An assessment of the impact of the first Italian Research Evaluation Exercise on student enrollment choices*

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Abstract

This paper investigates the impact of the first Italian Research Evaluation Exercise (VTR 2001-2003) on university students' enrollment choices. A before-after estimator with differential treatment intensities is used to investigate whether subject-group-Higher Education Institutions (HEIs) that received a better score also benefited from more student enrollments and enrollments of students with better entry qualifications after the VTR. This identification strategy enables us to control for both subject-group-HEI specific time invariant unobservable heterogeneity and pre-existing trends. Our analysis demonstrates that increasing the percentage of excellent research products by one standard deviation (19 percentage points) increases student enrollments by 6.3 percent. Effects are larger for high quality students, namely those with better high school final marks (10.3 percent) or coming from the academic track (11.8 percent). Effects are larger for subject-group-HEIs in the top quartile of the VTR quality distribution. Effect magnitudes appear to be similar across all macro-regions (North, Center and South and Islands), but are precisely estimated only for universities in Northern Italy. When HEIs are divided into new and old universities, only the former, which have a less established reputation in teaching and research, appear to have gained from a good performance in the VTR.

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1 Introduction

Research evaluation 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, while the third REE (VQR 2011-2014) ended 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 rebut that in a period of shrinking public funding of Higher Education it is more important than ever to allocate resources in an effective and efficient way.

Representing the first adoption of a Performance-based Research Funding System (PRFS) in Italy, the VTR, but also the following REEs, attracted a 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 enough, there are no studies of the effect of VTR on the demand side, i.e. on students. In the current paper, we aim at filling this gap by investigating whether the score obtained in the VTR had any consequence for Italian Higher Education Institutions (HEIs, hereafter) in terms of the number and the quality of enrolled students.

Our paper is related to the literature which, especially in the US, 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 and World Report College Rankings). In general, these studies do find a positive effect of improving institutional ranking on student applications (see the literature review in Tutterow and Evans, 2016), whose size however is not very large, and is generally lower in time-series studies controlling for prior rank (Sauder and Lancaster, 2006). Moreover, the effect of ranking 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 rank 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 a well established reputation (Luca and Jonathan, 2013). A higher rank is also associated with more selectivity in admissions and lower acceptance rates (Monks and Ehrenberg, 1999; Meredith, 2004), and

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

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

a higher student quality (Monks and Ehrenberg, 1999; Griffith and Rask, 2007).[3] Evidence exists also 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. 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, 2015). Papers which pool all subjects and analyze 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 due to the high heterogeneity existing in the quality of subject-groups within an institution (Chevalier and Jia, 2015; Gibbons et al., 2015). Interestingly, also UK studies confirm that the salience of information matters. Information on student satisfaction only affects applications when it is incorporated in league tables, and ranking scores are more relevant when there is high 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 one study by Horstschrer (2012), which focuses on a single field of study, however, and demonstrates that being awarded excellence status in a government-run excellence competition significantly increased Medical schools' student applications in Germany.

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' enrollment decisions.[4] Italy is an interesting case study. Italy has always been characterized by the so-called *legal value* of university degrees. This grants a formal equality among all degrees irrespective of the awarding institutions, e.g., in the access to public sector jobs. However, the progressive reduction in the universities' public funding,[5] together with a decrease in student numbers[6]

[3] An effect on the SAT score is not found by Meredith (2004) instead.

[4] The results of the VTR have been already used in some individual-level studies of Italian students' geographical mobility and labor market outcomes. Ciriaci (2014) reports that the probability that a student enrolls in a university outside her region of residence increases with the VTR score of the university of destination and decreases with the average regional score of the universities in her residence. Sylos Labini and Zinovyeva (2011) demonstrate that research quality, measured by the VTR score, raises the probability that an individual enrolls in a Ph.D. course.

[5] The *Fondo di Finanziamento Ordinario* (FFO), that 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 thousands in the academic year 2003/2004, after the 'Bologna reform' of 2001, to 255 thousands in 2014/2015, the last academic year for which the Ministry of Education, University and Research provides data.

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 starting to produce specialized publications with HEIs' league tables. On the one hand, in this context, the setting of an official REE is likely to have provided a reliable source of information to students and to have had an impact on their choices. On the other hand, since the object of 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 this was the case or not.

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 (Fondazione RES, 2016). Indeed, Northern regions have been historically characterized by a net inflow of university students, also thanks to their labor markets which offer students better employment prospects. However, the geographical gap between Northern and Southern HEIs seems to have widened after 2006, that is incidentally the year the VTR results were released (see Section 5). It is then important to assess whether a bad performance in REEs might have been an important factor in accelerating the hemorrhage of students that Southern HEIs are suffering.

We provide a first assessment of the impact of the VTR on student choices using a before-after estimator which exploits differential treatment intensities across HEIs. The quality score obtained in the VTR is the 'dose' of the treatment administered to HEIs. In our analysis we compare HEIs' outcomes (total enrollments and student quality) before and after the VTR, and look at whether in the post-VTR period there were changes significantly (positively or negatively) associated with the score obtained in the VTR. The main identification assumption is that there are no omitted variables which may be responsible for these changes. Such unobservable factors must have two features to threat our identification strategy: 1) they must have the same timing as the diffusion of the VTR results; 2) they must be correlated with the VTR scores. This makes it clear the importance of exploiting differences in VTR scores for identification. When making a simple before-after comparison, i.e. by simply comparing outcomes between the pre- and post-VTR period, the effect of the VTR may be confounded, for instance, with that of the Great Recession starting in 2008. By contrast, by exploiting for identification also 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 effect of the Great Recession, even in the case it was different across the regions 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 enrollments, and to include 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 one 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 to the period where a REE was functioning. Thus, our paper is not concerned with the effects of increasing HEIs' ranking, but with how HEIs' enrollments changed over time as a consequence of having performed well (or badly) in the first REE. In this sense, our estimates can be roughly interpreted as the effect on student choices of establishing a REE. This is of interest not only to stakeholders in Italy but also to readers in the many countries which are thinking of implementing similar Research Evaluation Exercises. Second, in line with the most recent literature (Chevalier and Jia, 2015; Gibbons et al., 2015), we frame the analysis at the subject-group-HEI level. This is important because like for newspapers' league tables, also in REE ranking scores are very likely to differ across disciplines. We show that this is the case for the VTR evaluation exercise, where differences in the evaluation between subject-groups of the same university are often huge.[7] Thus aggregating the analysis at the HEI level is likely to wash out most of the variation across subject-groups hiding the true effect of the research quality assessment on student choice.

The main findings of our paper can be summarized as follows. First, we show that while the VTR score (an indicator of average HEIs' quality) does not affect student demand at the subject-group-HEI level, the percentage of excellent products is positively associated with student enrollment. This is partly due to the higher ability of the second research quality indicator to discriminate across subject-groups-HEIs. Second, the VTR has a larger effect on enrollment of high-quality students, i.e. those with better entry qualifications. Those are indeed the students who are likely to care most about HEIs' quality. Third, the positive effect of VTR rating on enrollment is stronger in the top quartile of the quality distribution. This is consistent with REE and in general Performance-based Research Funding Systems to increase competition among those HEIs which have some chances to win in the 'race for quality.' Fourth, the effect of 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 VTR only emerge for New universities, i.e. those that having been created after 1970 have less tradition in teaching and research, and for which the information released by the VTR might have contributed to partly fill the reputation gap

[7] It is important to notice that within the same *alma mater* researchers of different subject-groups can be affiliated to the same Department, and researchers in the same subject-groups can be affiliated to different Departments.

compared to 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 in Section 5. A brief discussion of the main mechanism through which the VTR could have affected student choices is presented in Section 6. Finally, Section 7 summarizes the main findings and concludes.

