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Working Paper

Nudging taxpayer registration? Field experimental evidence on backfiring incentives

IDB Working Paper Series, No. IDB-WP-1135

Provided in Cooperation with:

Inter-American Development Bank (IDB), Washington, DC

Suggested Citation: Eguino, Huáscar; Roman, Soraya; Schächtele, Simeon (2020) : Nudging taxpayer registration? Field experimental evidence on backfiring incentives, IDB Working Paper Series, No. IDB-WP-1135, Inter-American Development Bank (IDB), Washington, DC, <https://doi.org/10.18235/0002827>

This Version is available at:

<https://hdl.handle.net/10419/237446>

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Cataloging-in-Publication data provided by the
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Eguino Lijerón, Huáscar.

Nudging taxpayer registration?: field experimental evidence on backfiring
incentives / Huáscar Eguino, Soraya Roman, Simeon Schächtele.

p. cm. — (IDB Working Paper Series ; 1135)

Includes bibliographic references.

1. Taxpayer compliance-Brazil. 2. Property tax-Brazil. 3. Tax incentives-Brazil.
4. Tax collection-Brazil. I. Roman, Soraya. II. Schächtele, Simeon. III. Inter-
American Development Bank. Fiscal Management Division. IV. Title. V. Series.
IDB-WP-1135

<http://www.iadb.org>

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Nudging Taxpayer Registration? Field Experimental Evidence on Backfiring Incentives

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Abstract*

Governments in Latin America raise little revenue from property taxation, despite arguments for its efficiency and equity. Adequate registry information would support consistent collection, but registries are costly to establish and maintain. Compared to tax collection, field experimental evidence on low-cost interventions in this area is scarce. This paper provides the first such evidence for online tax registration. The municipality of Fortaleza, Brazil, randomized 163K property taxpayers into three groups. The first group represents the status quo that did not receive a particular treatment. To the second group, the tax administration sent an e-mail asking for registration; to the third group, an e-mail that additionally offered a lottery reward for successful registration. Relative to the first group, both e-mails increased registration, especially among compliant taxpayers, men, intermediate age groups and intermediate property values. But adding the lottery incentive had a negative effect on registration. We hypothesize that this backfiring effect relates to an inadvertent signal about non-enforcement. Additional evidence from a post-experimental survey suggests that for taxpayers in the lottery group, norm compliance and the usefulness of the online registry were less important reasons to register. In sum, the results suggest that the intervention prompted parts of the population to register and that monetary incentives may be counterproductive.

JEL Classifications: C93, H26, K42, D91, D83

Keywords: tax compliance, tax registry, field experiment, lottery incentives, property tax, nudge, local public finance, Brazil

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*We thank the Municipal Secretary of Finance of Fortaleza, in particular Jurandir Gurgel, Andrei Simonassi and Augusto Oliveira, for their collaboration and for access to the data. We are grateful to Phil Keefer, Carlos Scartascini, Gustavo Canavire, Ulrich Glogowsky, Johannes Rincke, and two anonymous referees for their helpful comments.

1. Introduction

Governments in Latin America raise little revenue from property taxation, despite economic arguments for its efficiency, equity and stability (IMF, 2013; McCluskey, 1999; Kelly, 2013; Collier et al., 2018; Norregaard, 2013; Youngman, 2016).¹ The low revenues are partly due to a lack of adequate registry information. As for all taxes, such information is the backbone of tax administration. However, a major obstacle in creating and maintaining it is cost (IMF, 2013; Hollenbach and Silva, 2019). Against this backdrop, tax administrations test digital tools and so-called ‘behavioral interventions’. The latter low-cost persuasion strategies have been previously applied to tax compliance. The willingness of the tax administration of a Brazilian metropolis to randomize allows us to present the first field experimental evidence on interventions to increase tax registration online and the first for the ‘sleeping giant’ property tax (Corbacho, Cibils, and Lora, 2013).

The tax administration of Fortaleza, Brazil’s fifth-largest city, set up an online tax registry and service tool. It then randomized 163K property taxpayers into three groups. The first group did not receive a particular treatment and serves as a policy benchmark. To the second group, the tax administration sent an e-mail asking for registration.² To the third group, the administration sent an e-mail that besides asking for registration offered lottery tickets for successful registration. With the municipality’s help, we were able to gain insights into the mechanism driving the registration results by conducting a post-experimental survey.

Our analysis shows that both e-mails significantly increased registration. In line with our conceptual framework, the survey evidence suggests that the e-mails raised awareness about the registry system. The e-mails’ effectiveness varied with socio-economic characteristics: they were more effective for compliant taxpayers, men, intermediate ages and intermediate property values. Sending the e-mail without the lottery incentive increased registration in the order of 400%. Suggestive evidence indicates that about half of the e-mails were opened, putting the local average treatment effect of opening that e-mail in the order of 800%.

