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Money does it better! Economic incentives, nudging interventions and reusable shopping bags: Evidence from a natural field experiment

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Money does it better! Economic incentives, nudging interventions and reusable shopping bags: Evidence from a natural field experiment¹

Armenak Antinyan,² Luca Corazzini³

Abstract. Little is known about the impact of policy interventions other than taxes and bans aimed at reducing the demand for single-use plastic bags. We report results from a natural field experiment conducted in a large supermarket chain to test interventions based on nudges (information provision), financial bonuses (which are assigned through a competitive scheme) and free provision of reusable bags. We manipulate the type of the intervention, i.e., either a financial bonus or a nudge, and the presence of a reusable bag, i.e., either provided for free or not provided. Relative to the baseline with no intervention, both the bonus and the nudge considerably reduce the demand for single-use plastic bags. Free reusable bags are effective when combined with the bonus, albeit not effective when combined with the nudge. Finally, the bonus is more powerful than the nudge, irrespective of the absence or presence of reusable bags.

Keywords: pro-environmental behavior, nudge, financial bonus, reusable bag, single-use plastic bag, randomized controlled trial.

JEL Classifications: C93; D12; D91; H23.

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1. Introduction

Plastic shopping bags are one of the most frequently purchased items by consumers in the world and vividly represent the consumerist behavior of the “*throw-away*” society, which favors disposable items over durable goods that can be repaired and reused (Napper and Thompson, 2019; United Nations Environment Program, 2018, 2020). According to estimates, approximately 0.5-1 trillion plastic bags are consumed annually, which is roughly equivalent to 1-2 million bags every minute worldwide (Nielsen et al. 2019; Plastics Oceans, 2019). Beyond any doubt, the (over)consumption of plastic bags exerts a serious negative impact on the environment and poses a considerable threat to human and animal health.

In an effort to curb plastic usage, policy-makers worldwide actively design various policy interventions. Full or partial banning on plastic carriers is currently the most ubiquitous policy instrument, followed by taxes or levies that set a price for plastic bags that were previously provided for free to consumers (Nielsen et al., 2019). Although these policies are currently widely adopted, there are only a few rigorous studies that evaluate or compare their impact. More specifically, Homonoff et al. (2020) juxtapose a ban on single-use plastic bags (bags less than 2.5 mils thick) with a \$0.07 “per bag” tax in Chicago (US). The authors conclude that a partial ban on disposable bags is ineffective if there is no ban on close substitutes (bags more than 2.5 mils thick). In contrast, the tax is effective enough to curb disposable bag consumption in the first few months, although there seems to be a rebound effect; one year after the introduction of the tax, the consumption of the disposable bag gradually increases.⁴ Cabrera et al. (2021) also illustrate that a tax on bags can substantially lower the purchase of disposable bags over a one-year time window with respect to a pretreatment period of no regulation in Salto (Uruguay); however, unlike Homonoff et al. (2020), the authors do not find a rebound effect over time. Homonoff (2018) compares the effect of a \$0.05 “per bag” tax with that of a \$0.05 “per bag” bonus on the consumption of disposable bags in the Washington Metropolitan Area (US). The tax is found to cut consumption, while the bonus is found to have almost no impact.

Despite the prevalence of bans and taxes to curb disposable bag consumption, it is a well-established fact that the reaction to these policy instruments is not always affirmative and, in the most extreme

⁴ Such a complex behavioral response is coherent with the idea that, in the short run, customers perceive the tax on the disposable bags as a loss and curb their consumption of disposable bags; however, in the long run they get used to the tax as they change the reference price of the bags. Thus, the tax introduced on bags does not feel similar to a tax any longer.

cases, can result in strong opposition. For instance, the introduction of a tax or a levy on disposable plastic purchases (including disposable bags) can be politically sensitive and subject to overheated debates (Solletty, 2018; Reuters, 2019; Maldonado et al., 2020), with the same argument extending to plastic bag bans. Furthermore, substantial administrative resources may be necessary to enforce bans, which can be especially challenging in developing countries. For example, developing countries, including Papua New Guinea, Bhutan, and Uganda, have made multiple, although rather unsuccessful, attempts to enforce ordinances to ban plastic bags (Nielsen et al., 2019). The launch of alternative policy interventions that either do not prohibit individuals from undertaking a certain action (unlike bans) or do not negatively affect the economic incentives of individuals (unlike taxes) may serve as possible solutions to the aforementioned problems. This discussion triggers a number of open questions.

Can interventions based on behavioral science techniques reduce the demand for disposable plastic bags? In recent years, governments have been increasingly improving individual behavior through behavioral interventions to achieve policy objectives. In this context, nudge interventions that respect the freedom of choice and do not change economic incentives have turned out to be exceptionally useful (e.g., Benartzi et al., 2017). Despite the widespread use of nudging, its impact on the demand for disposable plastic bags is largely untested. A notable exception is the study by Romano and Sotis (2020), in which the authors discourage the purchase of disposable bags by donating a small sum to an institution that is perceived negatively by supermarket visitors every time a disposable bag is purchased and by donating a small sum to a charity every time a disposable bag is not purchased.

Can bonuses reduce the demand for disposable plastic bags? Unfortunately, little is known about the impact of bonuses on disposable bag consumption; the exception is the seminal study by Homonoff (2018), which finds no positive impact of bonuses on plastic bag consumption. It is also unknown how nudges compare to financial incentives in an effort to reduce the demand for plastic bags.

Can the provision of free reusable bags reduce the demand for disposable plastic bags? Among others, supermarket chains, department stores, and environmental non-governmental organizations (NGO) distribute reusable bags for free with the best intentions. For example, to celebrate the Earth day, a large American supermarket chain recently handed out 200,000 reusable bags for free across Texas (Rosenthal, 2021). Despite such efforts, to the best of our knowledge, there is almost no

evidence of whether the free provision of reusable bags ditches the single-use plastic bags and whether individuals use the reusable bags they received as a present.

In this paper, we conduct a natural field experiment (NFE) with loyalty card holders from the Tsiran supermarket, which is one of the largest supermarket chains in Yerevan (Armenia). An NFE occurs in an environment where the experimental subjects naturally undertake tasks (in our setting, in a supermarket where individuals shop), albeit these subjects *do not know* that they are participating in an experiment (Al-Ubaydli and List, 2013). Our NFE is centered around the policy questions posed in the previous paragraphs. First, we test the impact of introducing either an environmental nudge or a financial bonus on the purchase of single-use plastic bags. Second, we compare the impact of an environmental nudge with that of a financial bonus. Third, we check whether the distribution of free reusable bags affects the purchase of single-use plastic bags. To do so, we test whether interventions that combine free reusable bags (made of nonwoven polypropylene) with the environmental nudge or the financial bonus can be more effective than the environmental nudge or the financial bonus alone.

The NFE was conducted in all 9 branches of the Tsiran supermarket situated in the capital city of Yerevan at the time of the trial. We focused on loyalty card holders to be able to track their actual behavior in a natural environment.⁵ The target group of our interventions was represented by loyalty card holders who regularly visited the supermarket and did not exhibit environmentally friendly behavior in that they bought single-use plastic bags when shopping. The behavior of such visitors can be quite harmful to the environment, which is why we targeted this sample.

Regarding the treatment stimuli, the environmental nudge simply provides information about the harm disposable plastic bags cause to the environment and human and animal health. The provision of information is considered one of the most frequent and effective nudges adopted by policy-makers (e.g., Sunstein, 2014; Patel, 2018). The bonus structure—unlike that in Homonoff (2018)—creates competition among supermarket customers. More specifically, individuals are divided into small groups and participate in winner-take-all contests; the individual who purchases the least number of plastic bags wins the contest in each group. This design choice is motivated by a growing experimental literature that illustrates the strong effect of incentive-compatible competitive schemes

⁵ If we did not focus on loyalty card holders, we would not be able to implement an NFE. For instance, to track the behavior of customers without loyalty cards, we could distribute special cards to be used when shopping at the supermarket branches during the experiment. Alternatively, we could ask the study participants to self-report their behavior through surveys or diaries every time they went for shopping. An interested reader can refer to Al-Ubaydli and List (2013) for the advantages of NFEs over other experimental methods.

on human behavior in domains such as healthy dietary habits (Belot et al., 2016), energy consumption (Sintov et al., 2015), saving behavior (Linardi and Tanaka, 2013), and cooperation in social dilemmas (Corazzini et al., 2010; Cárdenas et al., 2019). Moreover, the competitive incentive scheme used in our trial also relates to the idea of gamification, i.e., the introduction of games into policy interventions to make them more enjoyable and engaging (BIT, 2014). Regarding the provision of a free reusable bag, our conjecture is that it can change the customers' default option, since without a reusable bag, the customer needs to opt in a pro-environmental behavior by exerting effort and spending money to purchase a bag, while with a reusable bag, the customer needs to opt out from pro-environmental behavior by not using the bag (Johnson and Goldstein, 2003). Furthermore, the change of the default can reveal the supermarket's attitude toward pro-environmental behavior since the customers may perceive the provision of the free bag as a strong indication that pro-environmental behavior is the course of action recommended by the supermarket (McKenzie et al., 2006).

