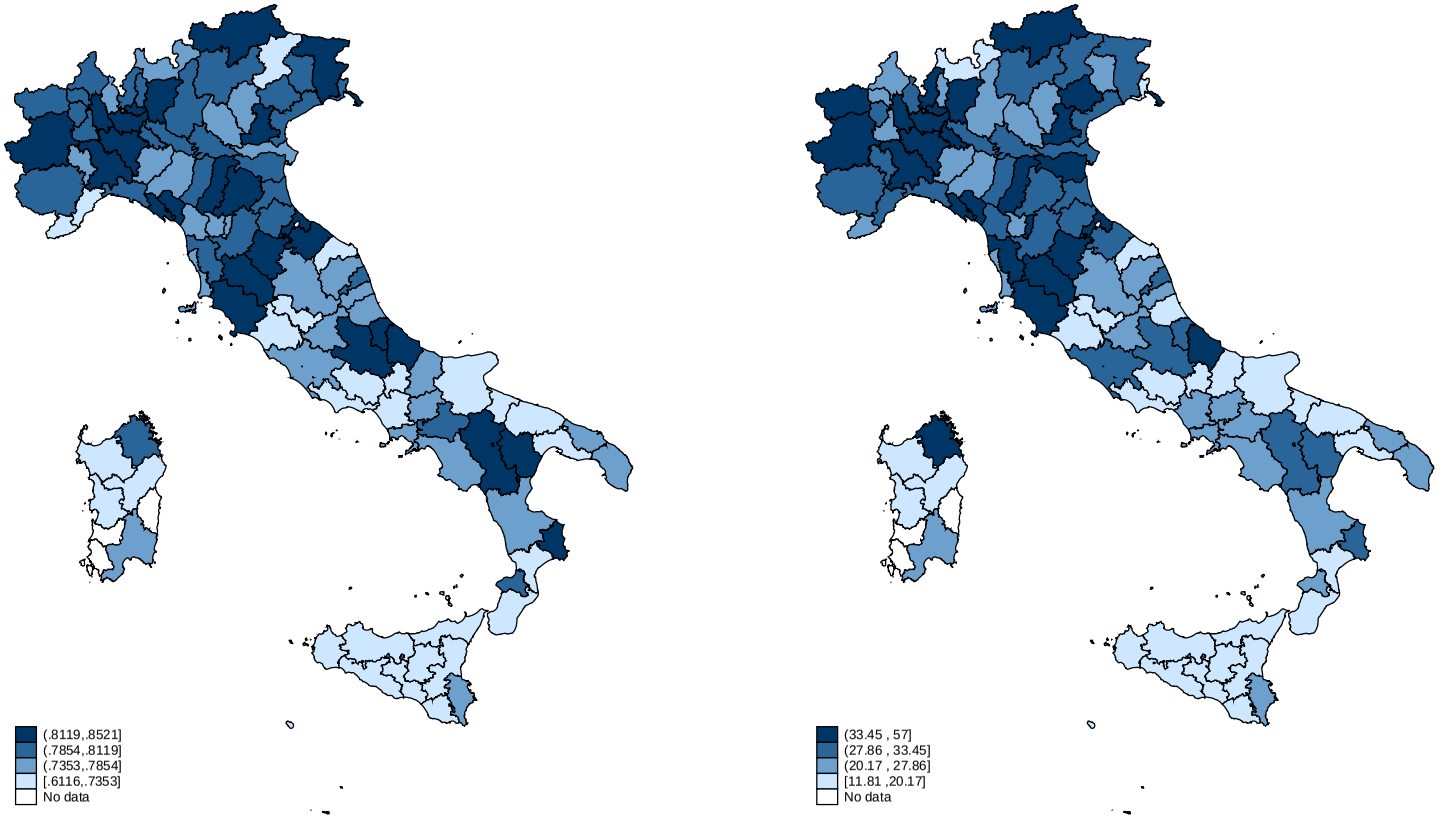
Note. The figure plots the maximum, the minimum and the mean of the VTR score by HEI. Each value refers to a different subject group.

Figure 2: Percentage of excellent VTR products by university



Note. The figure plots the maximum, the minimum and the mean of the Percentage of excellent VTR products by HEI. Each value refers to a different subject group.