Interestingly, adding the lottery incentive significantly lowered registrations in comparison to the simple request e-mail. The survey responses suggest this backfiring effect may be related to changed perceptions about the necessity and usefulness of registering. In particular, fulfilling civic duties and simplifying procedures lose importance as reported reasons to join the registry in the lottery group relative to the simple request e-mail group.

This article contributes to three strands of literature. A first strand studies behavioral interventions to increase tax compliance (see Mascagni, 2018; Alm, 2019; Antinyan and Asatryan, 2019; Slemrod, 2019, for overviews).³ The present study provides evidence earlier in the fiscal cycle, during registration, where individuals’ decisions may have longer-term repercussions. A second related literature concerns the formalization of firms and workers. Despite potentially more well-defined individual benefits in this context, two meta studies of field experiments find modest evidence for effective formalization interventions, with inspections and increased benefits tending to show the strongest results (Floridi, Demena,

¹Property taxes might also help curbing high inequality in the region (Martorano, 2018; De Cesare, 2012). On low revenues, see Mahon (2019), Corbacho, Cibils, and Lora (2013), and Bonet, Muñoz, and Pineda Mannheim (2014).

²For simplicity, we write ‘registration’ throughout, although 4% of the experimental population had already signed up for the online registry and needed to only update or confirm personal information. The municipality set up the online registry to update and improve its existing records.

³Within this strand, the interventions in Brockmeyer et al. (2019), Castro and Scartascini (2015), Chirico et al. (2016), Chirico et al. (2019), Carrillo, Castro, and Scartascini (2017), and Eguino and Schächtele (2020) address property taxes.

and Wagner, 2019; Jessen and Kluge, 2019). The present experiment constitutes an instance where e-mail communications increased registration. A third literature studies the effects of rewards, including in tax compliance contexts (see also Footnote 6). For example, lottery incentives increased third-party monitoring for tax compliance in Brazil (Naritomi, 2019). But in a different tax context, Dwenger et al. (2016) suggest that monetary rewards for compliance sent an adverse signal about enforcement.⁴ The behavioral effects and the survey evidence that the lottery changes perceptions relevant to the registry decision contribute to this literature.

The rest of this article is organized as follows. Section 2 presents a conceptual framework. Section 3 describes the institutional context. Section 4 lays out the experiment. Section 5 presents the results. The final section discusses them and offers policy implications.

2. Conceptual Framework

We can generically describe the decision to join the online tax registry and services platform: a taxpayer registers when the perceived benefits exceed the perceived costs. The benefits could include access to services and reduced compliance costs and the costs may include increased effective future tax liabilities as well as the hassle of registering.⁵ To begin with, a taxpayer needs to be aware of the existence of the registry and the choice to register: if unaware, she or he does not register. Mathematically, this decision-making can be succinctly formulated as

$$Y_i = \mathbb{1}[Aware_i] \cdot \mathbb{1}[\tilde{b}_i > \tilde{c}_i], \quad (1)$$

where Y_i denotes the binary registration decision of individual i , $\mathbb{1}[Aware_i]$ indicates awareness of the registry, \tilde{b}_i denotes perceived benefits and \tilde{c}_i perceived costs of joining the registry. Allowing perceived net benefits $\tilde{b} - \tilde{c}$ to be heterogeneous across taxpayers and denoting by $F_A(\cdot)$ their cdf conditional on being aware, the fraction $Pr(Aware) \cdot [1 - F_A(\tilde{b} - \tilde{c})]$ registers.

This simple framework allows to consider hypotheses about the effects of the experimental treatments without pinning down the precise elements of benefits and costs. E-mails about the tax registry should increase the number of taxpayers knowing of it. Unless costs exceed benefits for everybody who becomes aware, registration increases. In addition, an e-mail might affect the perceived costs and benefits.

The lottery e-mail specifically aims at increasing the perceived benefits of registering. Preferences for risky gains and a tendency to overweight small probabilities (Tversky and Kahneman, 1992; Burns et al., 2010) can mean that lotteries are particularly cost-effective.⁶ By enhancing perceived benefits, the lottery should increase registration beyond an information e-mail. However, two alternatives are conceivable. First, the incentive might not be strong enough, leaving registrations unchanged. Second, the incentive could ‘backfire’ by carrying an

⁴In the unenforced German church tax context of Dwenger et al. (2016), lottery rewards for compliance had heterogeneous effects: For evaders, they led to worse compliance, and vice versa for ‘donors’. Notwithstanding differences in context, experimental treatments, and testable hypotheses, we view the evidence in this paper as broadly consistent with the explanation proposed by Dwenger et al. (2016).