The contribution of our work to the scientific literature is twofold. First, we contribute to the limited literature that studies the impact of policy interventions on the demand for plastic bags (e.g., Homonoff, 2018; Cabrera et al., 2021; Homonoff et al., 2020). In this respect, little is known about the effect of nudges, financial bonuses, and free reusable bags on disposable bag purchase and consumption. Furthermore, while the existing studies rely on a quasi-experimental research design and (mainly) use a difference-in-difference statistical technique to evaluate the impact of a policy change (such as the introduction of a tax) on the demand for single-use plastic bags, we report results from an NFE that does not require the strong identification assumptions of the difference-in-difference method (Gertler et al., 2016).⁶ Second, we add to the growing literature that compares the power of nudges with that of financial incentives in the field (e.g., Ito et al., 2018; Campos-Mercade et al., 2021; Gravert and Collentine, 2021). Given the excitement around nudges in recent years, we believe that it is important to understand how policy interventions based on nudges that do not change the financial incentives of individuals and preserve the freedom of choice compare with classical policy interventions that usually affect human behavior through economic incentives.⁷

⁶ “NFE represents the cleanest possible manner in which to estimate the treatment effect of interest” (Al-Ubaydli and List, 2013, p.6).

⁷ This issue has also been acknowledged in the context of pro-environmental behavior. For example, a recent paper by Carlsson et al. (2021) acknowledges that there is a limited understanding of the effectiveness of conventional policy instruments versus that of green nudges (i.e., nudges that reduce a negative environmental externality).

The rest of the paper is structured as follows. Section 2 details the institutional context in the RoA, the experimental design and the implementation details. A summary of the results is depicted in Section 3. Section 4 concludes the paper and puts forth policy recommendations.

2. The experiment

2.1. The institutional context

Similar to many developed and developing countries, the RoA suffers from the excessive use of disposable plastic bags. More specifically, according to the estimates of the Ministry of Environment, approximately 12,000 tons of plastic bags are produced annually. In the RoA, the problems related to single-use plastic bags are exacerbated because of the poorly developed waste-management systems and poor infrastructure in place for collection and recycling. Given the latter, plastic bags end up either in open landfills or in nature, where they pose considerable threats to the environment, humans, and animals. Understanding this threat, the government of the RoA is actively designing regulations to curb the consumption of disposable plastic in the country, including a possible ban on disposable plastic bags starting in 2022 (Armenpress, 2020). In the last few years, the major supermarket chains (including the Tsiran supermarket) have sold disposable bags for a fee of up to 20 AMD (approximately 0.04 USD), thereby mimicking the tax on disposable bags implemented in other countries (Homonoff, 2018; Cabrera et al., 2021). Since there is no common regulation, the fee the supermarkets charge can differ. Meanwhile, smaller shops still provide plastic bags for free.

2.2. Treatments

The current experiment aimed i) to test the impact of an environmental nudge or a financial bonus on the purchase of single-use plastic bags, ii) to compare the impact of an environmental nudge with that of a financial bonus, and iii) to check whether the distribution of free reusable bags affects the purchase of single-use plastic bags on top of an environmental nudge or a financial bonus. Given these objectives, we designed an experiment consisting of 7 trial arms, as detailed below.

Control group (830 people): The subjects in this group received neither a letter from the supermarket nor a reusable bag. By comparing the remaining treatments with this group, we are able to check whether the interventions are effective relative to the business as usual setting.

Environmental nudge (829 people): The subjects in this group received an environmental letter explaining the harm of plastic to the environment and animal and human health. Please refer to Appendix A for the original letter in Armenian and the English translation.

Financial incentives (830 people): The subjects in this group received a letter, which provided them with information about the financial incentives if fewer plastic bags were purchased. More specifically, the subjects were anonymously divided into groups of 10, and they had no information about the identity of the other members of the group. The subjects were competing exclusively within their group throughout the experiment. The winner would receive 20,000 AMD (approximately 40 USD) deposited on her loyalty card. The rules of the competition were as follows:

- i) Customers received 2 points for spending less than 2,000 AMD (approximately 4 USD) and purchasing no plastic bags;
- ii) Customers received 10 points for spending more than 2,000 AMD and purchasing no plastic bags;
- iii) Customers received 0 points if they purchased a plastic bag irrespective of the amount spent shopping.

We opted for the abovementioned scoring rules for four main reasons. First, the rules are simple and can be easily internalized by costumers. Second, the rules imply that customers who spend more in the supermarket and buy more items have (relatively) higher incentives not to purchase plastic bags. Third, the rules are (relatively) fair in that costumers who spend more are assigned a higher number of points compared to those who spend less. Fourth, the rules are administratively simple to implement, which in turn implies, from the perspective of policy-makers, that they can be easily scaled up to larger populations. The original letter in Armenian and the English translation are depicted in Appendix A.

Environmental nudge & small bag (830 people): The subjects in this group received the same environmental letter as that provided in the *Environmental nudge* treatment and a small tote bag made of nonwoven polypropylene. There are important reasons to opt for nonwoven polypropylene bags. First, nonwoven polypropylene bags represent one of the most environmentally friendly alternatives to disposable bags since they come from recycled material. That is why such bags are frequently used worldwide. Second, nonwoven polypropylene bags are available in Armenia. Third, these bags are made of a strong, washable material that guarantees their resilience over time.

Environmental nudge & big bag (830 people): The subjects in this group received the same environmental letter as that provided in the *Environmental nudge* treatment and a big tote bag.

Financial incentives & small bag (830 people): The subjects in this group received the same letter with financial incentives as that provided in the *Financial incentives* treatment and a small tote bag.

Financial incentives & big bag (830 people): The subjects in this group received the same letter with financial incentives as that provided in the *Financial incentives* treatment and a big tote bag.

During the experiment, we also sent reminders either once (January, April, July) or twice a month. The subjects in the environmental nudge treatments were reminded of how important it is to purchase fewer plastic bags for the sake of environmental protection. Those in the bonus treatments were reminded about the competition and the financial incentives to purchase fewer plastic bags. The participants in the bonus treatments received an additional monthly SMS text informing them about their ranking within the group. The reminders were sent on a different day each month to exclude day-of-the-week effects. Both the text and the dates of the reminders are depicted in Appendix B.

2.3. Implementation

The preparations for the study took place in the second half of 2019, while the experiment kicked off on January 21, 2020, and lasted until July 11, 2020.⁸ The experiment was conducted in all 9 branches of the Tsiran supermarket chain located in the capital city of Yerevan.⁹ Overall, 5,809 loyalty card holders who regularly visited the supermarket and purchased plastic bags were randomized into 7 arms in August 2019. The next subsections detail the sample selection, randomization and bag and envelope distribution procedures.

2.3.1. Selection of the randomization sample

Our objective was to focus on regular supermarket visitors whose shopping behavior can exhibit environmentally unfriendly behavior. Keeping this objective in mind, we introduced several selection criteria to define the randomization sample.

⁸ The start of the experiment was planned on January 13 (this date is mentioned in the financial letters); nonetheless, the experiment (hence the delivery of the packages) started on January 21, because of minor issues related to the software for distributing letters and bags (see the description of the software later in this section). Since the starting date of the trial was common for all participants, this short delay does not threaten the validity of the trial.

⁹ At the time of the implementation of the trial, the vast majority of the supermarket branches were situated in Yerevan.

The definition of regular customers. We focused on those cardholders who shopped every month from April to July 2019, visited the supermarket at least twice on average in each month, and spent at least 5,000 AMD (approximately 10 USD) on average per month. We excluded customers who used their card more than 60 times from April to July 2019 (i.e., on average 15 times each month, which is almost every second day). The excessive usage of the card could imply that the individuals shared the card with a friend or a family member, which would result in biased estimates and threaten the internal validity of the experiment.

The definition of environmentally unfriendly behavior. The cardholder should have purchased at least 3 plastic bags from the supermarket from April to July 2019. Since we faced a reusable bag constraint, we wanted to assure that the distribution of these bags is as targeted as possible (i.e., the individuals who exhibited relatively more environmentally unfriendly behavior received these bags). For example, an individual who did not purchase any plastic bag or purchased one plastic bag in four months could already use a reusable shopping bag of her own. Thus, providing a second reusable bag for free would have minimal impact on her behavior. We kept the threshold of this inclusion criterion as low as possible (i.e., 3 plastic bags purchased in 4 months) not to harm the external validity of the findings (i.e., not to focus only on those individuals who purchase a considerable number of plastic bags).

Further selection criteria. The loyalty card database of the supermarket does not distinguish between business customers (e.g., sole proprietor who runs a small restaurant) and ordinary customers. Those with excessive plastic bag consumption could be businesses customers rather than ordinary customers. Indeed, the responses of these two groups to the treatment stimuli can be rather heterogeneous. Since we could not distinguish business customers from ordinary customers, we introduced a further selection criterion that stated that cardholders should have purchased fewer than 80 single-use plastic bags from April to July 2019 (i.e., on average 20 bags per month) to be included in the randomization sample. For the same reason, we excluded cardholders who spent more than 800,000 AMD (approximately 1,600 USD, which is on average 400 USD per month).

The abovementioned selection criteria left us with 5,809 cardholders to work with out of approximately 9,000 cardholders who visited the supermarket from April to June 2019 at least once per month.

