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## Breaking the bag habit: Testing interventions to reduce plastic bag demand in a developing country

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# Cardiff Economics Working Papers



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# Breaking the Bag Habit: Testing Interventions to Reduce Plastic Bag Demand in a Developing Country<sup>1</sup>

Armenak Antinyan,<sup>2</sup> Luca Corazzini<sup>3</sup>

**Abstract.** Little is known about the impact of interventions aimed at reducing the demand for single-use plastic bags. In a natural field experiment conducted in a big supermarket chain in Armenia, we test how a nudge (information on the environmental impact of plastic), a competitive financial bonus scheme, and a free provision of reusable bags affect the demand for disposable bags. Relative to the baseline with no intervention, both the bonus and the nudge considerably reduce the purchase of disposable bags. The bonus scheme and the environmental nudge are equally effective when not combined with free reusable bags. However, the financial bonus scheme combined with a free reusable bag is a more potent catalyst of pro-environmental behavior than the environmental nudge combined with a similar bag. Individuals actively use the tote bags to ditch plastic in the presence of a competitive bonus.

**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

Human-induced climate change is undoubtedly one of the most acute policy challenges of the 21<sup>st</sup> century that can seriously disrupt the world economy and shrink the soaring living standards. Plastic is a major contributor to climate change from the beginning to the end of its lifecycle and emits around 3.4% of global greenhouse gas emissions (OECD Global Plastics Outlook Database). Furthermore, plastic pollution leaks to the environment and poses a considerable threat to animal and human health, reducing productivity, straining the healthcare systems, and surging economic inequalities (Pörtner et al., 2022). Around half of the plastic produced is for single-use purposes, with most of this produce ending up in landfills (Lindwall, 2020). Disposable plastic bags are one of the most common single-use items, with approximately 0.5-1 trillion bags consumed annually worldwide (equivalent to 1-2 million bags every minute) (Nielsen et al. 2019; Plastics Oceans, 2019).

This paper reports the results of a natural field experiment (NFE)<sup>4</sup> conducted in a large supermarket chain in Armenia (a developing post-Soviet country in the South Caucasus) aimed at assessing the efficacy of demand-side interventions to curb the purchase of single-use plastic bags.

In the first step, we test and compare the impact of an environmental nudge<sup>5</sup> and of a competitive financial bonus scheme on the number of single-use plastic bags the customers buy. The environmental nudge simply provides information about the harm caused by disposable plastic bags, since the provision of information is considered as one of the most frequent and effective nudges adopted by policymakers (e.g., Sunstein, 2014; Patel, 2018). The financial bonus scheme creates competition among supermarket customers. This is motivated by the experimental literature that studies the impact of incentive-compatible competitive schemes on human behavior (Corazzini et al., 2010; Linardi and Tanaka, 2013; Sintov et al., 2016; Belot et al., 2016, Cárdenas et al., 2019). More

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<sup>4</sup> 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).

<sup>5</sup> An intervention is classified as a nudge if it i) is inexpensive to implement, ii) does not prohibit economic agents from undertaking a certain action, iii) does not affect the financial incentives of economic agents (Thaler and Sunstein, 2021).

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.

In the second step, we test the impact of distributing free reusable bags alongside the environmental nudge or the financial bonus scheme. More specifically, we compare the effectiveness of combining the nudge or the financial bonus scheme with free reusable bags (made of nonwoven polypropylene) to using these interventions alone. While many organizations distribute reusable bags for free with the best intentions, there is no evidence of whether individuals use the bags they receive. Our experimental design allows us to generate such evidence. The distribution of free reusable bags can change the customers' default option (Johnson and Goldstein, 2003)<sup>6</sup> or send a strong signal that that pro-environmental behavior is the course of action recommended by the supermarket (McKenzie et al., 2006).

We contribute to the scarce and recent literature that studies the causal impact of policies on the demand for disposable bags. This literature can be categorized into two groups. The first group looks at the impact of conventional policies such as taxes, bans, and bonuses, while the second group explores the impact of behavioral interventions such as nudges. As for the conventional policies, the evidence suggests that partial bans on thin plastic bags may be counterproductive if thick bags are widely available, while the effectiveness of taxes varies and may lead to a rebound effect in the long run (Homonoff et al., 2020, Cabrera et al., 2021).<sup>7</sup> A single study finds the financial bonus to be ineffective (Homonoff, 2018). As for behavioral interventions, money donated to institutions if customers do not purchase disposable bags reduces the demand for single-use plastic bags from 10%

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<sup>6</sup> 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.

<sup>7</sup> 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.

to 30% (Romano and Sotis, 2020; Penn et al., 2022). Reminders sent to farmers increase plastic bag returns by 83% compared to the pre-intervention period.

Several limitations of the extant literature are worth mentioning. First, most of the studies rely on a quasi-experimental research design and use a difference-in-difference approach to evaluate the impact of an intervention (e.g., a nudge or a tax) on the demand for disposable bags. Second, there is heavy reliance on observational data which may introduce noise in the estimates (Cabrera et al., 2021). Third, these studies are either implemented in specific locations or with specific subgroups such as on-campus stores, farmers, cost-sensitive customers, or a single supermarket store, which may hinder the generalizability of the findings. We believe that our setting overcomes these limitations to a large extent. Not only does our NFE avoid the need for the strong identification assumptions of the difference-in-difference method (Gertler et al., 2016),<sup>8</sup> but we also conduct a city-wide experiment across all branches of a general supermarket chain. This allows us to capture the purchasing behavior of a diverse range of population subgroups in terms of income, age, and profession among other characteristics instead of relying on a specific subgroup. Finally, we utilize supermarket scanner data rather than observational data which enhances the accuracy of our results. On top of the methodological advancements, our study incorporates several distinctive factors that furtherly augment the existing literature: i) we generate evidence on a novel bonus scheme that future research may want to adapt and experiment with as the impact of bonuses on the disposable plastic bag demand is particularly understudied;<sup>9</sup> ii) we compare the bonus scheme with the nudge contributing to the literature that urges to juxtapose the effectiveness of behavioral and conventional instruments (Carlsson et al., 2021; List et al., 2022); iii) we assess for the first time whether individuals use the reusable bags they receive for free and how the use of these bags interacts with other policy interventions; iv) we report evidence from a developing country addressing an important gap, since

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<sup>8</sup> “NFE represents the cleanest possible manner in which to estimate the treatment effect of interest” (Al-Ubaydli and List, 2013, p.6).