⁵Benefits might further include avoiding enforcement. Satellite imagery provides administrations with better information about properties at low cost, reducing the cost of registers Ali, Deininger, and Wild (2020).

⁶Lottery incentives for third-party monitoring raised tax compliance in Brazil despite small chances of winning (Naritomi, 2019). In a public reward lottery in Argentina (Carrillo, Castro, and Scartascini, 2017) and a laboratory experiment (Bazart and Pickhardt, 2011), the net revenues of lottery rewards for tax compliance were not necessarily positive. Lottery incentives effectively changed health (Beatty and Katare, 2018; Haisley et al., 2012), transportation (Fabbri, Barbieri, and Bigoni, 2019) and survey participation (Laguilles, Williams, and Saunders, 2011; Singer and Ye, 2013) behavior.

adverse signal about compliance and enforcement (Dwenger et al., 2016) and ‘crowding out’ motivation (see Jegen and Frey, 2001; Gneezy, Meier, and Rey-Biel, 2011). Especially if the incentive is small, such adverse effects may outweigh positive price effects and hence result in fewer registrations.

3. Institutional Background

We provide a brief background on the city of Fortaleza and then describe the property tax, the online tax registry platform and the program through which the lottery was implemented.

Fortaleza. Fortaleza is the capital of the northeastern Brazilian State of Ceará and borders the Atlantic coast. With about 2.7 million inhabitants, it is Brazil’s fifth-largest city and the tenth-largest in terms of GDP (IBGE, 2019). The incomes of Fortalezanos are highly unequal (UN-Habitat, 2010). Most economic activity stems from the service sector.

Property tax IPTU. The property tax IPTU (“Imposto sobre a Propriedade Predial e Territorial Urbana”) is the second largest source of tax revenue for the municipality (surpassed by the municipal tax on services remitted by businesses). At the time of this experiment, Fortaleza had about 785K registered properties, of which about 613K were subject to IPTU. These properties were registered with about 385K persons. According to municipal estimates, about one third of IPTU payments were outstanding. To collect property taxes, the administration usually sends a tax bill by mail. At a cost of R\$ 2 (Brazilian Reals) per letter for a total of R\$ 1.2 million (ca. US\$ 300K) per year, this represents a sizable cost. Although Fortaleza has a digital property value assessment system, due to outdated information, some of these letters never reach their destinations. For instance, in November 2018, 7% of the letters were returned.

Online tax registry and service platform. In 2017, the municipality launched an online tax registry and service platform called ‘e-SEFIN’ to increase administrative efficiency. Figure A.1 in the appendix shows its starting page. It allows taxpayers to view tax-related information, offers tax-related services and makes it easier to collect the tax.⁷ To join, taxpayers had to provide verifiable personal information (e.g. upload national IDs for verification by the municipal staff). In this way, the municipality replaces outdated or uncertain information, expanding the scope of taxpayers that can be contacted. Moreover, the online system could replace more costly mail or in-person communications. For this to materialize, the municipality needed to expand the number of registered taxpayers. Joining the online tax registry is voluntary and therefore not enforceable by the tax administration.

Nota Fortaleza. The lottery e-mail offered a ticket for an existing lottery, the program Nota Fortaleza. This program incentivizes consumers to ask businesses for receipts for services purchased.⁸ 114 money prizes worth R\$ 130K (about US\$ 30K) are raffled every month. The expected value of a lottery ticket was about US\$ 0.02.⁹ The low expected value is in line with the definition of a nudge.

⁷Some of the services are only available through this platform. It did not offer service functionality for the property tax at the time of the experiment.

⁸Like in the pioneering Nota Fiscal Paulista and other ‘Nota’ programs in Brazil, the goal is to reduce tax evasion by businesses, employing ‘consumers as tax auditors’ (see Naritomi, 2019).

⁹There are about 1.5 million monthly lottery tickets, so $114/1,500,000 \cdot (R\$130,000 \cdot 0.25 \frac{US\$}{R\$})/114 \approx US\0.02 .

4. The Experiment

The municipality had e-mail addresses for 163,260 of the 385K property taxpayers.¹⁰ It randomized the 163,260 taxpayers into three groups, two of which received e-mails. Appendix A translates the e-mails (displayed in Figure 1) to English.

4.1. Treatments

Status Quo (T1). One group did not receive tax registry specific e-mail communications and represents the status quo, i.e. how the registry was advertised before the experiment. Its members may have learned about the registry via other channels. For instance, by browsing the Municipal Secretary of Finance’s website, which featured prompts to join the registry.



(a) T2: Request

(b) T3: Request+Reward

Figure 1: Treatment E-mails

Request (T2). Another group received the e-mail displayed in Figure 1a. It informed taxpayers about the online tax registry and solicited joining by October 31, 2019. It included two links, one for the registration and one for further information (the tax administration’s website). On the bottom left, it featured the logo of the municipality, On the bottom right, it showed a diagrammatic figure of people and a city silhouette.

