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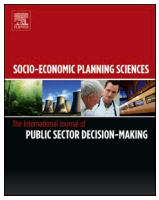

The effect of pricing policies on students' use of university canteens

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ABSTRACT

University canteens play an important role in academic life; they not only allow students to benefit from subsidised food services and meals at lower prices than those commonly available at other local eateries but also affect other aspects, such as students' health, social relationships and academic achievement. Therefore, any intervention that changes the conditions of food service delivery, such as a pricing policy, is also expected to influence students' behaviours and academic life. Using a quasi-experimental design and a difference-in-differences approach applied on data from an Italian university, this study aims to evaluate the impact of an income-based pricing policy on students' frequency of using university canteens and their meal choices. Results show that users who experienced a meal price increase significantly reduced their use of university canteens. Given the role of universities in driving young adults' behaviours, especially in the transition from living at home to independent living, in which they become responsible for food planning, preparation and choices, an evaluation of such policies is crucial – even for minimal price changes – not only because of economic and health implications but also because of their effects on students' academic life and well-being.

1. Introduction

The transition from school to university can be a challenging time for students as it involves numerous changes and potential difficulties that can affect their daily lives. This is not only due to their new role as university students but also because they experience a drastic shift in their daily routines. During their university years, students gain independence and become responsible for academic matters and practical issues in their daily lives, such as making food choices, preparing meals [1] and finding suitable places to eat meals outside of their homes. Research has shown that students, especially freshmen, can be highly vulnerable during university life [2,3], particularly as regards their food habits [1], with a decline in healthy eating habits often occurring [4]. On the other hand, other studies have revealed that easy access to high-quality food is crucial for students' well-being, potentially contributing to their general health, with considerable implications for long-term health preservation and a reduction of the collective healthcare burden [5,6]. Furthermore, economic constraints can play a significant role in shaping students' habits and choices [7], and this also applies to food choices.

During this complicated period in students' lives, universities and related facilities can play a critical role in promoting students' well-being by ensuring their academic success and enhancing their social lives, overall health status and human dignity [8]. Among these facilities, university canteens play an essential role as they offer controlled, low-cost and good-quality meals and allow students to benefit from subsidised food services and meals at lower prices than those commonly found among their competitors [9]. University canteens are also a place of socialisation and can help strengthen students' social integration, academic life and university careers.

The literature in the field of university facilities is limited [1], with only a few studies focused on students' food choices at university canteens [10–12]. Instead, some researchers have analysed the consequences of healthy food choices by students during university life and the factors that influence those choices. Furthermore, previous evidence has shown that less well-off students tend to eat less regularly at university canteens, that socioeconomic status is associated with eating habits [10] and that pricing policies influence both food choice and eating behaviour [3,13,14]. Finally, according to French [15] and Tam et al. [16], the greatest determinants of food choices among university students are taste, value, convenience, cost and demand for healthy food, but price manipulation is an important lever for change.

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To the best of our knowledge, there are so far only a few studies evaluating the effects of price changes on students' food choices, and no previous study has examined the effect of a tariff change on their eating habits at university canteens. On the other hand, the effect of similar policies on tuition fees has been widely studied [17,18] because of their broader impact on access to higher education and related outcomes. The literature on pricing policies in the context of food facilities mainly refers to their impact on encouraging the consumption of healthy foods or discouraging the consumption of fatty foods or sugary drinks, among others, to promote healthier eating habits. Among these policies, Michels et al. [19] have observed that reducing the price for the identified healthy foods and dishes increased consumption of healthy foods. Schneider et al. [12] have shown that promoting a healthy food option in a university canteen, which included a lunch option and healthy snacks, was appreciated by students but did not produce a significant change in food consumption and nutrient intake. Cárdenas et al. [20] conducted a quasi-experimental study to evaluate the impact of increasing fruit visibility, adding information and lowering prices on fruit purchasing at a university canteen Peru; the results showed a significant increase in fruit consumption. Also, other studies have identified cost as a relevant issue in students' food choices, linking increased costs to reduced disposable income [9,21,22]. Despite their different focus, results from these studies suggest that pricing changes play a role in driving students' eating behaviour [23,24]. Thus, it is reasonable to suppose that any intervention changing food delivery prices, even slightly, could affect students' behaviour, eating habits and other aspects of their lives [25,26].