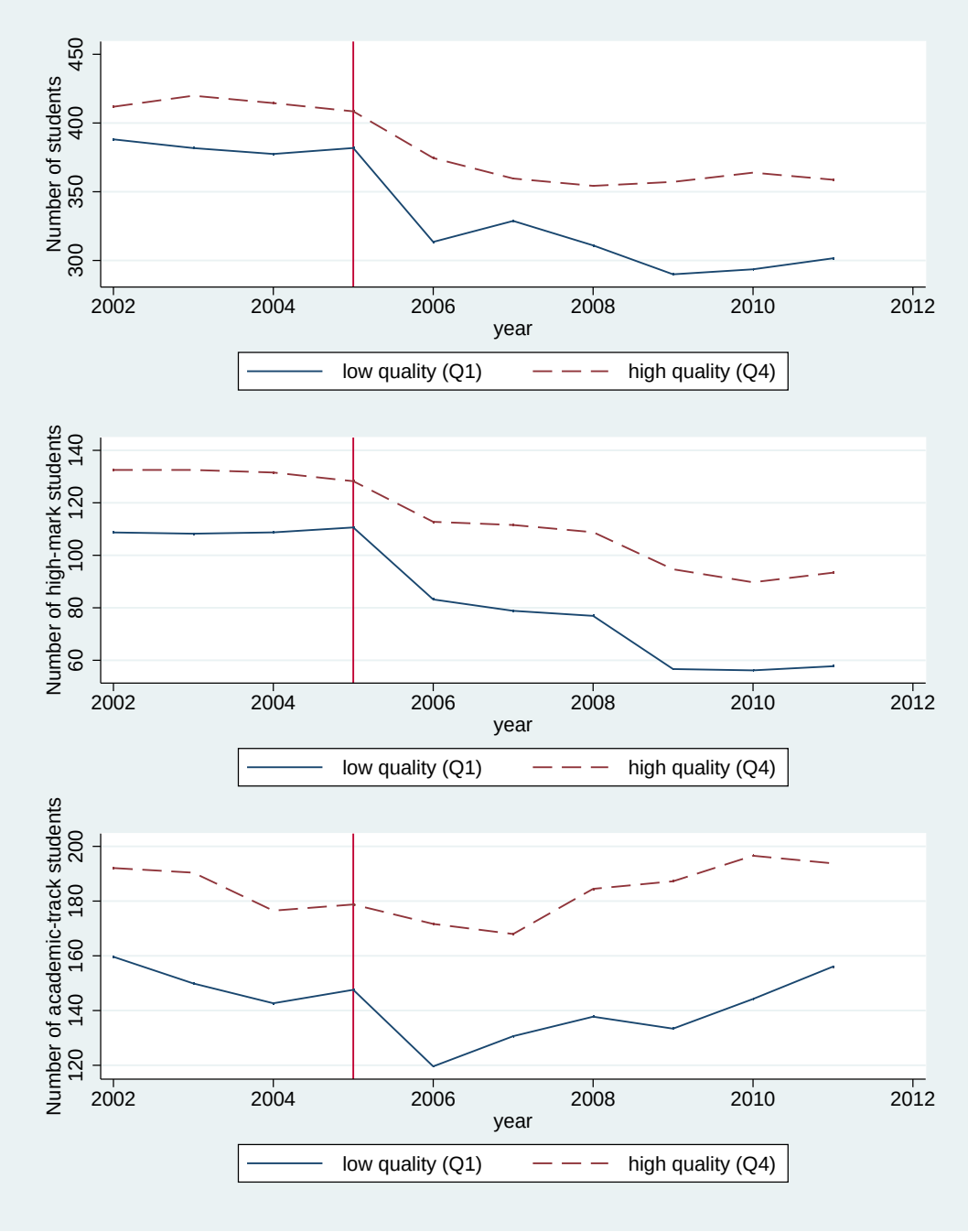
Figure 3: Province-level variation in VTR research quality