Request+Reward (T3). A third group received the e-mail displayed in Figure 1b. On top of the request communicated identical to T2, it offered lottery tickets for completing registration. Specifically, its text, supported by a graphical display of coins in the top right corner, highlights the possibility of winning up to R\$ 30K (ca. US\$ 7200), without specifying probabilities. It mentions that the lottery ticket belongs to the program Nota Fortaleza with its 114 prizes ranging from R\$ 500 (ca. US\$ 120) to R\$ 30K. The prompt to register was framed as avoiding to lose out on the lottery.

Treatment comparisons and interpretation. The Status Quo group (T1) provides a useful benchmark for assessing the effects of the e-mails. To the extent that this group is also treated with information and registration requests (on the municipal website), registration impacts relative to this group are a lower bound for effects relative to no contact. Although registering

¹⁰Having an e-mail address neither implies that the tax administration has all required registry information about the taxpayer, nor that the e-mail address is valid.

is voluntary and therefore not enforced by the tax administration, the e-mails featured language that could be interpreted as implying an obligation to register. Hence it is possible that both e-mails not only made taxpayers aware of the online registry but also instilled a sense of obligation to join. The comparison of T2 and T3 isolates the effect of the lottery incentive communication.

4.2. Timeline and Procedures

The municipality sent the e-mails to taxpayers on October 7 and again on October 11, 18, and 29, 2019. The content of each e-mail was embedded in an image, displayed if the user agreed to downloading it.¹¹ Both treatment e-mails mentioned that registration had to be done by October 31, 2019, which marks the end of the data collection period for registration. To respect equal treatment requirements, all taxpayers who completed the registration process were eventually eligible for the lottery tickets. Finally, the municipality invited the 163,260 taxpayers to participate in an online survey that was open for 10 days in the middle of November 2019.

4.3. Random Assignment

The tax administration randomized treatments to taxpayers in equal proportion. Table 1 compares the mean values of pre-treatment characteristics across the three groups. The equality of treatment means is rejected in F-tests at the ten percent level for age, the share of apartments, and associated with that, the location of properties (see Table A.1 in the appendix). Difference in co-variate means can occur by chance and are small in the present case. Importantly, as the appendix shows, the treatment effects are robust to the inclusion of control variables, including those that are not perfectly balanced across treatments.

5. Results

5.1. Empirical Strategy

Did the simple request e-mail increase registration in the online tax registry and if so, by how much? Did the lottery increase registration further? To answer these questions, we run regressions of the form:

$$Y_i = \alpha + \beta_2 T2_i + \beta_3 T3_i + \gamma X_i + \epsilon_i, \quad (2)$$

where Y_i is an outcome of taxpayer i , $T2_i$ and $T3_i$ are treatment indicators for groups 2 and 3 respectively, X_i is a vector of control variables and ϵ_i an idiosyncratic error term. Standard errors are robust to heteroscedasticity.

The primary outcome Y_i is if a taxpayer attempted to register in the online registry by uploading one of the required documents. Alternatively, we consider successful registrations (which depend on forces beyond the taxpayer's control, e.g. the municipal verification of the uploaded documents).

With T1 as the omitted category, equation (2) tests T2 and T3 against the status quo group. The estimates recover the effects of *sending* a particular e-mail. Whether because of invalid e-

¹¹These downloads were registered by the administration, but due to technical difficulties, this only worked reliably from October 18. We can make an informed guess about the order of magnitude of e-mails opened, but not rely on individual data for it.

Table 1: Balance Table

	T1	T2-T1	T3-T1	T3-T2	p-value	N
female	42.85 (49.49)	0.32 (0.30)	-0.20 (0.30)	-0.52* (0.30)	0.22	163,096
age	44.77 (14.82)	-0.05 (0.09)	0.15* (0.09)	0.20** (0.09)	0.06	162,884
married	47.42 (49.94)	-0.15 (0.97)	0.14 (0.97)	0.29 (0.97)	0.96	15,811
single	43.59 (49.59)	-0.20 (0.96)	-0.87 (0.96)	-0.67 (0.97)	0.64	15,811
already registered	3.98 (19.54)	0.04 (0.12)	0.02 (0.12)	-0.02 (0.12)	0.94	163,198
Nota Fortaleza registered	20.78 (40.57)	-0.11 (0.25)	0.33 (0.25)	0.44* (0.25)	0.20	157,084
apartment	27.05 (44.42)	-0.45* (0.27)	-0.59** (0.27)	-0.14 (0.27)	0.07	163,198
house	31.14 (46.31)	0.08 (0.28)	0.31 (0.28)	0.23 (0.28)	0.53	163,198
registered property value	202.39 (4849.15)	-30.30 (28.92)	-41.94 (29.45)	-11.63 (18.14)	0.36	102,194
outstanding IPTU debt	1.27 (20.13)	0.02 (0.13)	-0.11 (0.12)	-0.12 (0.09)	0.31	103,429
debt exempt	13.57 (34.25)	-0.10 (0.21)	-0.14 (0.21)	-0.04 (0.21)	0.78	163,198
prepaid IPTU 2019	14.15 (34.86)	-0.37* (0.21)	-0.17 (0.21)	0.19 (0.21)	0.21	163,198

