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Grazia Graziosi
DEAMS 'Bruno de Finetti'
Università degli Studi di Trieste

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Dipartimento di Scienze Economiche, Aziendali, Matematiche e Statistiche
"Bruno de Finetti"
Piazzale Europa 1
34127, Trieste
Tel. +390405587927
Fax +390405587033
http://www.deams.units.it

EUT Edizioni Università di Trieste
Via E.Weiss, 21 - 34128 Trieste
Tel. +390405586183
Fax +390405586185
http://eut.units.it
eut@units.it

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Grazia Graziosi
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ABSTRACT[1]

The aim of this article is to investigate whether the Italian University grants are an effective tool to prevent student drop-out and to favor the degree attainment, both for merit and need-based financial aids. The survey units are Italian students enrolled on a degree course in Chemistry, Physics and Mathematics from 2002/03 until 2007/08 in the University of Trieste. On the one hand, the Regional Agency for the Right to Education offers some grants every year to eligible students from low-income families (rarely related to merit). On the other hand, Fonda Foundation offers some (only) merit-based grants to the best students enrolled in Chemistry, Physics and Mathematics degree courses. In order to estimate the causal effect of receiving a grant, we follow the counterfactual analysis and we match treated and control units using Genetic matching and Coarsened Exact Matching. The results suggest that the income-based financial aids have a positive impact to prevent drop-out at 2^{nd} year, but a non significant effect on graduation time, whereas the merit-based scholarships increase the probability to achieve the degree in the time alloted.

[1]**Corresponding author:** Grazia Graziosi, DEAMS 'Bruno de Finetti', Università degli Studi di Trieste , piazzale Europa 1, Trieste

KEYWORDS: Financial higher education; evaluation of university grants; counterfactual analysis.

1. Introduction

In a context of decreasing of higher education funds and the difficulties of education systems in obtaining the necessary resources to ensure high quality levels, there is a need to introduce a culture of evaluation of public policies that suggest which actions to take for improving the effectiveness of resources.

In Italy, public funding for tertiary education sees the predominance of income-based grants as the main type of intervention for "capable and deserving students, even those without adequate economic resources."[2]

The main objective of this public policy is to encourage investment in tertiary education for students from low income families and to reduce socioeconomic inequalities.

From this point of view, the income-based scholarships seems to respond to the extensive concept of equal opportunity: "having an equal opportunity necessitates there being on equal starting position; this means also starting from an equal financial position or at least from one which is not disadvantageous" (Sartori, 1987).

Contrary to the expectations, the social inequalities are noticeable in the rates of completion of tertiary education, both in the Italian and European systems (M. and Checchi, 2008) and (EQUNET, 2010).

A wide-ranging policy discussion focuses on merit incentives. The main criticism of this approach regards the fact that the best students, on average, come from better socioeconomic backgrounds, which plays a crucial role in choosing higher education.

However, the higher returns of human capital investment occur when they are carried out in early childhood and pre-school age, particularly for low-background pupils, because these early interventions yield more fertile ground for enhancing future learning (Carneiro and Heckman, 2003), (Cunha et al., 2006).

Afterwards, overcoming the initial gap allows students to remove those obstacles dependent on external factors and influencing the education choices.

According to this procedure, the equality of opportunity is guaranteed for "the formation of a career based on talent and solely talent due to one's capacities and merits" (Sartori, 1987).

A good theoretical argument which support this thesis can be found in Walzer (1983).

The Italian political attention towards the merit criterion is recent: the Law of 30 December 2010 no. 240 establishes a merit-fund with the aim of both awarding funds to the best students and lending them their part of the higher education expenditures, to be reimbursed at the end of their studies, in proportion to their future income.

Regarding the effects of Italian university grants, little attention has been paid. The aim of this research is to contribute using an empirical analysis on the causal effects of the scholarships both on the probability of enrolling in the 2^{nd} year and to completing the degree in the time alloted.

The peculiarity of this analysis resides in the evaluation of incentives that differ from student's requirement: based mainly on family-income or solely on merit.

[2] Art. 34, c. 2, Constitution of Italian Republic.

2. Background literature

There is a growing body of international literature that examines the effects of student financial aid on student enrollment and graduation; however the majority examines all forms of aid without distinguishing their nature and mixing different types of financial aids: scholarships, grants, loans and tax concessions, based on income and merit criteria at the same time.

The incentives examined here are those of which the selection criteria rest on very different bases (Bresciani and Carson, 2002), (Gladieux and Perna, 2005)(Gladieux and Perna, 2005), while there are few studies that examine separately the effects of the income related incentives and those for merit (Cornwell et al., 2005),(Scott-Clayton, 2011) and even fewer studies that compare the results (Singell and Stater, 2006).

In any case, researchers must grapple with the difficulties that are encountered in identifying the causal effect of economic incentives. First of all, both the methodology and the empirical research estimate the average effects on the entire population, failing to consider the potential different effects on different sub-populations. Therefore, the correctness of measuring the causal effects of economic incentives by comparing the academic careers of students who diverge strongly from each other, not only with respect to the grants awarded, is doubtful.

Moreover, in spite of the political actors being interested in the long-term causal effects, such as obtaining a qualification, most of the research focuses on the short-term effects, such as registrations and drop-outs in the second year.

For estimating the causal effect of receiving an incentive, most research focus on projects that randomly assign some form of benefits to improve academic performance.