<sup>9</sup> To the best of our knowledge, only Homonoff (2018) explores this question.

most of the studies discussed concentrate on developed countries. This is unfortunate, as plastic waste may inflict disproportionate harm on developing countries because of their constrained financial and institutional resources.

The rest of the paper is structured as follows. Section 2 discusses the institutional context in Armenia, the experimental design, and the implementation details. The 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**

Like many developed and developing countries, Armenia 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 Armenia, 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 Armenian Government is actively designing regulations to curb the consumption of disposable plastic in the country. In the last few years, the major supermarket chains (including the supermarket we collaborated with) 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).<sup>10</sup> Since there is no common regulation, the fee the supermarkets charge can differ. Meanwhile, smaller shops still provide plastic bags for free. In the beginning of 2022, the Armenian Government introduced a partial ban on single-use plastic bags.

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<sup>10</sup> In 2020, 1 USD was roughly 500 AMD. All calculations in the paper are implemented with this exchange rate in mind.

## 2.2. Treatments

The current experiment aimed i) to test and compare the impact of an environmental nudge and of a financial bonus scheme on the purchase of single-use plastic bags, ii) 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 focused on loyalty card holders and designed an experiment consisting of 7 trial arms, as detailed below.<sup>11</sup>

**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 can 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 bonus (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 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 at the time of the study) 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 at the time of the study) and purchasing no plastic bags;

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<sup>11</sup> We focused on loyalty card holders to be able to implement an NFE with scanner data that captures the actual behavior of the supermarket customers. For instance, to track the behavior of the customers without loyalty cards, we could have distributed special cards to be used when shopping at the supermarket branches. Alternatively, we could have asked the study participants to self-report their behavior through surveys or diaries every time they went for shopping. Both approaches would require us to obtain the customers’ informed consent to participate in a study. This would violate one of the main NFE conditions. Furthermore, the self-reported data could be subject to recall and social desirability biases. We will come back to NFEs in Section 2.4.



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

**Financial bonus & big bag (830 people):** The subjects in this group received the same letter with financial incentives as that provided in the *Financial bonus* 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 commenced on January 21, 2020, and lasted until July 11, 2020.<sup>12</sup> The experiment was conducted in all 9 branches of the Tsiran supermarket chain (the supermarket we collaborated with) located in the capital city of Yerevan.<sup>13</sup> Tsiran is one of the largest supermarket chains in Yerevan and the branches are in different parts of the city. Furthermore, the supermarket chain is used by all population subgroups in terms of income, age, and profession among other characteristics. 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.

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<sup>12</sup> 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.

<sup>13</sup> At the time of the implementation of the trial, most of the supermarket branches were located in Yerevan.

### **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.

*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, which could pose a threat for 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 rather than ordinary customers. The responses of these two groups to the treatment stimuli can be rather heterogeneous. Since we could

not distinguish the business customers from the ordinary ones, we introduced a further selection criterion which 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 the supermarket branch the individual “belongs” to. 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 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). 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. In any case, we believe the threat of potential spillovers to be rather minimal in the experiment. First, the supermarket chain we worked with is one of the largest in Armenia 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

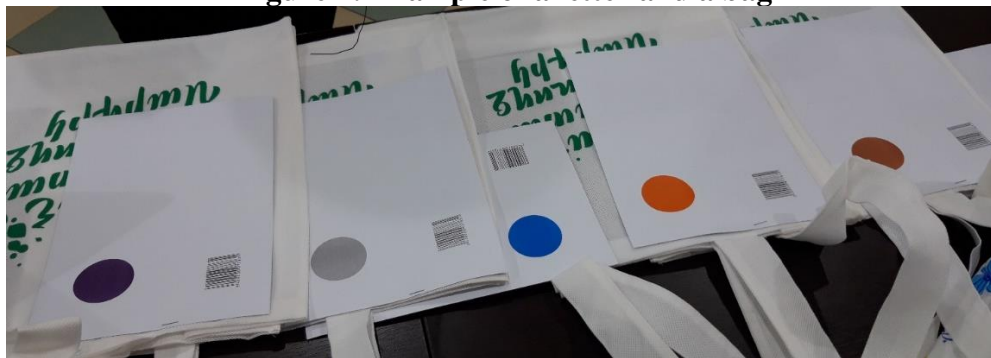
supermarket (approximately 50,000 individuals at the time of the study). Thus, the probability that many of the participants randomized to treatment arms know each other and interact is rather small.

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, iv) the visit frequency, and v) the gender of the loyalty card holder.<sup>14</sup> 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 bonus* 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 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 bag**



Note: An example of a letter and a bag.

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<sup>14</sup> 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, the total shopping amount, and the visit frequency (proxied by the number of times the loyalty card was used) from April to December 2019, instead of April to July 2019, when checking the balance of the trial arms.

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.<sup>15</sup> 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.<sup>16</sup> Second, this process served as proof that the packages had been delivered to the participants, thus allowing us to calculate the number of subjects who were given packages for each treatment. There was also a barcode inside each reusable bag. The cashiers were instructed to scan this barcode every time a customer showed up with such a bag. This would allow us to check the frequency of tote bag usage.

During the trial, the team regularly visited all 9 supermarket branches to follow the implementation process and remained actively in touch with the managers of the supermarket branches.

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<sup>15</sup> 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.

<sup>16</sup> 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.

#### **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. Most importantly, the cashiers were instructed to frame the distribution of the packages as a supermarket campaign for randomly selected loyalty cardholders. 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 also instructed to flag the 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.

#### **2.4. Further remarks**

A few further remarks on the experimental design are worth a discussion. First, in an NFE, the subjects make decisions in a naturally occurring environment, and do not know that they are part of an experiment (e.g., Al-Ubaydli and List, 2013). We believe that both conditions are held in the current experiment since the subjects make single-use plastic bag purchase decisions during their regular

shopping visits to the supermarket and do not know that they are participating in an experiment. In this regard, as already discussed, the cashiers were instructed to frame the distribution of the packages as a supermarket campaign for randomly selected loyalty cardholders. Even when it comes to scanning the barcodes inside the reusable bags, in Armenia, the cashiers are responsible for placing the shopping into the bags. As a result, the customers typically hand their bags to the supermarket staff at the till. This means that during the experiment a cashier would not request the bag, scan it, and give it back to the customer to place the shopping inside, triggering the customer suspicion that something irregular was happening.