(a) VTR score

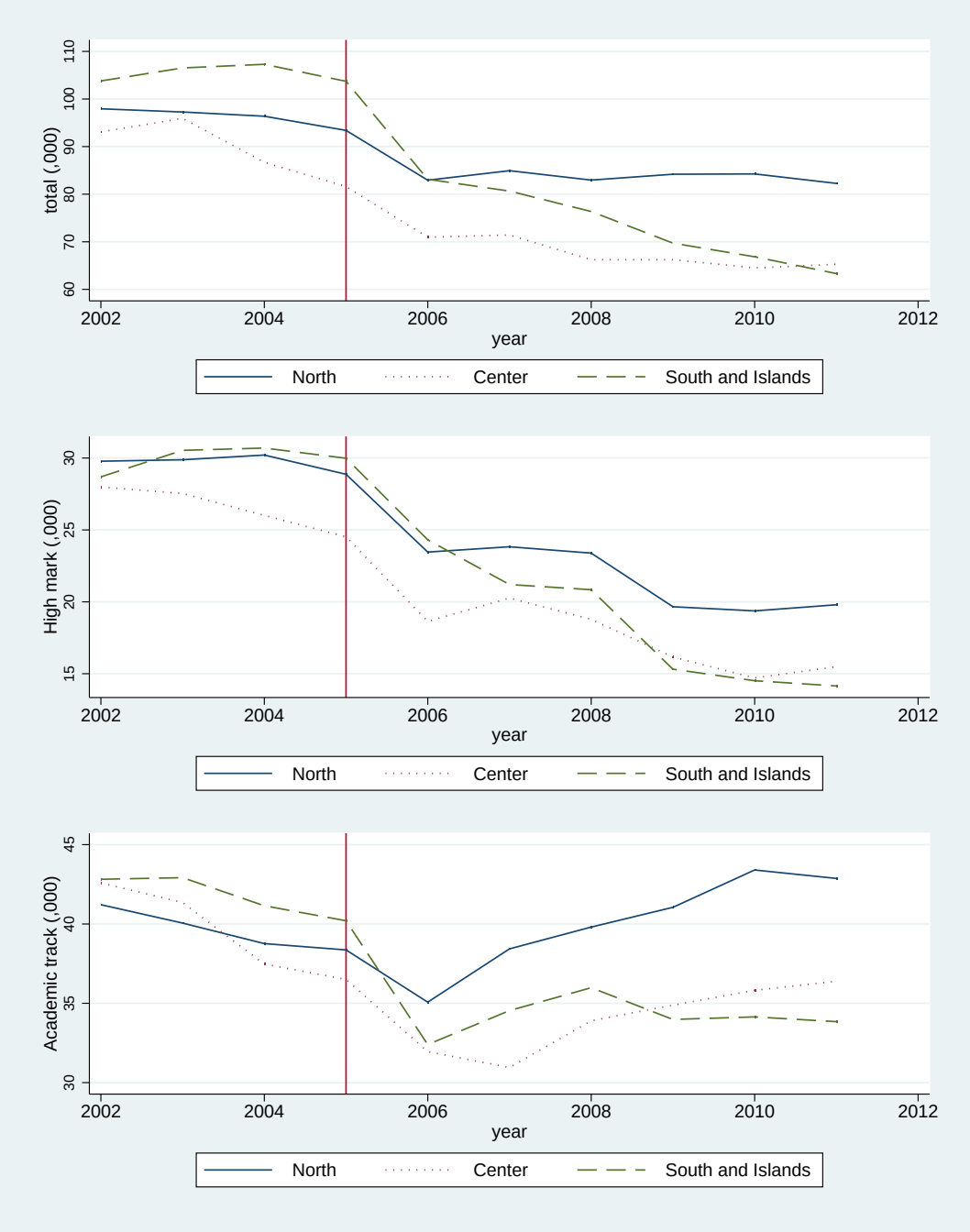
(b) Percentage of excellent VTR products

Figure 4: Average number of students enrolled by year for first (Q1) and fourth (Q4) quartiles of VTR score



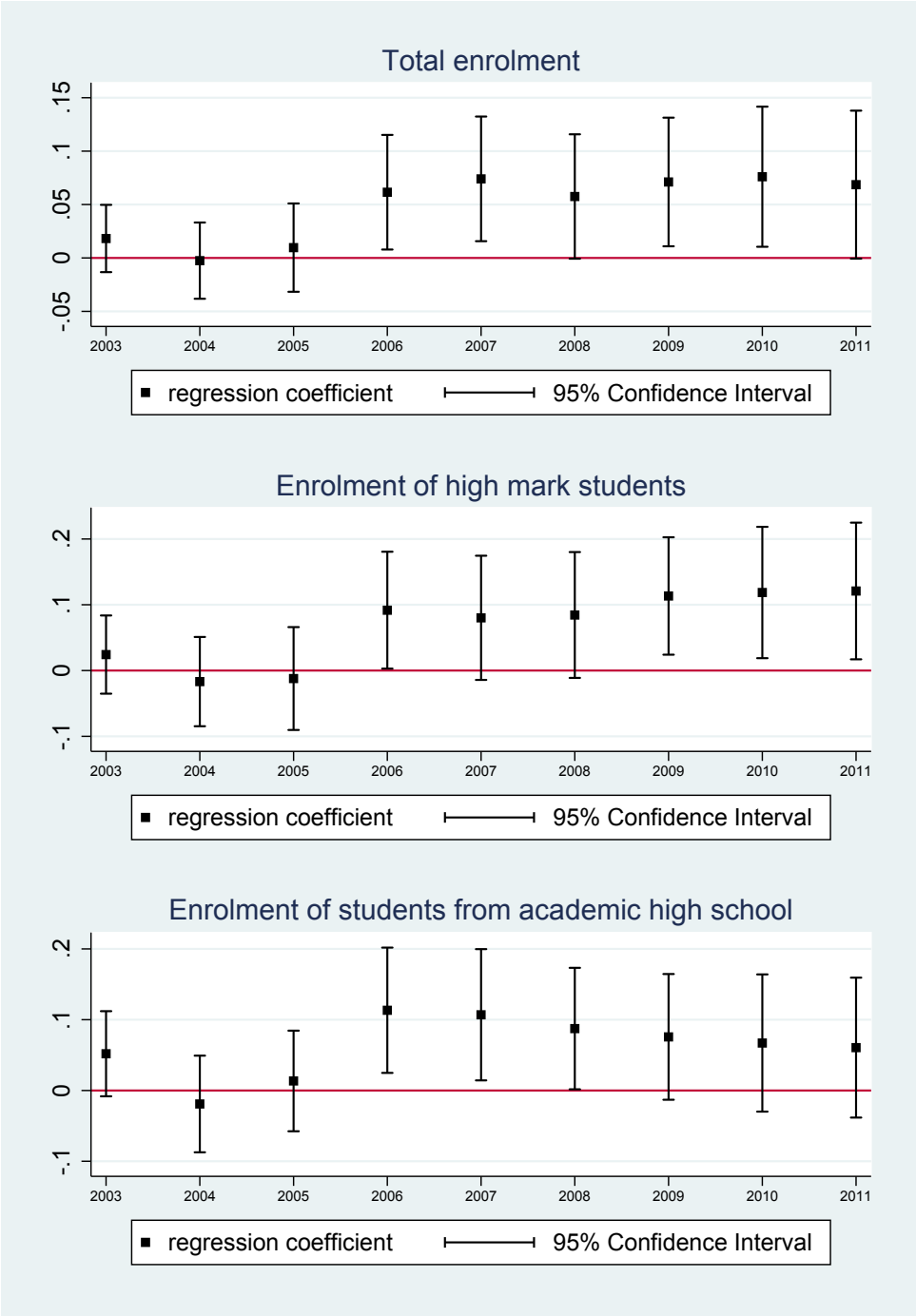
Note. The vertical line is drawn for the last academic year (2005/2006) that was not affected by the VTR.