Given the lack of studies on this topic, using a difference-in-differences (DID) approach, this paper aims to contribute to an evaluation of the effect of introducing an income-based pricing system on students' use of university canteens and their meal choices at these canteens. DID is a statistical technique used for policy evaluation in quasi-experimental designs with both panel data as well as repeated cross-section data. Two aspects were analysed as outcome variables to evaluate the impact of the new income-based pricing system on students' eating habits: 1) the frequency of university canteen use and 2) the proportion of light and large meals consumed, each of which is characterised by a different composition of the dishes included on the menu, as will be explained later. The study was carried out at a university in Central Italy that has three university canteens administered by the Financial Aid and Scholarship Office. The office supports food services for all students and accommodation, grants and scholarships for the most deserving students. This context is an ideal setting for evaluating the impact of pricing policy changes on students' behaviour. On 1 April 2018, a new pricing system based on three gross household income groups replaced the previous system, which set a fixed price for all students. This radical overhaul of the pricing structure, with its attendant consequences, provides an opportunity to assess the effect of the intervention on students' behaviour. Data on students who used the university canteen, divided into frequent and non-frequent users, were analysed to investigate whether the impact of the price change varied according to the frequency of use.

The remainder of the paper is organised as follows: Section 2 describes the evaluation framework and specifies the context of the study, the characteristics of the intervention and the strategy for identifying the treated and untreated groups. Section 3 details the data sources and variables considered and briefly explains the DID approach used for the analysis. Section 4 presents the results of the study. Section 5 is devoted to the discussion of findings and concluding remarks.

2. Evaluation framework and identification strategy

A new pricing system was introduced at the University considered in this study under on 1 April 2018, based on three gross household income groups defined by the Equivalent Economic Status Indicator (ISEE) as a household income indicator. Before then, meals were provided at a fixed price of €3.00 for all students (excepting scholarship holders, who received free meals). Students could have a full meal (FM) for €3.00, while light meals were offered for €2.00 and €2.50 if pasta or a main course, respectively, were added to the vegetables, bread, fruit or cake, and beverage. In accordance with the new price system based on ISEE levels, the meal prices for students with an ISEE above €75,000 increased by €1, the meal prices for students with an ISEE below €36,000 was reduced by €0.2 and no changes were introduced for students with an ISEE of €36,000–€75,000. The new system was applied to both full and light meals.

Within this evaluation framework, which represents a typical natural experiment, two different treated (or intervention) groups were considered: 1) students whose meal prices increased and 2) students whose meal prices decreased. In both cases, the natural control group was represented by students whose meal prices remained unchanged.

The overall timeframe comprised in the analysis is the period between 1 April 2017 and 31 March 2019. The two subperiods before and after the intervention were determined considering the date of the introduction of the new pricing system with the cutoff (1 April 2018) as midpoint. From that date, the analysis refers to all canteen meals eaten by the same students one year before the introduction of the new pricing scheme (from 1 April 2017 to 31 March 2018) and one year after (from 1 April 2018 to 31 March 2019). The selection of a one-year period of observation allows for the evaluation of the same group of students in the two periods and is sufficient for assessing the short-term impact of the intervention.

We hypothesised that the effect of the intervention may affect not only the frequency of canteen use but also the selection of the different types of meal as the new tariff scheme determined a different price variation for each type of meal. Moreover, we also hypothesised that the effect of the intervention was influenced by the frequency of canteen use; thus, analyses were both performed considering all students and repeated for the subgroups of frequent and non-frequent users, identified respectively as those who reported a frequency of canteen use prior to the intervention above the 75th percentile or below the 25th percentile.

