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# THE EFFECT OF GRANTS ON UNIVERSITY DROP-OUT RATES: EVIDENCE ON THE ITALIAN CASE

by Francesca Modena*, Enrico Rettore** and Giulia Martina Tanzi***

## Abstract

In this paper we measure the impact of need-based grants on university dropout rates in the first year, using student-level data from all Italian universities in the period 2003-2013. In Italy, some of the students eligible for grants do not receive them due to a lack of funds. We exploit this phenomenon to identify the causal effect of financial assistance. We find that need-based aid prevents students belonging to low-income families from dropping out from higher education; the estimated effect is sizeable. This evidence is robust to a variety of specifications and sample selection criteria.

**JEL Classification**: I22, I23, C21, C35.
**Keywords**: human capital, higher education, university dropout, student financial aid, treatment effect model, Italy.

## Contents



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## 1. Introduction[1]

The aim of this paper is to evaluate the causal effect of need-based grants on the dropout rate among university students in their first year. Household economic conditions and credit constraints may be reasons for being unable to afford university and for abandoning studies (Stinebrickner and Stinebrickner (2008)). In fact, the need to pay educational and living expenses imposes a strain on many students and their families that may encourage the student to leave university and start working in order to contribute to the household income. Moreover, the perceived benefits from higher education may be heterogeneous and it may be the case that expected benefits are lower for poor students (Zimmerman (2013)). Obtaining a grant, which covers university fees and living costs, may reduce the dropout probability by decreasing the direct and indirect costs of university attendance.

How to reduce university dropout rates is a matter of increasing concern: higher enrolment translates into a higher stock of human capital only if the propensity to quit before completion is low (Cappellari and Lucifora (2009); Zotti (2015)). This issue is particularly important in the Italian context. Italy has one of the lowest percentages of university graduates among European Union countries[2], due to both a low enrolment rate [3] and to high dropout rates (Di Pietro (2006); Cingano and Cipollone (2007)). In recent years the percentage of students dropping out has fallen[4] but it is still very high: the completion rate was 58% in 2013 (70% on average across OECD countries; ANVUR (2016)). Significant numbers of dropouts occur during the first year of study (Zotti (2015); Gitto et al. (2015); Mealli and Rampichini (2012)): between 2003 and 2014, on average, about 15% of new entrants to first level tertiary education[5] did not enrol for the second year, with a declining trend (from 16% in 2003 to about 12% in 2014; ANVUR (2016); De Angelis et al. (2016)).

We measure the impact of need-based aid on university dropout rates in the first year by using student-level administrative data over the period 2003-2013 that cover the entire population of Italian university students. The data follow the student from his/her enrolment to graduation/dropout and provide several items of information on

[1]We would like to thank ANVUR for providing us with data from the Anagrafe Nazionale degli Studenti (ANS). We also thank Paolo Sestito, Roberto Torrini, Antonio Accetturo, Effrosyni Adamopoulou, Ilaria De Angelis, Federica Laudisa, Vincenzo Mariani and Pasqualino Montanaro for their useful suggestions. The views expressed in the paper are those of the authors and do not necessarily reflect those of the Bank of Italy. Any remaining errors are ours.

[2]Italy's first-time tertiary graduation rate is 35%, the fourth lowest among the OECD countries (OECD (2017)).

[3]Between 2007 and 2015 new entrants to first level programmes dropped by roughly 10% (De Angelis et al. (2017)).

[4]The reduction was partly a consequence of the 2001 reform (the "3+2" reform; Di Pietro and Cutillo (2008); Bratti et al. (2006); DHombres (2007); Cappellari and Lucifora (2009)). Indeed, one of the goals of the reform was to improve the performance of Italian university students, in terms of reducing both dropout rates and age at graduation (Bratti et al. (2010)).

[5]First level courses include three-year and five-year bachelor degrees.

students' academic career and educational background. In order to estimate the effect of grants correctly, we exploit the fact that, due to insufficient funds, some eligible students are not awarded their grants. The methodology consists in comparing, within each university, grant beneficiaries - the treated group - with eligible non beneficiaries - the control group. We followed two steps: first we estimated the propensity score, defined as the probability of receiving treatment - the grant - given some student and university covariates. Then, the empirical strategy was based on blocking on the estimated propensity score in combination with regression adjustments within the blocks (Rosenbaum and Rubin (1983) and Rosenbaum and Rubin (1984)).

We find that being the recipient of a grant reduces the probability of dropout among low-income students by 2.7 percentage points (from 9.6%). Several robustness checks confirm this result: the estimated coefficients in the different specifications range from -2.7 to -4.3 percentage points. Our analysis also shows that the impact of the grant is heterogeneous depending on students' characteristics (area of residence, type of high school and final grade attained at high school) and on the share of eligible students in each university who actually receive the grant.

Information available in our database and the applied estimation strategy allow us to address several endogeneity concerns that could arise when investigating the causal impact of a grant on college persistence. One of the main issues is the difficulty in separating the unique effect of the grant from all the other factors that influence whether students succeed in college (Bettinger (2007)). In particular, family financial conditions determine the access to aid and are also directly associated with student outcomes[6]. However, the treated and the control groups - beneficiaries and eligible students - had very similar family characteristics: to be eligible for a grant certain thresholds in terms of the family's yearly income and assets must not be exceeded. Another endogeneity problem may arise when scholarships are (also) merit-based. In this case the estimate of the effect on dropout is negatively biased because students with scholarships perform better on average. For this reason, we only considered first year grants, which are only assigned on the basis of the household's financial situation: in this way beneficiaries should not be ex ante different in terms of a student's merit and abilities. Introducing a rich set of covariates into the matching procedure enabled us to control better for the remaining differences in terms of skills.