Second, it can be posited that the customers in our experiment are subject to the Hawthorne effect, i.e., the feeling of being observed or participating in an experiment. As already discussed in the previous paragraph, individuals do not know that they are part of an experimental investigation. Furthermore, if we try to restate the interventions in simple words, the distributed materials – framed to be part of a supermarket campaign – instruct the individuals to purchase fewer plastic bags either for the sake of the environment or for the sake of money. Thus, it is hard to imagine why an individual, who does not know that she is participating in a study, should develop a feeling of being observed based on the materials distributed during a supermarket campaign. We also believe that other NFEs in literature share a setting like ours, which implies that if a Hawthorne effect is present in our work then it may be deep-rooted in other studies as well. For example, a taxpayer, who receives a deterrence or a non-deterrence nudge to pay her taxes, may be argued to change her behavior because of a feeling of being observed by tax authorities rather than because of other theoretical considerations (see Antinyan and Asatryan (2020) for a meta-analysis of NFEs in tax compliance). Similarly, an individual who receives a reminder nudge to go to gym (Calzolari and Nardotto, 2017), to visit her dentist (Altmann and Traxler, 2014), or to donate to a charity (Damgaard and Gravert, 2018) may do so because of the feeling of being observed rather than because of different behavioral fallacies being targeted.



Third, one may disagree with the competitive incentive scheme, arguing that the administrative burden and the General Data Protection Regulations (GDPR) or other privacy regulations would make this scheme impossible to implement on a scale. Regarding the administrative burden, given that many modern supermarkets use advanced IT systems for data management, it would not require substantial administrative and financial resources to randomize the loyalty card holders into groups and monitor their progress (a few lines of a code in the system). Similarly, it is neither financially demanding, nor administratively costly to reach out to the customers using SMS or various social networks (such as Facebook, Whatsapp, Viber, etc.), and to print/distribute leaflets as part of a supermarket campaign. Many supermarkets are involved in such operations daily and have an established infrastructure and dedicated funds at place. As for GDPR or other privacy concerns, the supermarkets track the shopping behavior of their loyalty cardholders, assess how loyal these cardholders are, what they buy and how much they spend. In this regard, tracking the number of plastic bags purchased by cardholders, checking whether they won the competition in each group, and rewarding them with a certain amount of money does not violate the legal framework the supermarkets operate in. In this experiment, we chose to randomize the data ourselves to have full control of the experiment. Similarly, complex color-coding was implemented to maximize the control over the distribution of the packages. No color-coding is necessary if a supermarket wants to upscale one of the best performing interventions discussed in this paper.

Fourth, the choice of the competitive scheme does not come out of the blue. There is evidence in the literature that ordinary incentive schemes can be ineffective in such domains as pro-environmental and health behavior (e.g., Belot et al., 2016; Homonoff, 2018). Furthermore, competitive incentive schemes can outperform ordinary incentive schemes (e.g., Belot et al., 2016). Given this evidence and the fact that we could test only a limited number of treatments, we decided to generate new knowledge instead of replicating an incentive structure tested and proven to be ineffective elsewhere (Homonoff, 2018). Given that this area of research is largely understudied, there are many interesting and feasible

open questions to be studied in this context, such as how i) the incentive structure (i.e., ordinary bonus vs a competitive scheme), ii) the size of the financial incentives, iii) the size of the group, iv) the time interval of the study, and v) the country context affect the single-use plastic bag purchase. This list of potential research questions is non-exhaustive.

### 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 highlighting.

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). 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). In sum, in the entire analysis that follows, all individuals, but the ones who never showed up in the supermarket, are included in the sample.

Second, we pooled the *Environmental nudge & small bag (Financial bonus & small bag)* and *Environmental nudge & big bag (Financial bonus & big bag)* groups, since i) there was a marginal difference in the treatment stimuli between these arms (the bag sizes differed only slightly) and ii) there were no significant differences in plastic bag purchases, the average number of items purchased, or the average amount of shopping between these treatments (the results of the tests are available upon request).

### 3.1. 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 number of subjects in the treatment groups) were 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 did so (3,367 subjects out of 4,979).

Table 1 illustrates the percentage of the subjects who received a package by treatment, while Figure 2 depicts this statistic over time.<sup>17</sup> The figure suggests that the packages were mainly distributed in January. The remaining packages were distributed in February and March.

**Table 1: Number of subjects with a package**

Treatment	Subjects given a package	Percentage of the sample
Environmental nudge	529	63.812%
Financial bonus	525	63.253%
Environmental nudge & bag	1,150	69.277%
Financial bonus & bag	1,163	70.060%
Overall	3,367	67.624%

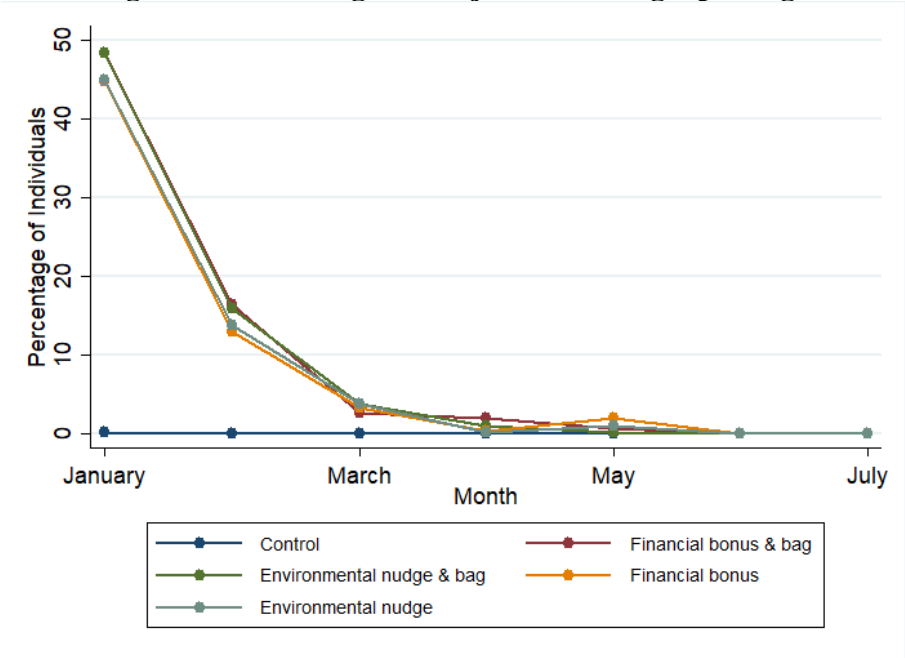
Note: The table illustrates the number of subjects to which the packages were delivered. *Environmental nudge & bag* (*Financial bonus & bag*) report the combined number of bags distributed in *Environmental nudge & big bag* (*Financial bonus & big bag*) and *Environmental nudge & small bag* (*Financial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