3. Method

3.1. Population, data sources and variables

The population under study consists of students who were enrolled in the first year of the university's first cycle degree courses in the 2016–2017 academic year and who accessed (at least once) the canteens both the year before (up to 31 March 2018) and the year after (from 1 April 2018) the new pricing scheme was implemented. The inclusion of students in the first year allows the observation of the same group of students both in the period before and after the intervention. To prevent the inclusion of occasional users, students who accessed the canteens less than five times during the year before the intervention were also excluded. Finally, scholarship holders, supplementary year students and students in their last year during the 2016–2017 academic year were also excluded. The former were excluded because they benefited from free meals and the latter because their graduation would have prevented the observation of their behaviour in the subsequent year. Overall, 6472 students were included in the analysis, of whom 5609 belonged to the intervention groups and 863 belonged to the control group. Among the students in the intervention groups, 1894 experienced a meal price increase, and 3715 experienced a meal price reduction.

Two administrative data sources were merged to obtain the final dataset and the variables used for the analysis. The first source contained the records of consumed meals and data on the date and time of the meals, the number and type of dishes, student IDs and the cost of each meal. The university's administrative archives provided data on students' demographics and university careers.

The following outcome variables were considered in the analysis: 1)

the frequency of canteen use and 2) the proportion of meal types consumed. The university canteens included in the study offered three meal types: an FM and two types of light meals. The FM was composed of pasta or soup, a main course, vegetables, bread, fruit or cake, and a beverage. The light meal consisted of vegetables, bread, fruit or cake, and a beverage, together with pasta or soup for light meal 1 (LM1) or a main course for light meal 2 (LM2).

Table 1 presents the summary statistics of the four outcome variables (number of accesses, FM, LM1 and LM2) for the control group and the two intervention groups. Here, the frequency of canteen use is represented by the median and the 25th and 75th percentiles (in brackets), while the meals consumed are represented by the frequency and percentage (in parentheses) of each type of meal (FM, LM1 and LM2) out of the total. Before the intervention, the median frequency of canteen use was relatively higher in the control group (33 per year) compared to the two intervention groups (27 and 28 per year, respectively). However, the number of accesses decreased in all the groups during the post-intervention period. The reduction was higher among students whose meal prices had increased than among students whose meal prices had decreased (11 and 19 per year, respectively). No significant differences were found in the amount of FM, LM1 or LM2 consumed by the groups.

The following control variables were used to describe the students' demographics and university careers: age, gender (a dummy variable taking a value of 1 = male, 0 = female), year of course (a categorical variable taking a value of 1, 2 or 3 depending on the year of course) and university department (a categorical variable taking a value of 1–7). The variables *year of course* and *department* helped capture the effect of different schedules on the patronage of university canteens. The inclusion of the variable 'department' helped in adjusting for the possible neighbourhood effect caused by the proximity between the canteens and the place where students attended lectures. Departments were grouped based on their distance to the nearest university canteen and their mutual proximity, as detailed in Table 2.

Despite sharing a comparable distance from the university canteen, Department 1 and Department 6 were distinguished because of their different disciplines, implying students' diverse behaviours and habits. In the analysis, we hypothesised the same availability of alternatives for lunch in the vicinity of the different departments because it was not possible to obtain exact and objective data on the number of alternatives available in the vicinity of each department; moreover, all the departments are located almost in the centre of the city with an availability of alternatives for eating that can be assumed to be comparable.

Table 3 shows the distribution of control variables in the control group and the two intervention groups. Student characteristics were well matched among these groups, except mean age, which was slightly lower in the control group. In view of the extent of the difference and the statistical method used in the analysis, this factor does not represent a threat to the validity of our estimates.

Table 1
Outcome variables by study group.

	Control group (n = 863)	Intervention groups	
		Price increase (n = 1894)	Price decrease (n = 3715)
Number of accesses			
Before	33 [17–65]	27 [14–51][a]	28 [14–55][a]
After	21 [7–50]	11 [3–29] [a]	19 [5–47]
FM consumed			
Before	26,740 (58.7 %)	49,732 (64.0 %)	105,422 (60.2 %)
After	19,051 (56.7 %)	27,743 (60.1 %)	81,931 (58.6 %)
LM1 consumed			
Before	10,135 (22.2 %)	15,800 (20.3 %)	38,145 (21.8 %)
After	8067 (24.0 %)	11,174 (24.2 %)	32,134 (23.0 %)
LM2 consumed			
Before	8677 (19.0 %)	12,131 (15.6 %)	31,678 (18.1 %)
After	6453 (19.2 %)	7253 (15.7 %)	25,698 (18.4 %)

[a] $p < .05$ vs control group. FM=Full Meal (pasta or soup, a main course, vegetables, bread, fruit or cake, and a beverage); LM1 = Light Meal 1 (vegetables, bread, fruit or cake, and a beverage, together with pasta or soup); LM2 = Light Meal 2 (pasta or soup).