2 The Italian system of Higher Education and the first Research Evaluation Exercise

The Italian higher education system has always been characterized by a high degree of centralization. Law n. 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 Education 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, 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 with a relatively high socio-economic background. 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 United States is 12%. The evolution from an elite to a mass university system started in 1969, when access to university was liberalized and enrollment in any field became possible for students holding all types of upper secondary school degrees (Law 11 december 1969, n. 910).[8]

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 80s and the early 90s granted an unprecedented level of autonomy to universities regarding the management of teaching and financial resources. The requirement of parliamentary approval was abandoned in 1990 (Law n. 341 19/12/1990), whereas the inclusion in a

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

university development plan was still retained. However, universities gained autonomy to advance proposals for new initiatives to the Ministry. Many institutions used this new autonomy to open branches in smaller cities and to increase dramatically the number of degrees offered (Bratti et al., 2008; Oppedisano, 2011). The entry of new actors in 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 characterized by a much larger variance of quality within departments than between departments in the same field of study (see Bonaccorsi and Cicero, 2015, 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 n. 509/99).[9] The older long (mostly 4 or 5 years) degrees were replaced with two levels of degrees, three-year first-level degrees and two-year second-level degrees.[10] 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 stimulated a growing interest of prospective students to know 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 to publish yearly rankings of Italian universities and Faculties.[11]

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 the stakeholders, the Steering Committee for Research Evaluation (CIVR) initiated the first Research Evaluation Exercise (VTR) 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 in 20 disciplinary areas, the 14 CUN areas plus 6 interdisciplinary sectors.[12] Each university had to send one (autonomously selected) product every four researchers, while research agencies were required to submit one product every 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 limited. Furthermore, universities communicated data on human resources,

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

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

[11] Faculties are the equivalent of Schools in the international context.

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

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 there has been very limited funding 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 enrollments from the 2006-2007 academic year. The assessment of each single research product has not been published, but has been disclosed just to Rectors (i.e., Chancelors). The final VTR ranking score has been 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

$$\text{final VTR score} = \frac{1 * E + 0.8 * G + 0.6 * P + 0.2 * L}{\text{total products evaluated}}. \quad (1)$$

This indicator can vary between 0.2, if all products are judged as 'limited value', and 1, in case all products are 'excellent'. For the purpose of the current study we will be using two main 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 which obtained the evaluation of 'excellent'). In order to make the results of the estimated regressions easier to read both indicators are included in the econometric models as standardized variables with zero mean and unit standard deviation (s.d., hereafter), so as their coefficients correspond to the percentage increase (as the dependent variable is measured in logarithm) in the dependent variable produced by a one-s.d. increase in the indicator.[13]

3 Empirical strategy

Our primary interest lies in the impact of VTR on the number of university enrollments 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 the number of students with grades in the upper secondary school final exam above 90 (grades vary in the 60-100 interval).[14] We use data on enrollment from year 2002 to 2011,

[13]The final VTR score for research quality has been used by the Ministry of Education, University 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, since the latter were produced by university size groups (large, medium, small). We do not think such classification to be particularly informative to students who are interested in enrolling in high-quality HEIs, although it may be for the Ministry of Education, University and Research which has to allocate public resources.

[14]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.

that is before the starting of the following REEs.[15] We base our identification strategy on a before-after estimator with differential treatment intensities.[16] The main idea is to look at whether subject-groups-HEIs which performed well in the evaluation exercise attracted after the VTR a higher number of students and better students compared to 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

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

where D_i is an indicator defined at the HE institution (a) $\times$ subject-group (k) level; D_{jt} are province-year 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 value one. In this baseline specification, α_3 captures a higher or lower *level* of the outcome variable (e.g., student enrollments or student quality) after 2005 for subject-group-HEIs which obtained a higher score in the VTR. Subject-group-HEIs time-invariant factors are captured by α_{1i} while local factors (e.g. cost of housing, local unemployment) by α_{2jt}.

Since the information released by VTR may take time to diffuse, we estimate a variant of equation (2) in which the VTR term is also interacted with time elapsed since the end of the VTR. The idea is to capture a post-VTR differential *trend* in student enrollments or student quality correlated with the VTR score. The corresponding estimated equation is

$$Y_{ijt} = \alpha_0 + \alpha_{1i} D_i + \alpha_{2jt} D_{jt} + \alpha_3 (V_i * POST_{2005}) + \alpha_4 V_i * (t - 2006) * POST_{2005} + \epsilon_{it}. \quad (3)$$

In this specification, enrollments and student quality are allowed to *grow* differently after 2006 according to the VTR results.[18] The specifications in (2) and (3) control for subject-group-HEI fixed effects, i.e. subject-group-HEIs are allowed to start from different intercepts as far as enrollments and student quality are concerned. These fixed effects allow us to control for time-invariant unobserved heterogeneity which might affect the number of

The second is the technical track and the third the vocational track. Students who choose the academic track generally go on in tertiary education.

[15] All our data falls into the post-'3+2' reform period.

[16] Since all higher institutions are 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).

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

[18] The baseline coefficient α_3 captures the effect of the VTR in the first year.

enrollments 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 who saw an increase of enrollments or of student quality after the VTR may have been already on an increasing trend before the research assessment. The corresponding specifications are

$$Y_{ijt} = \alpha_0 + \alpha_{1i} D_i + \gamma_i (D_i * t) + \alpha_{2jt} D_{jt} + \alpha_3 (V_i * POST_{2005}) + \epsilon_{it} \tag{4}$$

$$\begin{aligned} Y_{ijt} = \alpha_0 + \alpha_{1i} D_i + \gamma_i (D_i * t) + \alpha_{2jt} D_{jt} + \alpha_3 (V_i * POST_{2005}) \\ + \alpha_4 V_i * (t - 2006) * POST_{2005} + \epsilon_{it}. \end{aligned} \tag{5}$$

where the γ_is are the subject-group-HEI specific trends.

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 little sensitive to rankings. In order to test this hypothesis we dichotomize the VTR score in two quartile dummies, one for the fourth quartile of the quality indicator (Q4), meaning higher quality, and the other for the lowest quartiles (Q1-Q3). Then V_i is replaced with the fourth quartile dummy in all specifications above.[19] The coefficient on the $POST_{2005}$*Q4 has to be interpreted as the differential effect with respect to lower quartiles of quality.

The VTR produced several indicators. As we said, in this study we use the overall VTR score and the share of excellent products (see data description). The first is an indicator of 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 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 degrees. This

[19] 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.

choice is dictated by the fact that second-level degrees were activated 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 enrollments.[20] Student enrollment data for each first-level degree course were aggregated in university × province ×subject group × year cells, where university × province cells defines university branches since Italian universities often have branches located in different provinces.

The second data source is the report released by the Committee for the Evaluation of Research (CIVR) in February 2006. The document contains information on research quality divided by scientific areas 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. Indeed, in both sources data are recorded for different fields, which are, however, different in the enrollment data (MIUR), where a classification based on teaching is adopted, and in the VTR data, where research fields are instead used. The mapping was done as described in Table A1. Merging the two datasets, we managed to obtain complete information about enrollment and research quality for 518 subject-group-HEI groups.

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 score obtained by each institution. A large majority of universities have quite similar average values of the score, while a much larger variation occurs between fields of study within the same institution. Just to take an example, the University of Catanzaro obtained a maximum score of 0.87 in Biology and a minimum score of 0.2 in Economics, with an average score of 0.656. This makes it clear the advantage of shaping the analysis at the field of study level, since averaging enrollments and REE scores at the HEIs 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, since the number of products to be sent for the evaluation was quite low, one

[20]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 free almost everywhere in Italy in the period that we consider. Since we are interested in the effect of research quality on student enrollments, restrictions on the number of slots (for which we do not have data) would be a potential threat to our identification strategy. We expect in particular that HEIs with a better score in the REE would tend to rely more on selective admissions at the second-level degree, leading to a bias in our estimates. 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 degree was designed so as to be the natural continuation of first-level degrees provided by the same Alma Mater, and there was little mobility of students across HEIs.

every four researchers.[21] Figure 2 presents the same information as Figure 1 for the second indicator of research quality, the percentage of 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 product and some others for which all the research output sent was judged as 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 NUTS-3 in the Eurostat's Nomenclature of Territorial Units for Statistics (NUTS) 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.

Figure 4 visualizes by plotting the raw data the kind of empirical exercise that we do in this paper. The figure plots the average number of enrolled students per year in subject-group-HEIs who got a low (first quartile) vs. a high (fourth quartile) score in the VTR. The number of enrolled students 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 share of the divergence took place right after the publication of the results. Thus the effect of a better VTR rating on enrollments 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 graduates of academic high schools the initial decrease in enrollments is compensated by a similar increase between 2007 and 2011 for both high and low research quality subject-group-HEIs.