To date, very little research has investigated the effect of need-based grants on college completion, mainly because of the unavailability of longitudinal data with which to track students' success in college after initial enrolment and which make it possible to distinguish between transfers to other universities and dropouts (Bettinger (2007)). In contrast, numerous papers have examined the effect of financial assistance on enrolment (Lauer (2002); Kane (2003); Baumgartner and Steiner (2006); Cornwell et al. (2006); Goodman (2008); Steiner and Wrohlich (2012); Deming and Dynarski (2009); Nielsen

[6]Students from the poorest families tend to attend lower-quality high schools, have fewer resources for learning and, in general, parents who provide less support for their education.

et al. (2010); Vergolini and Zanini (2015)). Moreover, most empirical works on college persistence focus on specific case studies, whose results are more difficult to generalize. Some recent studies have also examined the impact of merit-based grants on degree completion (Dynarski (2008); Scott-Clayton (2011)), but these scholarships target a population of students different from the one targeted by need-based grants (Castleman and Long (2016)).

The existing studies have found a negative effect of need-based grants on the probability of withdrawing from college (Bettinger (2007); Castleman and Long (2016); Bettinger et al. (2012); Singell (2004b); Singell (2004a))[7]. The universal coverage of our dataset constitutes a major advantage with respect to previous works undertaken in the Italian context, which relied on small samples of students in selected universities and academic years. Mealli and Rampichini (2012) used data from four Italian universities in 1999: by employing a Regression Discontinuity Design (RDD) they showed that, at the threshold, the grant is effective in preventing low-income students from dropping out of higher education. Sneyers et al. (2016) considered first-year students at five universities located in Northern Italy in the academic year 2007-08; their findings suggested that financial aid positively affects students' performances and completion in a substantial and statistically robust way.

The rest of the paper is organized as follows. Section 2 describes the grant assignment rule and Section 3 presents the data. Section 4 describes the empirical strategy and discusses the identification issues; the results are set out in Section 5. Section 6 concludes.

## 2. Grant assignment rule

The Italian financial aid system for higher education is mainly based on the *Diritto allo studio universitario* (DSU) program, intended to encourage enrolment and attendance by students from more disadvantaged families. The main objective of the DSU is to enable motivated students to obtain higher education, irrespective of their income (Prime Ministerial Decree, April 9, 2001). The main benefits offered by the DSU are student grants. After the 2001 constitutional reform, the DSU became part of the exclusive competence of regional legislations; grants are generally managed by regional agencies, with some administrative tasks assigned to universities[8].

In the first year of enrolment, eligibility for a grant is exclusively based on the student's family situation[9]. Applicants are ranked according to an index (the ISEE, which is an equivalized economic situation indicator), computed on the basis of the family's

[7]Other works have focused on different student outcomes: grades (Cappelli and Won (2016)) and time taken to complete a degree (Glocker (2011); Garibaldi et al. (2012); Denning et al. (2017)).

[8]Calabria and Lombardy are the only regions where grants are entirely managed by universities.

[9]The second payment of the grant is conditional on the achievement of a minimum level of credits (established by the regions after consulting the universities, up to a maximum of 20 credits; Prime Ministerial Decree, April 9, 2001).

yearly income and assets and which also takes account of the family's composition. If this score is below a threshold set at national level, the student becomes eligible for grants and is awarded a grant as long as funds are available.

An application for a grant is submitted after enrolment with the regional agency where the university is located[10] and it is voluntary. Notice of acceptance is generally communicated a few months after enrolment. The amount of the grant depends on whether students are resident in the city where the university is located, if they can commute in order to reach the university or if they are out-of-site students. Every year the Ministry of Education sets the minimum amount for a grant, but the differences over time are very small. For example, in 2013 the minimum amounts for the three categories of students were, respectively, €1,904, €2,785 and €5,053; the average amount was about €3,400[11].

Funds come mainly from the central government (*Fondo Integrativo Statale*), from a specific tax paid by non-eligible students and from regional governments. The amount of funding available for these grants thus differs among regions, years and also among universities within regions. There are marked differences between geographical areas due to the lower amount of funding available for the regions in the South of Italy: in 2013 the coverage rate was 90% in the North and 56% in the South (ANVUR (2016)). The percentage of eligible students who actually received the grant declined during the periods of recession that have hit Italy in recent years: it was about 82% in the period 2006-08, it reached the minimum in 2011 (69%) and then increased to 76.5% in 2013.

Even if not all the eligible students are awarded the grant, these students are all exempted from the payment of tuition fees. In 2013 the average yearly amount of tuition fees in state universities was about €1,000 (about €700 in the South and €1,400 in the North), and it was lower for students from low-income families (the lowest bracket was €200; ANVUR (2016)). This implies that the economic impact of the grant, which is supposed to cover students' living expenses, is higher compared with that of exemption.

## 3. Data

We exploited the *Anagrafe Nazionale Studenti* (ANS), a unique dataset that contains administrative records on enrolments, students' school backgrounds and their academic careers in Italian universities. The main advantage of our database was that it covered the entire population of university students in Italy. We focused on students aged between 18 and 20[12], enrolled for the first time at an Italian university over the period 2003-2013. Our working sample included first-year student recipients of grants,

[10]In Calabria and in Lombardy the application is submitted directly to the university.

[11]Source: *Osservatorio Regionale per l'Universit e il Diritto allo studio universitario del Piemonte.*

[12]The rationale for this is to avoid problems of comparability between students who started university immediately after completing high school and those who started an undergraduate program later on.

the treatment group, and those that were eligible but were not awarded the grant, the control group. Both groups are exempted from the payment of tuition fees. Unfortunately, our control group also included students exempted from the payment of tuition fees for other reasons (mainly severely disabled students) although these categories are residual[13]. After deleting observations with missing variables of interest, on average 19,000 students per year were recorded (about 8% of all the 18-20-year-old new entrants to first-level tertiary education). Descriptive statistics of the sample are shown in Table 1. We defined dropout students as those who did not enrol at any university in the following academic year *t+1* (ANVUR (2016); De Angelis et al. (2016); De Angelis et al. (2017)). The dropout rate was, on average, 7.6%, with a downward trend; recipients of grants represented about 70% of all exempted students. Table 2 reports the mean differences between the two groups (treated and non-treated). The dropout rate is statistically lower for treated students. Moreover, treated students are more likely to live in the North or Centre of Italy and to study in an area different from that of residence, they have lower high school grades and there is a higher proportion of students with diplomas from vocational high schools.