Notes: Column T1 shows the mean and standard deviation (in parentheses below) of the variables on the left for treatment group T1 (Status Quo). Column T2-T1 shows the difference in means between treatment group T2 (Request) and T1, with heteroscedasticity-robust standard errors in parentheses below. Similarly, columns T3-T1 and T3-T2 show the difference in means between treatment group T3 (Request+Reward) and T1 and T2 respectively. The next column shows the p-values of F-tests for the equality of means across T1, T2, and T3 for each variable. Column N gives the number of observations for each variable. All means are expressed as percentage points (and the variables are indicators) – except age (in years), registered property value (Brazilian R\$ 1,000), outstanding IPTU debt (Brazilian R\$ 1,000). Stars indicate significance levels of t- and F-tests (heteroscedasticity-robust standard errors): * $p < .1$, ** $p < .05$ and *** $p < .01$

mail addresses or a conscious decision not to read the e-mail, the β coefficients in (2) represent lower bounds for the effects of *opening* an e-mail.¹² Importantly, as we are interested in the added effect of the lottery reward, we additionally report and test the difference between T3 and T2 ($\beta_3 - \beta_2$).

The results are robust to the estimation method (OLS or limited dependent variable models) and the inclusion of covariates. In the main text, we focus on the parsimonious (OLS) specification without covariates (i.e. $X_i = \emptyset$). The results with covariates (already registered, Nota Fortaleza registered, female, age, apartment, house, property value, IPTU debt amount, debt exemption, prepaid, regional fixed effects) and with limited dependent variable models are available in the appendix.

After the average effects, we estimate heterogeneous impacts. To this end, we interact covariates of interest with the treatment indicators of Equation (2). Finally, we analyze the survey data.

5.2. Treatment Effects

A simple and transparent way of analyzing experimental treatment effects is to compare outcome means between the treatment groups (equivalent to Eq. (2) without covariates). Table 2 shows the registration rates in the three treatment groups and the differences between them.

Both e-mail groups had significantly higher rates of attempted and successful registrations than the status quo group. The request e-mail (T2) increased attempted registrations 5.6 percentage points above the status quo group. This represents a 433% increase. The request and reward e-mail (T3) increased attempted registrations by 2.8 percentage points above T1, a 218% increase. Moreover, the e-mail without incentive elicited a significantly higher rate of attempted and successful registrations than the e-mail with the additional lottery reward.

Results for successful registrations are analogous albeit smaller in magnitude. All differences are significant at the one percent level and robust to the inclusion of covariates and substituting OLS for Probit regressions (see Appendix Tables A.2 and A.3). In sum, while both e-mails increased registration, the monetary incentive communication was counterproductive.

Table 2: Treatment Effects: Mean Registration Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)
	T1 (Status Quo)	T2 (Request)	T3 (Request+ Reward)	T2 vs T1	T3 vs T1	T2 vs T3
attempted registration	1.31 (11.35)	6.95 (25.43)	4.15 (19.94)	5.64*** (0.12)	2.84*** (0.10)	2.80*** (0.14)
successful registration	0.41 (6.42)	1.89 (13.62)	1.11 (10.47)	1.48*** (0.06)	0.69*** (0.05)	0.78*** (0.07)
Observations	54,400	54,399	54,399	108,799	108,799	108,798

Notes: Columns (4)-(6) show the differences in mean registration rates between treatment groups T1 (column 1), T2 (column 2) and T3 (column 3). Rates are expressed as percentages. In parentheses: standard deviations (columns 1-3) and heteroscedasticity-robust standard errors (columns 4-6), * $p < .10$, ** $p < .05$ and *** $p < .01$.

¹²Given that a download event was registered for about half of the e-mails, an upper bound for the local average treatment effect of opening an e-mail is double the effect of sending it (Wald estimator calculation, compare Angrist and Pischke, 2009).

5.3. Heterogeneous Treatment Effects

We next analyze heterogeneity across gender, age, compliance status and property values. To this end, Figures 2a-2d visualize the results from OLS regressions that separately add each co-variate and its interactions with the treatment indicators to the baseline regression (Table A.4). In addition, Tables A.5 and A.6 in the appendix show that the backfiring effect of the lottery is present independent of prior registration with the Nota Fortaleza program.