5 Results

Tables 1-4 in this Section consists of two panels. Panel A reports the results using the VTR score and panel B those using the share of excellent VTR products. Models in columns (1) and (2) only allow for an intercept effect of the VTR, the first including only subject-group-HEI FEs and the second also subject-group-HEI specific trends. Models in columns (3) and (4) also allow for a differential trend after the VTR according to a HEIs' performances in the VTR.

The results in columns (1) and (2) of Table 1 show an interesting pattern. While the VTR score does not seem to be associated with total (log) student enrollments, irrespective

[21] This changed in the following REE. In the VQR 2004-2010, each university research staff had to submit three research products, and in the VQR 2011-2014 two products.

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

of the controls included, student enrollments are sensitive instead to the share of excellent VTR products. A possible interpretation is that given the limited number of research products submitted, the VTR score was less able to discriminate quality than the share of excellent products, which indeed exhibits larger variation both between and within HEIs (see Figure 3). Raising the latter by one-s.d. increases enrollments by 6.2 percent when only controlling for subject-group-HEI FEs and by 5.8 percent when subject-group-HEI trends are included. Both effects are statistically significant at the 5% level. Allowing the post-2005 trend in enrollments to differ according to the VTR outcomes leads to similar estimates, 0.058 and 0.063, in column (3) and (4) respectively. The VTR score-post 2005-time trend interactions are never statistically significant. Hence, there is no evidence of an increasing reputational effect overtime (see Section 3). In what follows, we consider the more general model estimated in column (4) as our preferred specification.

A one-standard deviation (s.d.) increase in the first indicator of quality is equivalent to a 0.1 increase in the final VTR 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 the first position (together with the university of Reggio Emilia) — and the same subject-group in universities such as Sassari, Siena or Bolzano (see Figure C1). Similarly, a one-s.d. increase in the second indicator of quality is equivalent to a 19 percentage points increase in the share of excellent products submitted, which roughly corresponds to the difference between the performance of Economics in Bocconi University with 50% of excellent products and the University of Bologna with 31% of excellent products (see Figure C2).

Tables 2 and 3 investigate potential differential effects by students' entry qualifications.[23] We expect especially better students to respond to the release of new information concerning research quality. Results in Table 2 relate to the enrollment of high-mark students (i.e. those who graduated from high school with a mark of 90 or more, out of maximum of 100) and confirm those of the previous table regarding the salience of the share of excellent products compared to the VTR score. The estimated effects are very robust across specifications also in this case. Our preferred specification in column (4) returns a coefficient of 0.103, statistically significant at the 5% level. It is worth noting that the point estimate is larger than that obtained in the previous table, demonstrating the higher responsiveness of high-quality students to rankings compared to the average student.[24] Results in Table 3 mimic those in Table 2. Our preferred model indicates that increasing the share of excellent VTR products by one s.d. raises the number of students coming from the academic track by 11.8 percent. These results are consistent with the

[23] In these regressions we lose 48 observations for which data on student quality is not available.

[24] However, the two coefficients are not statistically different.

evidence coming from individual level data that in Italy are especially the most talented students, irrespective of their family backgrounds, who value quality when making their university enrollment decisions (Pigini and Staffolani, 2016).

A robust finding of the past literature is that rankings especially affect enrollments of HEIs in the top of the quality distribution, while the other institutions are less sensitive to the release of quality information. We investigate this hypothesis by allowing the VTR coefficients to change between the fourth quartile (Q4) and the other quartiles (Q1-Q3) of the VTR score's and share of excellent VTR products' distributions, using interaction terms as described in Section 3. Interestingly, Table 4 shows that the effect of ranking in the fourth quartile of the VTR score on total enrollments is now statistically significant at the 5% level, and points to a 11.9 percent increase in enrollments compared to HEIs in lower quartiles of quality (column 4). Similarly, being in the fourth quartile of the share of excellent products produces a 14.5 percent increase in total enrollments, which is significant at the 1% level.

The effects of being in the top quartile of the VTR on enrollments of high quality students are even larger. Column (4) of Table 5 shows that performing in the top quartile of the VTR score (share of excellent products) raises the number of enrollments of high-mark students by 20.4 (20) percent. Effects of similar magnitude are found in column (4) of Table 6 on enrollments of students coming from the academic high school track. The magnitude of the effect of having the VTR score (share of excellent products) in the fourth quartile is 0.25 (0.26) log-points. All these coefficients are significant at the 1% level. All in all, these last estimates show, in line with the past literature on league tables, the existence of substantial nonlinearities in the effects of rankings.

Since the direct impact of VTR on public funding was initially very limited, we expect the effect of the REE results on student enrollment, if any, to be the result of a change in HEIs' reputation. Given that student mobility increased in Italy over the last decade (De Angelis et al., 2016)[25] it is important to study if this phenomenon is due to a better awareness of differences in quality between HEIs or, since the trend accelerated dramatically after 2008, it can simply be explained by the fact that students increasingly prefer to enroll in universities located in labor markets offering more opportunities. 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 labor market both at origin and at destination plays an important role (Dotti et al., 2013). However, there are concerns that a bad performance of Southern Italy's universities in REEs may exacerbate the

[25]Mobility of high school graduates to HEIs in other areas of the country increased everywhere but the North-West. The area experiencing the largest growth is the South, where the share of high school graduates enrolling in the Center and Northern Italy increased from 16.5% in 2008 to 22.3% in 2014.

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 areas, 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 a higher number of local students but also of external students (i.e. students from other regions). Southern students who have decided to move out of their regions may, for instance, change their enrollment choices compared to the past in favor of high-VTR-rated destinations. Southern universities, in contrast, are more likely to compete in local catchment areas and to enjoy much lower gains from a good ranking in the REE. Table B1 explores this hypothesis, by reporting estimates split by geographical macro-area (North, Center, 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 enrollments and the VTR score for all geographical areas. When considering the percentage of excellent VTR products, in panel A, only the coefficient for Northern Italy is statistically significant at the 10% level. The coefficients for the two remaining areas, especially that for Southern Italy, are not very dissimilar in magnitude, but are much less precisely estimated. The same happens considering the number of enrollments of high-mark or academic-track students. As for the former, the coefficient for the North (0.134) is statistically significant at the 5% level, while the coefficient for the South in spite of having a similar magnitude (0.138) has a standard error that is twice as large. The percentage of excellent VTR products increases the enrollments of academic-track students by 0.174 log-points (statistically significant at 5%). The coefficient on the South is a bit smaller (0.133) but statistically insignificant. All in all, we conclude that there is no striking evidence that the VTR was only effective for the North of Italy, as the estimates for the other macro-regions generally are not close to zero but are imprecisely estimated.

In Table B2 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 put forward that if the estimated VTR effect is mainly explainable in terms of an increase in the supply of information on university quality provided to students, it should be larger for newly created universities which do not have a well established reputation compared to universities that have a long tradition of teaching and research. To test this hypothesis, HEIs are divided into Old and New universities, respectively those founded before an after 1970. The estimation results suggest that VTR had statistically significant effects on New universities only, for which positive effects are found on all outcomes, (total enrollments, high-mark students and academic-track students). A one-SD increase in the percentage of

excellent products increases total enrollments by 11%, and the number of high-mark and academic-track students by 15.4% and 17.9%, respectively. These results contrast with 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. From this evidence, it turns out that are especially recently created universities which have more to gain from official REEs in terms of increasing the number and quality of their student enrollments. A good performance in REEs could be a way for these HEIs to quickly fill the reputation gap they have compared to historical universities.

6 Discussion

This section provides a brief discussion of the potential channels through which the VTR might have affected student choices. In order for new information to have had an impact on students, it is necessary that they had access to it. To have an idea of the potential degree of 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) that is the committee that was in charge of managing the VTR. We limited the search to 2006, i.e. the year when the VTR final results were released. The search delivered 13 results, 8 of which are related to the VTR and are summarized in Table **??**. Apart from an article, which comments in general on the performance of the whole Italian University system in the VTR, the other ones are focused on specific universities, and make a comparison of their performance compared to other HEIs. The press coverage concerns both North-Centre Italy's institutions (University of Turin, University of Bologna) and Southern Italy's universities (University of Palermo, University of Basilicata, University Federico II of Naples). Articles are not limited to good performance in the VTR, but 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 research evaluation exercise and of a university ranking produced by CIVR, which was 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, where final results where made available in February 2006. Indeed, the website has been visited 460,000 times in the few weeks after the release of the results (Rebora and Turri, 2013). Figure D1 depicts the trend in Google searches for the 'CIVR' acronym in Italy, and 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 (Febuary 2006).