## 4. Estimation strategy

We were interested in estimating the following equation on the sample of treated and control groups:

$$Y_{iut} = \alpha S_{iut} + \beta X_{iut} + \gamma D_{ut} + \epsilon_{iut}. \tag{1}$$

where the student, the university and time are indexed by $i$, $u$ and $t$ respectively.

$Y_{iut}$ is a dummy variable taking the value 1 if the student $i$ enrolled at university $u$ at time $t$ dropped out at the end of the year.

$S_{iut}$ is a binary treatment status denoting recipients of a grant: this dummy variable takes the value 1 if the student received a grant, and 0 if the student did not have a grant but was eligible for one (plus residual categories that are also exempted paying fees).

In line with other studies (Adamopoulou and Tanzi (2017); Di Pietro (2004); Rumberg, 1983), $X_{iut}$ are individual characteristics that can influence dropout rates, namely gender, nationality, area of residence (North, Centre, South), a dummy for studying in a macro area different from the area of residence, high school type and grade, and a dummy for the local urban labour system of residence (as a proxy for the economic status of the home town). Finally, $D_{uT}$ are university dummies that interact with period dummies, in order to capture university/period-specific patterns (we considered

[13]The Prime Ministerial Decree, April 9, 2001 lists the categories of students exempted from paying tuition fees. According to ANVUR (2016) and considering all enrolled students, students eligible for grants represent about 85% of the exempted students. Since we are only considering students enrolled in the first year of university, this percentage should be even higher in our sample, because for some students the exemption is based on university performance, which cannot yet be evaluated in the first year.

three periods: 2003-06, 2007-10 and 2011-13)[14]. This means that we were comparing eligible and beneficiary students at a certain university and in a certain period.

$\alpha$ was our parameter of interest, the average impact of need-based financial aid on the dropout probability. Endogeneity issues may arise in the estimation of $\alpha$. Firstly, one could presume that only more able students receive the grant, making it impossible to distinguish the real effect of the grant on dropout from the role of students' merit and capabilities. However, in Italy in the first year grants are only assigned on the basis of students' financial need; as we said, our working sample only included first-year students. In addition, we were able to control for some factors relating to students' abilities and merits (study in an area different from that of residence, high school type and grades). Given the assignment rule based on financial conditions, what seems really necessary is to distinguish the consequence of the grant from the effects of family background, which may affect student outcomes independently of financial aid. In our setting the treated and control groups had very similar household financial conditions: both consisted of students eligible for grants, and to be eligible the family's yearly income could not exceed certain ISEE thresholds, set by a national law. Unfortunately, we did not have precise information about the ISEE of the students. However, the available set of covariates and the fact that the analysis compared beneficiaries and eligible students within a particular university helped to reduce possible remaining differences. It should be noted, however, that if our strategy was not enough to net out the differences between the two groups with respect to financial conditions, the resulting bias is likely to be positive, i.e. against finding a negative effect of the grant on the drop-out probability.

Another endogeneity issue that has frequently emerged in the literature relates to the fact that application for a grant is voluntary and the propensity to apply may depend on a set of observable and unobservable individual characteristics, possibly correlated to the outcome. This concern did not apply in our setting, because both the treated and the control groups were students that had voluntarily applied for the grant.

Moreover, the timing of the grants' assignment and the type of information available to students may cause selection along different dimensions, which must be taken into account in the analysis. First, if the assignment is known beforehand, the grant may encourage enrolment by students with a low probability of academic success simply because the financial costs that they incur for their educations are artificially lowered. In Italy, notice of acceptance is in general communicated a few months after enrolment. Hence, students that enrol - without knowing if a grant will be awarded or not - are probably more motivated to begin their studies. The existence of this bias would again work against finding a negative effect of the grant on dropout rates. Second, more informed and motivated students can strategically select regions and universities with higher shares of eligible students who actually receive the grant (i.e. with a

[14]Results are robust to the inclusion of the interaction terms university*year.

higher coverage rate). Because of the delayed notice of acceptance, the coverage rates are not public information. Students' strategic behaviour is based on information about the past coverage rate, but the coverage rate varies widely over time because it depends on the availability of public funds and on political choices. Moreover, since we control for university/year fixed effects, this selection would have been a concern only if beneficiaries and eligible students within the same university had had a different set of information about coverage rates, i.e. if students' strategic behaviour had been correlated with ISEE scores.

We followed two steps. First we estimated the propensity score defined as the probability of receiving treatment given some students' and universities' covariates, when it is possible to control for student and university-specific traits (the covariates are described in Table 2, plus university dummies interactions with period dummies):

$$e(X, D) = \mathbf{E}[S_{iut}|X_{iut}, D_{ut}] = Pr(S_{iut} = 1|X_{iut}, D_{ut}) \tag{2}$$

where the estimator is based on a logit model.

Then, the empirical strategy was based on blocking the estimated propensity score combined with regression adjustments within the blocks. The idea behind this method, proposed by Rosenbaum and Rubin (1983) and Rosenbaum and Rubin (1984), is to split the sample into subclasses according to the propensity score and then run the regression of the outcome on the treatment status as well as on the list of controls included in the p-score within each subclass. The two main advantages of this estimator are as follows (Imbens (2015)): first, the sub-classification approximately averages the propensity score within the subclasses, smoothing over the extreme values of the propensity score; and second, the regression within the subclasses adds a large amount of flexibility compared with a single weighted regression.

Following Imbens (2015), we need to partition the range [0,1] of the propensity score into J intervals $[b_{j-1}, b_j)$, for $j = \{1, \ldots, J\}$, where $b_0 = 0$ and $b_J = 1$. Let $B_i(j) \in \{0, 1\}$ be a binary indicator where the estimated propensity score for unit $i$, $\hat{e}(x)$, satisfies $b_{j-1} < \hat{e}(x) < b_j$. In particular, we choose to partition the sample into 5 blocks according to the following propensity score values: $j$=1 if $0 \leq \hat{e}(x) < 0.2$; $j$=2 if $0.2 \leq \hat{e}(x) < 0.4$; $j$=3 if $0.4 \leq \hat{e}(x) < 0.6$; $j$=4 if $0.6 \leq \hat{e}(x) < 0.8$; $j$=5 if $0.8 \leq \hat{e}(x) \leq 1$.