Table 1 reveals very small differences in the percentage of subjects who received packages across treatments. Interestingly, fewer subjects received packages in the *Environmental nudge* and *Financial bonus* treatments than in the *Environmental nudge & bag* and *Financial bonus & bag* treatments.

<sup>17</sup> In May (43 subjects), June (7 subjects), and July (2 subjects) were delivered a package by mistake.

Probably, 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.

**Figure 2: Percentage of subjects receiving a package**



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

**3.2. 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. According to the figure:

- a. *(Effectiveness of the treatments vs control)* Compared to the control treatment, the reduction in the disposable bag purchase is 12% and 24% in the *Financial Bonus* and *Environmental Nudge* treatments, respectively.
- b. *(Effectiveness of the competitive financial bonus vs the environmental nudge)* The plastic bag purchase in the *Financial bonus* treatment is approximately 14% lower than that in the *Environmental nudge* treatment. Similarly, the plastic bag purchase in the *Financial bonus &*

*bag* treatment is approximately 27% lower than that in the *Environmental nudge & bag* treatment.

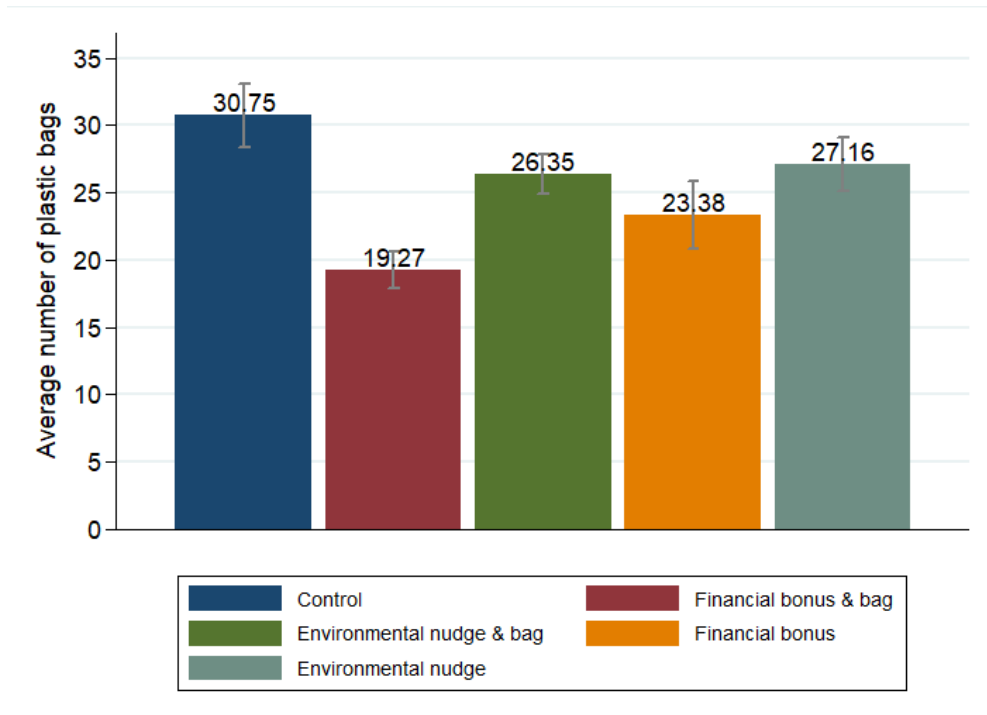
- c. (*Effectiveness of the reusable bag*) The difference in plastic bag purchase between *Environmental nudge & bag* and *Environmental nudge* is around 3%, while the same difference between *Financial bonus & bag* and *Financial bonus* is around 18%.

Figure 4 plots the average monthly purchase of plastic bags by treatment.<sup>18</sup> Note that the low number of bags purchased in January and July is 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 in 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 customers intensified the competition for getting additional money for subsistence. In sum, we believe that the COVID-19 pandemic did not undermine the validity of our experiment.