Figure 5: Number of students enrolled by year and geographic area



Note. The vertical line is drawn for the last academic year (2005/2006) that was not affected by the VTR.

Figure 6: Coefficients and confidence intervals for the proportion of excellent products interacted with year dummies



Note. This picture shows the coefficients on the interaction terms between proportion of excellent products and year dummies estimated in Table C1. The interaction with 2002 represents the reference group. The first, second and third graphs refer to regressions using total enrolment, enrolment of high-mark students and enrolment of students from academic high school track as dependent variables, respectively.

Table 1: Effect of VTR on total (log) students enrolled

	(1)	(2)	(3)	(4)	(5)	(6)
		VTR score			% Excellent products	
Panel A. Total enrolment						
$VTR \cdot Post_{2005}$	0.024	0.014	0.003	0.062***	0.058**	0.054**
	(0.024)	(0.024)	(0.030)	(0.024)	(0.023)	(0.027)
Number of observations	7302	7302	7302	7302	7302	7302
R^2	0.840	0.887	0.898	0.841	0.887	0.898
Panel B. High-mark enrolment						
$VTR \cdot Post_{2005}$	0.065**	-0.005	0.001	0.102***	0.083**	0.095**
	(0.031)	(0.042)	(0.044)	(0.031)	(0.036)	(0.038)
Number of observations	7254	7254	7254	7254	7254	7254
R^2	0.778	0.835	0.853	0.779	0.835	0.853
Panel C. Academic-track enrolment						
$VTR \cdot Post_{2005}$	0.012	0.030	0.004	0.074**	0.122***	0.100**
	(0.032)	(0.039)	(0.046)	(0.034)	(0.038)	(0.040)
Number of observations	7254	7254	7254	7254	7254	7254
R^2	0.801	0.854	0.870	0.801	0.855	0.870
control variables (all panels):						
Subject-group-HEI FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Subject-group-HEI linear time trends	No	Yes	Yes	No	Yes	Yes
Subject-group-HEI quadratic time trends	No	No	Yes	No	No	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.

Table 2: Effect of VTR on total (log) students enrolled by quartile of HEIs' "quality"

	(1)	(2)	(3)	(4)
	VTR score		% Excellent products	
Panel A. Total enrolment				
$Q4 \cdot Post_{2005}$	0.178***	0.128**	0.174***	0.133***
	(0.058)	(0.054)	(0.052)	(0.049)
Number of observations	7302	7302	7302	7302
R^2	0.841	0.887	0.841	0.887
Panel B. High-mark enrolment				
$Q4 \cdot Post_{2005}$	0.239***	0.210***	0.209***	0.188***
	(0.077)	(0.077)	(0.068)	(0.069)
Number of observations	7254	7254	7254	7254
R^2	0.779	0.835	0.779	0.835
Panel C. Academic-track enrolment				
$Q4 \cdot Post_{2005}$	0.196**	0.301***	0.186***	0.287***
	(0.080)	(0.081)	(0.071)	(0.072)
Number of observations	7254	7254	7254	7254
R^2	0.801	0.855	0.801	0.855
control variables (all panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI linear time trends	No	Yes	No	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.

Note. $Q4$ stands for the fourth quartile of the VTR score or percentage of excellent products distribution (lower quartiles are the reference group).