Within each block the average treatment effect is estimated using linear regression with all of the covariates $X_{iut}$ and $D_{uT}$ described in equation (1), and including an indicator for the treatment. The inclusion of $D_{uT}$ dummies means that we exploit the heterogeneity within a very small unit: the non-treated group is made up of students enrolled at the same university in the same period with respect to the treated one. Standard errors are corrected for the potential clustering of residuals at the university class level. This leads to J estimates $\hat{\alpha}_j$, one for each block. These J within-block estimates are then averaged over the J blocks, using the proportion of treated units in each block as the weights:

$$ATT = \alpha_{block,treat} = \sum_{j=1}^{J} \frac{N_{treatj}}{N_{treat}} \cdot \hat{\alpha}_j \quad (3)$$

The coefficient $\alpha_{block,treat}$ is the estimated value of the average effect of the grant on the probability to drop out for those receiving the grant, meaning that we are estimating the average treatment effect on the treated group (ATT). Of course, to explore the degree of heterogeneity of the causal effect one could also evaluate the weighted average with respect to a different set of weights, e.g. the proportion of untreated units in each block, so as to get the average treatment effect on those not receiving the grant (ATNT) or the proportion of units in the block to get the average treatment effect on the population (ATE).

## 5. Results

Figure 1 plots the distribution of the propensity score for the two groups. A large difference between the two groups is apparent with treated units closely concentrated just below 1 and untreated units more evenly distributed over the whole support with a mode of around 0.2. The mean (median) value is 0.85 (0.95) for treated students and 0.37 (0.29) for untreated ones. Of course, this is the straightforward consequence of the large differences between the two groups emerging from Table 2. However, the main driver of this large difference between the two distributions is the time-university fixed effect (see also Section 5.2). The strong case for including these fixed effects is that we can force the composition of the comparison group with respect to university/period to be exactly the same as for the treatment group.

Tables 3 and 4 report the baseline results. We find that a grant has a negative and significant effect on dropouts for the treated students: the estimated average effect is a reduction of 2.7 percentage points in the probability of dropping out (with a standard error of 0.0036; Table 4). This is very close to the crude difference in the dropout rate that we observe between the two groups in Table 2, meaning that the large differences with respect to observable characteristics summarized by the propensity score in this instance do not raise any substantial selection bias problem. The magnitude of the estimated coefficient is significant: the dropout rate for those who received the grant would have increased from 7% to about 10% in the absence of a grant.

In regard to the within-block estimates, the average effect is driven, as expected, by the fifth block (which includes 78% of treated students). On the contrary, the coefficients of the first three blocks are positive or not significantly different form zero; this may be explained by students' characteristics: in particular, in these blocks there are higher percentages of students from *licei* and who reported high grades at school. For these students, the effect of the grant, as explained in Section 5.1, is smaller[15].

[15] The positive sign of the coefficient in block 1 is also driven by students enrolled at the University of Genoa, for whom the measurement error in the treatment variable was particularly large (see Section

As a robustness check we further split the last block (Table 4, bottom panel): first we halved it and we obtained an average impact of -3.0 percentage points (standard error 0.0041); we then further divided the last block in half, resulting in an average total effect of -3.5 percentage points (standard error 0.0046).

Note that the economic conditions of the beneficiaries are worse than those for eligible students not receiving the grant. This implies that if our estimation strategy were not sufficient to compensate for the selection bias the likely bias of our estimate would be positive, i.e. a bias working against the main qualitative result we got: being assigned a grant reduces the drop-out rate.

As regards the other possible determinants of dropout, our results are in line with the findings of other studies (Adamopoulou and Tanzi (2017); Di Pietro (2004)): females, students from *licei*, those with better high school grades, out-of-site students and those living in the North are less likely to dropout (Table 3).

### *5.1. Heterogeneous effects*

Both the opportunity costs and the expected benefits of higher education may differ according to students' characteristics and to their family and educational backgrounds. Therefore in this section we analyse the heterogeneity of the average impact of the grant (Table 5; we report the average impact computed as in equation (3)[16]). We first interacted the treatment status with the female dummy and found that the coefficient of the interaction term was not statistically significant, thus suggesting that the impact of the grant does not vary by gender.

Second, we wanted to assess whether there are any differences in the impact according to the area of residence. The coefficient on the interaction term revealed that students resident in the South of Italy gain more from financial aid than students resident in the other areas. In particular, the drop-out rate would increase in absence of the grant from 6.5 to 10.8% for students in the South of Italy and from 7.2 to 8.5% for those resident in the Centre and North (in terms of the percentage variation, respectively, by 67% and by 17%). A possible explanation is that budget and credit constraints are more likely to be binding in the South, which is the poorest area of Italy. In order to deal with differences in the family and educational background, which affect both the opportunity costs and the expected benefits of higher education, we interacted the treatment status with dummies for high school type, which can also be considered a proxy for the family background, since in Italy social mobility is very low. Without the grant the dropout rate would increase from 4.3 to 5.5% for students from *licei* and from 10 to 14.5% for students from vocational studies (by 28% and by 46% respectively). These students benefit more from the financial aid: since they are more likely to find attractive employment opportunities they may have higher opportunity

5.2 for further details). When we excluded these students from the working sample, the estimated coefficient in the first block became negative and not significant, but the average coefficient in the baseline regression remained substantially unchanged. Results are available upon request.

[16]Results remain unchanged if we estimate all the interactions simultaneously.

costs and lower expected benefits in attending university. In the same way, more able students have higher expected benefits from obtaining a university degree and thus are less likely to dropout irrespective of the grant: without the grant the dropout rate would increase from 3.8 to 4.7% for students who reported a high grade and from 8.7 to 12.2% for low grade students[17] (by 24% and by 40% respectively).