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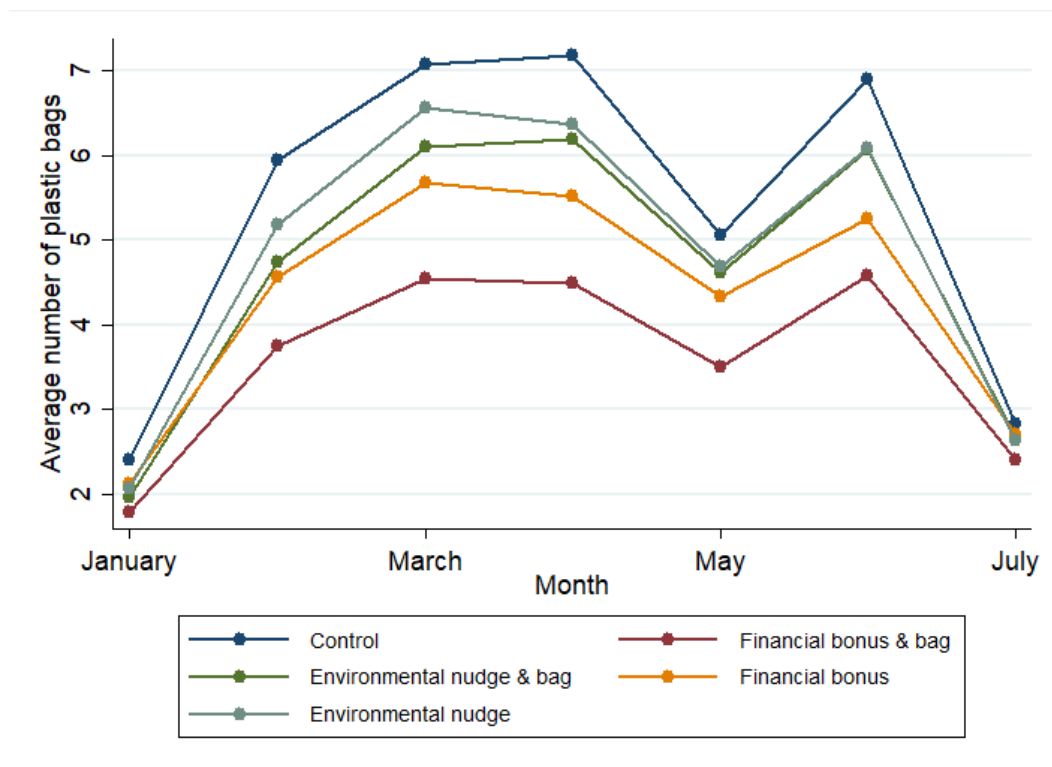
<sup>18</sup> The figure suggests a decrease in the number of plastic bags purchased in May 2020. This can be explained by the fact that the COVID restrictions imposed by the Armenian Government were relaxed in May 2020. Most likely individuals reduced their supermarket visits and used this money for going out. When checking the number of supermarket visits from January 2020 to July 2020, we observe a similar pattern for the average number of supermarket visits and the average number of items purchased.

**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.

### 3.3. 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:

$$Y_i = \beta_0 + \sum_{l=1}^4 \beta_l T_{il} + \beta_5 X_i + \varepsilon_i \quad (1),$$

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 individual  $i$  is associated with. 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  $\beta_l$  depicts the causal impact of treatment  $T_l$  relative to the control treatment without any intervention. In all regressions, we controlled the heteroscedasticity of the residuals by introducing White-robust standard errors. Table 2 reports the results. We base our discussion on the first regression specification. The results remain qualitatively unchanged when considering the second specification.

**Table 2: Treatment effects analysis**

	(1)	(2)
Financial bonus & bag	-11.484*** (1.382)	-11.490*** (1.360)
Environmental nudge & bag	-4.398** (1.413)	-4.403** (1.390)
Financial bonus	-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 bonus* – dummy variable that equals 1 in the *Financial bonus* treatment and 0 otherwise; *Environmental nudge & bag* – dummy variable that equals 1 in the *Environmental nudge & bag* treatments and 0 otherwise; *Financial bonus & bag* – dummy variable that equals 1 in the *Financial bonus & bag* treatments and 0 otherwise; *Gender* – dummy variable that equals 1 if an individual is a male, and 0 otherwise;

*Branch* – dummy variable that equals 1 if an individual belongs to the given supermarket branch and 0 otherwise. Significance levels: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

*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 bonus* and *Environmental nudge* treatment dummies in Table 2, 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 3.1 do not threaten the validity of this result. First, roughly an equal number of individuals received a package in the *Environmental nudge* and *Financial bonus* groups. Second, we compared each of these treatments to a baseline in which no packages were distributed.

*How do the interventions with the environmental nudge compare with the interventions with the competitive financial bonus scheme?* According to the results, the competitive financial bonus treatments outperform the respective environmental nudge treatments. More specifically, the purchase of plastic bags in the *Financial bonus & 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 response to the competitive financial bonus is approximately 14% lower than the purchase of plastic bags in response to the environmental nudge ( $F=5.39$ ,  $p=0.020$ ). Based on these findings, we state the following result:

**Result 2.** *The competitive financial bonus scheme is more effective in reducing the purchase of plastic bags than the environmental nudge.*

The differences in the percentage of the subjects who received a package documented in subsection 3.1 do not threaten the validity of this result either. First, we compare the *Environmental nudge*



treatment with *Financial bonus* treatment: in both treatments, an equal number of individuals received a package. Second, we compare the *Environmental nudge & bag* treatment with *Financial bonus & 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 the environmental nudge or the financial bonus scheme?* The provision of reusable bags dropped the purchase of single-use plastic bags in the treatments with competitive financial bonuses by around 18% ( $F=8.14$ ,  $p=0.004$ ). Meanwhile, the effect of reusable bags in the environmental nudge treatments was approximately 3% ( $F=0.41$ ,  $p=0.520$ ).

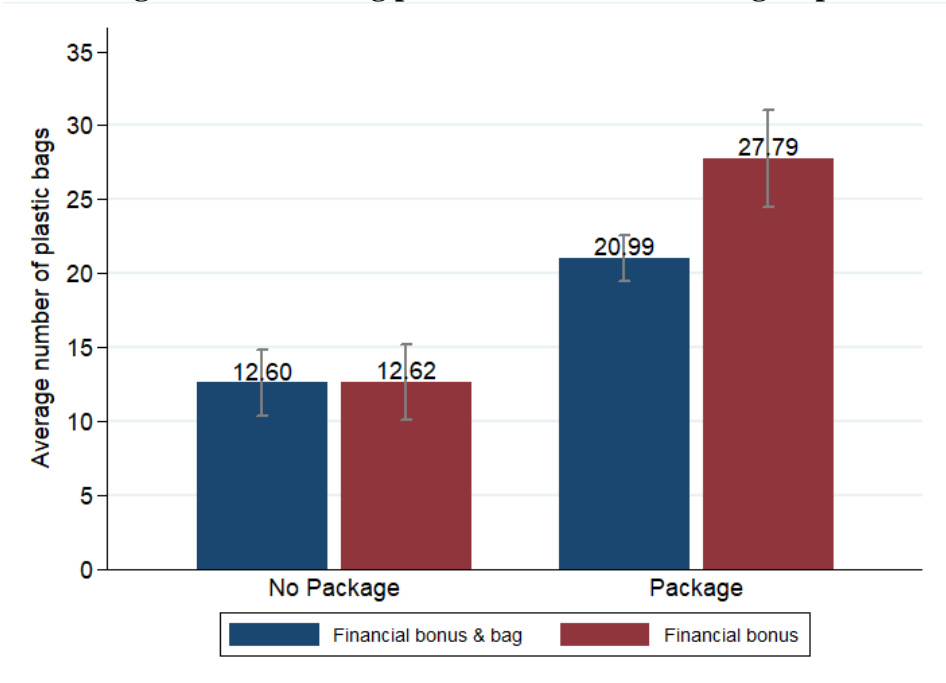
**Result 3.** *The reusable bag in combination with a financial bonus scheme shrinks the purchase of plastic bags compared to the financial bonus scheme alone. The reusable bag in combination with an environmental nudge has a negligible impact on the purchase of plastic bags compared to the environmental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