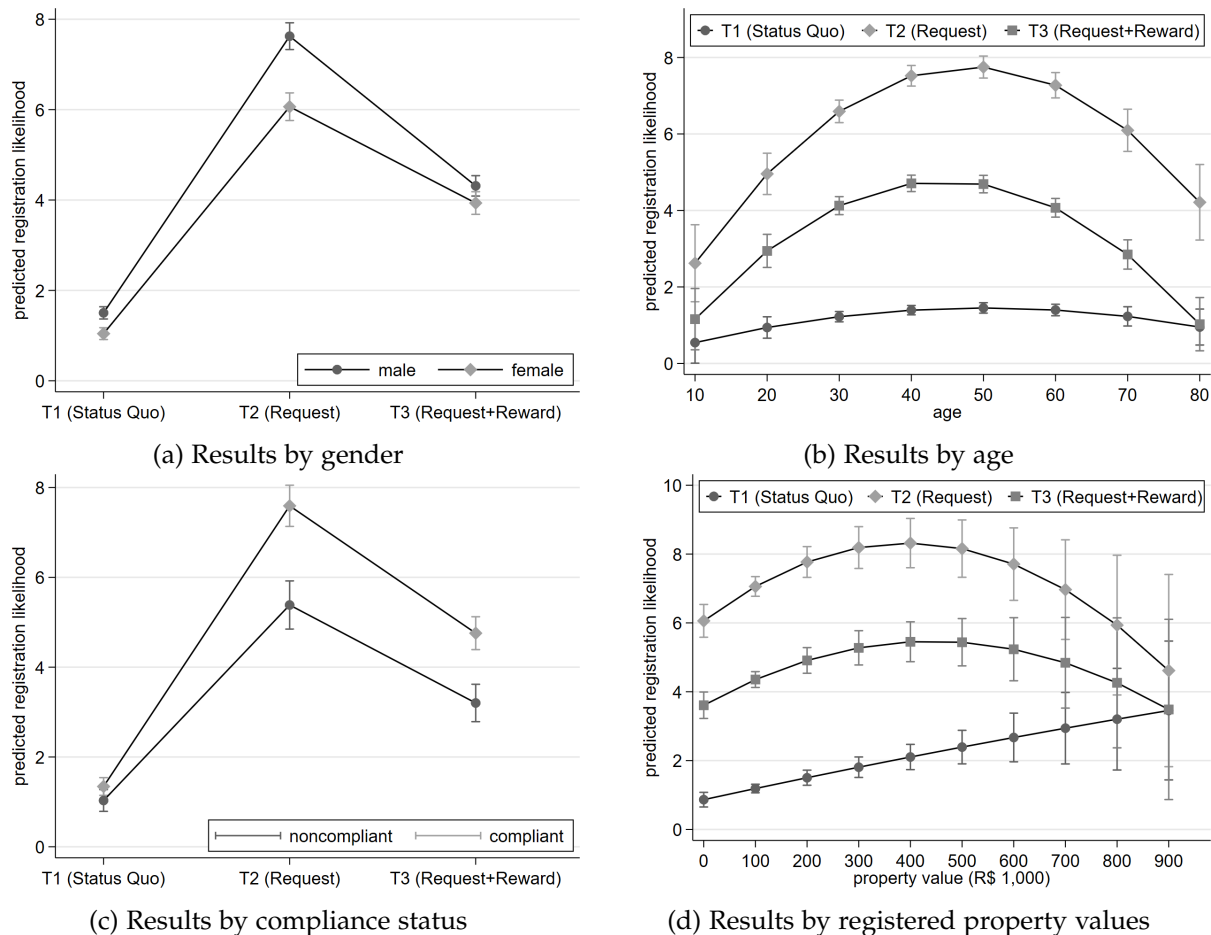


Figure 2: Heterogeneous Effects of the Treatment E-mails

Notes: Values on the vertical axis are percentages. Whiskers mark 95% confidence intervals. Standard errors are heteroscedasticity-robust.