The impact of the grant may also vary according to the share of eligible students who actually receive a grant. In fact, marginal recipients enrolled at universities where the coverage rate is low can be poorer than those enrolled at universities where almost all eligible students receive a grant and therefore they are expected to have a stronger reaction. This issue is particularly relevant in our analysis given the geographical divide in coverage rates, which are much smaller in Southern universities [18]. In order to check this hypothesis, we interacted the treatment dummy ($S_{iuT}$) with ($CR_{uT} - CR_{avr}$), which is the difference between the coverage rate at university $u$ in period $T$ and the average coverage rate. The coefficient on the treatment dummy represented the causal effect of a grant for students in a university/period with a coverage ratio at the average level. The coefficient on the interaction term represented the change in the causal effect of a grant induced by a marginal variation of the coverage rate with respect to the average. The sign of the interaction term is negative in all blocks but the highest one (Table 6): an increase in the coverage ratio leads to a statistically significant increase in the impact of grants on dropout rates. The interaction term is particularly large for blocks 2 and 4, where the coverage ratio is lower than the average, while it is much smaller for block 5 where the share of students receiving the grant is higher than the average. Block 3 stands out with respect to this pattern, a possible explanation being its geographical composition: there are far more (less) students from Central and Northern (Southern) regions of Italy than in the other blocks. Overall, it seems that an increase in the coverage ratio in the universities where it is below the average would be beneficial.

In a heterogeneous response model, the treated and non-treated may benefit differently from being awarded a grant, therefore the effect of the treatment on the treated will differ from the effect of the grant on the untreated and from the average treatment effect. To explore the degree of heterogeneity of the causal effect we computed the effect of the grant using different weighting strategies. We first use the proportion of untreated units in each block as a set of weights to get the average treatment effect on those not receiving a grant (ATNT): in this way we gave most weight to the left tail of the propensity score distribution, and in particular to the second block (see Figure 1), where the coefficient of the treatment dummy is not statistically significant (see Table 3 and Section 5). Consequently, the average coefficient becomes approximately zero and statistically not significant. Secondly, we computed the population's average

[17]The minimum high school grade is 60, the maximum is 100.

[18]On average, in our sample and in the mean of the period, almost 60% of the eligible students enrolled at university in the South of Italy obtained a grant, compared with more than 80% of the eligible students in the North.

treatment effect (ATE), which would be the average causal effect if eligible individuals were assigned at random to treatment. We used the share of units in each block as a set of weights to average out block coefficients and we found that the effect of the grant on the whole population of low income students is a reduction in the dropout rate of 1.9 percentage points (with a standard error of 0.002).

*5.2. Robustness*

We now present a set of robustness analyses in order to check whether our results hold to a variety of specifications and sample selection criteria.

The first robustness check was connected to the estimation of the propensity score (PS as in equation (2)). As shown in Figure 1, the distribution of the PS is unbalanced, due to the inclusion of university/period dummies that capture most of the variability in the dependent variable. If we remove these controls, and only include time dummies, we obtain a more balanced distribution (Figure 2). The average impact of a grant on dropout for the treated (ATT) is still negative and statistically significant, even if the magnitude is lower (1.15 percentage points, with a standard error of 0.0013; Table 7). It is important to note that in the baseline model presented in Table 4, the composition of the comparison group with respect to the university/period is forced to be the same as for the treatment group. This is no longer the case when we drop the university fixed effect, leaving only the period fixed effect.

Second, we replicated the analysis by using two alternative estimation procedures: kernel matching and propensity score re-weighting. In both cases we included the $X_{iut}$ and $D_{uT}$ controls described in equation (1). The results are reported in Table 8. Using the kernel matching method[19] (with a bandwidth of 0.06 and with bootstrap standard error[20]), the estimated average treatment effect on the treated group is -4 percentage points (bootstrap standard error 0.0037); following the propensity score re-weighting (where weights equal 1 for treated students and $\hat{e}(x)/(1-\hat{e}(x))$ for the control group) the estimated effect of a grant is -3.9 percentage points (with a robust standard error of 0.0058). These are basically the values of the estimated ATT we presented in Table 4 when breaking down the fifth block into three sub-blocks.

The third robustness check examined the presence of possible measurement errors in the treatment status. According to the statistical office of the Ministry of Education, University and Research (MIUR), and considering all enrolled students, the rate of students with grants was on average 7.4% over the period 2003-13 (ANVUR (2016)), while according to ANS data the rate was lower, about 5% of all enrolled students[21]; the gap between the two sources is lower in the first three years (1.5 percentage points

[19]The extent of balancing between the two samples significantly increases after matching is carried out. After matching, the pseudo R2 reduces to 0.05 from 0.43 and the mean bias to 3.0 from 9.5.

[20]We replicated the analysis with bandwidths of 0.08 and 0.04 and the results remain unchanged.

[21]Unfortunately, we cannot make these comparisons on grants for our working sample since there are no publicly available statistics for the sample of 18-20 year old students enrolled for the first time in Italian universities.

on average in 2003-05). The difference could be mainly due to the fact that data on grants are collected from different sources. ANS data are administrative data reported by universities while MIUR data are provided by the regional agencies that manage grants. These differences in the data could generate two problems relating to possible measurement error in our treatment variable. The first is a non random selection of the students awarded grants that occurs if the students with grants that are not reported in our database are not randomly selected in terms of students' or universities' characteristics. Since we are able to control for a large set of variables at the individual and university level, we do not think that this issue compromises the validity of our results. The second problem is contamination and it occurs if the control group includes some treated individuals; this would imply that we are underestimating the impact of a grant on dropouts. To deal with this issue, we restricted the sample of our analysis in order to minimize the gap between ANS and MIUR data. Table 8 shows the results. First, we replicated the analysis for the period 2003-05, the academic years in which we found the smallest differences between the share of treated students in the two databases. The estimated average effect of the grant is a reduction of 3.2 percentage points in the dropout probability (with a standard error of 0.0073; -2.7 percentage points in the baseline regression). Second, we further restricted the sample by only considering university-year pairs for which the difference between the two data sources was minimal (in particular, we only kept the universities for which the difference between the two databases in the number of students awarded grants was lower than 5%). This operation restricted our sample to about 93,000 students (the entire working sample consists of about 205,000 students, as shown in Table 2). The results confirmed the negative and statistical significant impact of grant, with an average effect of -4.3 percentage points (standard error 0.0059).