One may attribute the difference between *Financial bonus* and *Financial bonus & bag* to the fact that approximately 7% more packages were delivered in the latter than in the former (please refer to Table 1). For example, one may argue that awareness about competition in the *Financial bonus & bag* groups could be higher than that in the *Financial bonus* group, which could result in fewer plastic bag purchases in these treatments. If awareness were an important driver of this difference, we would also observe substantial differences between *Environmental nudge* and *Environmental nudge & bag* treatments, since in the latter roughly 7% more packages were delivered than in the former. However, we observe almost identical behavior.

To provide further support for the difference between *Financial bonus* and *Financial bonus & bag*, in these 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. Figure 5 plots the average plastic bag purchase for each of the subgroups by treatment. According to the figure, plastic

bag purchase is similar for the subgroups that did not receive a package. This is rather intuitive, as these subgroups have identical incentives and are equally informed about the competition. However, in the subgroups that were given a package, 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.

**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 bonus & bag* and *Financial bonus* treatments.

**3.4. How robust are the previous results? Multiple hypothesis testing correction**

In the treatment effects analysis presented in subsection 3.3, we simultaneously tested eight null hypotheses: four to compare each treatment arm with the control, two to assess whether the financial bonus scheme is more powerful than the environmental nudge, and two to determine the impact of free reusable bags on top of the financial bonus scheme and the environmental nudge. 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). We will only rely on the comparisons that keep their significance after the application of the multiple hypothesis testing correction.

Table 3 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. Panel A of Table 3 confirms *Result 1*. Panel B of Table 3 illustrates that, if combined with a bag, the competitive financial bonus scheme is more powerful than the environmental nudge to ditch single-use plastic bags. Otherwise, there is no difference between the competitive financial bonus and the environmental nudge. Thus, *Result 2* is confirmed only partially. Panel C of Table 3 confirms *Result 3*.

**Table 3: 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 bonus & bag	11.484	0.0003	0.0003	0.0003
Control	Environmental nudge & bag	4.398	0.0007	0.002	0.002
Control	Financial bonus	7.372	0.0003	0.0003	0.0003
Control	Environmental nudge	3.592	0.019	0.053	0.053
<i>Panel B: How does the competitive financial bonus scheme compare with the environmental nudge?</i>					
Financial bonus	Environmental nudge	3.781	0.018	0.061	0.061
Financial bonus & bag	Environmental nudge & bag	7.087	0.0003	0.0003	0.0003
<i>Panel C: Are reusable bags effective on top of the financial bonus or the environmental nudge?</i>					
Environmental nudge & bag	Environmental nudge	0.806	0.529	0.529	0.529
Financial bonus & bag	Financial bonus	4.112	0.007	0.028	0.025
<i>Panel D: Miscellaneous</i>					
Financial bonus & bag	Environmental nudge	7.893	0.0003	0.0003	0.0003
Environmental nudge & bag	Financial bonus	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.

### 3.5. General shopping behavior during the experiment

In this section, we provide further evidence on the shopping behavior to understand the drivers behind the results in Section 3.4. For example, one may conjecture that, to reduce the demand for single-use plastic bags, individuals in the financial bonus or environmental nudge treatments could have either increased the frequency of the visits to the supermarket to purchase fewer items per visit or purchased fewer items in general. To accomplish this exercise, we employed the same regression model as in (1), replacing the outcome variable with either the number of items purchased, or the amount of shopping, or the frequency of supermarket visits by individual  $i$  from January to July 2020.<sup>19</sup> Since the treatment assignment was random and the trial arms were balanced with regards to these variables before the start of the experiment, the change in the shopping behavior in trial arm  $m$  during the

<sup>19</sup> We winsorized the shopping amount recoding the top 1% of the cases corresponding to the 99<sup>th</sup> percentile. This is a rather common approach used in randomized controlled trials when dealing with monetary amounts (Pomeranz, 2015; Hoy et al., 2020; Brockmeyer et al., 2021, among others).

experiment compared to that in the control could be attributed to the intervention the trial arm  $m$  was exposed to with very high confidence. Table 4 reports the estimates.