Table 3: Effect of VTR on (log) enrolment of students by geographic area

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Total enrolment						
	VTR score			% Excellent products		
	North	Centre	South	North	Centre	South
$VTR \cdot Post_{2005}$	0.036	-0.012	0.054	0.061*	0.035	0.094
	(0.042)	(0.033)	(0.045)	(0.033)	(0.035)	(0.062)
Number of observations	2803	2114	2254	2803	2114	2254
R^2	0.876	0.883	0.909	0.876	0.883	0.909
Panel B. High-mark enrolment						
	VTR score			% Excellent products		
	North	Centre	South	North	Centre	South
$VTR \cdot Post_{2005}$	0.077	-0.040	0.011	0.115**	0.047	0.089
	(0.065)	(0.058)	(0.073)	(0.051)	(0.059)	(0.082)
Number of observations	2793	2094	2236	2793	2094	2236
R^2	0.836	0.822	0.868	0.837	0.822	0.868
Panel C. Academic-track enrolment						
	VTR score			% Excellent products		
	North	Centre	South	North	Centre	South
$VTR \cdot Post_{2005}$	0.117	0.005	0.044	0.164***	0.079	0.130*
	(0.080)	(0.047)	(0.064)	(0.062)	(0.062)	(0.072)
Number of observations	2793	2094	2236	2793	2094	2236
R^2	0.853	0.837	0.882	0.854	0.838	0.882
control variables (all panels):						
Subject-group-HEI FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Subject-group-HEI linear time trends	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.

Table 4: Effect of VTR on (log) enrolment of students: old vs new universities

	(1)	(2)	(3)	(4)
Panel A. Total enrolment				
	VTR score		% Excellent products	
	New	Old	New	Old
$VTR \cdot Post_{2005}$	0.077*	-0.013	0.103**	0.032
	(0.043)	(0.027)	(0.048)	(0.028)
Number of observations	1676	5408	1676	5408
R^2	0.913	0.888	0.913	0.888
Panel B. High-mark enrolment				
	VTR score		% Excellent products	
	New	Old	New	Old
$VTR \cdot Post_{2005}$	0.058	-0.019	0.126*	0.064
	(0.061)	(0.048)	(0.066)	(0.041)
Number of observations	1666	5363	1666	5363
R^2	0.883	0.837	0.884	0.837
Panel C. Academic-track enrolment				
	VTR score		% Excellent products	
	New	Old	New	Old
$VTR \cdot Post_{2005}$	0.129*	-0.005	0.165**	0.073*
	(0.070)	(0.045)	(0.075)	(0.042)
Number of observations	1666	5363	1666	5363
R^2	0.895	0.858	0.895	0.858
control variables (all panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI linear time trends	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.

Note. Old universities are those founded before 1970 and new universities those created in 1970 or later.

Appendix

A Mapping of research to teaching subject groups

Table A1: Mapping of VTR to area-mixed

Identifiers	Disciplinary areas (VTR)	Teaching subject groups
1	1+2	Hard sciences (maths and physics)
2	3	Chemistry
3	4+5+15e	Biology
4	6	Medicine
5	7+15b	Agriculture
6	8	Architecture
7	9+15c+15d	Engineering
8	10+15f	Humanities
9	11	Teaching and psychology
10	12	Law
11	13	Economics and Statistics
12	14+15a	Political and Social sciences

In the first column, we show the identifiers of the 12 areas that we use in the analysis. They result from merging the disciplinary areas in the VTR (second column) and the fields of study as classified by the Ministry of Education, Universities and Research (MIUR) for teaching purposes (third column). The disciplinary areas in the VTR are the 14 CUN areas (1 - Mathematics and Computer Sciences, 2 - Physics, 3 - Chemistry, 4 - Earth Sciences, 5 - Biology, 6 - Medicine, 7 - Agriculture and Veterinary, 8 - Civil Engineering and Architecture, 9 - Industrial and Information Engineering, 10 - Humanities, 11 - Teaching and Psychology, 12 - Law, 13 - Economics and Statistics and 14 - Political and Social Sciences) plus 6 inter-disciplinary areas (15a - Science of information and communication, 15b - Science for food quality and safety, 15c - Science for nano-microsystems, 15d - Aerospace sciences, 15e - Science for sustainable development and governance, and 15f - Science for the evaluation and enhancement of cultural heritage).