2.3.2. Randomization strategy and balancing

We opted for individual randomization. To enhance balancing, we stratified randomization by gender and by the supermarket branch to which the individual “belongs.” To construct the latter measure, we calculated the distance from the individual’s residential address to all 9 supermarket branches and assumed that the individual belongs to the supermarket branch that is the nearest to her residential address. There was a separate stratum for the individuals with no address, which was labeled as “*no branch.*”

Individual randomization exposed us to the threat of downward biases in the treatment effects due to potential spillovers across subjects in different treatment groups. Nonetheless, this randomization strategy was pretty much the most feasible option given the context. An alternative option could have been block randomization by supermarket branches (i.e., an entire supermarket branch would be allocated to a unique arm). However, since the supermarket counted only 9 branches in the capital city at the time of the randomization, we would end up with very few groups over which to randomize the treatment assignment. Nevertheless, in our view, the threat of potential spillovers was rather minimal given our randomization strategy. First, the supermarket chain we worked with is one of the largest in Yerevan and has a large customer base. Second, we selected only 5,809 loyalty card holders to participate in the study, which constitutes a small fraction of the loyalty card holders registered in the database of the supermarket (approximately 50,000 individuals at the time of the study). Thus, the probability that many of the participants randomized to treatment arms know each other and actively interact is rather small.

Once the randomization was carried out, we verified that the trial arms were well balanced in terms of the observable characteristics under our disposal: i) the overall number of items bought from April to December 2019, ii) the overall number of plastic bags bought from April to December 2019, iii) the total amount of shopping from April to December 2019, and iv) the gender of the loyalty card holder.¹⁰ Table C1 in Appendix C illustrates that the trial arms are indeed balanced.

2.3.3. Distribution of letters and bags

The environmental and financial bonus letters were distributed in envelopes. In the *Environmental nudge* and *Financial incentives* treatments, only the letters were distributed. In the bag treatments, envelopes with letters were stapled to the bags and distributed along with the bags. For the sake of

¹⁰ Since we implemented the randomization in August 2019, using the shopping data from April to July 2019, while the experiment started in January 2020 for each individual, we aggregated the overall number of items and plastic bags bought, as well as the total shopping amount, from April to December 2019, instead of April to July 2019, when checking whether the trial arms are balanced or not.

brevity, henceforth, we will refer to the letters or the combination of letters and bags as *packages*. These packages were stored at the cash desk and distributed by the cashiers. Figure 1 provides an example of a package distributed during the experiment.

Figure 1: Example of a letter and a



Note: An example of a letter and a bag.

There was a barcode and a colored circle located on each envelope. Each color corresponded to a unique treatment group. When a subject showed up in the supermarket for the first time during the experiment and her loyalty card was scanned at the cash desk, a text with the color (e.g., “blue”) appeared on the cashier’s screen, instructing her to hand in the package of the given color to the loyalty card holder. All envelopes shared the same barcode. Before handing in the package to the participant, the cashier scanned the barcode on the envelope. First, this allowed us to understand whether the participant had been given a package. If a participant was given a package on Day t , then her name was manually removed from the database at the end of Day t by the supermarket staff.¹¹ Thus, if the customer had already received a package on Day t , starting from Day $t+1$, no further instructions appeared on the cashier’s screen when this customer’s loyalty card was scanned again. This design choice was meant to ensure that each experimental subject would receive only one package during the experiment.¹² Second, this process served as proof that the packages had actually been delivered to the participants, thus allowing us to calculate the number of subjects who were given packages for each treatment. During the trial, the team regularly visited all 9

¹¹ This was done in the headquarter of the supermarket and did not depend on branches. Consequently, there is no branch-specific noise that could harm the validity of the results.

¹² Since the name of the subject who was given a package during her first visit on Day t was removed on Day $t+1$, those subjects who visited the supermarket stores more than once on Day t and presented their loyalty cards during their shopping could receive more than one package. Furthermore, since these names were removed manually from the database, due to some delay in the process, a small number of subjects received more than one package. Despite these limitations, there are aspects that guarantee the internal validity of our trial. First, the software allows us to track whether a subject was delivered more than one package. There were 230 such subjects (approximately 7% of the subjects who received a package). Our main results are intact if we drop these 230 subjects from the data. Second, receiving multiple packages would pose a substantial problem for the internal validity of the trial, if the majority of the subjects who received multiple packages in the bag treatments would give the extra bags to the subjects in the treatments without bags. Since we are also able to track the reusable bag usage (described later in this section), the analysis of the bag usage reveals that this is not the case.

supermarket branches to follow the implementation process and remained actively in touch with the managers of the supermarket branches.

2.3.4. Training sessions with the supermarket staff

Before starting the trial on January 21, 2020, several training sessions were held with all the cashiers and the managers of the supermarket branches. During the training, we introduced the main aim of the experiment and provided detailed instructions. Mock shopping scenarios were run with the cashiers to test their understanding of the instructions. If a cashier was hired after the training, she was separately instructed by the branch manager.

The cashiers were specifically instructed to flag loyalty card holders who would buy plastic bags after shopping (i.e., after the loyalty card would be scanned and shopping would be registered). This would decrease the number of plastic bags a customer bought and would be especially relevant in treatments with financial incentives. Although we instructed the cashiers, we were confident that the number of such cases would be very few, as the subjects were unaware of how the supermarket would monitor their purchase decisions. The financial letter did not specify this point (the letter simply asked loyalty cardholders to bring their personal loyalty card when going to the supermarket for shopping and give it to the cashier). During the experiment, no problematic cases were registered.

The regular SMS text sent to the customers also contained a hotline number for potential questions and inquiries (this refers to the treatments with financial incentives). The hotline was active throughout the entire experiment.

3. Results

The outcome variable of the NFE was the aggregate number of plastic bags purchased by each subject by the end of the experiment. Comparing the outcomes at the end of the intervention for the treatment and control groups is one of the potential strategies used to analyze the results of a randomized evaluation (Glennester and Takavarasha, 2013). Two points are worth noting.

First, 659 participants (approximately 11% of the sample) did not appear in the supermarket branches during the experiment. Thus, we dropped these subjects from the analysis. According to a formal regression model, the treatment noncompliance rate does not depend on the treatment allocation (please refer to Table D1 in Appendix D). In sum, while this noncompliance pattern can

reduce the statistical power of the experiment, it does not invalidate the results of the experiment (Glennester and Takavarasha, 2013).

Second, in the entire analysis that follows, we reduced the number of treatments by pooling the *Environmental nudge & small bag* (*Financial incentives & small bag*) and *Environmental nudge & big bag* (*Financial incentives & big bag*) groups. The rationale was fewfold:

- i) There is a marginal difference in the treatment stimuli between these arms (the bag sizes differ only slightly);
- ii) There were no significant differences in plastic bag purchases,¹³ the average number of items purchased,¹⁴ or the average amount of shopping between these treatments,¹⁵ and
- iii) By reducing the number of treatments, we make the p-value adjustments less severe whenever applying the multiple hypothesis testing procedure developed by List et al. (2019). We will detail this procedure later in the text.

3.1. Assessing the similarity in shopping behavior

In this subsection, we assess whether the shopping behavior of the subjects was similar across the trial arms. To identify a clean treatment effect (i.e., whether the interventions reduced the purchase of plastic bags), the shopping behavior of the subjects during the experiment should be similar across all trial arms. For example, if on average, more items are purchased in the control treatment than in the *Environmental nudge* treatment, then the shoppers may need more plastic bags to carry those items. Consequently, fewer plastic bags would be purchased in the *Environmental nudge* group than in the control group, which could be misleadingly attributed to the impact of the nudge. To assess the similarity of the arms in terms of shopping behavior, we employed the following regression model:

$$Y_i = \beta_0 + \sum_{l=1}^4 \beta_l T_{il} + \varepsilon_i \quad (1),$$

where Y_i is either the number of items purchased or the amount of shopping by individual i from January to July 2020, while T_{il} is an indicator variable denoting whether individual i belongs to

¹³ Mann–Whitney U tests: *Environmental nudge & small bag* vs. *Environmental nudge & big bag* ($z=0.161$, $p=0.872$), *Financial incentives & small bag* vs. *Financial incentives & big bag* (Mann–Whitney U test, $z=1.021$, $p=0.307$).

¹⁴ Mann–Whitney U tests: *Environmental nudge & small bag* vs. *Environmental nudge & big bag* ($z=0.419$, $p=0.675$), *Financial incentives & small bag* vs. *Financial incentives & big bag* ($z=0.956$, $p=0.339$).

¹⁵ Mann–Whitney U tests: *Environmental nudge & small bag* vs. *Environmental nudge & big bag* ($z=0.700$, $p=0.484$), *Financial incentives & small bag* vs. *Financial incentives & big bag* ($z=0.876$, $p=0.381$).

treatment l . In all specifications, the control treatment is the omitted category. Thus, the coefficient β_l depicts the causal impact of treatment T_l relative to the control treatment without any intervention. In all regressions, we controlled for the heteroscedasticity of the residuals by introducing White robust standard errors. We winsorized the shopping amount, recoding the top 1% of the cases corresponding to the 99th percentile. This is a rather common approach used in randomized controlled trials when dealing with monetary amounts (e.g., Pomeranz, 2015; Hoy et al., 2020; Brockmeyer et al., 2021, among others). Table 1 reports the estimates based on Equation (1).