We might wonder, however, if the new information provided by the VTR was indeed new, or just provided similar information to what was already available to students through newspapers' rankings. In order to test this hypothesis, we focus on the Censis-Repubblica University Guides, the sole providing rankings at the subject 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 [26] that was used by Censis to compile the rankings of subject-group-HEIs in a given field of study. This indicator is included as an additional control in the different models, and the estimation results for the specification including interaction terms between the VTR score and the post-VTR period are reported in Table E1. The estimates turn out to be very robust to the inclusion of the Censis-Repubblica quality indicator, suggesting that the VTR had an additional effect over and above the league tables already available to the public. The effect of the Censis score is instead positive but never statistically significant at conventional levels.

7 Concluding remarks

The Italian Higher Education system has always been characterized by the so-called 'legal value' of university degrees. The degree content being strongly regulated at the central level by the Ministry of Education, University and Research, all university degrees in the same field were (and still are) considered as 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 programs offered. This lack of information has been exploited by private intermediaries —in Italy by newspapers— which have published annually universities' league tables. Although the impact of unofficial university rankings on student choice has been already object of several studies in the US 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 Research Evaluation Exercise (VTR) that was completed in Italy in 2006, and features the first assessment of its impact on student choice, namely on the total number of university enrollments and on enrollments of high quality students, proxied by high school 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 enrollment choices of establishing a REE.

[26] The final score is constructed as the average of standardized scores in four areas: productivity, teaching, research and internationalization.

We relate the number of enrollments 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 rating in 2006 also had better enrollment 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 enrollment. In our preferred specification, a one-s.d. increase in the share of excellent research products leads to a 6.3% increase in total enrollments, a 10.3% increase on enrollments of students graduating from upper secondary school with a high mark (at least 90 out of 100) and a 11.8% increase for students coming from the academic high school track. We find, in line with the previous literature, that the coefficients are highly nonlinear, with most of the effect occurring in the fourth quartile of the research quality distribution. In fact, the total number of students enrolled is 11.9% and 14.5% higher for HEIs in the fourth quartile compared to HEIs in lower quartiles of quality for the first and second indicator 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 enrollments of around 20% for both measures of research quality, while for students coming from an academic track the effect is even larger at 25% and 25.8% for the VTR score and the share of excellent products, 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 shows up for New universities, which are more likely to suffer from a reputation gap compared to Old universities.

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

Some cautionary notes are in order. First, unlike with the following REEs, the VTR did not link initially the rating performance to a relevant amount of public funding received by institutions. The average share of total universities' public resources distributed according to 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 low share of performance-related funding might have changed student choices on the basis of financial concerns. However, the effect of the following REE could be much stronger, since a larger share of universities' public resources were distributed according to their

results. Within a few years 30% of the total public budget will be allocated according to quality indicators, and research quality, with a weight of 65% in the determination of the total score, will be the main determinants of these funds (Decree Law 69/2013). Second, since 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 rankings and ratings from REEs as proxies for the quality of teaching. However, little is known about the complementary between teaching and research activities (Hattie and Marsh, 1996; Becker and Kennedy, 2005). The two may be substitutes, and once students realize it, outcomes in REEs may even turn out to be negatively correlated with the enrollment of students who mostly care about teaching.

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Figure 1: VTR final score by university

Figure 2: Percentage of excellent VTR products by university

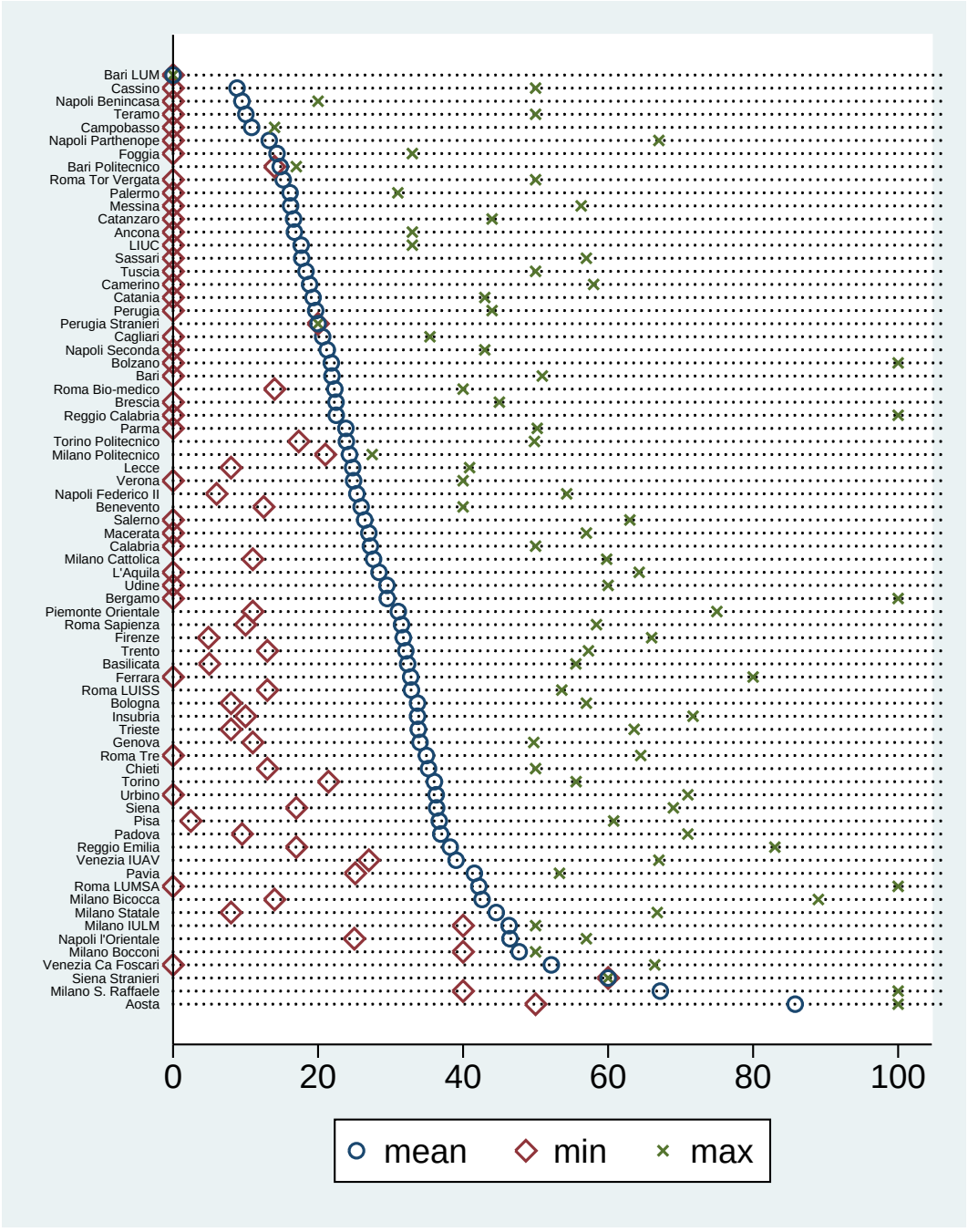
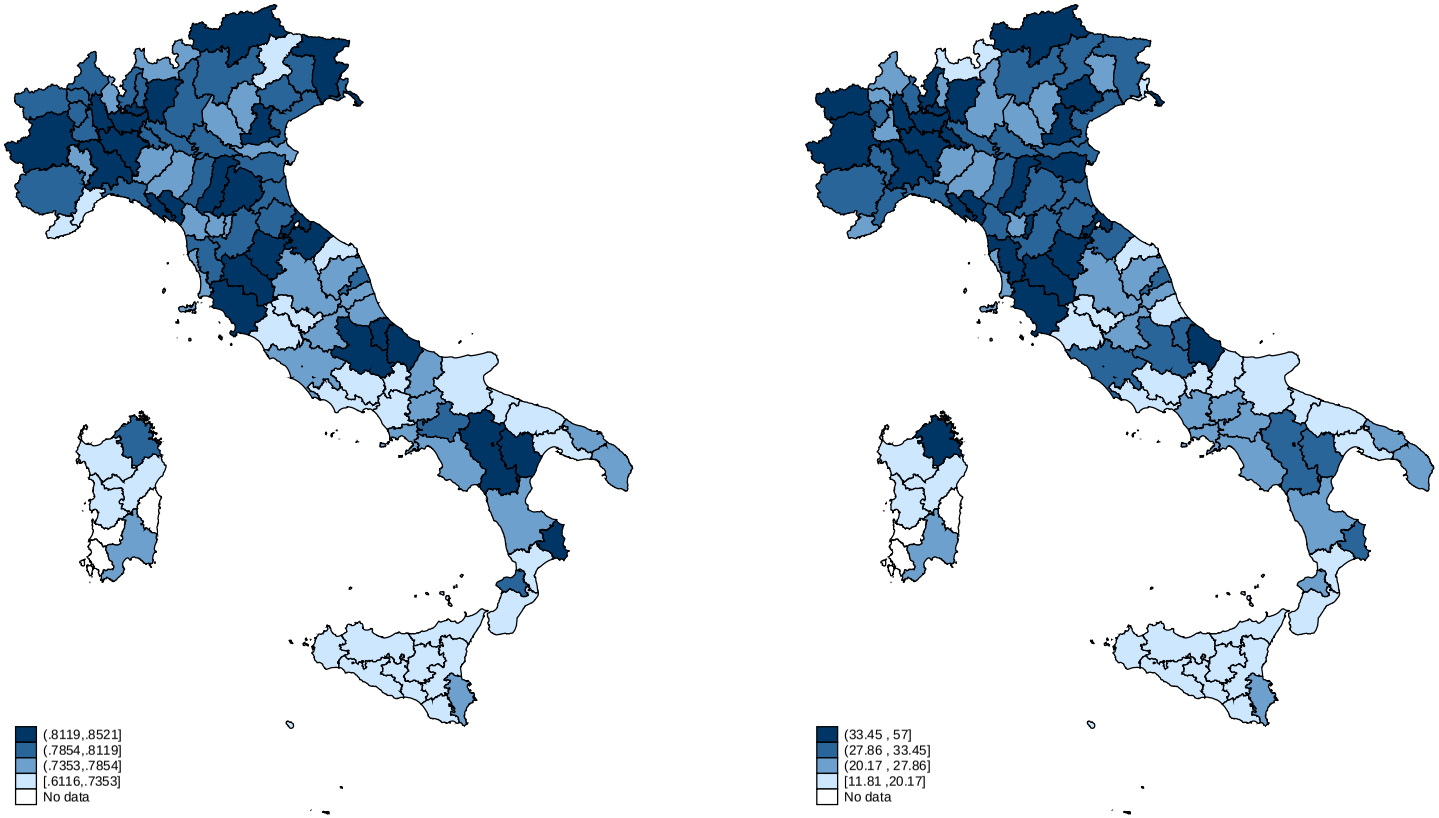