B VTR final score and proportion of excellent research products in economics

Figure B1: VTR final score by economics subject-group HEI

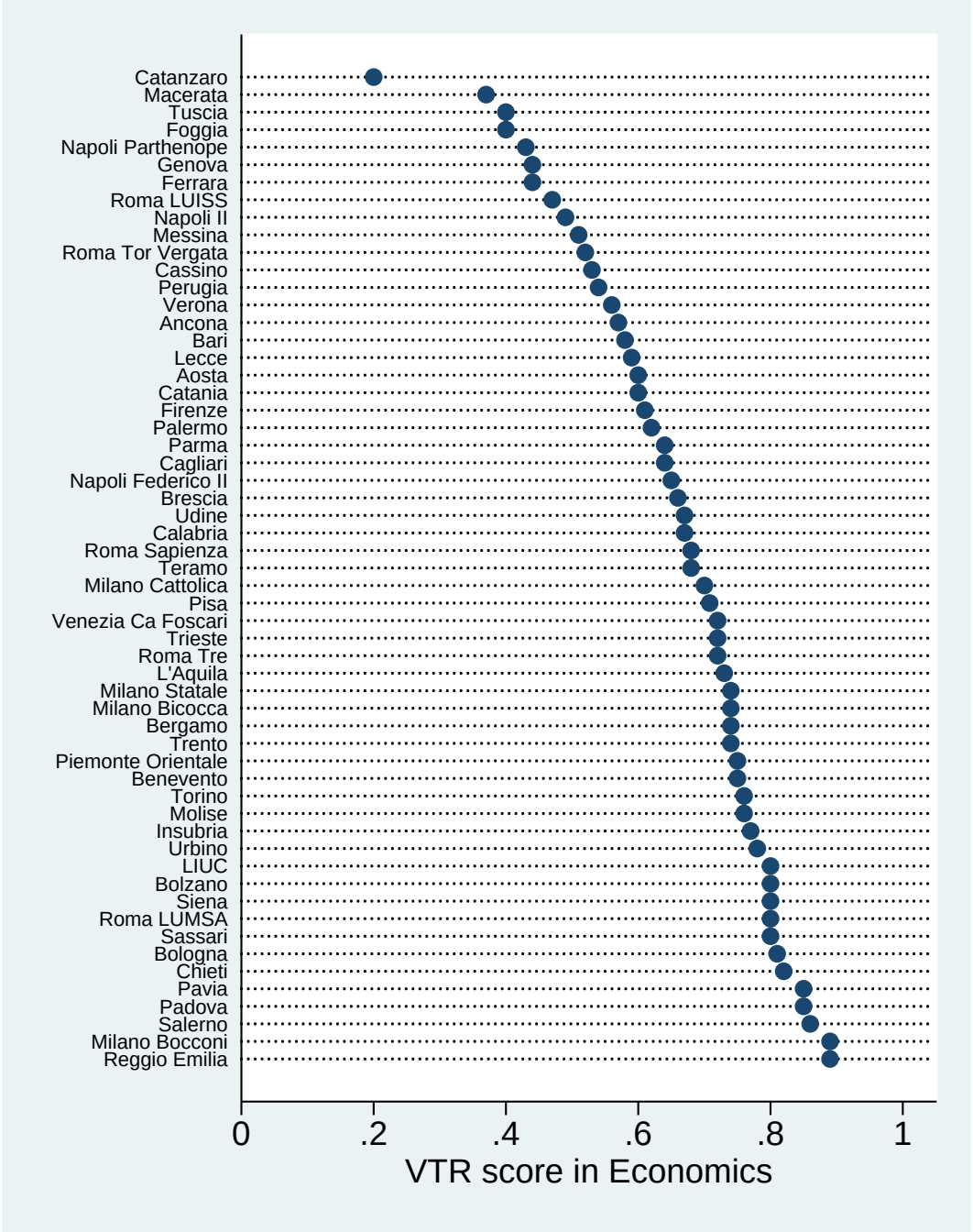
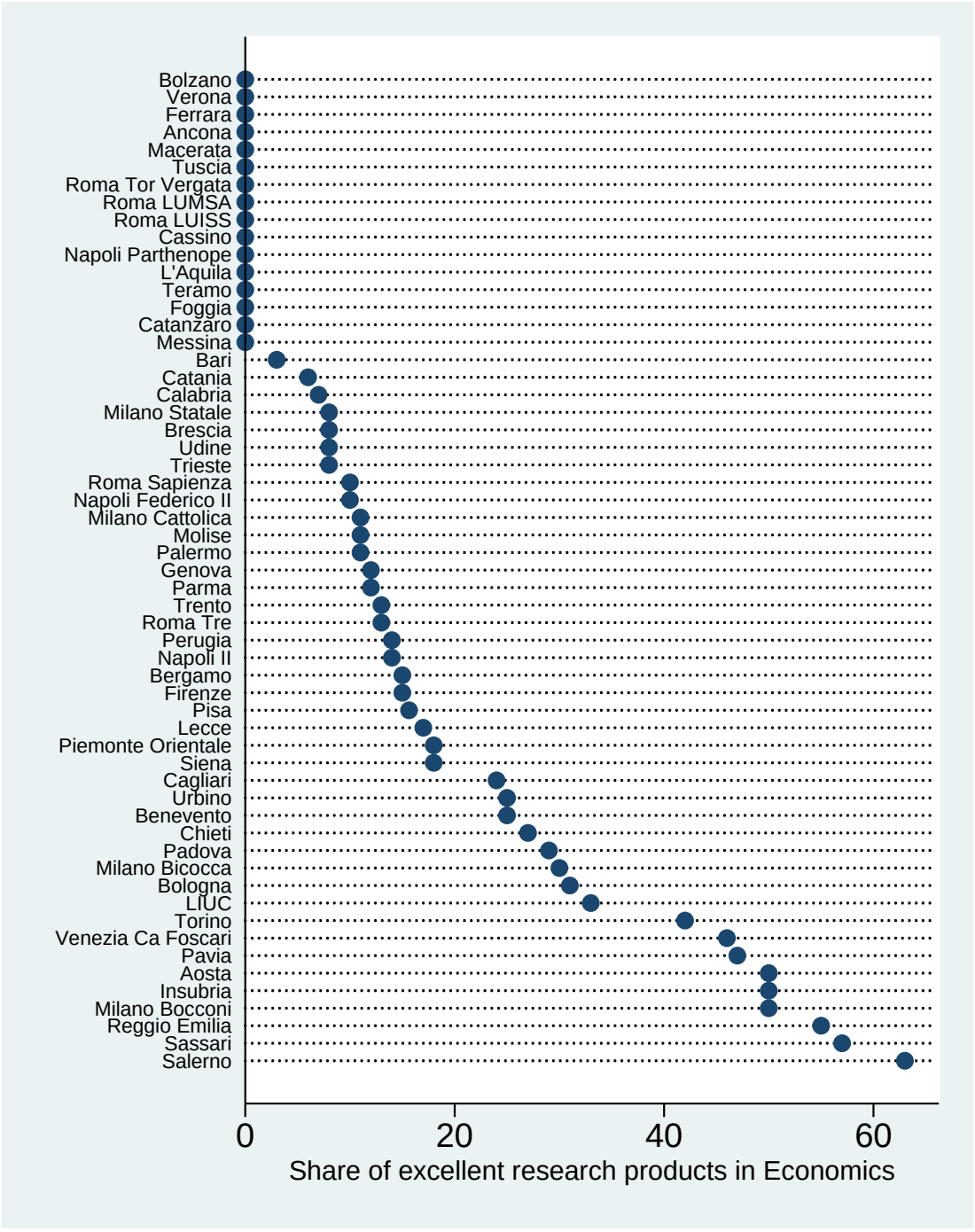