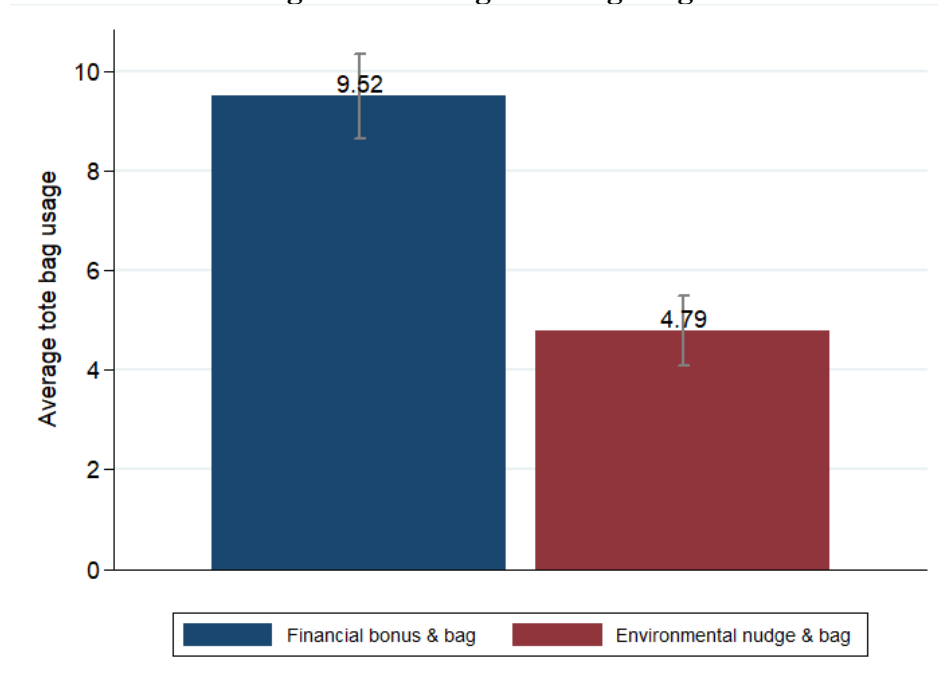
**Table 4: General shopping behavior**

	Items purchased	Shopping amount	Visit frequency
Financial bonus & bag	-18.265 (10.923)	-8,840.660 (5,865.467)	-3.161* (1.289)
Environmental nudge & bag	2.922 (11.459)	1,860.215 (6,122.238)	-0.492 (1.335)
Financial bonus	-17.279 (12.599)	-8,724.267 (6,813.711)	-0.016 (1.486)
Environmental nudge	-10.855 (12.559)	-4,641.793 (6,963.114)	-0.315 (1.524)
Constant	239.555*** (9.952)	120,264.145*** (5,451.926)	32.349*** (1.207)
Mean of the Control Group	268.639	138,402.564	35.457
Controls	Yes	Yes	Yes
F statistics	7.901***	10.220***	10.169***
Adjusted R-squared	0.021	0.026	0.025
Number of Observations	5,150	5,150	5,150

Note: OLS regression. Dependent variables. The overall number of items purchased (Column 1), the overall amount of shopping in AMD (Column 2), and the overall visit frequency (Column 3) by each individual from January to July. The shopping amount is winsorized at the top 1% to deal with extreme outliers. The remarks of Table 3 apply for the independent variables. Significance levels: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

Table 4 suggests that individuals purchase a similar number of items and spend a similar amount of money in all groups. As individuals buy mainly essential goods and services from supermarkets, most likely they did not compromise on the number of items purchased (consequently the amount of money spent) to reduce the demand for disposable bags. Interestingly, in the *Financial bonus & bag* treatment the visit frequency to the supermarket is significantly lower than in the control (and in the remaining treatments). Probably, individuals utilized the reusable bags because of the competitive bonus scheme and purchased more items per visit since the reusable bags were more voluminous and resistant than single-use plastic bags (this would reduce the visit frequency). Figure 6 seems to support this narrative as the reusable bags were used twice as frequently in the financial bonus treatment as in the environmental nudge treatment. However, we note that these numbers are lower bounds, since the cashiers may not have always scanned the barcodes in the bags.

**Figure 6: Average tote bag usage**



Note: The figure illustrates the average tote bag usage.

#### **4. Conclusion and policy recommendations**

The results of the NFE reported in this paper shed light on how understudied policy interventions affect the demand for single-use plastic bags in an understudied context (a developing country in the South Caucasus).

Our results suggest that both an environmental nudge and a competitive financial bonus can reduce the demand for single-use plastic bags. Interestingly, the environmental nudge is as potent catalyst of pro-environmental behavior as the financial bonus scheme. However, the latter is more powerful than the environmental nudge when both interventions are combined with a free reusable bag. This is because individuals actively use the reusable bags in the financial bonus treatment to curb the single-use plastic bag demand. In sum, the financial bonus coupled with a reusable bag can reduce the single-use plastic bag demand by approximately 42% compared to the baseline.

The results of our study have important policy implications. Both a nudge intervention disclosing the environmental harm of overusing plastic and a competitive financial bonus are always preferred to a setting with no intervention. However, when deciding between a nudge and a bonus the policymakers

may want to opt for a nudge, since it is cheaper, easier to implement, and produces a comparable result. Even though the nudge would not entirely solve the environmental problem related to single-use plastic bags, it can partially curb the demand at least in the short to medium run. Competitive bonus schemes will be preferred to environmental nudges when accompanied with a free distribution of reusable bags. In this respect, policymakers can think of (fiscal) interventions (in the form of tax deductions) to make large supermarket chains and other economic entities responsible for excessive plastic bag sales promote pro-environmental campaigns based on a combination of competitive bonus schemes and free reusable bags. Nevertheless, it is important to note that 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 bonuses coupled with free reusable bags can lead to more environmentally favorable outcomes relative to the baseline. Since more material and energy are required to produce a reusable bag compared to a disposable bag, this increases the environmental footprint of one reusable bag relative to one disposable bag. According to recent estimates a reusable nonwoven polypropylene bag can have the same environmental impact as a single-use plastic bag if used at least 10 times (UNEP, 2020).<sup>20</sup> Figure 6 suggests that this lower bound was reached in the *Financial bonus & bag treatment* given that a reusable bag was used around 10 times on average (also recall that this value most likely underestimates the actual use of the tote bag, given that the cashiers may not have always scanned the reusable bag).

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<sup>20</sup> The environmental impact of various types of shopping bags is assessed with the help of life cycle assessment (LCA), which is a quantitative tool designed to calculate the environmental impact of products and services across their full life cycle including raw material extraction, production, logistics and distribution, use and end-of-life (Edwards and Fry, 2011).

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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)



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

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

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:



## 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 ավսեսներում:

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)**

**Կանաչ  
Հայաստան,  
Սեռոզ  
Մարդիկ**



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

Պլաստիկ տոպրակների հաճախակի օգտագործումը հանգեցնում է պլաստիկ կուտակմանը աղբավայրերում, դրանից առաջացած թունավոր նյութերն արտահոսում են գետեր և լճեր, իսկ պլաստիկ 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 օրվաներում:

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

Նարգանջով,  
«Օրորան» 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 bonus* 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 տուպրակ մի գնեք: Փոխարենն առաջարկում ենք գնել և օգտագործել «Ծիրան» սուպերմարկետներում վաճառվող բավական օգտագործման տուպրակները. 1 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:**



### A3.2: The English translation of the letter used in the *Financial bonus* treatment

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. Please do not buy a plastic bag from the cashier. 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.**
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 XXXXXXXXX.