Table 2
Details of criteria used to group departments.

Grouped variable	Distance from the canteen	Department included
Department 1	<500 m	Law, Civilisations and Forms of Knowledge, Philology, Literature and Linguistics, and Political Sciences
Department 2	About 1300 m	Agricultural, Food and Agro-Environmental Sciences, Veterinary Sciences, and Economics and Management
Department 3	About 650 m	Clinical and Experimental Medicine, Surgical, Medical and Molecular Pathology and Critical Care Medicine and Translational Research and of New Surgical and Medical Technologies
Department 4	About 700 m	Biology and Chemistry and Industrial Chemistry
Department 5	About 850 m	Physics, Mathematics, Computer Science and Geosciences
Department 6	About 400 m	Pharmacy, Civil and Industrial Engineering, Energy, Systems, Territory, and Construction Engineering and Information Engineering

Table 3
Baseline characteristics by study group.

	Control group (n = 863)	Intervention groups	
		Price increase (n = 1894)	Price decrease (n = 3715)
Male	468 (54.3 %)	1045 (55.2 %)	1983 (53.4 %)
Age	21.4 ± 2.5	21.9 ± 4.1[a]	21.9 ± 2.9[a]
Registration year			
First	499 (57.7 %)	1080 (57.0 %)	2018 (54.3 %)
Second	172 (19.9 %)	382 (20.2 %)	735 (19.8 %)
Third	192 (22.3 %)	432 (22.8 %)	962 (25.9 %)
University department			
Department 1	177 (20.5 %)	486 (25.7 %)	899 (24.2 %)
Department 2	110 (12.8 %)	323 (17.1 %)	492 (13.2 %)
Department 3	67 (7.8 %)	111 (5.9 %)	268 (7.2 %)
Department 4	65 (7.5 %)	145 (7.7 %)	378 (10.2 %)
Department 5	83 (9.6 %)	175 (9.2 %)	341 (9.2 %)
Department 6	361 (41.8 %)	654 (34.5 %)	1337 (36.0 %)

[a] $p < .05$ vs control group.

3.2. Analytic approach

Given that this study used panel data and involved a natural experiment, where the treatment consisted of the introduction of a new income-based pricing system, a DID approach [27–30] was employed. The DID estimator is a popular tool in quasi-experimental designs for evaluating the impact of a treatment or intervention using a repeated cross-sectional or panel design. In our setting, the same students belonging to the treated and control groups were observed for two periods, before and after treatment, in such a way that the students were made into their own controls. The DID estimator is based on the parallel trends assumption, which states that trends of treated and non-treated groups in pretreatment outcomes should be the same. This assumption implies that, in the absence of treatment, the change in the mean outcome of the treated would have been the same as the change in the non-treated outcome. Thus, although the outcome levels may differ between the treated and control groups even in the pretreatment period,

the impact of the treatment could be measured by the DID estimator as the difference in average outcomes in the treatment group before and after treatment minus the difference in average outcomes in the control group before and after treatment [30]. The DID estimator can be easily implemented using a regression approach, which can obtain the estimates and corresponding standard errors in one step:

$$y_{it} = \beta_0 + \beta_1 t_{it} + \beta_2 T_{it} + \beta_3 (t_{it} \times T_{it}) + X_{it}\delta + \varepsilon_{it}$$