Angrist et al. (2009) assess the Project STAR[3] took place at one of the larger Canadian university. All first-year students[4] enrolling in September 2005 were randomly assigned to one of the three treatment groups or a control groups. One treatment group was offered financial incentives for good grades. Another was guaranteed academic support services. A third group mixed both interventions. As the consequence, service use was highest for women and for students in the combined group. The mixed treatment also raised their grades and improved the academic standing of women. These differentials persisted until the end of second year, though incentives were given in the first year only. This suggests study skills among some treated women increased. Opposite, the program had no effect on men.

The estimate of the causal effect of incentives on the results achieved by the students is not so easy to determine. Even if the scholarships are assigned randomly, the students who participate and success in the program have, from the start, some characteristics which make them different from other students.

For example, Witte (2000) modeled the probability of adherence to the Milwaukee Program[5] depending on the factors of eligibility and a number of other demographic

[3]Student Achievement and Retention Project.

[4]Except the students with the higher school grade point average (GPA).

[5]The Milwaukee Program awards grants to students who attend private schools and who, without the voucher, could not afford to do so. Sometimes this voucher is assigned randomly to volunteers participating in the program

characteristics such as the race of the students, the household income, gender, and the level of the mother's education. He came to the conclusion that African-American and Hispanic students participate more, and especially the girls, and the probability to take part in the program is higher in those families where the level of education of the mother is higher.

The set of socio-demographic characteristics that influence the probability of participating reflects the socio-cultural context in which the program is carried out and creates a distortion in the two groups of participants and non-participants, which are heterogeneous with respect to characteristics that affect the variable result (Heckman, 1996).

A further problem concerns those students who receive a contribution linked to income. On average, they come from a background which is culturally and socially more disadvantaged and this, even with an incentive, may affect the way the university life develops and a relevant initial effort could be required. In this perspective, it is difficult to separate the likely benefits of the scholarships from the academic results. A simple correlation between income related incentives and school career may underestimate the real benefit and it is probable that characteristics which are important, but also difficult to measure, may be omitted (Dynarski, 2003; Riegg, 2008).

This is the reason why studies of the observational type often suffer from selection bias, which results in an estimate of the effects which is not accurate.

The omission of variables which affect the response is a common problem in this type of analysis, and it derives both from the unavailability of data as well as from the nature of the analysis techniques. However, the assumption that the provision of more incentives is positively correlated with the rate of enrollment and of graduation is generally accepted and justified by empirical research. As for what is meant, then, by result of incentives, we can distinguish three aspects: registrations, subsequent years enrollments and the completion of studies.

Researches based on U.S. data, both national and federal, show how reducing the direct costs of education has a positive and statistically significant impact on registrations. For example Kane (2001) estimates that an increase of $1,000$\$ in income related incentives to the is associated with an increase in the number of enrolments by 6 percentage points.

Among the few researchers that consider the obtainment of the degree, Dynarski (2005) estimates that the scholarships awarded by the program HOPE[6] in the states of Arkansas and Georgia have increased the number of graduates in these two states.

An interesting national study in Italy that deals with the effects of national policies for the support of university studies was conducted by the IRPET (Regional Institute for Economic Planning of Tuscany) on behalf of the National Committee for the Evaluation of the University System (CNVSU), and aims to measure the impact of scholarships on the career of the students(Mealli and Rampichini, 2006, 2012). The analysis focuses on 11 universities evenly distributed throughout the country and considers students enrolled for the academic years 1998/99, 1999/2000 and 2001/02.

The two dimensions of the educational process investigated, persistence (enrollment in the second year) and productivity (exams taken in the second year), have been studied by analyzing each university separately. The effectiveness of the grant in relation to the

[6]Helping Outstanding Pupils Educationally.

probability of enrollment in the second year is demonstrated in 9 of the 11 universities considered only for non-resident students, while it is almost never effective for commuters and resident students. In the second year, and with respect to the completion of the exams, the grant shows greater efficacy, albeit limited to those students who qualify for the first time, and almost never shows a cumulative effect. In general, therefore, the scholarships do not always reduce first-year dropout rates and do not always favor, in the second year, the passing of the exams (Mealli and Rampichini, 2006).

Furthermore, Mealli and Rampichini (2012) show how that the effect of the grant on the continuation of studies decreases with a decrease of the income, that is to say that for the poorest students winning the grant does not affect the decision to abandon the university. The authors justify this result by attributing it to the amount of the scholarship being limited, and to the fact that, even if it is accompanied by the exemption from the payment of tuition fees, it is not sufficient to cover the maintenance costs of students concerned.

This consideration agrees with the conclusions drawn by Garibaldi et al. (2007) about the effects of grants on the completion of students studies within the set timeframe. From their analysis it appears that if the economic incentives were increased by 1 000 euros, the probability that the students[7] would obtain their degree beyond the duration of the studies would decrease by 5.2%

A randomized experiment was conducted by De Paola et al. (2012) at the University of Calabria involving 462 students enrolled at the first year of the degree course in Business and Administration in the academic year 2008/09. Students participating at the experiment were assigned to three different groups: two treated groups (one top award group and one modest reward group) and the control group. Bonus were assigned to the 30 best performing students in each treated group. Findings indicate that financial rewards intensify student performance both in terms of credits collected and grades earned at exams. High ability students react strongly while the effect is null for low ability students.

Finally, Covizzi et al. (2010) estimate the effect of a program of scholarships to deserving students from poor families in relation to the probability of enrollment at University of Trento. Preliminary results show that the effect is not statistically significant on the enrollment rates of the group of beneficiary students.