Table 1: Shopping behavior across trial arms

	Items purchased	Shopping amount
Financial incentives & bag	-18.547* (11.127)	-8,947.137 (5,983.520)
Environmental nudge & bag	3.146 (11.672)	2,016.395 (6,252.211)
Financial incentives	-17.124 (12.794)	-8,507.002 (6,931.957)
Environmental nudge	-10.760 (12.764)	-4,484.336 (7,088.115)
Constant	268.639*** (9.453)	138,402.564*** (5,078.838)
Mean of the control group	268.639	138,402.564
F statistics	1.900	1.668
Adjusted R-squared	0.001	0.001
Number of observations	5,150	5,150

Note: OLS regression. Dependent variables. The overall number of items purchased (Column 1) and the overall amount of shopping in AMD (Column 2) by each individual from January to July. The shopping amount is winsorized at the top 1% to deal with extreme outliers. Independent variables. *Environmental nudge* – dummy variable that equals 1 in the *Environmental nudge* treatment and 0 otherwise; *Financial incentives* – dummy variable that equals 1 in the *Financial incentives* treatment and 0 otherwise; *Environmental nudge & bag* – dummy variable that equals 1 in the *Environmental nudge & bag* treatments and 0 otherwise; *Financial incentives & bag* – dummy variable that equals 1 in the *Financial incentives & bag* treatments and 0 otherwise. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 1 suggests that the shopping behavior of individuals in various arms is rather similar in terms of the number of items purchased and the monetary amount of shopping (the treatment dummies are not significantly different from the omitted category, and the F-statistics are nonsignificant). Thus, the differences in plastic bag purchase across treatments cannot be attributed to the differences in shopping behavior.

3.2. How many subjects received a package?

In this subsection, we check how many subjects were given a package during the experiment and whether the number of these subjects is balanced across treatments. The distribution of the packages

started on January 21. Overall, 3,367 subjects out of 4,979 (the overall number of subjects in the treatment groups) were actually given a package. Approximately 35% of the subjects (571 subjects out of 1,612) who did not receive a package never showed up in the supermarket during the trial. The remaining 65% (1,041 subjects out of 1,612) either showed up in the supermarket before April 24 but did not take the package or showed up in the supermarket for the first time after April 24 when we had stopped distributing packages. To state it differently, approximately 68% of the sample who intended to receive the packages actually did so (3,367 subjects out of 4,979).

Table 2 illustrates the percentage of subjects who received a package by treatment, while Figure 2 depicts this statistic over time.¹⁶ The figure suggests that the packages were mainly distributed in January. The remaining packages were distributed in February and March.

Table 2: Number of subjects with a package

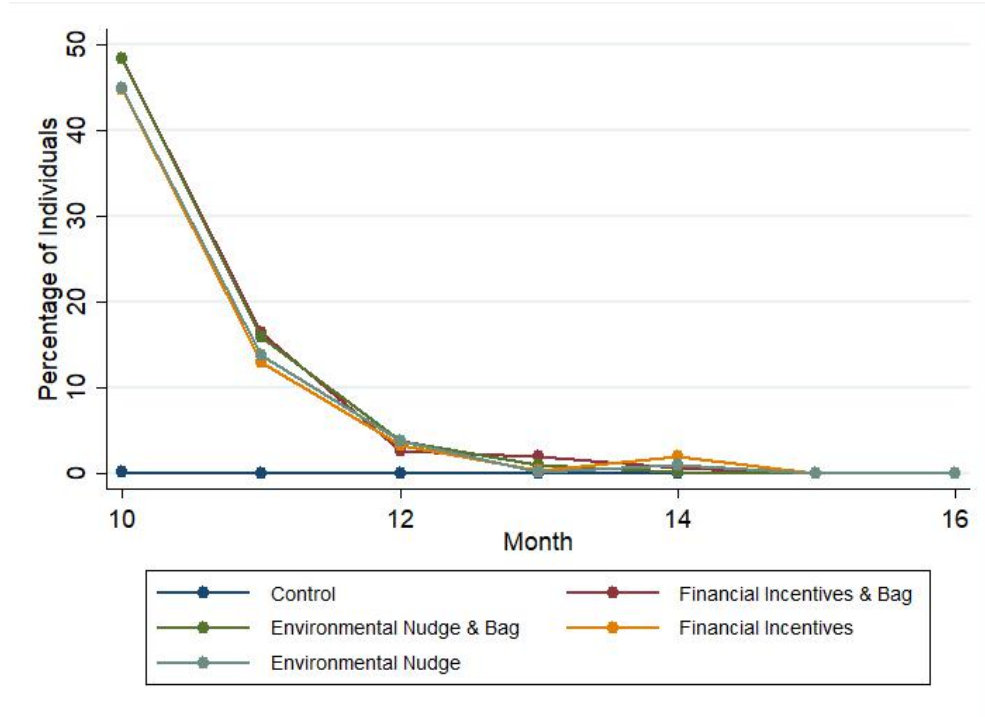
Treatment	Subjects Given a Package	Percentage of the Sample
Environmental Nudge	529	63.812%
Financial Incentives	525	63.253%
Environmental Nudge & Bag	1,150	69.277%
Financial Incentives & Bag	1,163	70.060%
Overall	3,367	67.624%

Note: The table illustrates the number of subjects to which the packages were delivered. *Environmental nudge & bag* (*Financial incentives & bag*) report the combined number of bags distributed in *Environmental nudge & big bag* (*Financial incentives & big bag*) and *Environmental nudge & small bag* (*Financial incentives & small bag*) treatments. The overall numbers of subjects are 829 in the *Environmental nudge* treatment and 830 in the *Financial incentives*, *Environmental nudge & big bag*, *Financial incentives & big bag*, *Environmental nudge & small bag*, and *Financial incentives & small bag* treatments. Thus, there are 1,660 subjects in the *Environmental nudge & bag* and *Financial incentives & bag* treatments.

Table 2 suggests slight differences in the percentage of subjects who received a package across treatments. Interestingly, fewer subjects received packages in the *Environmental nudge* and *Financial incentives* treatments than in the *Environmental nudge & bag* and *Financial incentives & bag* treatments. Most likely, the customers were more likely to take the envelope and the bag rather than the envelope alone. Later, in the text, we will discuss whether these differences can pose a threat to the validity of the conclusions.

¹⁶ In May (43 subjects), June (7 subjects), and July (2 subjects) were delivered a package by mistake.

Figure 2: Percentage of subjects receiving a package



Note: The figure illustrates the overall percentage of subjects who received a package during the experiment.

3.3. Descriptive discussion of the treatment effects

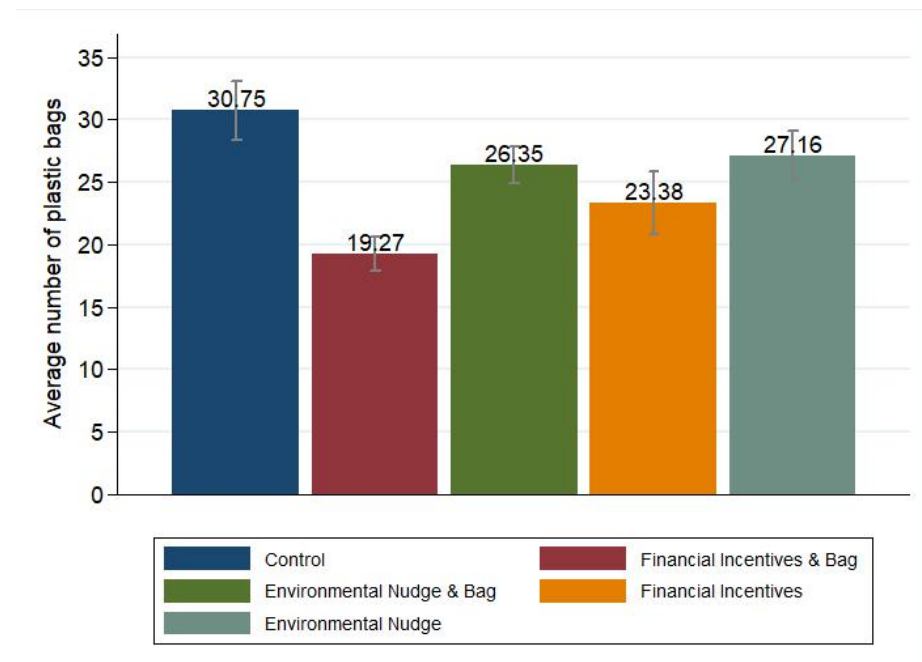
In this subsection, we provide a descriptive discussion of the treatment effects. Figure 3 depicts the average number of plastic bags purchased by treatment with the corresponding 95% confidence intervals by the end of the experiment (i.e., July 11, 2020). Several considerations regarding the figure are worth noting as follows:

- Compared to the control treatment, the reduction in the demand for disposable bags is quite large in the *Financial incentives* treatment (approximately 24% reduction) and less so in the *Environmental nudge* treatment (approximately 12% reduction).
- The treatments with financial incentives seem to outperform the respective treatments with environmental nudges. More specifically, the plastic bag purchase in the *Financial incentives* treatment is approximately 14% lower than that in the *Environmental nudge* treatment. Similarly, the plastic bag purchase in the *Financial incentives & bag* treatment is approximately 27% lower than that in the *Environmental nudge & bag* treatment.
- Reusable bags have a small impact on the demand for single-use plastic bags in addition to environmental nudges (an approximately 3% reduction compared to *Environmental nudge* treatment). Meanwhile, reusable bags have a much larger impact on the demand for single-

use plastic bags in addition to financial incentives (an approximately 18% reduction compared to the *Financial incentive* treatment).