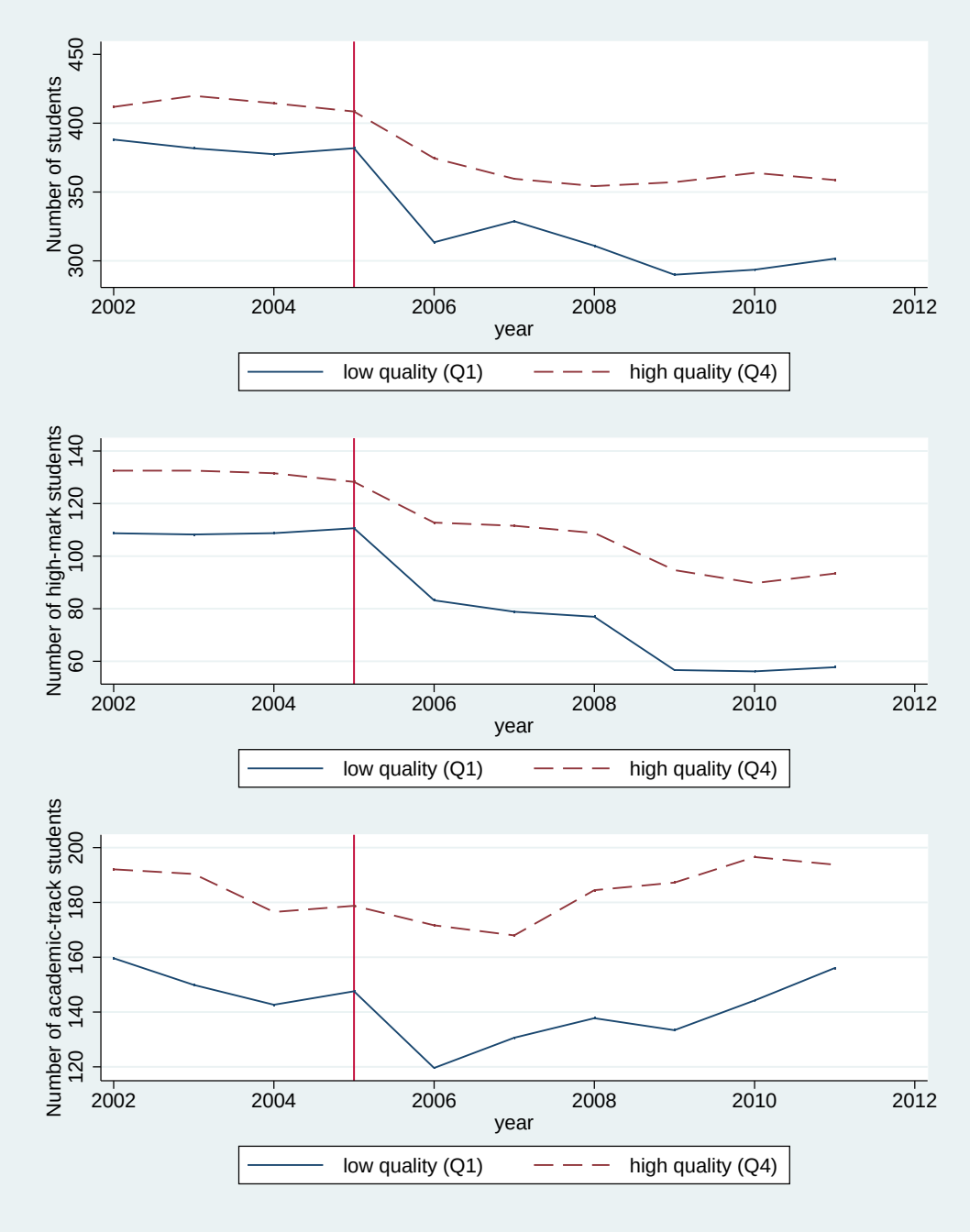
Figure 3: Province-level variation in VTR research quality