3. Sample selection

The dataset consists of 777 units which represent the individual data of the Italian students enrolled in an undergraduate program in chemistry, physics and mathematics from the academic year 2002/03 to the academic year 2007/08 (see figure 1), whose main identification element is the tax identification number of the student. This first datum is associated with the identification information provided by the University of Trieste and, among these, the following are of interest: age, sex, grade and year of graduation, city of residence, year of registration and the course of study.

As far as the income data are concerned, unfortunately, the University of Trieste does not request information on the financial position of the students when they are enrolling

[7]The sample is that of students at the Bocconi University.

or registering. This information is provided voluntarily by the student if he/she might be entitled to an adjustment in the payment of tuition fees based on his/her household income. In this case, the Secretariat assigns the student to an income range. Where the information is not present, the field is left blank and the student not having the right to a recalculation of the share of fees to pay, pays the higher amount.

Regarding the incentives granted, the archives of two funding institutions were acquired: the Regional Agency for the Right to Education and the Fonda College. The first contains the data of the students applying for an income related grant, the outcome of the application and the Iseeu declaration.[8].

The data about the scholarships awarded by the Fonda College on the basis of merit contain all the information about the candidates who are eligible and winners of scholarships, and the scores of the students who took part in the selection are shown. See the next section for a description of the selection process of the grants.

All the calculations were made with the statistical package R (R Development Core Team, 2011).

a. Treatments and outcomes

The objective is to estimate the effect of winning a scholarship, which is the subject of the treatment, compared with two response variables: enrollment in the second year and the achievement of a three-year degree within the three years envisaged by academics as the necessary duration of the degree concerned.

The following two variables were chosen, as they summarize the two phenomena of interest: the drop-out and completion of the studies. In fact it was observed in the exploratory analysis, that the drop-out in the second and subsequent years is a limited phenomenon (see figure 3), therefore the enrollment in the second year can be considered an indicator of effective completion of the course. On the other hand the graduation within the time foreseen for the course is an indicator of the quality of the path followed.

In this context, two different types of scholarships are chosen, which represent two different treatments.

The first regards the grant by the Regional Agency for the Right to Education, which is awarded in the first year of registration solely on the basis of income, and in subsequent years on the basis of income and merit.

Students who enroll in the first year of the course may, on a voluntary basis and presenting the Iseeu statement, obtain a scholarship varying from $1,706$ to $4,524$ euros (reference year 2008) depending on whether the student is resident, commuter or non-resident, and on the correspondence of the Iseeu indicator with the income thresholds set out in the grant conditions.

Without prejudice to the income requirement, students in the undergraduate courses who are winners of the scholarship must obtain, by the middle of August, 25 credits to enroll in the second year and 80 credits to access the third year, in order to maintain their entitlement to the scholarship.

The second treatment instead is winning the scholarship allocated by the "Luciano

[8]This is the recalculation of the Indicator of equivalent economic situation that considers, in addition to the family assets, also any income of the siblings who make up the household

Fonda" University College for Sciences to students who enroll in courses in chemistry, physics and mathematics. The scholarships are awarded to students who have completed secondary school in the previous year and who wish to get a degree in chemistry, physics and mathematics.

An invitation is published each academic year and the applications must reach the Secretariat of the Board by the end of August. Neither the high school diploma marks nor the income of the applicant are considered for the admission to the selection. Students who pass the written selection with at least 70/100 are called for an interview, after which a merit list is drawn up. The winners are announced on the basis of the position in the final ranking, the score obtained in the selection and number of scholarships allocated by the Board. This implies that, depending on the academic year considered, the same score may be either sufficient or insufficient to obtain the scholarship.

The number of scholarships varies depending on the academic year. In the first year of observation 15 grants were allocated, in the academic years 2003/2004 and 2004/05 14 scholarships were awarded, and 17 were awarded in the following years. The amount of the scholarship increased from $5,165$ euros to $5,200$ euros. The winning students must, by August 31^{st}, have passed all the exams included in the curriculum for the year with an average of at least 27/30.

The two treatments differ therefore for what is required from the students: in the first case the scholarship is awarded exclusively on an income criterion for the first year, while for the subsequent years a not so strict merit criterion also applies. In the second case, merit is the only criterion to obtain the scholarship, either for the first and the following years.

4. Empirical strategy

Attributing the changed observed to a causal effect of a policy consists in identifying the net contribution that this intervention has made with reference to the changes observed. This operation requires us to measure the difference (with respect to the variables on which public policy wants to intervene) between what happens downstream of the implementation of the intervention, the factual, and what would have happened if the intervention had not been made, the counterfactual (Trivellato, 2009). While the first term of comparison can be observed, the second term is hypothetical, unobservable by definition, and must therefore be reconstructed in a credible manner.

Hence what has been indicated by Holland (1986) as the fundamental problem of causal inference, and it is what Heckman et al. (1999) define the fundamental problem of the evaluation of the effects.

The counterfactual paradigm requires us to reconstruct credibly what would have been observed on the students exposed to the program in the absence of their having been exposed. Therefore, each subject has two potential outcomes (Rubin, 1974).

$$Y_i^T, \text{ if the individual is exposed to the treatment}$$
$$Y_i^{UT} \text{ if the individual is not exposed to the treatment (untreated)}$$

The parameter of interest in observational studies is the average effect of treatment on

those who are treated: the ATT.[9] This is the greatness of major interest from the point of the evaluation of the policies; through its estimate we are able to isolate the causal effect of the implementation of the policy.

$$ATT = E(Y^T - Y^{UT} \mid T = 1) = E(Y^T \mid T = 1)\ E(Y^{UT} \mid T = 1)$$

The average effect of treatment on the treated is the average difference between Y^T e Y^{UT}, depending on the treatment.