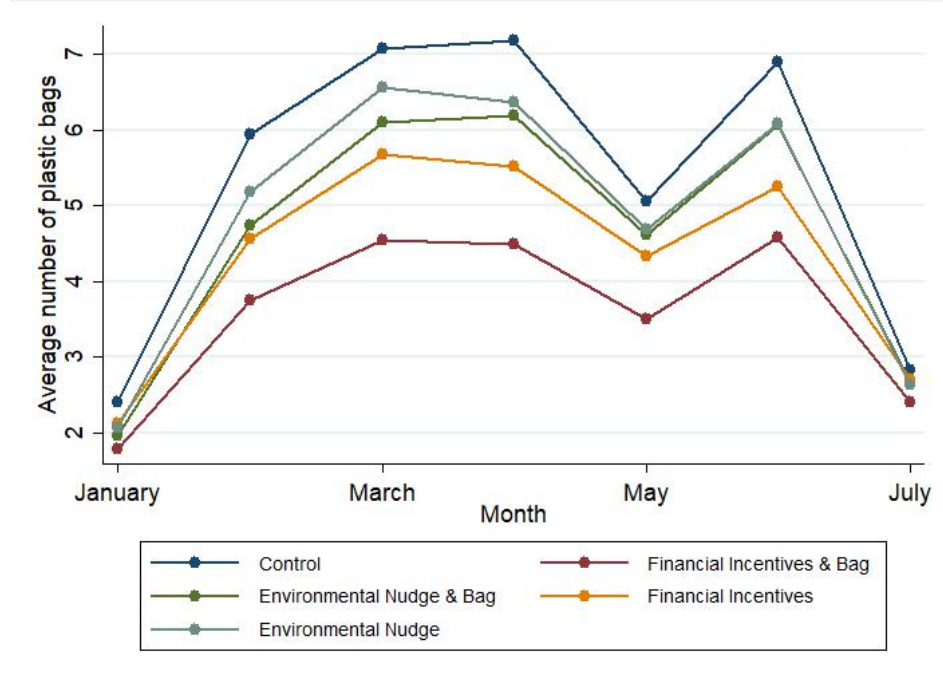
Figure 4 plots the average purchase of plastic bags over time from January 2020 to July 2020, in each treatment. The evidence in Figure 4 is aligned with that in Figure 3 in the sense that conclusions in points a)-c) mainly hold throughout the experiment. Note that the small differences across treatments in January and July can be explained by the fact that the customers were tracked for only 10 days in January and 11 days in July. Importantly, Figure 4 illustrates that the COVID-19 pandemic and the subsequent economic hardship did not seem to interact with the interventions since, within a treatment group, subjects exhibited similar behavior both in February (when no COVID-19 cases were detected in Armenia) and in the remaining months (when COVID-19 cases were detected). Had we observed a significant drop in plastic bag purchase in April, May or June relative to February within the treatments with financial incentives compared to the treatments without financial incentives, we would suspect that the economic hardship during COVID-19 interacted with our financial interventions in the sense that the consumers intensified the competition for getting extra amount of money for subsistence. In sum, we believe that the COVID-19 pandemic did not undermine the validity of our experiment.

Figure 3: Average plastic bag purchase by treatment



Note: The figure illustrates the average number of plastic bags purchased by treatment and the corresponding 95% confidence intervals. To construct this variable, we aggregated each subject's plastic bag purchases during the experiment and took the average over all subjects in each treatment.

Figure 4: Average plastic bag purchase over time



Note: The figure illustrates the average plastic bag purchase over time in each treatment.

3.4. Parametric analysis of the treatment effects

In this subsection, we report the results of the parametric analysis of the treatment effects. We estimate the following regression equation:

$$Y_i = \beta_0 + \sum_{l=1}^4 \beta_l T_{il} + \beta_2 X_i + \varepsilon_i \quad (2),$$

where Y_i is the aggregate plastic bag purchase of individual i from January to July 2020. T_{il} is an indicator variable denoting whether individual i belongs to treatment l . X_i is a vector of control variables, which includes the gender of individual i and the branch that individual i “belongs to.” In the analysis that follows, we report specifications both with and without the control variables. In all specifications, the control treatment is the omitted category. Thus, the coefficient β_l depicts the causal impact of treatment T_l relative to the control treatment without any intervention. In all regressions, we controlled for the heteroscedasticity of the residuals by introducing White robust standard errors. Table 3 reports the results. We base our discussion on the first regression specification. The results are similar when considering the second specification.

Table 3: Treatment effects analysis

	(1)	(2)
Financial Incentives & Bag	-11.484*** (1.382)	-11.490*** (1.360)
Environmental Nudge & Bag	-4.398*** (1.413)	-4.403*** (1.390)
Financial Incentives	-7.372*** (1.755)	-7.376*** (1.731)
Environmental Nudge	-3.592** (1.575)	-3.619** (1.555)
Constant	30.752*** (1.206)	27.109*** (1.214)
Mean of the Control Group	30.752	30.752
Controls	No	Yes
F statistics	25.142	15.900
Adjusted R-squared	0.017	0.037
Number of Observations	5,150	5,150

Note: OLS regression. Dependent variables. The aggregate plastic bag purchase of each individual from January to July. Independent variables. *Environmental nudge* – dummy variable that equals 1 in the *Environmental nudge* treatment and 0 otherwise; *Financial incentives* – dummy variable that equals 1 in the *Financial incentives* treatment and 0 otherwise; *Environmental nudge & bag* – dummy variable that equals 1 in the *Environmental nudge & bag* treatments and 0 otherwise; *Financial incentives & bag* – dummy variable that equals 1 in the *Financial incentives & bag* treatments and 0 otherwise. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

How does the plastic bag purchase in the treatment arms compare to the baseline? In all treatments, the plastic bag purchase was significantly lower than that at the baseline. Given the negative and significant coefficients of *Financial incentives* and *Environmental nudge* treatment dummies in Table 3, we can formulate the following result:

Result 1. *Both the environmental nudge and the financial bonus reduce the purchase of plastic bags and, therefore, stimulate pro-environmental behavior.*

The differences in the percentage of the subjects who received a package documented in subsection 3.2 do not threaten the validity of this result. First, roughly an equal number of individuals received a package in the *Environmental nudge* and *Financial incentives* groups. Second, we compared each of these treatments to a baseline in which no packages were distributed.

How do interventions with environmental nudges compare with interventions with financial incentives? According to the results, the financial bonus treatments outperform the respective environmental nudge treatments. More specifically, the purchase of plastic bags in the *Financial incentives & bag* treatments is approximately 27% lower than the purchase of plastic bags in the *Environmental nudge & bag* treatments ($F=50.49$, $p=0.000$). In a similar fashion, the purchase of plastic bags in regard to financial incentives is approximately 14% lower than the purchase of plastic

bags in regard to environmental nudges ($F=5.39$, $p=0.020$). On the basis of these findings, we state the following result:

Result 2. *Small financial bonuses are more effective in reducing the purchase of plastic bags than environmental nudges.*

The differences in the percentage of the subjects who received a package documented in subsection 3.2 do not threaten the validity of this result either. First, we compare the *Environmental nudge* treatment with *Financial incentives* treatment; in both treatments, an equal number of individuals received a package. Second, we compare the *Environmental nudge & bag* treatment with *Financial incentives & bag* treatment; in these treatments, an equal number of individuals received a package as well.

Do reusable bags affect plastic bag purchases on top of environmental nudges or financial bonuses?

The provision of reusable bags dropped the purchase of single-use plastic bags in the treatments with financial incentives by around 18% ($F=8.14$, $p=0.004$). Meanwhile, the effect of reusable bags in the environmental nudge treatments was approximately 3% ($F=0.41$, $p=0.520$).

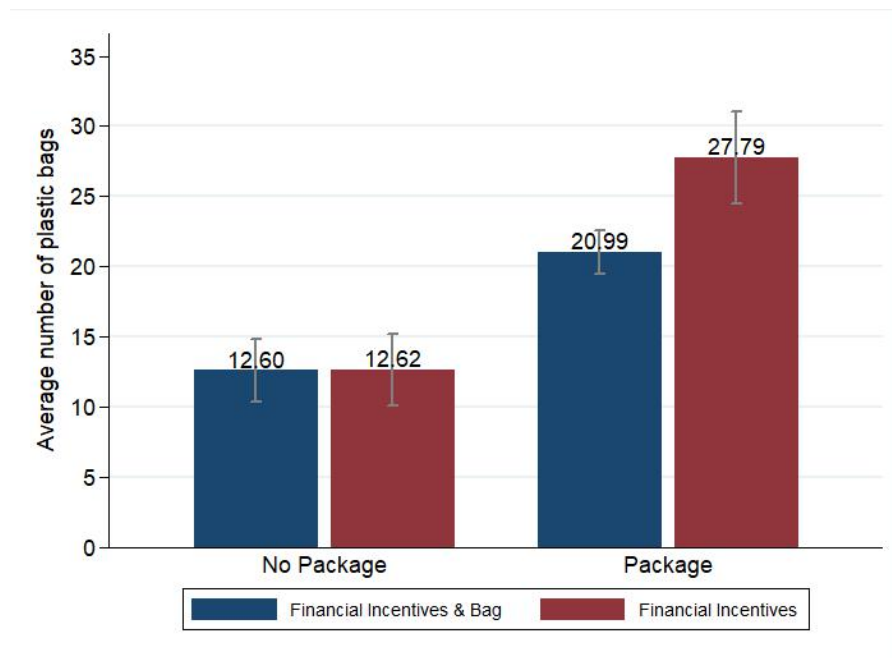
Result 3. *The reusable bag in combination with a financial bonus shrinks the purchase of plastic bags compared to the financial bonus alone. The reusable bag in combination with an environmental nudge has a negligible impact on the purchase of plastic bags compared to the environmental nudge alone.*

One may attribute the difference between *Financial incentives* and *Financial incentives & bags* to the fact that approximately 7% more packages were delivered in the latter group than in the *Financial incentives* group (please refer to Table 1). For example, one may argue that awareness about competition in the *Financial incentives & bag* groups could be higher than that in the *Financial incentives* group, which could result in fewer plastic bag purchases in these treatments. In our view, even if the subjects in the *Financial incentives* treatment did not receive a package (in this case, a letter), they were regularly notified about the competition through text messages. Thus, in terms of awareness, there should not be drastic differences since electronic communication channels such as SMS can be at least as powerful as traditional communication channels such as physical letters (e.g., Mascagni et al., 2017; Ortega and Scartascini, 2020).