where y_{it} represents the relevant outcome variable (the frequency of canteen use and the proportions of FM, LM1 and LM2); t_{it} is a binary variable for the period of observation, where $t_{it} = 0$ stands for the period before 1 April 2018 and $t_{it} = 1$ stands for the period from 1 April 2018 onwards; T_{it} is a binary treatment variable, where $T_{it} = 0$ indicates students in the control group (those with unchanged meal prices) and $T_{it} = 1$ stands for students in the treatment group (those whose meal prices increased or decreased); X_{it} is a vector of covariates, entered in the model as control variables; and ε_{it} is the error term. β_3 is the coefficient of interest and represents the DID estimator. It results from the interaction term obtained by multiplying the treatment indicator and the period of observation; it takes a value of 1 for students whose meal prices changed after the treatment. For the frequency of canteen use, the regression equation was estimated with the ordinary least squares technique; for the proportions of meal types, being a continuous variable constrained in the interval [0,1], a beta regression approach was carried out (for more details, see Ref. [31]; for more details on non-linear models, see Refs. [32,33]. In both cases, robust clustered standard errors were used to control for heteroskedasticity and clustered data [34].

Goodness-of-fit of the model was evaluated considering the R-squared for the linear DID estimates and with McFadden's pseudo R-squared for the zero- and one-inflated beta regression estimates. As for the question of the parallel trends assumption, it is not testable, given the short period considered in our evaluation framework (i.e., one year before the introduction of the new pricing scheme and one year after). However, it is useful to note that the shorter the observation period, the greater the probability that this assumption will be met. In any case, a visual inspection of these trends over monthly data before the intervention was performed for each dependent variable, and no departure from the parallel trends assumption was detected. This result strengthens the validity of our approach.

4. Results

Two outcome variables were used to assess the impact of the new pricing system on the students' eating habits: 1) the frequency of university canteen use and 2) the proportion of meal types (large and light meals) consumed.

Taking the number of accesses as a dependent variable, the effect of price variation was evaluated using two DID models: one for students whose meal prices increased and the other for those whose meal prices decreased. Data on the number of accesses were preventively transformed on a logarithmic scale to mitigate the effects of a skewed distribution. Taking the proportion of meal types consumed (FM, LM1 and LM2) as a dependent variable and the two intervention groups, additional DID models were also estimated. In both cases, analyses were carried out separately for all students, as well as for frequent and non-frequent users.

The general DID model used in our analysis allows for the inclusion of both fixed and time-varying covariates. For each model, we present only the DID estimates summarised as β_3, which represents the main parameter of interest and measures the magnitude and direction of the effect of the price variation.

4.1. Effect on frequency of university canteen use

Table 4 shows the results of the DID linear regression models that were estimated using the frequency of university canteen use as a dependent variable. Regarding the students whose meal prices increased, the DID estimate (β_3) indicates a significant decrease in the total number of accesses; this effect was also observed among both frequent and non-frequent users. Given the logarithmic scale of the dependent variable, results can be interpreted more effectively in terms of percentage change. On average, the price increase produced a 29.9 % (95 % confidence interval - CI: 23.2%–36.0 %) reduction in the number of accesses. The magnitude of the effect produced by the price variation is higher among frequent users, whose canteen use was reduced by 36.3 % (95 % CI: 25.2%–45.7 %) compared to the 20.2 % (95 % CI: 7.0%–31.5 %) decrease among non-frequent users. No effect was detected among the students whose meal prices were reduced.

Table 4
DID estimates on the number of accesses according to the type of price change.

	Overall	Non-frequent users	Frequent users
Price increase	−0.356 (0.046)[b]	−0.225 (0.078)[a]	−0.450 (0.081)[b]
R-squared	0.16	0.26	0.26
Price reduction	0.043 (0.041)	0.071 (0.075)	0.096 (0.065)
R-squared	0.11	0.15	0.15

The dependent variable is the log-transformed frequency of canteen use. Models also include the individual-level covariates (age, gender, registration year and department). Robust standard errors are in parentheses; for all the models, the McFadden's pseudo R2 is also reported.
*$p < 0.05$.
[a] $p < .01$.
[b] $p < .001$.