In this equation the term counterfactual is $E(Y^{UT}|T = 1)$ and indicates how they would behave if the treated had not been exposed to the treatment.

In the estimation of the ATT it is necessary on the one hand to estimate $E(Y^T|T = 1)$, which is (relatively) trivial since you have a sample of observations of Y^T for individuals treated. On the other hand, it is necessary to estimate $E(Y^{UT}|T = 1)$, i.e. the variable result in the absence of treatment, which was not observed on the treated individuals . This, then, will have to be estimated on the basis of the results referring to those who were untreated.

It is reasonable to assume that the results of the winners of the scholarship do not affect the results of non-beneficiaries, whereas the intervention being limited in size involves a small percentage of members. The realization of this condition satisfied the hypothesis of the absence of interference between individuals, called by Rubin (1980a) *Stable Unit Treatment Value Assignment* (SUTVA).

Since this is an observational study, the operation of estimating the counterfactual term, $E(Y^{UT}|T = 1)$, using the observations on untreated subjects could lead to mistakes due to selection bias. In order to avoid this, the two groups, the one on which is estimated $E(Y^T|T = 1)$, treated, and that one on which an estimated $E(Y^{UT}|T = 1)$, control group, must be balanced in all material respects.

The balance prevents distortion if the *Conditional Independent Assumption* (CIA) is valid, an assumption which states that, subject to the observable variables X pre-treatment, the allocation to the program is independent of the potential outcomes.

This implies identifying all the X variables responsible for the selection process and building the control group subject to the abovementioned variables, thus minimizing the selection bias. In this way we can go back to the *ceteris paribus* condition: treated and controls are equivalent because they are balanced with respect to all explanatory variables which, in the absence of treatment, affect the outcome variables (Trivellato, 2009).

Implicitly, therefore, it is assumed that at least part of the treated group has, in the control group, matching individuals. This condition, known in the literature as *common support*, must be satisfied, otherwise it is not possible to apply the logic of counterfactual.

When checking the common support between the two groups it is possible to lose some units treated and this complicates the interpretation of the causal effect, since it doesnt represent anymore the average effect of treatment on the treated, but a subset of treated units . It would therefore be more appropriate to define the effect of treatment as *Sample Average Treatment Effect on the Treated* (Imbens, 2004).

[9] Average Treatment Effect on the Treated.

Matching techniques

Assuming that we observe all variables X responsible for the selection bias, a nonparametric method to obtain an unbiased estimate of the effect on medium treated with any treated is to combine an untreated who has the same characteristics, and calculate the average of the differences between the results observed for the pairs of matched subjects. More realistically, one compares units which are similar, according to some criteria, with respect to the X variables.

In the literature there are several matching techniques that allow to compare treated and untreated and they differ on how similarity in the characteristics X is defined. The estimated treatment effect may change according to the matching approach which is use; for this reason, in order to assess the sensitiveness of our results, we performed the analysis employing different methods: in particular Propensity Score, *Genetich Matching* based on Mahalanobis distance and *Coarsened Exact Matching* (CEM) have been considered.

Two common approaches are propensity score matching (Rosenbaum and Rubin, 1983), in which similarity is measured by the difference in the probability of being treated (estimated as a logistic regression of the X variables) and multivariate matching, where assessment of similarity is based on the Mahalanobis distance between units (Cochran and Rubin, 1973; Rubin, 1980b) (Rubin, 1979). A notable drawback of common matching methods, such as Mahalanobis distance and propensity score matching, is that they may make balance worse across measured potential counfounders, particularly if the sample size is small. In applying these methods to our data, this was particularly true for the propensity score approach; as we have not been able to obtain a satisfying balance across measured potential counfounders, we discarded this method. Results are given below for the matching based on Mahalanobis distance changes, the *Genetich Matching* (Diamond and Sekhon, 2006; Sekhon, 2008).

This method consists of a matching algorithm able to optimize the balance of the covariates observed between the treated group and that of the controls. This algorithm uses a generalization of propensity score and Mahalanobis distance matching in which the variables are weighted with weights determined (via a genetic algorithm) so as to minimize the maximum distortion between the control variables. If the Mahalobis distance is not optimal for attaining balance, the *GenMatch* algorithm is able to search over the space of distance metrics and find something better (Sekhon, 2008), including an additional weigh matrix:

$$d(X_i, X_j) = \left\{ (X_i, X_j)'(S^{-1/2})' W S^{-1/2}(X_i - X_j) \right\}^{1/2}$$

where W is a k x k positive definite weight matrix and $S^{1/2}$ is the Cholesky decomposition of S which is the variance-covariance matrix of X.

A second matching technique has been employed: the *Coarsened Exact Matching* (Iacus et al., Winter 2012, 2009). The CEM is a balancing tool that operates in a different manner from the Mahalanobis distance. Through the technique implemented by the CEM each covariate is temporarily coarsened. The units are then matched if they have the same values of the coarsened variables. At this point control units within each stratum are weighed in order to match the number of units processed. The strata in which there

is not at least one treated and one control are effectively pruned from the dataset. The most important advantage of CEM is that it belongs to the monotonic imbalance bounding method, as proven in (Iacus et al., 2011).

5. The effects of incentives

The scholarship as a tool to motivate the continuation of the student's study.

The first analysis proposed relates to the effects of a scholarship awarded on the basis of income on the probability of enrollment in the second year.

In this context those students who get the scholarship are considered treated, while the control group consists of those who, despite having the income requirements, do not receive the scholarship. The reasons why these students were excluded is that either they did not submit all the required documentation on time, or, more simply, did not apply in spite of having all the requirements.