To provide further support for Result 3, within the financial bonus treatments, we distinguish between subgroups that received a package and subgroups that did not receive a package but still

showed up in the supermarket during the experiment. All subgroups were sent text messages during the experiment. Figure 5 plots the average plastic bag purchase for each of the subgroups by treatment. The figure suggests that the plastic bag purchase is similar for the subgroups who were sent text messages but who did not receive a package. This is rather intuitive, as the incentives in both treatments are identical. Aligned with Result 3, those who received a reusable bag on top of the financial incentives purchased much fewer single-use plastic bags than did those who received financial incentives only. The purchase of plastic bags in the *no package* subgroups is lower than that in the *package* subgroups since individuals in the former subgroups are less active (i.e., purchase much fewer items and spend much less money) than the individuals in the latter subgroups.¹⁷

Figure 5: Plastic bag purchase for different subgroups



Note: The figure illustrates the average number of plastic bags purchased and the corresponding 95% confidence intervals for subgroups that received a package and for subgroups that did not receive a package but who still showed-up in the supermarket chains in *Financial incentives & bag* and *Financial incentives* treatments.

3.5. Multiple hypothesis testing correction

In the treatment effects analysis in subsection 3.4, we simultaneously tested eight null hypotheses, i.e., four to compare each treatment arm with the control, two to assess whether financial incentives are more powerful than environmental nudges, and two to determine the impact of free reusable

¹⁷ The average number of items purchased and the average amount spent is balanced across the treatments for a given subgroup. Please refer to Figures E1 and E2 in Appendix E.

bags on top of financial incentives and environmental nudges. When testing each of these null hypotheses in the usual way, i.e., at the $\alpha=0.05$ significance level, the probability of one or more false rejections equals 34% ($1 - (1 - 0.05)^8$). To account for the multiplicity of null hypotheses being tested and to control the familywise error rate (FWER)—the probability of one or more false rejections—we applied the procedure developed by List et al. (2019). This is a bootstrap-based procedure for testing multiple null hypotheses simultaneously using experimental data. This procedure has a much greater ability to detect truly false null hypotheses since it incorporates information about dependence ignored in classical multiple testing procedures, such as Bonferroni (1935) and Holm (1979) corrections (List et al., 2019).

Table 4 displays the following four quantities: the differences in means between two trial arms, the multiplicity-unadjusted p-values, the multiplicity-adjusted p-values computed using Theorem 3.1 of List et al.’s paper, and the improvement in the multiplicity-adjusted p-values described in Remark 3.7.¹⁸ Table 4 suggests that all the main results of the paper still hold even after accounting for the multiplicity of the null hypotheses being tested and controlling the FWER. More specifically, Panel A of Table 4 suggests that financial incentives and environmental nudges reduce the purchase of single-use plastic bags and stimulate pro-environmental behavior. Panel B of Table 4 illustrates that financial incentives are more powerful than environmental nudges in regard to ditching single-use plastic bags. Panel C of Table 4 shows that reusable bags are effective if combined with financial incentives; otherwise, they have a negligible impact if combined with environmental nudges.

Table 4: All pairwise comparisons across multiple treatments and a control

Treatment comparison		Difference in means	Unadjusted p-values (Remark 3.1)	Adjusted p- values (Theorem 3.1)	Adjusted p- values (Remark 3.7)
<i>Panel A: Are the interventions effective compared to the control?</i>					
Control	Financial incentives & bag	11.484	0.0003	0.0003***	0.0003***
Control	Environmental nudge & bag	4.398	0.0007	0.002***	0.002***
Control	Financial incentives	7.372	0.0003	0.0003***	0.0003***
Control	Environmental nudge	3.592	0.019	0.053**	0.053**
<i>Panel B: How do financial incentives compare with environmental nudges?</i>					
Financial incentives	Environmental nudge	3.781	0.018	0.061*	0.061*
Financial incentives & bag	Environmental nudge & bag	7.087	0.0003	0.0003***	0.0003***
<i>Panel C: Are reusable bags effective on top of financial incentives or environmental nudges?</i>					
Environmental nudge & bag	Environmental nudge	0.806	0.529	0.529	0.529
Financial incentives & bag	Financial incentives	4.112	0.007	0.028**	0.025**

¹⁸ In order not to overload the reader, we do not provide the multiplicity-adjusted p-values obtained by applying Bonferroni and Holm procedures to the multiplicity-unadjusted p-values.

Panel D: Miscellaneous					
Financial incentives & bag	Environmental nudge	7.893	0.0003	0.0003***	0.0003***
Environmental nudge & bag	Financial incentives	2.975	0.050	0.093*	0.093*

Notes: The table reports all pairwise comparisons across multiple treatments and a control. *The treatment comparison* column depicts the treatment under comparison. *The difference in the means* column shows the difference in plastic bag purchase between the two treatments. *Unadjusted p-values* and *adjusted p-values* illustrate the multiplicity-unadjusted and multiplicity-adjusted p-values. Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

4. Conclusion and Policy Recommendations

The results of the natural field experiment reported in this paper shed light on the impact of understudied policy interventions (other than taxes and bans) aimed at curbing the demand for single-use plastic bags. A number of important open questions are approached.

First, do environmental nudges and financial incentives that are assigned through a competitive scheme affect the demand for single-use plastic bags? Our results provide a positive answer to this question. More specifically, a leaflet explaining the harm of single-use plastic bags to the environment in combination with text messages sent as reminders can reduce the demand for single-use plastic bags by approximately 12% compared to the baseline. Competitive financial incentives exert a substantially stronger effect than environmental nudges and result in an approximately 24% reduction compared to the baseline.

Second, how effective are environmental nudges compared to financial incentives? We find that financial incentives are much more powerful catalysts to curb the demand for single-use plastic bags compared to environmental nudges.

Third, do free reusable bags help users ditch single-use plastic bags in addition to financial incentives or environmental nudges? Our findings indicate that free reusable bags provide a negligible added value on top of environmental nudges (approximately 3% reduction). The picture is entirely different in the case of financial bonuses (approximately 18% reduction). Thus, financial incentives coupled with a reusable bag can reduce the demand for single-use plastic bags by approximately 42% compared to the baseline. We believe this to be a truly fascinating result.

What are the policy implications of our study? A nudge intervention disclosing the harm of plastic is always preferred to a setting with no intervention. While such easily implementable nudges would not entirely solve the environmental problem related to single-use plastic bags, they can curb the demand at least in the short to medium run. Nevertheless, competitive bonus schemes will be preferred to environmental nudges. To motivate the adoption of such schemes, policy-makers can think of (fiscal) interventions (in the form of tax deductions) aimed at large supermarket chains and

other economic entities that are responsible for excessive plastic bag sales. Competitive bonus schemes can be accompanied by a free distribution of reusable bags, which can further ditch the single-use plastic bag. To exclude the possibility that a household receives multiple reusable bags from several economic entities (e.g., each supermarket chain provides a separate reusable bag), an ad hoc governmental agency could be designated to distribute reusable bags to households on a biannual or annual basis. Indeed, there are precedents of free reusable bag distribution by designated governmental agencies. For instance, New York City distributed reusable bags given the state's plastic bag ban (New York Times, 2020). However, most importantly, the free distribution of reusable bags with the best intentions can result in environmental harm if individuals are not incentivized to use these bags.

An important question to consider is whether financial incentives coupled with free reusable bags can lead to more environmentally favorable outcomes relative to the baseline. In general, more material and energy are required to produce a reusable bag compared to a disposable bag, which in turn increases the environmental footprint of one reusable bag relative to one disposable bag. Ultimately, both bag types have pros and cons, and whether they should be widely used can trigger serious environmental tradeoffs without a straightforward answer. More specifically, single-use plastic bags are a poor option in terms of litter on land, marine litter and microplastics, although they score rather high in environmental impact categories such as climate change, acidification, water use, and land use (United Nations Environment Program, 2020). Thus, whether a single-use plastic bag or a reusable nonwoven polypropylene bag is deemed more appropriate should largely depend on which of the abovementioned environmental aspects are given the highest priority in a given context. For instance, if a country has underdeveloped waste-management systems and poor infrastructure in place for collection and recycling (the RoA is such a country), then there are sound arguments against single-use plastic bags because of high volumes of littering and the related negative environmental impact (e.g., United Nations Environment Program, 2020). In these countries, reusable bags should be considered viable substitutes for disposable plastic bags. If this is the case, then one of the main objectives that policy-makers face is to promote the usage of reusable bags because the more frequently these bags are used, the more environmentally friendly they become compared to single-use plastic bags.