(a) VTR score

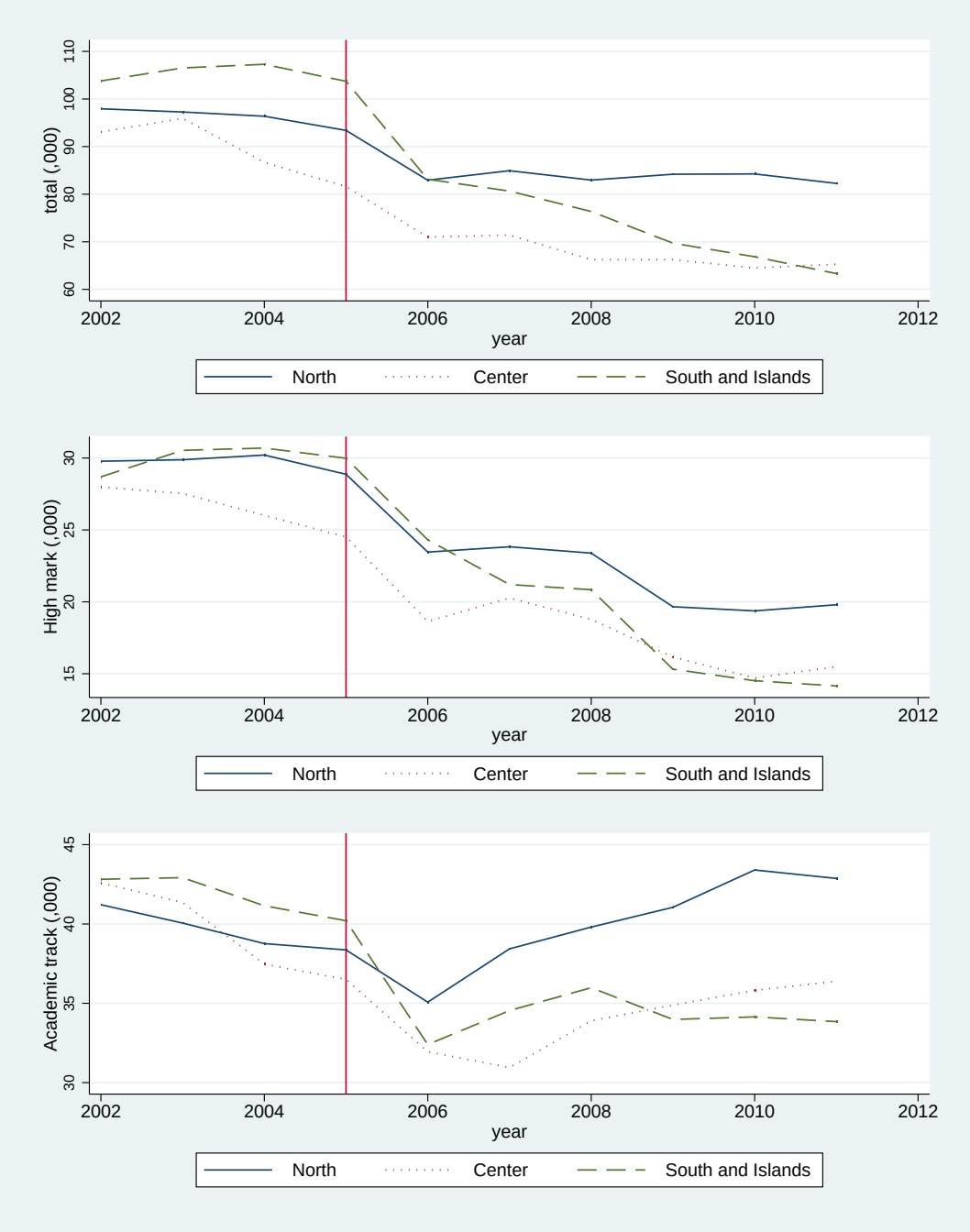
(b) Percentage of VTR excellent products

Figure 4: Average number of students enrolled by year for 1st (Q1) and 4th (Q4) quartiles of VTR score



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

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



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

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

	(1)	(2)	(3)	(4)
Panel A. VTR score				
VTR*$Post_{2005}$	0.024	0.021	0.014	-0.004
	(0.024)	(0.022)	(0.024)	(0.030)
VTR*$Post_{2005}$*(Time-2006)		0.001		-0.013
		(0.005)		(0.011)
Number of obs.	7302	7302	7302	7302
R^2	0.840	0.840	0.887	0.887
Panel B. % Excellent products				
VTR*$Post_{2005}$	0.062***	0.058***	0.058**	0.063**
	(0.024)	(0.022)	(0.023)	(0.026)
VTR*$Post_{2005}$*(Time-2006)		0.002		0.003
		(0.005)		(0.010)
Number of obs.	7302	7302	7302	7302
R^2	0.841	0.841	0.887	0.887
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level.

Table 2: Effect of VTR on (log) enrollments of high-mark students

	(1)	(2)	(3)	(4)
Panel A. VTR score				
VTR*$Post_{2005}$	0.065**	0.026	-0.005	-0.016
	(0.031)	(0.034)	(0.042)	(0.053)
VTR*$Post_{2005}$*(Time-2006)		0.016**		-0.009
		(0.007)		(0.018)
Number of obs.	7254	7254	7254	7254
R^2	0.778	0.778	0.835	0.835
Panel B. % Excellent products				
VTR*$Post_{2005}$	0.102***	0.082**	0.083**	0.103**
	(0.031)	(0.032)	(0.036)	(0.042)
VTR*$Post_{2005}$*(Time-2006)		0.008		0.015
		(0.007)		(0.016)
Number of obs.	7254	7254	7254	7254
R^2	0.779	0.779	0.835	0.835
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level.

Table 3: Effect of VTR on (log) enrollments of academic-track students

	(1)	(2)	(3)	(4)
Panel A. VTR score				
VTR*$Post_{2005}$	0.012	0.028	0.030	-0.001
	(0.033)	(0.033)	(0.039)	(0.052)
VTR*$Post_{2005}$*(Time-2006)		-0.006		-0.023
		(0.007)		(0.019)
Number of obs.	7254	7254	7254	7254
R^2	0.801	0.801	0.854	0.854
Panel B. % Excellent products				
VTR*$Post_{2005}$	0.074**	0.102***	0.122***	0.118***
	(0.034)	(0.034)	(0.038)	(0.044)
VTR*$Post_{2005}$*(Time-2006)		-0.011		-0.004
		(0.008)		(0.015)
Number of obs.	7254	7254	7254	7254
R^2	0.801	0.801	0.855	0.855
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level.

Table 4: Effect of VTR on total (log) enrolled students by quartile of HEIs' 'quality'

	(1)	(2)	(3)	(4)
Panel A. VTR score				
$Post_{2005}$*Q4	0.178***	0.154***	0.128**	0.119**
	(0.058)	(0.051)	(0.054)	(0.059)
$Post_{2005}$*(Time-2006)*Q4		0.010		-0.006
		(0.012)		(0.022)
Number of obs.	7302	7302	7302	7302
R^2	0.841	0.841	0.887	0.887
Panel B. % Excellent products				
$Post_{2005}$*Q4	0.174***	0.150***	0.133***	0.145***
	(0.052)	(0.046)	(0.049)	(0.052)
$Post_{2005}$*(Time-2006)*Q4		0.010		0.009
		(0.012)		(0.022)
Number of obs.	7302	7302	7302	7302
R^2	0.841	0.841	0.887	0.887
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level. Q4 stands for the fourth quartile of the VTR score or percentage of excellent products distribution.

Table 5: Effect of VTR on (log) enrollments of high-mark students by quartile of HEIs' 'quality'

	(1)	(2)	(3)	(4)
Panel A. VTR score				
$Post_{2005}$*Q4	0.239***	0.222***	0.210***	0.204**
	(0.077)	(0.074)	(0.077)	(0.082)
$Post_{2005}$*(Time-2006)*Q4		0.007		-0.005
		(0.016)		(0.033)
Number of obs.	7254	7254	7254	7254
R^2	0.779	0.779	0.835	0.836
Panel B. % Excellent products				
$Post_{2005}$*Q4	0.209***	0.191***	0.188***	0.200***
	(0.068)	(0.066)	(0.069)	(0.073)
$Post_{2005}$*(Time-2006)*Q4		0.008		0.009
		(0.016)		(0.032)
Number of obs.	7254	7254	7254	7254
R^2	0.779	0.779	0.835	0.835
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level. Q4 stands for the fourth quartile of the VTR score or percentage of excellent products distribution.

Table 6: Effect of VTR on (log) enrollments of academic-track students by quartile of HEIs' 'quality'

	(1)	(2)	(3)	(4)
Panel A. VTR score				
$Post_{2005}$*Q4	0.196**	0.271***	0.301***	0.250***
	(0.080)	(0.074)	(0.081)	(0.091)
$Post_{2005}$*(Time-2006)*Q4		-0.031*		-0.037
		(0.017)		(0.034)
Number of obs.	7254	7254	7254	7254
R^2	0.801	0.802	0.855	0.855
Panel B. % Excellent products				
$Post_{2005}$*Q4	0.186***	0.253***	0.287***	0.258***
	(0.071)	(0.066)	(0.072)	(0.084)
$Post_{2005}$*(Time-2006)*Q4		-0.028*		-0.022
		(0.016)		(0.034)
Number of obs.	7254	7254	7254	7254
R^2	0.801	0.801	0.855	0.855
control variables (both panels):				
Subject-group-HEI FE	Yes	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes	Yes
Subject-group-HEI time trends	No	No	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level. Q4 stands for the fourth quartile of the VTR score or percentage of excellent products distribution.