Some objections could be made about the construction of the control group, as it is reasonable to assume that students who have not applied for the scholarship despite having the requirements are less motivated and/or do not need an economic incentive. This choice is dictated by the need not to reduce too much the number of individuals in the group which match the controls: the number of students who do not get the income-based grant despite having applied for it is limited to such an extent that it would be in fact impossible to carry out an estimate should the non-applicants be excluded. In this case the effect of the grant would be overestimated. It must also be considered that the level of income to which they are assigned is calculated by the Secretariat based on the Iseeu form voluntarily submitted by the students for the purpose of obtaining reductions in the payment of tuition fees.

In order to meet the Conditional Independent Assumption and therefore to identify all the variables X which could affect the outcome variable, it was decided to impose the exact matching for sex, degree course, the residence in Friuli Venezia Giulia region and income group. Furthermore, a maximum tolerance level, commonly called Caliper, was fixed for the high school diploma marks and the age of the students.

The above-mentioned covariates makes the two groups, treated and controls, equivalent in relation to all of the explanatory variables. For examples, the geographical origin defines the status of a student in the allocation of the scholarship and can also be considered an indicator of socioeconomic status; matching the students according to their income bracket means clear differences in their economic conditions; sex was chosen because it is known that there are gender differences in academic achievement, and finally the degree course so that students, treated and untreated, belong to the same field of study chosen and are therefore required to make the same commitment in passing the exams.

The results obtained with the two matching methods, the genetic matching and the CEM, listed under table 1, indicate how receiving a scholarship for low-income students increases their likelihood of enrolling in the second year by 0.18. In the case of CEM, however, this result is not statistically significant.[10]

[10]In Appendix 2 the matching balance is reported, both for genetic matching and CEM.

TABLE 1. Probability of enrolling 2^{nd} year for students that receive income-based financial aid.

Obs. N.		Genetic matching		CEM		
Treated	Controls	$\widehat{ATT}$	Matched observations	$\widehat{ATT}$	Treated	Controls
99	117	0.18 s.e. 0.04	31	0.18 (-0.09; 0.46)	18	21

TABLE 2. Probability of enrolling in 2^{nd} year for students that receive merit-based financial aid.

Obs. N.		Genetic matching		CEM		
Treated	Controls	$\widehat{ATT}$	Matched observations	$\widehat{ATT}$	Treated	Controls
85	191	0.06 s.e. 0.03	72	0.05 (-0.02; 0.12)	59	74

The second analysis considers the students who won the scholarship allocated solely on the basis of merit and the possible effects that receiving this economic incentive has on the probability of enrollment in the second year. In the academic years observed, with respect to the 777 students registered in the three degree courses, only 280 participated in the voluntary selection, which is just over 36% of those eligible for it. This results in a process of self-selection: the participating students differ from the start, for their motivational characteristics, from those who, despite having the requirements, do not take part in the selection. It was therefore decided to restrict the survey sample to students registered for the three degree courses who participated in the selection of the Fonda grant, in order to have a group of students with the same characteristics as far as motivation is concerned.

As a result, the control group was made up of students who had applied for the Fonda selection, but who had not passed it, and therefore the useful explanatory variables are the degree course, sex, residence in the region Friuli Venezia Giulia, high school diploma mark, age and income group. Furthermore, the exact matching for almost all pre-treatment variables is required, except for age, high school diploma mark and the income band on which the Caliper is applied.

The results obtained using both matching techniques are shown in table 2.

In general, the comparison between winners and candidates doesn't show a statistically significant effect compared to enrollment in the second year. Both winners and candidates

TABLE 3. Probability to take the degree in the time alloted for students that receive income-based financial aid.

Obs. N.		Genetic matching		CEM		
Treated	Controls	$\widehat{ATT}$	Matched observations	$\widehat{ATT}$	Treated	Controls
99	117	0.09 s.e. 0.04	31	0.02 (-0.29; 0.34)	18	21

who didn't win seem to have the same motivations in pursuing the course of study chosen; therefore, winning a scholarship for merit, doesn't have a significant effect towards the probability of enrollment in the second year.

The scholarship as an incentive to graduate within the set time frame.

In this section we want to investigate the effect of winning the scholarship on the probability of concluding the three-year degree within the time frame foreseen by the academic regulations.[11]

In the analysis of the effects of the income-based scholarship, the choice was to use in the matching the X characteristics able to influence the outcome, and the exact matching was fixed for sex, the degree course, the residence in the Friuli Venezia Giulia region and income group, while the Caliper was used for age and the high school diploma mark.

As shown in table 3, the effect of receiving an income-based scholarship in obtaining a degree is not statistically significant; in other words, those who receive the scholarship are not more likely to graduate within the three years of the course than their colleagues who, in spite of having the same characteristics, did not receive a financial incentive.

The survey on the impact of the Fonda grant aims at investigating whether the winners of the scholarship are further encouraged to conclude their studies within the timeframe foreseen by the university, and so what their probability of graduating is, compared to their colleagues who do not receive any financial incentive.

The explanatory variables useful for this analysis are the degree course, sex, residence in Friuli Venezia Giulia, the high school diploma mark, age and income group. The exact match is required for almost all pre-treatment variables, except for age, high school diploma grade and income bracket in which we have imposed the Caliper.

The results presented in table 4 show a positive and statistically significant effect of the scholarship on the probability of graduating within the three years set for those students receiving financial aid. This conclusion is reinforced by the following analysis, the assumption of which however differs from the previous one.