Concerning other covariates used in the models adapted, both among those having their meal prices increased and decreased, males showed a significant increase in the number of accesses, overall and for the two subgroups considered. On the other hand, in all groups, increasing registration year resulted in a significant decrease in the number of accesses. Concerning the effect of department, results suggested a significant effect only on the overall group of those experiencing a price decrease, with Department 2 (the furthest from the canteens) and Department 3 resulting in a significant decrease in the number of accesses, while the remaining departments were positively and significantly correlated with the number of accesses (see Table S1 in Supplementary Material).

4.2. Effect on meal type

Tables 5–7 present the results of the DID zero- and one-inflated beta regression models estimated using as a dependent variable the

Table 5
DID estimates on the proportion of FM consumption.

	Overall	Non-frequent users	Frequent users
Proportion			
Price increase	−0.083 (0.046)	−0.092 (0.093)	−0.139 (0.069)[a]
Price reduction	0.048 (0.040)	0.011 (0.089)	0.062 (0.056)
Always choose FM			
Price increase	0.343 (0.145)[a]	0.324 (0.212)	0.603 (0.458)
Price reduction	−0.010 (0.139)	0.201 (0.208)	−0.052 (0.441)
Never choose FM			
Price increase	0.630 (0.206)[b]	0.384 (0.264)	1.233 (0.773)
Price reduction	0.217 (0.191)	0.221 (0.251)	0.074 (0.676)
Pseudo R^2			
Price increase	0.23	0.21	0.23
Price reduction	0.23	0.22	0.22

Models also include the following covariates: age, gender, course year and department. Robust standard errors are in parentheses; for all the models, McFadden's pseudo R^2 is also reported.
***$p < 0.001$.
[a] $p < .05$.
[b] $p < .01$.

Table 6
DID estimates of the proportion of LM1 consumption.

	Overall	Non-frequent users	Frequent users
Proportion			
Price increase	0.147 (0.045)[b]	0.257 (0.098)[b]	0.198 (0.067)[b]
Price reduction	0.014 (0.040)	0.159 (0.093)	−0.082 (0.054)
Always choose LM1			
Price increase	0.748 (0.476)	0.890 (0.531)	1.668 (1.497)
Price reduction	0.639 (0.455)	1.160 (0.518)[a]	1.130 (1.517)
Never choose LM1			
Price increase	0.148 (0.111)	0.126 (0.181)	0.427 (0.244)
Price reduction	−0.011 (0.102)	0.132 (0.175)	−0.012 (0.225)
Pseudo R^2			
Price increase	0.17	0.18	0.23
Price reduction	0.16	0.18	0.19

Models also include the following covariates: age, gender, course year and department. Robust standard errors are in parentheses; for all the models, McFadden's pseudo R^2 is also reported.
***$p < 0.001$.
[a] $p < .05$.
[b] $p < .01$.

Table 7
DID estimates on the proportion of LM2 consumption.

	Overall	Non-frequent users	Frequent users
Proportion			
Price increase	0.080 (0.046)	−0.018 (0.097)	0.120 (0.063)
Price reduction	−0.054 (0.040)	−0.138 (0.094)	−0.039 (0.053)
Always choose LM2			
Price increase	−12.537 (0.443)[b]	−13.575 (0.518)[b]	−1.182 (9.461
Price reduction	−12.033 (0.446)[b]	−12.428 (0.466)[b]	−0.179 (0.651)
Never choose LM2			
Price increase	0.352 (0.100)[b]	0.356 (0.163)[a]	0.135 (0.252)
Price reduction	0.102 (0.093)	0.213 (0.160)	−0.219 (0.243)
Pseudo R^2			
Price increase	0.18	0.18	0.24
Price reduction	0.21	0.18	0.23

Models also include the following covariates: age, gender, course year and department. Robust standard errors are in parentheses; for all the models, McFadden's pseudo R^2 is also reported.
**$p < 0.01$.
[a] $p < .05$.
[b] $p < .001$.

proportion of each meal type (FM, LM1 and LM2) consumed. For each type of meal, three DID estimates are shown, describing the impact on 1) the proportion of each type of meal chosen, 2) the probability of not choosing that type of meal (*never choose*) and 3) the probability of always choosing that type of meal (*always choose*).