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

Հարգելի հաճախորդ,

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



**Ինչ է պետք անել հաղթելու համար:**

1. **Գանձապահից պլաստիկ տոպրակ մի գնեք:** Փոխարենը կարող եք օգտագործել **Ձեզ** նվեր տրված բալամակի օգտագործման տոպրակը: Այս 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:
- Շահած գումարը փոխանցվելու է Ձեր կուտակային քարտի վրա:

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

Մրցույթի ավարտից հետո արդյունքները կձևակերպվեն 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 bonus & 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. **Please 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
31/01/2020	<p><b><i>Environmental nudge treatment</i></b></p> <p>When shopping at Tsiran supermarket please do not buy plastic bags since they pollute the environment. Instead, please buy one reusable bag and use it for a long time.</p> <p><b><i>Environmental nudge &amp; small bag and Environmental nudge &amp; big bag treatments</i></b></p> <p>When shopping at Tsiran supermarket please do not buy plastic bags since they pollute the environment.</p> <p><b><i>Financial bonus, Financial bonus &amp; small bag, Financial bonus &amp; big bag treatments</i></b></p>
14/02/2020	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
28/02/2020	when shopping in the supermarket. The competition will continue until July 11. Please call xxxxxxxxxx for more details. You will be provided with more information during
13/03/2020	your next visit to the supermarket.
27/03/2020	<p><b><i>Environmental nudge treatment</i></b></p> <p>When shopping at Tsiran supermarket please do not buy plastic bags since they pollute the environment.</p> <p><b><i>Environmental nudge &amp; small bag and Environmental nudge &amp; big bag treatments</i></b></p>
23/04/2020	When shopping at Tsiran supermarket please do not buy plastic bags since they pollute the environment. Instead, please use the reusable bag the supermarket provided to you.
08/05/2020	
22/05/2020	<b><i>Financial bonus, Financial bonus &amp; small bag, Financial bonus &amp; big bag treatments</i></b>
05/06/2020	
22/06/2020	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
03/07/2020	when shopping in the supermarket. The competition will continue until July 11. Please call xxxxxxxxxx for more 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 purchased	Plastic bags purchased	Visit frequency
Environmental nudge	-0.001 (0.023)	-830.239 (4,769.896)	1.613 (8.368)	-0.313 (1.030)	0.297 (1.227)
Financial bonus	0.000 (0.023)	1,196.630 (4,648.312)	5.576 (8.267)	-0.039 (0.988)	2.095 (1.214)
Environmental nudge & big bag	0.002 (0.023)	-1,303.323 (4,666.037)	-6.243 (8.098)	-0.765 (1.016)	-0.237 (1.169)
Financial bonus & big bag	-0.002 (0.023)	4,582.026 (5,238.916)	1.630 (8.779)	0.353 (1.051)	-0.275 (1.211)
Environmental nudge & small bag	-0.001 (0.023)	4,957.551 (4,880.749)	4.100 (8.423)	0.414 (1.039)	-0.087 (1.171)
Financial bonus & small bag	-0.001 (0.023)	2,633.004 (4,810.926)	4.175 (8.536)	0.339 (1.090)	-0.905 (1.181)
Constant	0.339*** (0.016)	108,325.449*** (3,378.842)	214.022*** (5.736)	24.852*** (0.710)	32.320*** (0.818)
F statistics	0.008	0.517	0.454	0.326	1.130
Adjusted R-squared	-0.001	-0.000	-0.001	-0.001	0.000
Number of Observations	5,809	5,809	5,809	5,809	5,809

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$



## Appendix D. Treatment non-compliance in the experiment

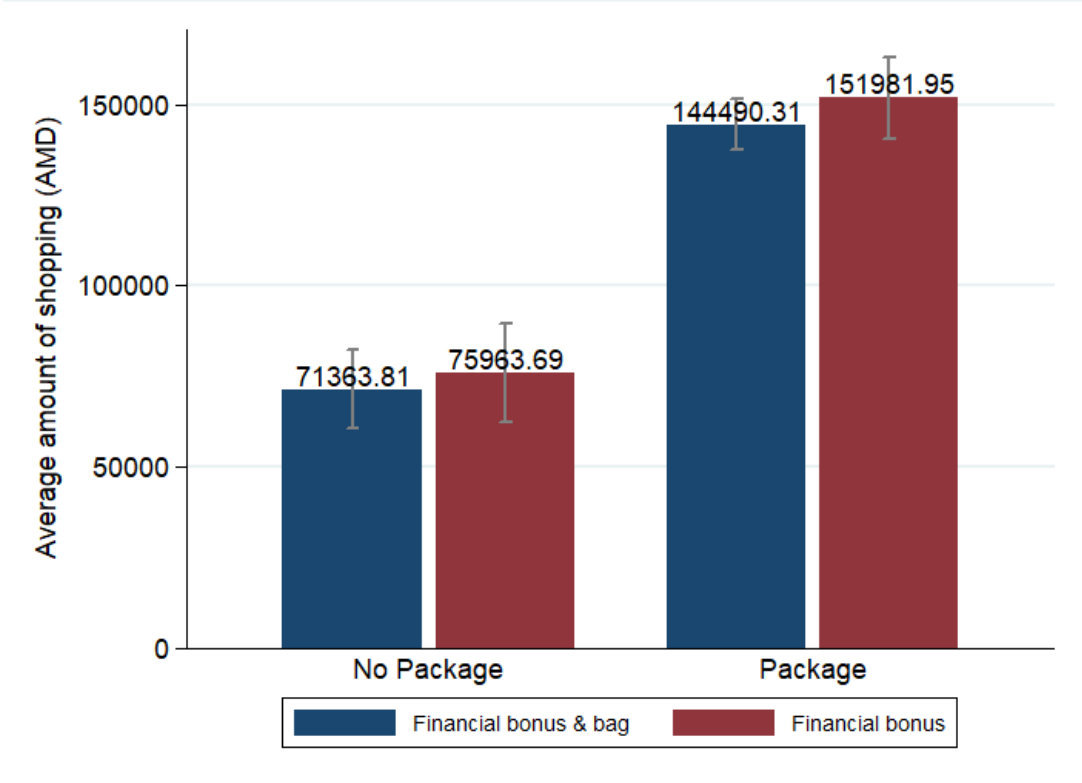
**Table D1: The pattern of missingness**

	(1)
Financial bonus & bag	0.012 (0.013)
Environmental nudge & bag	0.013 (0.013)
Financial bonus	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

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

# Appendix E. Sub-group differences

Figure E1: Average amount of shopping in different subgroups



**Figure E2: Average number of items purchased in different subgroups**