It was noted that the score useful to obtain the Fonda grant varies from year to year

[11] In Italy, university students are not obliged to graduate within a fixed time frame, thus the course length can vary beyond the recommended length of the course according to the student's ability or choice.

TABLE 4. Probability to take the degree in the time alloted for students that receive merit-based financial aid.

Obs. N.		Genetic matching		CEM		
Treated	Controls	$\widehat{ATT}$	Matched observations	$\widehat{ATT}$	Treated	Controls
85	191	0.24 s.e. 0.07	72	0.21 (-0.06; 0.36)	59	74

TABLE 5. Probability to take the degree in the time alloted for students that receive merit-based financial aid matched solely on the scores

Obs. N.		$\widehat{ATT}$	
Treated	Controls	0.30	Matched observations
65	56	s.e. 0.12	26

because both the number of grants payable and the score required change[12] and therefore the same score, for example 80, in one academic year provides a scholarship, while in the next academic year it might be not sufficient to attract a grant.

It seems therefore legitimate to consider those students who got the same score in different years, even though some of whom get the grant and others don't, as casually treated or as a control group, as the threshold for the disbursement of the scholarship is independent of anything else.

It was decided, therefore, to combine students solely on the basis of the score obtained in the final selection, thus simulating an experimental design in which the group assignment of the treated (winners) and that of controls (suitable) occurs randomly.

The results shown in table 5 show a statistically significant effect on the probability of completing their education due to the merit economic incentive.

[12] All those who obtain a minimum score in the written exam of 70/100, required to get the grant are considered suitable. During the subsequent oral selection a merit rank is established, and it varies from year to year.

6. Conclusions

The objective of this study is, generally speaking, the analysis of the effectiveness of financial incentives to reinforce a desired behavior, which in this specific case is in terms of persistence and graduation within the timeframe set by the course of study against financial incentives tied to income limits or to "open" ones, related to merit only.

The group of students surveyed enrolled in degree courses in chemistry, physics and mathematics at the University of Trieste from the academic year 2002/2003 to academic year 2007/2008.

With regard to this group of students, the effects of two forms of incentives, the one based on income (scholarships provided by the Regional Agency for the Right to Education) and the other provided exclusively to deserving students, regardless of their income, by the College of Sciences "Luciano Fonda" were evaluated.

Graduates in the relevant disciplines are deemed strategic to build a "knowledge-based economy more competitive and dynamic, capable of creating a sustainable economic growth with more and better jobs."[13] These subject areas are considered to be among those able to boost research allowing our country to regain competitiveness, but even before starting university, and possibly getting a job in the research, the Italian students face serious weaknesses in these areas. In this case it is difficult to deny the connection: *post hoc ergo propter hoc.*

In the case presented here, it is reasonable to suggest that the students considered in the evaluation do not suffer the problems raised by Heckman about the lack of human capital for social and family reasons, as both the OECD-PISA analysis[14], and the investigation INVALSI[15] placed the students from the Friuli Venezia Giulia region significantly above not only the Italian average, but also the OECD average.

The high school diploma held by those registered in the three university courses considered is primarily from school which have a scientific (55% of the sample) and industrial technical (15%) leaning. As far as the distribution of the diploma marks is concerned (see figure 2), it is to be noted that those with top marks enrolled in the physics degree course,[16] thus there is a important effect of self-selection.

The results of the estimates of the model we propose using the *Genetic matching* and *Coarsened Exact matching* reveal that:

- The grants allocated for reasons of income increased by 0.18[17] the probability of enrollment in the second year of the beneficiary students. The financial incentive, therefore, is useful in countering the dropout from university and encourage students to continue their academic career. On the contrary, there is no statistically significant effect on the probability of the scholarship recipients to graduate within the timeframe set by their curricula.

  Consequently, the income related grant acts as an incentive against dropout. It can be assumed that in the absence of the grant, some of the beneficiaries would not

[13] Footnote European Council, Lisbon, 2000.
[14] Program for International Student Assessment
[15] National Institute for the Evaluation of the Education and Training 2006 and 2009
[16] The majority of these students had a mark between 95 and 100 out of a 100.
[17] The change is expressed in absolute terms on the scale $0 - 1$.

have continued their studies.

- The scholarships awarded because of merit do not show a statistically significant effect on the probability of enrollment in the second year. In this context, therefore, it does not play any role in encouraging the continuation of studies. The causal effect of receiving the scholarship is evident in relation to graduation: the probability that students who received the financial incentive have to graduate in three years exceeds 0.21 (CEM) and 0.24 (Genetic matching) that of their peers. These results are reinforced by further analysis where the winners are compared to non-beneficiaries who have the same initial requirements of merit. In this case the probability of the winning students to graduate within 3 academic years is even 0.3 higher than those who were excluded.

  The causal effect of the scholarship for merit, then, is to encourage the completion of studies exactly within the timeframe set by academic regulations.

In the light of these estimates the following line of reasoning can be followed: the public resources supporting the student's income do not appear to be such as to motivate the students to graduate within the timeframe foreseen by the academic regulations, while they rather appear to be a great help to not dropout; a partial support of this thesis is found can be found in Mealli and Rampichini (2006).

However, the assessment of the effectiveness of this educational policy can only be questionable, since the current distribution of resources does not seem useful to reach the final goal.

Pursuing excellence, however, stimulates the quick completion of studies and is a clear signal (Spence, 1973) of productivity useful for inclusion in the labor market. The assessment of the efficiency of the incentive that rewards merit seems to be positive, both as a result inside the educational system as well as an external indicator.[18]

This assumption is justified by the analysis presented, the research sample of which does not show dishomogeneity in initial conditions, or in terms of socioeconomic background, nor with respect to the basic preparation. The use of merit based incentives, then, seems to be the most effective tool.