4.2.1. Effect on FM consumption

Table 5 shows the results related to FM consumption. DID estimates show significant effects only for students whose meal prices increased. Among these students, the probability of always choosing and never choosing FM increased by 40.9 % and 87.8 %, respectively. This effect was not observed when the subgroups of frequent and non-frequent users were evaluated. Among frequent users, the price increase was associated with a 12.9 % reduction, on average, in choosing FM.

Regarding the effect of other covariates, it is of note that males exhibited a positive and significant association with the probability of always or sometimes choosing FM in all groups of students, both in consequence of a price increase and a price decrease. On the other hand, males resulted as negatively associated with the probability of never choosing FM in all models.

Registration year was negatively associated with the proportion of FM choice in all groups and in relation to both a price increase as well as a price decrease; moreover, increasing registration year was significantly associated with the probability of never choosing FM in all groups, except for frequent users experiencing a price decrease (see Table S2 in Supplementary Material).

4.2.2. Effect on LM1 consumption

Table 6 shows the results of the DID estimates for LM1. Among the students whose meal prices increased, results show a rise in the proportion of those who chose LM1, both overall (+15.8 %) and in the two subgroups of frequent (+21.9 %) and non-frequent users (+29.3 %). On the other hand, the probabilities of never and always choosing LM1 were not affected by the price variation. When the effect of price reduction on LM1 selection was analysed, the only significant effect observed was a threefold increase in the probability of always choosing LM1 among non-frequent users.

Among other covariates, a clear effect was found for gender, with males whose meal prices increased exhibiting a significant lower probability of always or sometimes choosing LM1 and a significant higher probability of never opting for LM1, overall as well as both among frequent and non-frequent users. A similar effect was detected among males whose meal prices decreased according to the new tariff scheme. The probability of always or sometimes choosing LM1 also significantly increased as registration year increased, both among those having their price increased (except for non-frequent users with respect to the probability of sometimes choosing LM1) and among students having their price decreased (except for frequent users with respect to the probability of always choosing LM1).

For the effect of the variable *department*, results suggest a negative association with the probability of never choosing LM1 for the overall group of students experiencing a price decrease and enrolled in degree courses in scientific departments located between 400 and 700 m from the canteen (see Table S3 in Supplementary Material).

4.2.3. Effect on LM2 consumption

Regarding the proportion of LM2s consumed, the analysis of students whose meal prices increased (Table 7) shows that the intervention produced a higher probability of not choosing LM2, both overall (+42.2 %) and among non-frequent users (+42.8 %). Conversely, the probability of always choosing LM2 decreased significantly in the same groups. Overall and among non-frequent users, price reduction had a significant negative effect on the probability of always choosing LM2. No other significant effect was associated with price reduction. Regarding other covariates, a consistent, statistically significant effect was found for gender, with males whose meal prices increased exhibiting lower probability of always or sometimes choosing LM2 and a higher probability of never opting for LM2, overall as well as both among frequent and non-frequent users. A similar effect was detected among males whose meal prices decreased.

Registration year was positively associated with the probability of always choosing LM2 as consequence of a price increase in the overall group and among frequent users; a similar association was also found for those experiencing a price decrease, overall and among non-frequent users.

On the other hand, increasing registration year resulted in being negatively associated with the probability of never choosing LM2, both among the overall group experiencing a price increase and those experiencing a price decrease. Results also highlighted a negative association with the probability of never choosing LM2 for the overall group of students experiencing a price decrease and enrolled in degree courses in scientific departments located between 400 and 700 m from the canteen (see Table S4 in Supplementary Material).

5. Discussion and conclusion

The beginning of university studies is a critical period for changes in students' eating behaviours, especially for those who leave their parents' homes to live independently, as this is when they become responsible for food planning, preparation and choices. This study

aimed to evaluate the effect of introducing an income-based pricing system on students' use of university canteens in terms of frequency of access and meal choices. The strengths of the study are several. First, it is an initial contribution for evaluating the effect of the introduction of an income-based pricing system on students' use of university canteens. Second, it is based on cashier transaction data that considered all canteen visits and all canteen meals consumed by students, albeit for a relatively brief period. And finally, it resembles a typical natural experiment.