Considering all the results yielded by our analysis, the estimated impact of grants on beneficiaries is a reduction in the dropout probability that ranges from 2.7 percentage points in the baseline analysis to 4.3 percentage points in the most stringent specification.

As we said previously, one of the main advantages of our analysis was that we could rely on longitudinal data which allowed us to track the student after enrolment. Using this feature of the database, we checked whether the grants obtained in the first year also had an impact on subsequent years' outcomes. In particular we computed the share of those graduating within one or more years of the set length of the course and we found that treated students were significantly more likely to graduate and to do so within the set timeframe of the course (Table 9). The results suggested that first-year grants, in addition to reducing the drop-out rate immediately, also encourage students to finish their studies within a set time.

## 6. Conclusions

In this paper we have explored the effects of Italian university need-based grants on student dropout rates in the first year of enrolment. Our focus on dropout is determined by the importance of this phenomenon in Italy: only about 60 per cent of students who enrol obtain a university degree (Gitto et al. (2015)) and the majority of dropouts occur at the end of the first year of enrolment (Mealli and Rampichini (2012)). The main advantage of our analysis is that it is based on a unique database covering the entire population of university students in Italy. The paper addresses endogeneity issues by restricting the sample to eligible students and by exploiting the fact that, due to insufficient funds, some of them are not awarded a grant. A blocking with regression adjustments estimation strategy further refined the comparison by partitioning treated and control students within blocks based on their propensity score. We found that the grants help in preventing students from low-income families from dropping out of higher education. The estimated effect is sizeable: the dropout rate for low-income students would pass from about 7% to 10% as a consequence of not receiving a grant. The result is quite robust to different estimation methods and also holds when we restricted the sample for further robustness checks.

As for the policy implications of the paper, our analysis confirms the role of financial constraints in explaining large differences in university dropout rates: reducing the dropout rate of students from low-income families can lead to more equitable schooling opportunities, thus improving educational mobility across generations. Moreover, low university completion rates have an impact on several outcomes (OECD (2016)): educational attainment affects participation in the labour market (the employment rate of tertiary graduates is higher than that of upper-secondary students) and earnings, and it influences social outcomes (good health, life satisfaction). University completion is particularly important in Italy, given the "legal" value of university degrees (in terms of access to public-sector jobs and to specific regulated occupations) and the honorific title of "dottore" which conveys an important social status (Cappellari and Lucifora (2009)). All these aspects reinforce the need to augment college graduation rates, in terms of both increasing enrolment and reducing dropout rates.

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## Tables and figures

Table 1: Descriptive statistics of the working sample. Mean values over each period of enrolment.

| | 2003-06 | 2007-10 | 2011-13 |
|---|---|---|---|
| Pct. of dropouts | 0.082 | 0.076 | 0.067 |
| Pct. of recipients of grants | 0.681 | 0.736 | 0.726 |
| Pct. of females | 0.633 | 0.628 | 0.621 |
| Pct. of residents in the North | 0.268 | 0.325 | 0.314 |
| Pct. of residents in the Centre | 0.154 | 0.176 | 0.165 |
| Pct. of residents in the South | 0.578 | 0.499 | 0.521 |
| Average high school grade | 85.016 | 82.828 | 83.484 |
| Pct. from *licei* | 0.517 | 0.595 | 0.623 |
| Pct. of out-of-site | 0.139 | 0.180 | 0.213 |
| Pct. living in an urban LLS | 0.398 | 0.398 | 0.400 |
| Pct. of foreign students | 0.014 | 0.034 | 0.044 |
| N (annual average) | 20,918 | 19,149 | 14,985 |

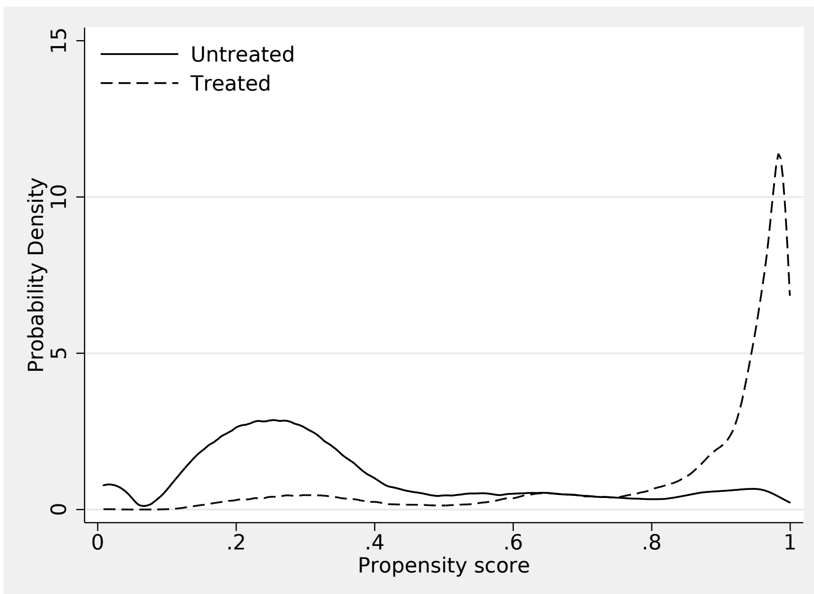
Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university, who were eligible for the grant and exempted from paying tuition fees.

Table 2: Descriptive statistics for treated and non-treated groups.

| | Treated | Non-treated | Differences |
|---|---|---|---|
| Pct. of dropouts | 0.069 | 0.096 | -0.027*** |
| | | | (0.001) |
| Pct. of females | 0.638 | 0.606 | 0.032*** |
| | | | (0.002) |
| Pct. of residents in the North | 0.323 | 0.241 | 0.082*** |
| | | | (0.002) |
| Pct. of residents in the Centre | 0.178 | 0.128 | 0.051*** |
| | | | (0.002) |
| Pct. of residents in the South | 0.498 | 0.631 | -0.133*** |
| | | | (0.002) |
| Average high school grades | 83.296 | 85.264 | -1.969*** |
| | | | (0.061) |
| Pct. from *licei* | 0.552 | 0.613 | -0.061*** |
| | | | (0.002) |
| Pct. of out-of-site | 0.215 | 0.061 | 0.154*** |
| | | | (0.002) |
| Pct. living in an urban LLS | 0.388 | 0.425 | -0.038*** |
| | | | (0.002) |
| Pct. of foreign students | 0.035 | 0.010 | 0.025*** |
| | | | (0.001) |
| N | 146,005 | 59,219 | |

Source: our calculations based on ANS data.
Notes: Years 2003-13. Standard errors in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Figure 1: Distribution of the propensity score in the treated and non-treated group




Source: our calculations based on ANS data.