APPENDIX A

Descriptive statistics

[18]The education system turns out to be efficient both in relation to the results obtained by the students and for the best chances of employment.

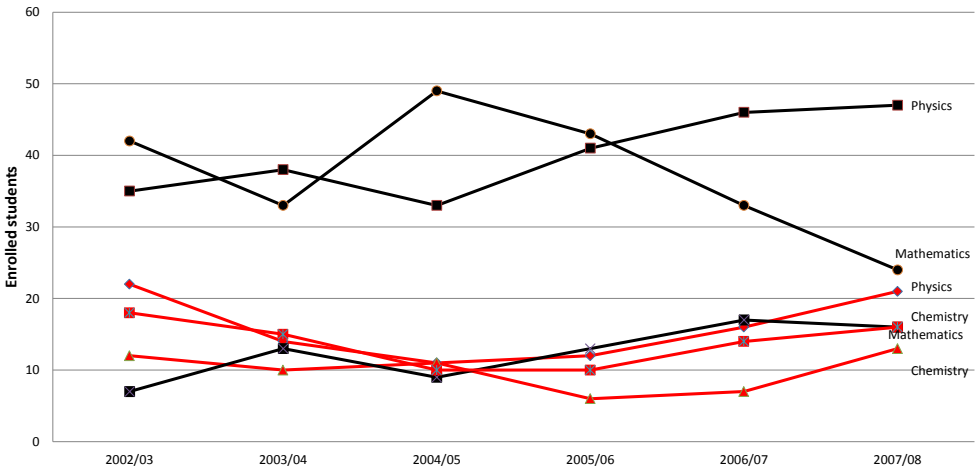

FIG. 1. Enrolled students by gender and course degree. Black=male; red=female. (Data Source: University of Trieste)

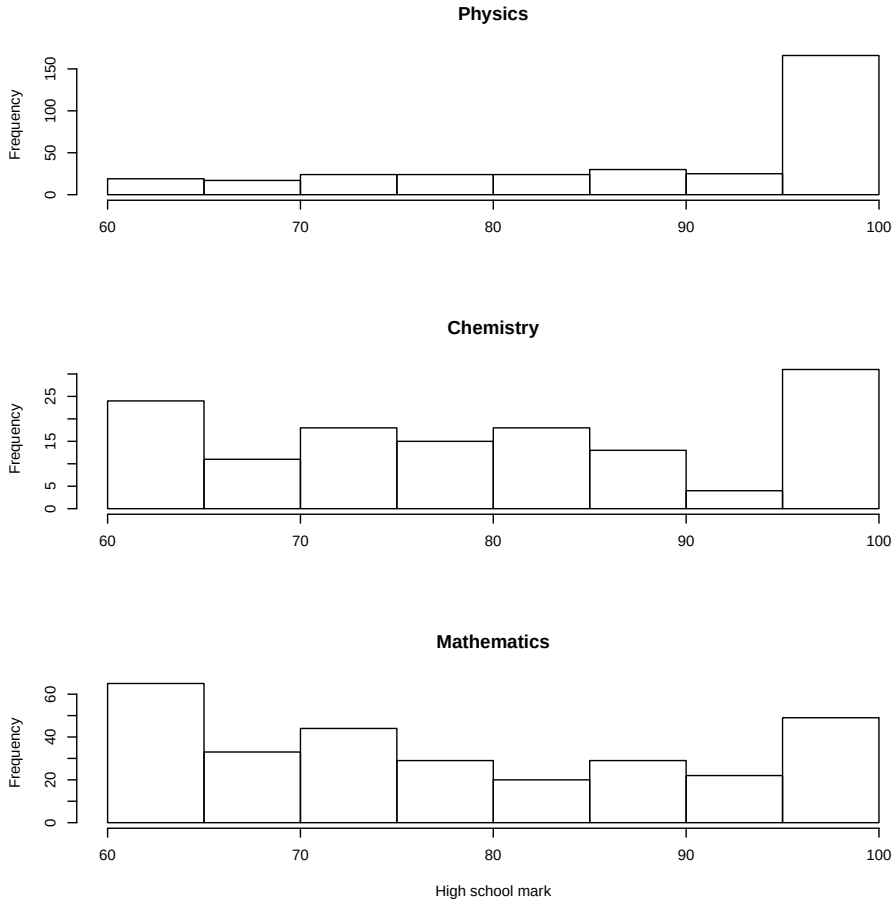

FIG. 2. Enrolled students by course degree and high school mark (Data Source: University of Trieste)

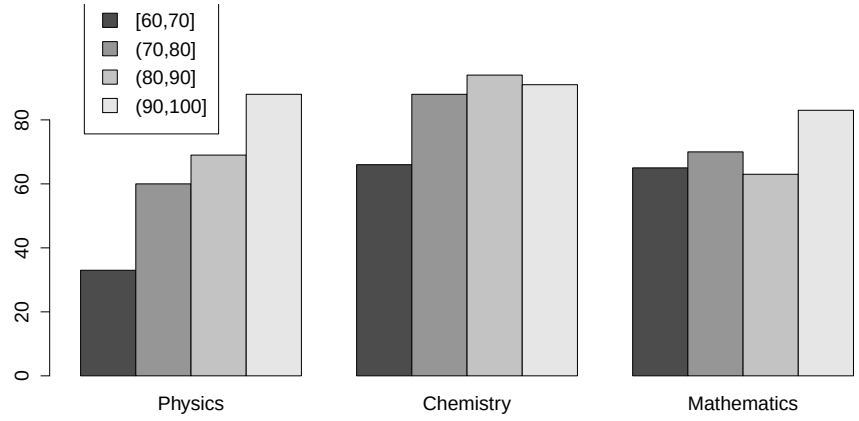

FIG. 3. Percentage of enrolling 2^{nd} year by course degree and high school mark (Data Source: University of Trieste)