Gender. Men are significantly more likely to register in all treatment groups and appear particularly responsive to the simple request e-mail (Figure 2a). The gender gap in treatments T1 and T3 is significantly smaller, but still different from zero at $p < .05$.¹³

Age. Registration likelihood in the e-mail groups reaches a peak around the age of 50 (see Figure 2b). Older taxpayers might be less prone to use an online tax registry and respond to e-mails. Younger taxpayers may have moved beyond using e-mails regularly and therefore

¹³The gender differences could reflect gender biases in dealing with tax issues, digital technologies or administrative requests. This research, however, is not suited to drawing such conclusions.

be less responsive.¹⁴ The observable differences suggest that e-mails are not an equally good communication channel for all age groups.¹⁵

Compliance status. Non-compliant taxpayers are expected to be less interested in joining a registry that facilitates tax collection. However, some might be willing to comply and hope to reduce their compliance costs by joining the tax registry and online services platform. We define taxpayers as compliant when they have no outstanding property tax liabilities and made a property tax payment in 2019. Taxpayers with outstanding property tax liabilities and no payment made for 2019 are classified as non-compliant. Figure 2c shows that indeed compliant taxpayers responded more to the e-mails, consistent with the idea that registration is less attractive to non-compliant taxpayers. Compliant and non-compliant taxpayers in the status quo group are almost equally likely to join the registry, consistent with the idea that there are ‘non-compliant but willing’ taxpayers that benefit from the registry and service tool. Finally, both compliant and non-compliant taxpayers reacted negatively to the lottery incentive.

Property values. Figure 2d shows that registration in response to the e-mails peaks for intermediate property values (in the tax administrations data base for 2019). In contrast, the likelihood of registration rises linearly with property values for the status quo group which must seek information about the only registry more actively. Fixed costs of registering and tax exemption of small properties might underlie the increasing likelihoods; small property value owners, even if willing to comply with tax duties, might have less interest in streamlining their interactions with municipal tax authorities by joining an online tax registry.¹⁶ The drop in registration likelihood for the e-mail treatments at high property values could reflect that non-compliant taxpayers with high property values are wary of registering.

5.4. Survey Evidence

The post-experimental survey provides insights into taxpayers’ perceptions and the mechanisms behind the treatment effects.

Because participation was voluntary and response rates were small and varied slightly with treatment (Appendix Table A.7), a typical survey response disclaimer applies: the survey respondents are not necessarily representative. Table A.8 in the appendix shows how the respondents differed in characteristics from the experimental population. However, the treatment effects among the 2,826 survey participants are qualitatively similar to the experimental population, including the backfiring effect of the lottery (Appendix Table A.9).

The survey answers produce consistent results suggesting the lottery changed the interpretation of the tax administrations’ actions and effective motivations. Limited dependent variable models (Appendix Tables A.10 and A.11) and non-parametric tests produce the same qualitative results as the OLS results displayed here.

¹⁴Age is not random and so any correlation of age with other relevant factors (e.g. property values) could (also) cause the observable age gradient.

¹⁵Interestingly, a relative majority of the survey respondents indicated a preference to be contacted by the tax authorities via Whatsapp.

¹⁶Small property values might also be associated with less access to technology, more liquidity constraints, less education, less interest in formalization activities, less trust in the local government, or other adverse factors.

Table 3: Survey Results: Knowledge and Cost-Benefit (OLS)

DV:	(1) Knowledge	(2) Lack of know-how	(3) Advantageous	(4) Disadvantageous
T2 (Request)	0.17*** (0.063)	-0.09*** (0.032)	0.06 (0.053)	-0.03 (0.056)
T3 (Request+Reward)	0.15** (0.065)	-0.08** (0.032)	0.15*** (0.053)	0.02 (0.058)
Difference (T3-T2)	-0.02 (0.057)	0.02 (0.033)	0.08* (0.049)	0.05 (0.054)
T1 mean	3.62	0.49	3.82	2.28
Observations	2,826	1,412	2,826	2,826

Notes: The dependent variable (DV) in column (1) is agreement to the statement “I know what the e-SEFIN system is” on a scale from 1 (do not agree at all) to 5 (completely agree). The DV in column (2) is marking the answer option “I did not know how it works” (yes or no) in response to a multiple choice question about the reasons for not registering. The DV in column (3) is agreement to the statement “Registering in the e-SEFIN system has advantages for me” on a scale from 1 to 5. The DV in column (4) is agreement to the statement “Registering in the e-SEFIN system has disadvantages for me” on a scale from 1 to 5. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table 4: Survey Results: Reasons for Registering (OLS)

DV:	(1) Easier	(2) Contribute	(3) Nota Fortaleza	(4) Civic Duty	(5) Curiosity
T2 (Request)	-25.85** (12.589)	7.24 (12.555)	12.52 (11.475)	0.10 (13.266)	-3.29 (11.319)
T3 (Request+Reward)	-38.10*** (12.639)	3.04 (12.625)	45.81*** (11.572)	-11.00 (13.266)	-6.49 (11.337)
Difference (T3-T2)	-12.25** (4.949)	-4.20 (4.826)	33.29*** (4.823)	-11.10** (4.642)	-3.20 (3.784)
T1 mean	71.43	28.57	21.43	35.71	21.43
Observations	403	403	403	403	403

Notes: Each column refers to a response option to a multiple choice question asking for the reasons for registering in e-SEFIN. The dependent variable (DV) in column (1) is marking the answer option “to make my dealings with the municipal tax authorities easier”. Column (2): “to contribute to a modern and efficient administration”. Column (3): “to participate in the raffle of the Nota Fortaleza program”. Column (4): “to comply with civic duties”. Column (5): “to find out how it works (curiosity)”. Values are displayed as percentage points. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Awareness and information about the online tax registry. In line with the conceptual framework of Section 2, the e-mails increased taxpayers’ information about the online tax registry: Taxpayers in T2 and T3 affirmed having significantly greater knowledge about the tax registry than those under the status quo (column 1 of Table 3). Moreover, status quo group participants more often indicated lack of knowledge about how to register as a reason for not registering (column 2).