Appendix

A Mapping of research to teaching subject-groups

Table A1: Mapping of VTR to Area-Mixed

Mixed Area	Disciplinary Area (VTR)	Field name
1	1+2	Hard sciences (math 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
12	14+15a	Political sciences

In the first column (Mixed Area) we show the 12 areas that we use in the analysis. They result from merging the Disciplinary Areas in the VTR and the fields of study as classified by the Ministry of Education, University and Research (MIUR). 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, 8 - Architecture, 9 - Industrial Engineering, 10 - Humanities, 11 - Teaching and Psychology, 12 - Law, 13 - Economics and 14 - Political 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, 15f - Science for the evaluation and enhancement of cultural heritage).

B Heterogeneous effects by geographic area and universities' age

Table B1: Effect of VTR on (log) enrollment of students by geographic area

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. All students						
	VTR score			% Excellent		
	North	Center	South	North	Center	South
VTR*$Post_{2005}$	0.037	-0.010	0.032	0.064*	0.045	0.104
	(0.046)	(0.035)	(0.053)	(0.037)	(0.038)	(0.066)
VTR*$Post_{2005}$*(Time-2006)	0.001	0.002	-0.017	0.002	0.008	0.008
	(0.017)	(0.016)	(0.018)	(0.013)	(0.015)	(0.022)
Number of obs.	2803	2114	2254	2803	2114	2254
R^2	0.876	0.883	0.909	0.876	0.883	0.909
Panel B. High-mark students						
	VTR score			% Excellent		
	North	Center	South	North	Center	South
VTR*$Post_{2005}$	0.097	-0.026	0.007	0.134**	0.056	0.138
	(0.064)	(0.057)	(0.088)	(0.054)	(0.060)	(0.102)
VTR*$Post_{2005}$*(Time-2006)	0.015	0.011	-0.003	0.014	0.006	0.038
	(0.022)	(0.023)	(0.026)	(0.019)	(0.024)	(0.038)
Number of obs.	2793	2094	2236	2793	2094	2236
R^2	0.836	0.822	0.868	0.837	0.822	0.868
Panel C. Academic-track students						
	VTR score			% Excellent		
	North	Center	South	North	Center	South
VTR*$Post_{2005}$	0.145	-0.007	0.000	0.174**	0.066	0.133
	(0.089)	(0.046)	(0.079)	(0.071)	(0.060)	(0.083)
VTR*$Post_{2005}$*(Time-2006)	0.021	-0.009	-0.034	0.007	-0.010	0.002
	(0.026)	(0.024)	(0.025)	(0.020)	(0.027)	(0.030)
Number of obs.	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 time trends	Yes	Yes	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level.

Table B2: Effect of VTR on (log) enrollment of students: Old vs New universities

	(1)	(2)	(3)	(4)
Panel A. All students				
	VTR score		% Excellent	
	New	Old	New	Old
VTR*$Post_{2005}$	0.070	-0.042	0.110**	0.031
	(0.048)	(0.035)	(0.053)	(0.030)
VTR*$Post_{2005}$*(Time-2006)	-0.005	-0.022	0.005	-0.001
	(0.016)	(0.014)	(0.015)	(0.011)
Number of obs.	1676	5408	1676	5408
R^2	0.913	0.888	0.913	0.888
Panel B. High-mark students				
	VTR score		% Excellent	
	New	Old	New	Old
VTR*$Post_{2005}$	0.062	-0.050	0.154**	0.066
	(0.071)	(0.065)	(0.078)	(0.046)
VTR*$Post_{2005}$*(Time-2006)	0.003	-0.024	0.020	0.002
	(0.022)	(0.022)	(0.024)	(0.017)
Number of obs.	1666	5363	1666	5363
R^2	0.883	0.837	0.884	0.837
Panel C. Academic-track students				
	VTR score		% Excellent	
	New	Old	New	Old
VTR*$Post_{2005}$	0.115	-0.051	0.179**	0.063
	(0.075)	(0.064)	(0.085)	(0.047)
VTR*$Post_{2005}$*(Time-2006)	-0.010	-0.035	0.011	-0.008
	(0.022)	(0.023)	(0.023)	(0.019)
Number of obs.	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 time trends	Yes	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level. Old universities are those founded before 1970 and New universities those created in 1970 or later.