Notes: The following controls are included: female, area of residence (North, Centre, South of Italy), foreign, a dummy for studying in an area different from that of residence, high school type (dummies for different types) and grade (categorical variable with 5 classes), a dummy for residing in an urban local labour system, and university dummies interacting with period dummies.

Table 3: Estimated effect of grants on dropout.

| Dep. var. | dummy dropout | | | | |
|---|---|---|---|---|---|
| block # | (1) | (2) | (3) | (4) | (5) |
| grant | 0.026*** | 0.001 | -0.005 | -0.024*** | -0.032*** |
| | (0.007) | (0.004) | (0.005) | (0.005) | (0.005) |
| females | -0.005 | -0.016*** | -0.007 | -0.004 | -0.007*** |
| | (0.005) | (0.004) | (0.006) | (0.005) | (0.002) |
| residents in the Centre | 0.046 | -0.032* | 0.035** | -0.004 | 0.023*** |
| | (0.032) | (0.017) | (0.014) | (0.013) | (0.003) |
| residents in the South | 0.009 | 0.012 | 0.004 | 0.004 | -0.002 |
| | (0.034) | (0.017) | (0.020) | (0.012) | (0.003) |
| foreign student | 0.034 | -0.021 | -0.013 | -0.027 | -0.029*** |
| | (0.081) | (0.030) | (0.022) | (0.017) | (0.003) |
| out-of-site student | -0.086*** | -0.025* | -0.003 | -0.025** | -0.007** |
| | (0.025) | (0.013) | (0.012) | (0.011) | (0.003) |
| high school grade | -0.036*** | -0.033*** | -0.027*** | -0.022*** | -0.021*** |
| | (0.002) | (0.001) | (0.002) | (0.002) | (0.001) |
| vocational high school | 0.116*** | 0.091*** | 0.083*** | 0.054*** | 0.050*** |
| | (0.007) | (0.005) | (0.008) | (0.005) | (0.002) |
| other high school | 0.137*** | 0.126*** | 0.076*** | 0.063*** | 0.065*** |
| | (0.010) | (0.007) | (0.009) | (0.007) | (0.003) |
| living in an urban LLS | -0.002 | 0.011*** | 0.001 | 0.007* | 0.006*** |
| | (0.005) | (0.004) | (0.006) | (0.004) | (0.002) |
| University/period FE | YES | YES | YES | YES | YES |
| R-sq | 0.076 | 0.059 | 0.065 | 0.063 | 0.054 |
| N (treated) | 2,313 | 11,124 | 5,575 | 13,373 | 113,577 |
| N tot | 16,749 | 38,247 | 11,822 | 18,607 | 119,722 |

Source: our calculations based on ANS data.
Note: Omitted categories are: high school *licei* and students resident in the North of Italy. High school grade is a categorical variable with 5 classes. Standard errors clustered at university-class level in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Estimated effect of grants on dropout.

| block # | weight | $\alpha_j$ | standard error |
|---|---|---|---|
| $j$=1 | 0.0158 | 0.0256*** | 0.0075 |
| $j$=2 | 0.0762 | 0.0008 | 0.0035 |
| $j$=3 | 0.0382 | -0.0047 | 0.0053 |
| $j$=4 | 0.0916 | -0.0236*** | 0.0049 |
| $j$=5 | 0.7781 | -0.0323*** | 0.0046 |
| ATT | | -0.0270*** | 0.0036 |
| Robustness checks with different partitions of the sample | | | |
| $j$=5 | 0.1180 | -0.0228*** | 0.0066 |
| $j$=6 | 0.6601 | -0.0391*** | 0.0060 |
| ATT | | -0.0303*** | 0.0041 |
| $j$=5 | 0.1180 | -0.0228*** | 0.0066 |
| $j$=6 | 0.1610 | -0.0247*** | 0.0080 |
| $j$=7 | 0.4992 | -0.0530*** | 0.0086 |
| ATT | | -0.0350*** | 0.0046 |
| N | 205,147 | | |

Source: our calculations based on ANS data
Notes: The average effect (ATT) is computed as the weighted average over the J blocks, using the proportion of treated units in each block as weights (equation (3)). Each within-blocks regression includes the following controls: female, area of residence, foreign, a dummy for studying in an area different from that of residence, high school type and grade, a dummy for residing in an urban local labour system, and university dummies interacting with period dummies. Residuals are clustered at the university class level. * p<0.10, ** p<0.05, *** p<0.01.

Table 5: Estimated effect of grants on dropout, interaction terms.

| Estimated average impact (ATT) | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| treatment | -0.0315*** | -0.0123*** | -0.0455*** | -0.0355*** |
| | (0.0056) | (0.0041) | (0.0059) | (0.0045) |
| treatment*female | 0.0075 | | | |
| | (0.0067) | | | |
| treatment*resident South | | -0.0311*** | | |
| | | (0.0075) | | |
| treatment**licei* | | | 0.0335*** | |
| | | | (0.0066) | |
| treatment*high school grade | | | | 0.0263*** |
| | | | | (0.0058) |
| N | 205,147 | 205,147 | 205,147 | 205,147 |

Source: our calculations based on ANS data
Notes: The table reports the ATT: the average impact computed as the weighted average over the J blocks, using the proportion of treated units in each block as weights (equation (3)). Each within-blocks regression includes the following controls: female, area of residence, foreign, a dummy for studying in an area different from that of residence, high school type and grade, a dummy for residing in an urban local labour system, and university dummies interacting with period dummies. Residuals are clustered at the university class level. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Estimated effect of grants on dropout, interaction with the coverage rate.