Figure B2: Proportion of excellent products by economics subject-group HEI



C Non-parametric specification

Table C1: Effect of VTR percentage of excellent products on student enrolment outcomes

Dependent variable:	Total enrolment	High-mark	Academic-track
	(1)	(2)	(3)
$VTR \cdot 2003$	0.018	0.024	0.052*
	(0.016)	(0.030)	(0.031)
$VTR \cdot 2004$	-0.003	-0.017	-0.019
	(0.018)	(0.035)	(0.035)
$VTR \cdot 2005$	0.010	-0.012	0.013
	(0.021)	(0.040)	(0.036)
$VTR \cdot 2006$	0.062**	0.092**	0.113**
	(0.027)	(0.045)	(0.045)
$VTR \cdot 2007$	0.074**	0.080*	0.107**
	(0.030)	(0.048)	(0.047)
$VTR \cdot 2008$	0.058*	0.084*	0.087**
	(0.030)	(0.049)	(0.044)
$VTR \cdot 2009$	0.071**	0.113**	0.076*
	(0.031)	(0.045)	(0.045)
$VTR \cdot 2010$	0.076**	0.119**	0.067
	(0.033)	(0.051)	(0.049)
$VTR \cdot 2011$	0.069*	0.121**	0.061
	(0.035)	(0.053)	(0.050)
Number of observations	7302	7254	7254
R^2	0.841	0.779	0.801
control variables:			
Subject-group-HEI FE	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.

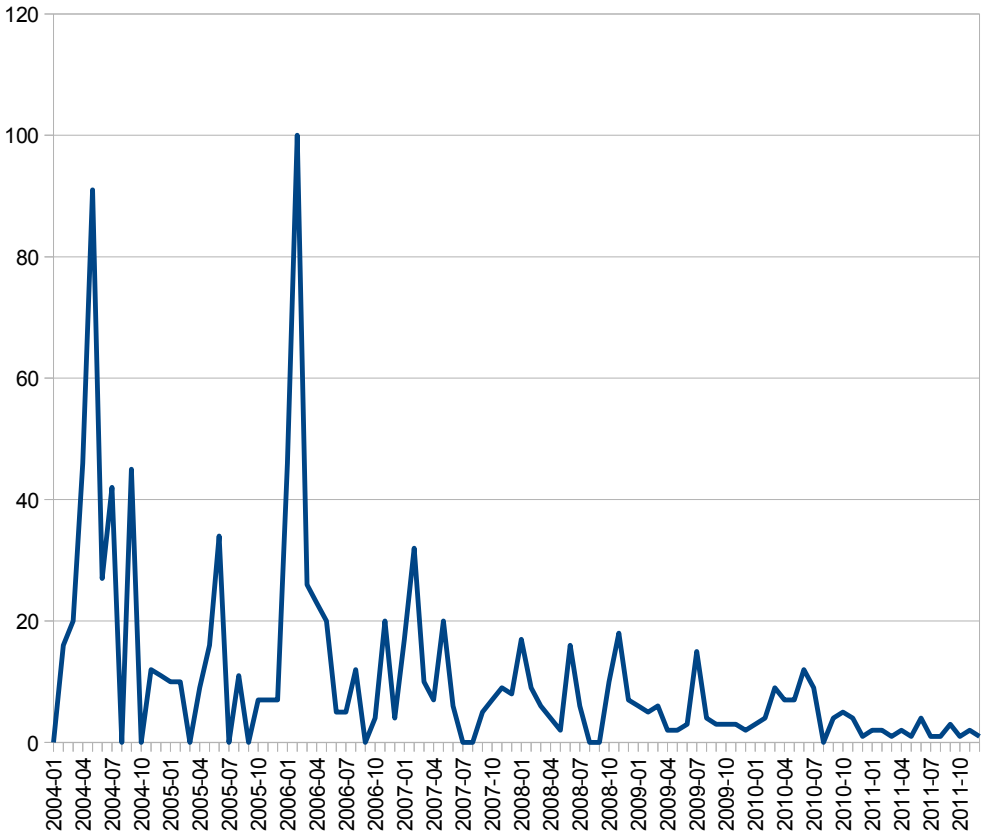
Note. Columns (1)-(3) report coefficients on the percentage of excellent products by year interactions for the three regressions using (log) total enrolment, (log) high-mark enrolment and (log) academic-track enrolment, respectively, as dependent variables. The interaction with 2002 is omitted and represents the reference group.