C VTR final score and share of excellent research products in Economics

Figure C1: VTR final score by economics subject-group-HEI

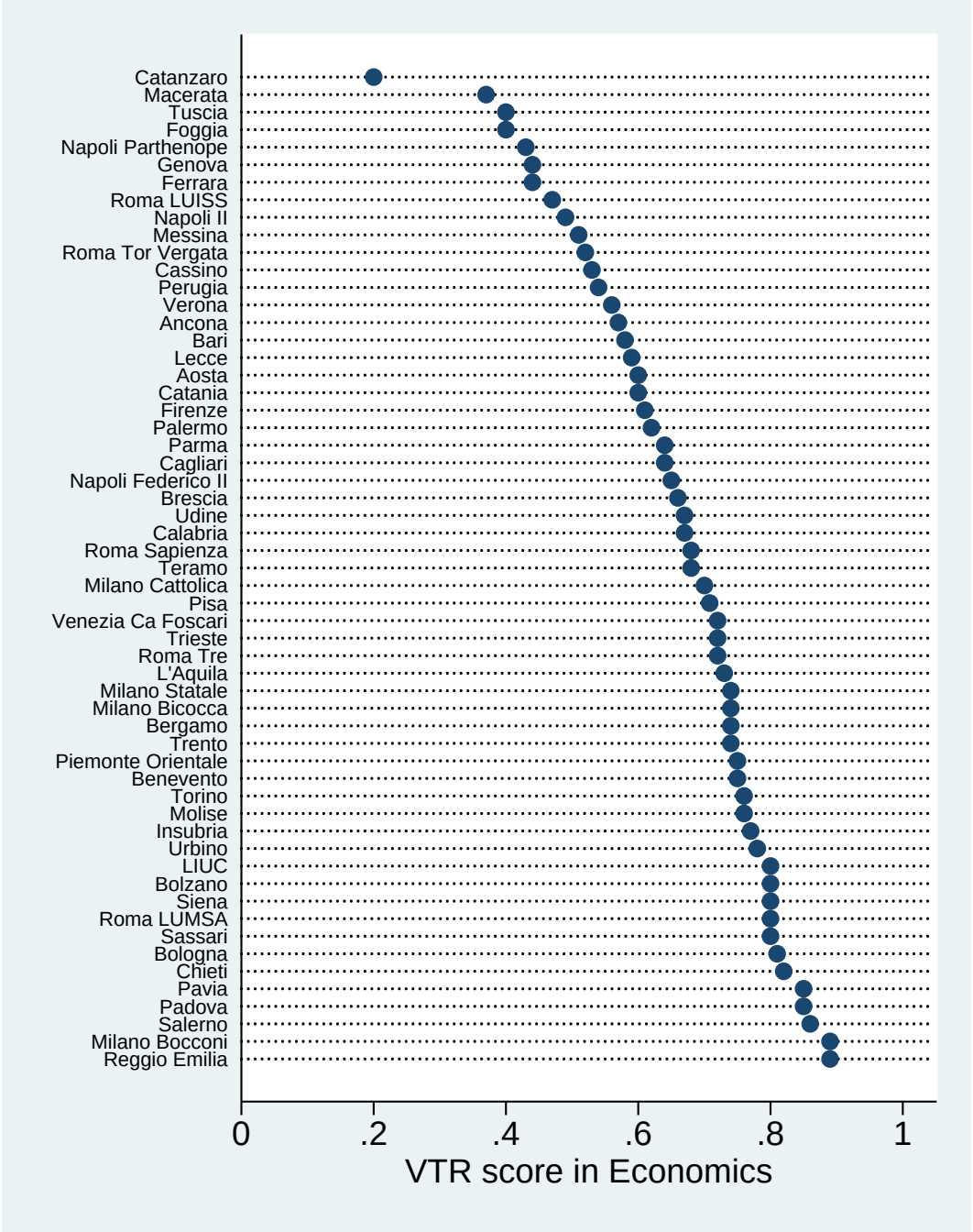
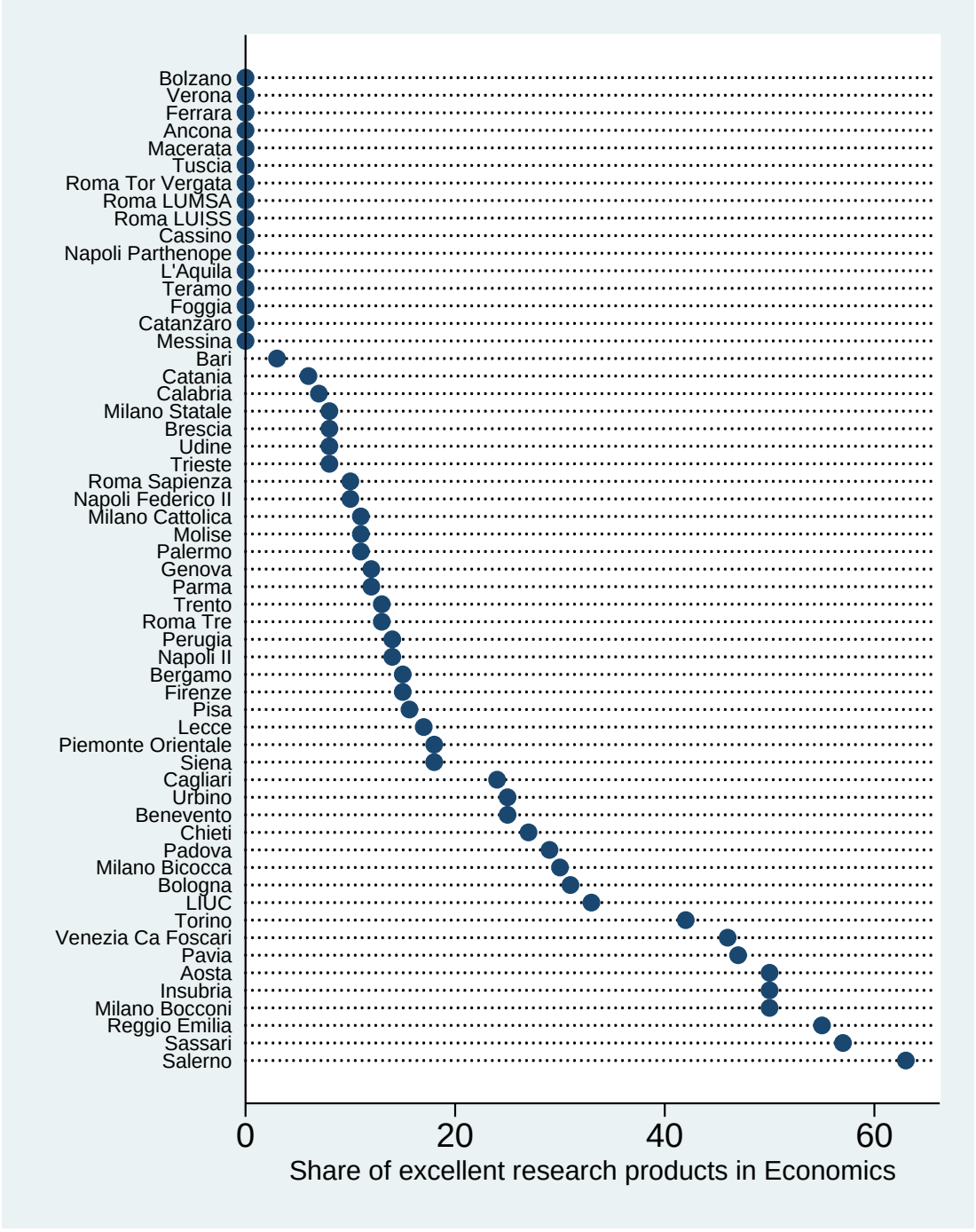
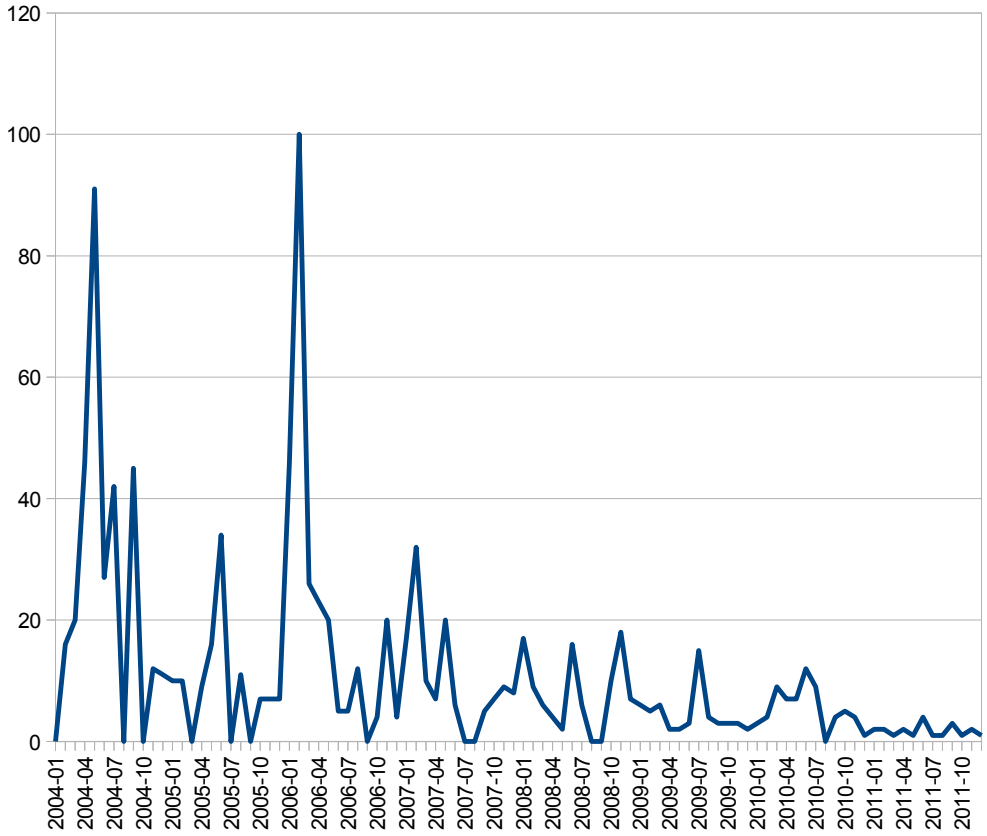


Figure C2: Share excellent products by economics subject-group-HEI



D VTR media coverage

Figure D1: Trend in Google searches for the 'CIVR' word



Note. Trend of Google searches for the 'CIVR' word, i.e. the Steering Committee for Research Evaluation's acronym, in 2016. The maximum number is normalized to 100.

Table E2: 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" 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

E Models controlling for Censis-Repubblica university ranking

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

	(1)	(2)	(3)
Panel A. VTR final score			
	Total enrollment	High-mark enrollment	Academic enrollment
Censis-Repubblica score	0.011	0.023	0.030
	(0.023)	(0.033)	(0.033)
VTR*$Post_{2005}$	-0.003	-0.016	-0.002
	(0.030)	(0.053)	(0.052)
VTR*$Post_{2005}$*(Time-2006)	-0.013	-0.008	-0.023
	(0.011)	(0.018)	(0.019)
Number of obs	7302	7254	7254
R^2	0.887	0.835	0.855
Panel B. % Excellent products			
	Total enrollment	High-mark enrollment	Academic enrollment
Censis score	0.010	0.020	0.027
	(0.023)	(0.033)	(0.033)
VTR*$Post_{2005}$	0.064**	0.105**	0.119***
	(0.026)	(0.042)	(0.044)
VTR*$Post_{2005}$*(Time-2006)	0.003	0.015	-0.003
	(0.010)	(0.016)	(0.015)
Number of obs	7302	7254	7254
R^2	0.887	0.836	0.855
control variables (all panels):			
Subject-group-HEI FE	Yes	Yes	Yes
Province × year FE	Yes	Yes	Yes
Subject-group-HEI time trends	Yes	Yes	Yes

*, **, *** statistically significant at the 10, 5 and 1% level. Standard errors are clustered at the Department level.