TABLE 6. Pre and post-matching balance statistics for variable Physics

	Before matching	After matching
Mean treatment	0.64706	0.70833
Mean control	0.6911	0.70833
Std mean diff	-9.1614	0

TABLE 7. Pre and post-matching balance statistics for variable Chemistry

	Before matching	After matching
Mean treatment	0.18824	0.13889
Mean control	0.1623	0.13889
Std mean diff	6.5947	0

APPENDIX B

Goodness of matching

a. Goodness of matching

1) GENETIC MATCHING BALANCE

The measure of imbalance - the degree to which the multivariate empirical density of the treated units differs from the multivariate empirical density of the control units - is the absolute difference in means between each of the pre-treatment variables.

In the tables 6 to 13 there are two columns for each variable. The first column contains the pre-matching balance statistics and the second one the post-matching statistics.

A different measure, the QQ plots (see figure 4), is reported for better capture difference in features of the distribution of high school mark.

TABLE 8. Pre and post-matching balance statistics for variable Mathematics

	Before matching	After matching
Mean treatment	0.16471	0.15278
Mean control	0.1466	0.15278
Std mean diff	4.8535	0

TABLE 9. Pre and post-matching balance statistics for variable Sex male

	Before matching	After matching
Mean treatment	0.77647	0.77778
Mean control	0.65969	0.77778
Std mean diff	27.867	0

TABLE 10. Pre and post-matching balance statistics for variable FVG region residence

	Before matching	After matching
Mean treatment	0.74118	0.79167
Mean control	0.7644	0.79167
Std mean diff	-5.2706	0

TABLE 11. Pre and post-matching balance statistics for variable High School Mark

	Before matching	After matching
Mean treatment	96.176	95.514
Mean control	89.948	95.403
Std mean diff	82.552	1.4867

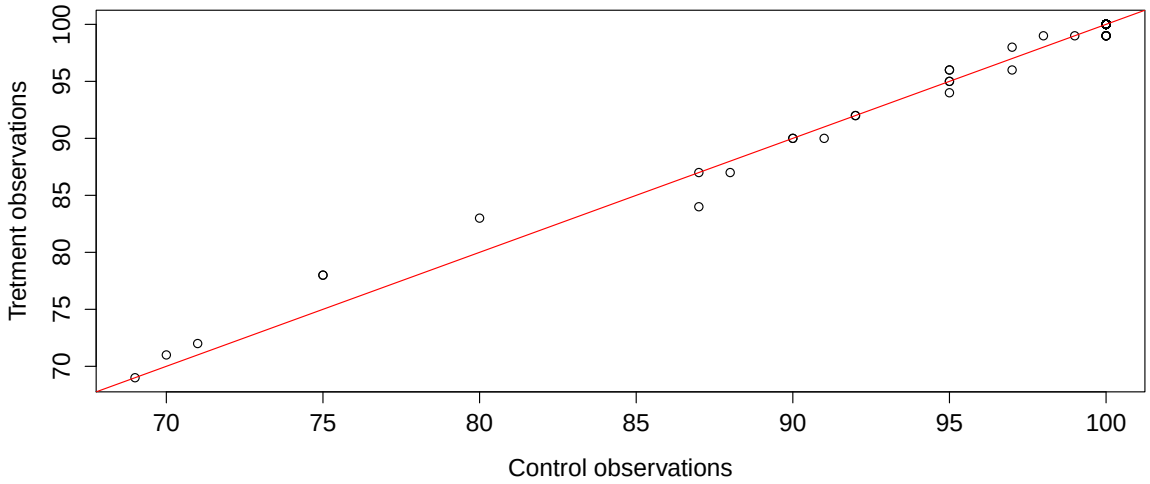

FIG. 4. Empirical-QQ Plot of High School Mark

TABLE 12. Pre and post-matching balance statistics for variable Age

	Before matching	After matching
Mean treatment	19.082	19.014
Mean control	19.461	19.014
Std mean diff	-107.41	0

TABLE 13. Pre and post-matching balance statistics for variable Income bracket

	Before matching	After matching
Mean treatment	7.1529	7.2639
Mean control	6.7696	7.2639
Std mean diff	17.998	0

TABLE 14. CEM imbalance measure

	Statistics	Type	L1
Degree course	2.338010e+00	Chi2	5.551115e-17
Sex	1.631293e+00	Chi2	0.000000e+00
FVG residence diff	0.000000e+00	diff	0.000000e+00
High school marks	-6.779661e-02	diff	0.000000e+00
Age	-1.683764e-02	diff	0.000000e+00
Income bracket	-8881784e-16	diff	0.000000e+00

2) CEM IMBALANCE MEASURE.

The measure employed by CEM is L_1 imbalance metric, which is the average of the absolute differences in the frequencies of the populated cells of the multivariate histogram of the treated group and the multivariate histogram of the control group (Iacus et al., 2011).

A value of $L_1 = 0$ indicates identical treatment and control distribution, and $L_1 = 1$ indicates complete imbalance and no overlap between the densities (see table 14).

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