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Appendices for online publication

Appendix A. The original letters used in the Experiment (in Armenian) and their English translations

A1.1: The Original letter used in the *Environmental nudge* treatment (first page and second page)



Հարգելի հաճախորդ,

«Ծիրան» սուպերմարկետների ցանցը խնդրում է Ձեզ սուպերմարկետում գնումներ կատարելիս՝ ընդհանրապես չգնել մեկանգամյա օգտագործման պլաստիկ տոպրակներ գանձապահից՝ աջակցելով շրջակա միջավայրի պահպանությանը: Փոխարենն առաջարկում ենք գնել և օգտագործել «Ծիրան» սուպերմարկետներում վաճառվող բազմակի օգտագործման տոպրակները, 1 տոպրակը բավական է երկար ժամանակ գնումներ կատարելու համար:

Ինչո՞ւ

Պլաստիկը աղտոտում է Ձեր շրջակա միջավայրը:



Եթե պլաստիկը չի վերամշակվում, այն 100-ավոր տարիներ մնում է բնության մեջ:

Պլաստիկ տոպրակների հաճախակի օգտագործումը հանգեցնում է պլաստիկի կուտակմանը աղբավայրերում, դրանից առաջացած թունավոր նյութերն արտահոսում են՝ գետեր և լճեր, իսկ պլաստիկի այրման հետևանքով աղտոտվում է օդը:





Պլաստիկը հայտնվում է Ձեր սննդային շղթայում

Գիտե՞ք, որ այսօր պլաստիկ տոպրակներից առաջացած պլաստիկի փոքրիկ կտորներն ամենուր են: Կենդանիները հաճախ կուլ են տալիս այդ կտորները, և այդ կերպ պլաստիկը հայտնվում է մեր ակսեսներում:

Հաշվի առնելով մեկանգամյա օգտագործման պլաստիկ տոպրակների բացասական ազդեցությունը շրջակա միջավայրի վրա՝ խնդրում ենք սուպերմարկետում գնումներ կատարելիս չգնել պլաստիկ տոպրակներ գանձապահից:

Հարգանքով,
«Ծիրան» սուպերմարկետ



A1.2: The English translation of the letter used in the *Environmental nudge* treatment (first page and second page)

**Green Armenia,
Healthy People**



If plastic is not recycled it can stay in the environment for hundreds of years.

The frequent use of plastic results in the accumulation of plastic in the landfills, toxic chemicals from plastics drain out and seep into lakes and rivers, while burning the plastic pollutes the air.

Dear Customer,

“Tsiran” supermarket chain asks you not to purchase single-use plastic bags at the cashier when shopping at the supermarket in order to protect the environment.

Instead, we suggest you to buy and use the reusable bags sold at the supermarket. 1 bag is enough for shopping in the supermarket for a long time.

Why?

Plastic pollutes the environment.



Plastic appears in Your Food Chain

Do you know that the particles of plastic bags are everywhere? The animals usually swallow these particles and in this way the plastic appears in our plates.

Taking into account the negative impact of single-use plastic bags on the environment we ask you not to buy single-use plastic bags from the cashiers when shopping in the supermarket.

Sincerely,

Tsiran Supermarket



A2.1: The original letter used in the *Environmental nudge & bag* treatments (first page and second page)



Հարգելի հաճախորդ,

«Ծիրան» սուպերմարկետների ցանցը խնդրում է Ձեզ սուպերմարկետում գնումներ կատարելիս ընդհանրապես չգնել մեկանգամյա օգտագործման պլաստիկ տոպրակներ գանձապահից՝ աջակցելով շրջակա միջավայրի պահպանությանը: **Փոխարենն առաջարկում ենք գնումներ կատարելիս օգտագործել Ձեզ նվեր տրված բազմակի օգտագործման տոպրակը:** Այս տոպրակը բավական է երկար ժամանակ գնումներ կատարելու համար:

Ինչո՞ւ

Պլաստիկը աղտոտում է Ձեր շրջակա միջավայրը:

Եթե պլաստիկը չի վերամշակվում, այն 100-ավոր տարիներ մնում է բնության մեջ:

Պլաստիկ տոպրակների հաճախակի օգտագործումը հանգեցնում է պլաստիկի կուտակմանը աղբավայրերում, դրանից առաջացած թունավոր նյութերն արտահոսում են գետեր և լճեր, իսկ պլաստիկի այրման հետևանքով աղտոտվում է օդը:



Պլաստիկը հայտնվում է Ձեր սննդային շղթայում



Գիտե՞ք, որ այսօր պլաստիկ տոպրակներից առաջացած պլաստիկ փոքրիկ կտորներն ամենուր են: Կենդանիները շատ հաճախ կուլ են տալիս այդ կտորները, և այդ կերպ պլաստիկը հայտնվում է մեր օրգանիզմում:

Նաշվի ամենելով մեկանգամյա օգտագործման պլաստիկ տոպրակների բացասական ազդեցությունը շրջակա միջավայրի վրա՝ խնդրում ենք սուպերմարկետում գնումներ կատարելիս չգնել պլաստիկ տոպրակներ գանձապահից:

Նարգանջով,
«Ծիրան» սուպերմարկետ



**A2.2: The English translation of the letter used in the *Environmental nudge & bag* treatments
(first page and second page)**

**Green Armenia,
Healthy People**



If plastic is not recycled it can stay in the environment for hundreds of years.

The frequent use of plastic results in the accumulation of plastic in the landfills, toxic chemicals from plastics drain out and seep into lakes and rivers, while burning the plastic pollutes the air.

Dear Customer,

“Tsiran” supermarket chain asks you not to purchase single-use plastic bags at the cashier when shopping at the supermarket in order to protect the environment.

Instead, we suggest you to use the reusable bag that you received as a present. This bag is enough for shopping in the supermarket for a long time.

Why?

Plastic pollutes the environment.



Plastic appears in Your Food Chain



Do you know that the particles of plastic bags are everywhere? The animals usually swallow these particles and in this way the plastic appears in our plates.

Taking into account the negative impact of single-use plastic bags on the environment we ask you not to buy single-use plastic bags from the cashiers when shopping in the supermarket.

Sincerely,
Tsiran Supermarket



A3.1: The original letter used in the *Financial incentives* treatment

Հարգելի հաճախորդ,

Դուք մասնակցում եք «Ծիրան» սուպերմարկետի կապակերպած մրցույթին և կարող եք վաստակել **20.000 դրամ**:

Ինչ է պետք անել հաղթելու համար:

1. Գանձապահից պլաստիկ տոպրակ մի գնեք: Փոխարենն առաջարկում ենք գնել և օգտագործել «Ծիրան» սուպերմարկետներում վաճառվող բավական օգտագործման տոպրակները. 1 տոպրակը բավական է երկար ժամանակ գնումներ կատարելու համար:
2. «Ծիրան» սուպերմարկետում գնումներ կատարելիս միշտ ներկայացրեք Ձեր կուտակային քարտը:
3. Հնարավորինս շատ մրցութային միավորներ հավաքեք **2020թ. հունվարի 13-ից 2020թ. հուլիսի 11-ն ընկած ժամանակահատվածում**:

Ինչպես են հաշվարկվում մրցութային միավորները:

- Եթե այցի ընթացքում պլաստիկ տոպրակ չեք գնում, և Ձեր ծախսած գումարը չի գերազանցում 2000 դրամը, Դուք ստանում եք 2 մրցութային միավոր:
- Եթե այցի ընթացքում պլաստիկ տոպրակ չեք գնում, և Ձեր ծախսած գումարը 2000 դրամ ու ավելի է, դուք ստանում եք 10 մրցութային միավոր:
- Եթե այցի ընթացքում մեկ կամ ավելի պլաստիկ տոպրակ եք գնում, Դուք ոչ մի մրցութային միավոր չեք ստանում: Օրինակ եթե այցի ընթացքում ծախսել եք 15.000 դրամ և գնել եք մեկ կամ ավելի պլաստիկ տոպրակ, ստանում եք 0 միավոր:

Կարևոր է հիշել.

- Ձեր այցերի ընթացքում վաստակած մրցութային միավորները կուտակվում են:
- Դուք մրցում եք «Ծիրան» սուպերմարկետի կուտակային քարտ ունեցող 9-ը այլ հաճախորդի հետ: Ձեր խմբի նման խմբերը շատ են:
- Խմբերում ամենաշատ միավոր վաստակած անձն ընտրվելու է որպես հաղթող:
- Հաճած գումարը փոխանցվելու է Ձեր կուտակային քարտի վրա:

Մրցույթը սկսվել է **հունվարի 13-ին** և կշարունակվի մինչև **հուլիսի 11-ը**:


Մրցույթի ավարտից հետո արդյունքները կծանուցվեն Ձեզ SMS հաղորդագրության միջոցով: **Հարցերի դեպքում կարող եք պանգահարել «Ծիրան» սուպերմարկետի թեժ գիծ** **համարով:**



A4.1: The original letter used in the *Financial incentives & bag treatments*

Հարգելի հաճախորդ,

Դուք մասնակցում եք «Ծիրան» սուպերմարկետի կապակերպած մրցույթին և կարող եք վաստակել **20.000 դրամ**:



Ինչ է պետք անել հաղթելու համար:

1. Գանձապահից պլաստիկ տուպրակ մի գնեք: Փոխարենը կարող եք օգտագործել **Ձեզ նվեր տրված բալամակի օգտագործման տուպրակը**: Այս տուպրակը բավական է երկար ժամանակ գնումներ կատարելու համար:
2. «Ծիրան» սուպերմարկետում գնումներ կատարելիս միշտ ներկայացրեք Ձեր կուտակային քարտը:
3. Հնարավորինս շատ մրցութային միավորներ հավաքեք **2020թ. հունվարի 13-ից 2020թ. հուլիսի 11-ն ընկած ժամանակահատվածում**:

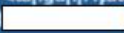
Ինչպես են հաշվարկվում մրցութային միավորները:

- Եթե այցի ընթացքում պլաստիկ տուպրակ չեք գնում, և Ձեր ծախսած գումարը չի գերազանցում 2000 դրամը, Դուք ստանում եք 2 մրցութային միավոր:
- Եթե այցի ընթացքում պլաստիկ տուպրակ չեք գնում, և Ձեր ծախսած գումարը 2000 դրամ ու ավելի է, դուք ստանում եք 10 մրցութային միավոր:
- Եթե այցի ընթացքում մեկ կամ ավելի պլաստիկ տուպրակ եք գնում, Դուք ոչ մի մրցութային միավոր չեք ստանում: Օրինակ՝ եթե այցի ընթացքում ծախսել եք 15.000 դրամ և գնել եք մեկ կամ ավելի պլաստիկ տուպրակ, ստանում եք 0 միավոր:

Կարևոր է հիշել

- Ձեր այցերի ընթացքում վաստակած մրցութային միավորները կուտակվում են:
- Դուք մրցում եք, «Ծիրան» սուպերմարկետի կուտակային քարտ ունեցող 9-ը այլ հաճախորդի հետ: Ձեր խմբի նման խմբերը շատ են:
- Խմբերում ամենաշատ միավոր վաստակած անձն ընտրվելու է որպես հաղթող:
- Շահած գումարը փոխանցվելու է Ձեր կուտակային քարտի վրա:

Մրցույթը սկսվել է **հունվարի 13-ին** և կշարունակվի մինչև **հուլիսի 11-ը**:

Մրցույթի ավարտից հետո արդյունքները կծանուցվեն Ձեզ SMS հաղորդագրության միջոցով: **Հարցերի դեպքում կարող եք վանգահարել «Ծիրան» սուպերմարկետի թեժ գիծ**  **համարով:**



A4.2: The English translation of the letter used in the *Financial incentives & bag treatments*

Dear Customer,

You take part in a competition organized by “Tsiran” supermarket where you can win **20.000 AMD**.

What do you need for winning?

1. **Do not buy a plastic bag from the cashier. Instead you can use the reusable bag you received as a present. This bag is enough for shopping in the supermarket for a long time.**
2. When shopping in the supermarket always present your loyalty card.
3. Accumulate as many competition points as possible from January 13, 2020 to July 11, 2020.



How are the competition points calculated?

- If you do not buy plastic bags during your visit and your shopping amount does not exceed 2000 AMD, you receive 2 competition points.
- If you do not buy plastic bags during your visit and your shopping amount is greater or equal to 2000 AMD, you receive 10 competition points.
- If you buy one or more plastic bags during your visit you do not receive any competition point. For instance, if you have spent 15.000 AMD during your visit and you have bought one or more plastic bags you receive 0 points.

Important points to remember.

- The competition points you earn during your visits accumulate.
- You compete with 9 other customers who also hold loyalty cards issued by “Tsiran” supermarket. There are many groups like yours.
- The individuals who accumulate the highest number of competition points in each group win the competition.
- The amount you win will be transferred to your loyalty card.

The competition started on **January 13** and will last until **July 11**.

You will be notified about the results of the competition through an SMS. In case of questions you can call “Tsiran” supermarket hotline at XXXXXXXX.



Appendix B. The content and the dates of the text messages sent to the participants

Dates Sent	Text
	<p><i>Environmental nudge treatment</i></p> <p>When shopping at Tsiran supermarket do not buy plastic bags, since they pollute the environment. Instead buy one reusable bag and use for a long time.</p> <p><i>Environmental nudge & small bag and Environmental nudge & big bag treatments</i></p> <p>When shopping at Tsiran supermarket do not buy plastic bags, since they pollute the environment.</p> <p><i>Financial incentives, Financial incentives & small bag, Financial incentives & big bag treatments</i></p>
31/01/2020	<p>As a loyalty card holder you participate in a competition held by Tsiran supermarket where you can win around 20.000 AMD. To do so, you should not buy plastic bags when shopping in the supermarket. The competition will continue until July 11. Please call xxxxxxxxx for more details. You will be provided with more information during your next visit to the supermarket.</p>
14/02/2020	
28/02/2020	
13/03/2020	
	<p><i>Environmental nudge treatment</i></p> <p>When shopping at Tsiran supermarket do not buy plastic bags, since they pollute the environment.</p>
27/03/2020	<p><i>Environmental nudge & small bag and Environmental nudge & big bag treatments</i></p>
23/04/2020	
08/05/2020	<p>When shopping at Tsiran supermarket do not buy plastic bags, since they pollute the environment. Instead, use the reusable bag the supermarket provided to you.</p>
22/05/2020	
05/06/2020	<p><i>Financial incentives, Financial incentives & small bag, Financial incentives & big bag treatments</i></p>
22/06/2020	
03/07/2020	<p>As a loyalty card holder you participate in a competition held by Tsiran supermarket where you can win around 20.000 AMD. To do so, you should not buy plastic bags when shopping in the supermarket. The competition will continue until July 11. Please call xxxxxxxxx for more</p>

	details. You will be provided with more information during your next visit to the supermarket.
14/07/2020	The results of the competition held by Tsiran supermarket are being finalized and the winners will be soon notified through an SMS.

Appendix C. Balance checks

Table C1: Checking differences across trial arms

	Gender	Shopping Amount	Items Bought	Plastic Bags Purchased
Environmental nudge	-0.001 (0.023)	-830.239 (4,769.896)	1.613 (8.368)	-0.313 (1.030)
Financial incentives	0.000 (0.023)	1,196.630 (4,648.312)	5.576 (8.267)	-0.039 (0.988)
Environmental nudge & big bag	0.002 (0.023)	-1,303.323 (4,666.037)	-6.243 (8.098)	-0.765 (1.016)
Financial incentives & big bag	-0.002 (0.023)	4,582.026 (5,238.916)	1.630 (8.779)	0.353 (1.051)
Environmental nudge & small bag	-0.001 (0.023)	4,957.551 (4,880.749)	4.100 (8.423)	0.414 (1.039)
Financial incentives & small bag	-0.001 (0.023)	2,633.004 (4,810.926)	4.175 (8.536)	0.339 (1.090)
Constant	0.339*** (0.016)	108,325.449*** (3,378.842)	214.022*** (5.736)	24.852*** (0.710)
F statistics	0.008	0.517	0.454	0.326
Adjusted R-squared	-0.001	-0.000	-0.001	-0.001
Number of Observations	5,809	5,809	5,809	5,809

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Appendix D. Treatment non-compliance in the experiment

Table D1: The pattern of missingness

	(1)
Financial incentives & bag	0.012 (0.013)
Environmental nudge & bag	0.013 (0.013)
Financial incentives	0.002 (0.015)
Environmental nudge	-0.001 (0.015)
Constant	0.106*** (0.011)
F statistics	0.552
Adjusted R-squared	-0.000
Number of Observations	5,809

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Appendix E. Sub-group differences

Figure E1: Average amount of shopping in different subgroups

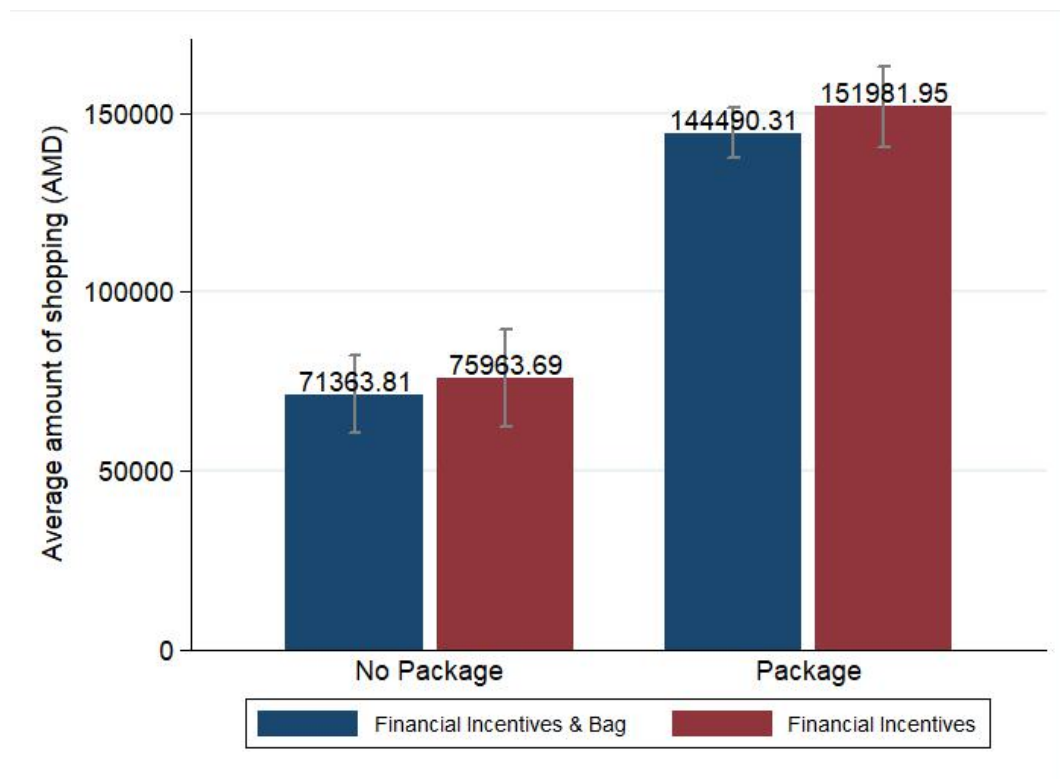


Figure E2: Average number of items purchased in different subgroups