| block # | weight | $\alpha_j$ | standard error | $\beta_j$ | standard error |
|---|---|---|---|---|---|
| $j$=1 | 0.0158 | 0.0147 | 0.0735 | -0.0211 | 0.1440 |
| $j$=2 | 0.0762 | -0.0443** | 0.0212 | -0.1090** | 0.0530 |
| $j$=3 | 0.0382 | -0.0044 | 0.0092 | 0.0012 | 0.0490 |
| $j$=4 | 0.0916 | -0.0277*** | 0.0051 | -0.1128** | 0.0524 |
| $j$=5 | 0.7781 | -0.0234* | 0.0139 | -0.0451 | 0.0669 |
| N | 205,147 | | | | |

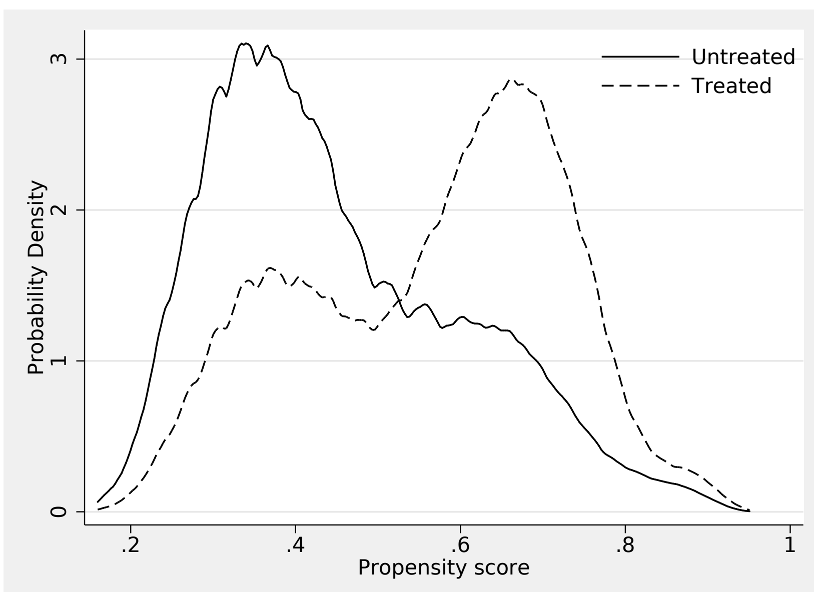
Source: our calculations based on ANS data
Notes: $\alpha_j$ is the coefficient of the treatment variable; $\beta_j$ is the coefficient of the interaction term between $S_{iuT}$ (the treatment dummy) and $(CR_{uT} - CR_{avr})$ (the difference between the coverage ratio at university $u$ in period $T$ and the average coverage ratio). Each within-blocks regression includes the following controls: female, area of residence, foreign, a dummy for studying in an area different from that of residence, high school type and grade, a dummy for residing in an urban local labour system, and university dummies interacting with period dummies. Residuals are clustered at the university class level. * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Estimated effect of grants on dropout, with year dummies (without university/period dummies).

| block # | weight | $\alpha_j$ | standard error |
|---|---|---|---|
| $j$=1 | 0.0018 | -0.0157* | 0.0092 |
| $j$=2 | 0.2110 | -0.0220*** | 0.0021 |
| $j$=3 | 0.2951 | -0.0114*** | 0.0023 |
| $j$=4 | 0.4495 | -0.0076*** | 0.0023 |
| $j$=5 | 0.0425 | -0.0017 | 0.0058 |
| ATT | | -0.0115*** | 0.0013 |
| N | 340,205 | | |

Source: our calculations based on ANS data
Notes: The average effect ATT is computed as the weighted average over the J blocks, using the proportion of treated units in each block as weights (equation (3)). Each within blocks regression includes the following controls: female, area of residence, foreign, a dummy for studying in an area different from that of residence, high school type and grade, a dummy for residing in an urban local labour system, and university dummies interacting with period dummies. Residuals are clustered at the university class level. * p<0.10, ** p<0.05, *** p<0.01.

Figure 2: Distribution of the propensity score, with year dummies (without university/period dummies).




Source: our calculations on ANS data.
Notes: We included the following controls: female, area of residence, foreign, a dummy for studying in an area different from the one of residence, high school type and grade, a dummy for residing in an urban local labor system, year dummies.

Table 8: Estimated effect of grants on dropout. Robustness checks with different estimation methods and different sub-samples.

| | $\alpha$ | standard error |
|---|---|---|
| *Different estimation methods* | | |
| Kernel matching | -0.0397*** | 0.0037 |
| Propensity score re-weighting | -0.0389*** | 0.0059 |
| N | 204,759 | |
| *Different sub-samples* | | |
| Years of enrolment: 2003-05 | -0.0321*** | 0.0073 |
| N | 62,605 | |
| Universities/years with low gap | -0.0431*** | 0.0060 |
| N | 119,131 | |

Source: our calculations based on ANS data
Notes: We included the following controls: female, area of residence, foreign, a dummy for studying in an area different from that of residence, high school type and grade, a dummy for residing in an urban local labour system, universities dummies interacting with period dummies. Residuals in the propensity score re-weighting are clustered at the university class level. * p<0.10, ** p<0.05, *** p<0.01. Different estimation methods: kernel matching is estimated with a bandwidth of 0.06 and with bootstrap standard error. Different sub-samples: the analysis is based on blocking with regression adjustments. The average effect (ATT=$\alpha$) is computed as the weighted average over the J blocks, using the proportion of treated units in each block as weights.

Table 9: Share of graduates within $x$ years of the set lenght of the course.

| | Treated | Non-treated | Differences |
|---|---|---|---|
| within 1 year | 0.527 | 0.430 | 0.097*** |
| | | | (0.003) |
| within 2 years | 0.577 | 0.486 | 0.090*** |
| | | | (0.003) |
| within 3 years | 0.604 | 0.519 | 0.085*** |
| | | | (0.003) |
| within 4 years | 0.618 | 0.537 | 0.081*** |
| | | | (0.003) |
| N | 110,199 | 45,383 | |

Source: our calculations based on ANS data
Notes: * p<0.10, ** p<0.05, *** p<0.01.

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