D VTR media coverage

Table D1: Press coverage of VTR in 2006, *La Repubblica* newspaper

Article title	Date	Universities covered	Content
Research? A sector or excellence. Still huge the North-South divide	31 January	Whole university system	General coverage of VTR results
Chemistry, economics and politics the gold research of the university	1 February	University of Bologna	Comparison between University of Bologna and other Italian Universities (also by subject) in VTR performance
Federico II among the "big ones" of research	15 February	Federico II, Naples	Comparison between Federico II and other Italian universities (also by subject) in VTR performance
The Faculty of Medicine last in Italy for research	8 February	University of Palermo	Information of poor performance of the University of Palermo's Faculty of Medicine
The ranking of faculties help us to improve the university	10 February	University of Palermo	General discussion on how to use the VTR to improve universities' performances
Research, university promoted first place for biomedicine	17 March	University of Turin	Comparison of University of Turin and other universities in VTR performance
Promoted Guido the innovator but on the Statuto he made a mistake	9 May	Federico II, Naples	Mention of good performance of Federico II in VTR
University of Basilicata	16 June	University of Basilicata	Censis-Repubblica page of the University of Basilicata mentions good position in VTR

Figure D1: Trend in internet searches for the abbreviation "CIVR"



Note. Trend in internet searches for the "CIVR", i.e. the abbreviation for the Italian term Steering Committee for Research Evaluation (*Comitato di Indirizzo per la Valutazione della Ricerca*), in 2016. The maximum number is normalised to 100.

E Models controlling for Censis-Repubblica university ranking

Table E1: Effect of VTR on (log) enrolment of students including Censis-Repubblica score

	(1)	(2)	(3)	(4)	(5)	(6)
	VTR score			% Excellent products		
Panel A. Total enrolment						
Censis-Repubblica score	0.059**	0.012	0.016	0.058**	0.010	0.014
	(0.028)	(0.023)	(0.025)	(0.028)	(0.023)	(0.024)
$VTR \cdot Post_{2005}$	0.023	0.014	0.003	0.062**	0.060**	0.056**
	(0.024)	(0.024)	(0.030)	(0.024)	(0.023)	(0.027)
Number of observations	7302	7302	7302	7302	7302	7302
R^2	0.841	0.886	0.898	0.842	0.887	0.898
Panel B. High-mark enrolment						
	VTR score			% Excellent products		
Censis-Repubblica score	0.060	0.023	0.018	0.060	0.019	0.014
	(0.039)	(0.033)	(0.038)	(0.038)	(0.033)	(0.037)
$VTR \cdot Post_{2005}$	0.064**	-0.005	0.000	0.102***	0.085**	0.097**
	(0.031)	(0.042)	(0.045)	(0.031)	(0.036)	(0.039)
Number of observations	7254	7254	7254	7254	7254	7254
R^2	0.780	0.835	0.853	0.780	0.835	0.854
Panel C. Academic-track enrolment						
	VTR score			% Excellent products		
Censis-Repubblica score	0.081**	0.031	0.035	0.080**	0.028	0.032
	(0.036)	(0.033)	(0.036)	(0.036)	(0.033)	(0.035)
$VTR \cdot Post_{2005}$	0.011	0.028	0.003	0.074**	0.124***	0.102**
	(0.033)	(0.040)	(0.046)	(0.034)	(0.038)	(0.041)
Number of observations	7254	7254	7254	7254	7254	7254
R^2	0.802	0.855	0.870	0.803	0.855	0.870
control variables (all panels):						
Subject-group-HEI FE	Yes	Yes	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Subject-group-HEI linear time trends	No	Yes	No	No	Yes	No
Subject-group-HEI quadratic time trends	No	No	Yes	No	No	Yes

*, **, *** statistically significant at the 10, 5 and 1% levels. Standard errors are clustered at the subject-group-HEI level.