The empirical analysis showed that the intervention did not have a significant impact on the behaviour of students whose meal prices decreased (with respect to both the frequency of canteen use and meal choice); this could be attributed to the limited price reduction under the new pricing system. By contrast, for students whose meal prices increased, the results suggest that the intervention had a significant effect on both the frequency of canteen use and meal choice. In particular, students experiencing a price increase generally decreased the number of canteen accesses, and this may be related to the fact that, as prices increase, the options available for the same price also increase or, even, that being students with supposedly greater financial resources, they can also afford alternative places to eat that could be preferable for reasons other than price (i.e., they are closer to their department or less time-consuming). Those students using the canteen less frequently reduce the frequency of canteen access and also change the type of meal consumed.

With respect to students' meal choices, those who experienced a price increase essentially showed two opposite behaviours: they either chose FM over other meal types or stopped choosing FM, thus increasing the frequency of choosing LM1 while decreasing the selection of LM2, the most expensive type of meal. The two opposite behaviours need to be interpreted taking into account the fact that it is related to students with generally better wealth conditions, which might both allow them to afford even more expensive alternatives and make them less sensitive to price increase. The different behaviours observed among students who experienced a price increase could be explained by different factors. First, individual decisions may also depend on other factors [13,19] not considered in the present analysis (e.g., convenience and taste), and individuals may react differently to price variations depending on the importance they give to other factors. For instance, time constraints because of lesson schedules may lead students to choose the easiest alternative to obtain meals, while others might base their decisions on personal taste or health consciousness. Second, among students whose meal prices increased, the persistence of or even increase in the selection of the most expensive type of meal (i.e., FM) may be explained by the fact that, in Italy, the university canteen is the cheapest source of FM. On the other hand, in the same group of students, the reduced selection of FM may be due to the market law that implies a decrease in demand when prices increase. The latter mechanism could also explain the only significant impact observed among students experiencing a price decrease: their choice shifted from LM2, the most expensive light meal, to LM1, the cheapest alternative. Although the new income-based pricing system provides a diverse selection of food suppliers for students who can afford it, it could also create discrimination because of the establishment of different prices for access to the same services. The latter mechanism has been observed in the context of tuition fees [17].

The results support our hypothesis that a price change – even a small one – in university canteens affects students' frequency of canteen use and choice of meal type.

Nevertheless, further research could offer a more comprehensive assessment of the effects of such interventions. Studies could provide evidence on the possibility that a price reduction could encourage the use of canteens among non-users, as documented in a US study on a universal free meal program [35]. From a different perspective, research could examine the consequences for eating habits to clarify the impact of such policies in terms of public health. The possible modification in the nutritional profiles of consumed meals could also have implications for long-term effects for health. Finally, the potential spillover effect on social integration could be a relevant issue because of its possible academic effects. Policies that influence the conditions of food service delivery at university canteens are expected to have an impact on factors other than eating behaviours, such as social relationships, academic and social integration, achievements and retention. For example, students who reduce their canteen use could find it more difficult to strengthen their networks with other students, adversely affecting their social relationships, which are known to have a positive effect on university performance in terms of persistence and career progression [36–44].

Some possible limitations of the current study could be the unavailability of detailed information on possible alternative places could be the unavailability of detailed information on the availability of possible alternative places where students might eat in the vicinity of their department of study but also the fact that the analysis takes into account a single university, thus restricting this evaluation to a specific context. However, our study acts as a primer on this topic and can contribute to the higher education literature from an economic point of view, stimulating the ongoing debate on the opportunity to set income-based prices for access to public services as a tool for redistributing income [45]. It also serves as a starting point for evaluating the consequences of these policies on academic outcomes. Policy actions within university facilities seem to contribute to behaviour changes related to food choice, thus producing diverse effects on body weight, general health and the long-term burden of chronic disease [46,47], and related expenses.

CRediT authorship contribution statement

Lucio Masserini: Conceptualization, Data curation, Formal analysis, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Matilde Bini:** Supervision, Writing – review & editing. **Valentina Lorenzoni:** Conceptualization, Data curation, Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing, Visualization.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.seps.2024.101946.

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