Costs and benefits. In line with the conceptual framework, the survey featured separate questions about the perceived benefits and disadvantages from registering. The survey

responses indicate that the lottery significantly increased the perceived benefits relative to the status quo group and to the request e-mail (column 3 in Table 3). Qualitatively, the lottery hence worked as intended. As for the disadvantages of registering, offering a monetary reward could trigger thinking about why it is being offered and lower the perception of the intrinsic value of the registry. In this case, taxpayers could start to perceive greater disadvantages from registering. The signs of the coefficients in column 4 of Table 3 are consistent with that hypothesis, but they are statistically insignificant.

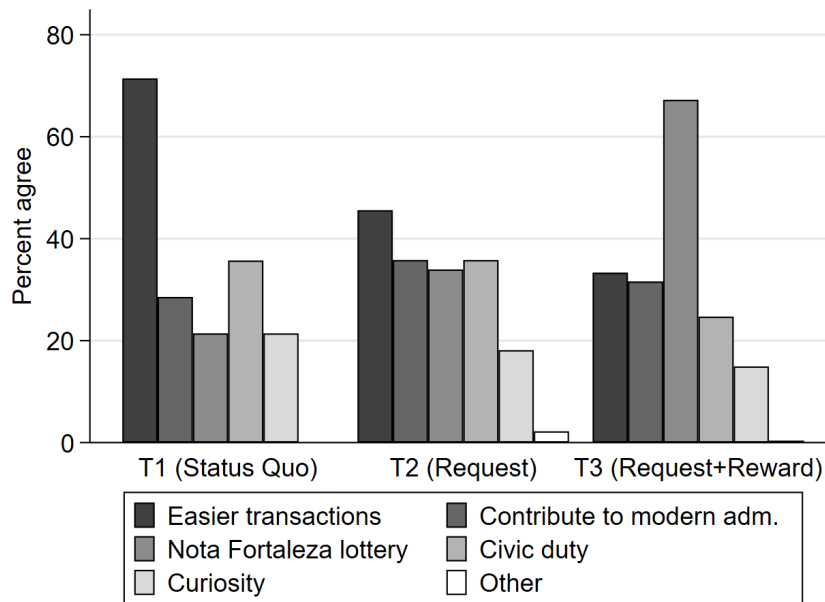


Figure 3: Reasons for Registering (Survey Results)

Reasons for registering. Figure 3 shows the reasons taxpayers gave for registering. Corresponding OLS estimations are contained in Table 4 (Probit in Table A.11).¹⁷ Respondents from the request and reward treatment were significantly less likely to cite easier transactions as a reason for registering. This is true relative to T2 and especially T1. It seems as if the lottery incentive reduced practical motivations to register. Not surprisingly, a large fraction of T3 respondents gives the lottery (Nota Fortaleza) as a reason for registering. The results for joining out of a sentiment of civic duty are most interesting: in comparison with the simple request e-mail, a significantly smaller portion of respondents in the lottery group cited complying with civic duties as a reason for registering. This is consistent with the lottery signaling the voluntary nature of registering and consequent non-enforcement, thereby reducing motivations to comply with a moral or legal duty.

6. Discussion and Conclusion

The present paper presented the first field experimental evidence on interventions to increase registration in an online tax registry for a property tax. The tax administration of Fortaleza set up an online tax registry and services platform that built on existing taxpayer records and served to update and substitute them with an online version. It then randomized property taxpayers into three treatment groups. Two e-mail treatments raised the rates of

¹⁷Figure 3 and Tables 4 and A.11 refer to taxpayers who registered. Results for all survey respondents are similar.

registration relative to a control group representing the status quo. One e-mail simply asked taxpayers to join the registry; the other one additionally advertised lottery tickets as a reward for successful registration. Consistent with our conceptual framework, both e-mails raised taxpayers' information about the online tax registry and the e-mail offering a lottery reward increased its perceived attractiveness. However, communicating the lottery reward did not increase registration rates beyond the simple request and in fact decreased them by around 40%.

The strong backfiring effect of the lottery is intriguing. Dwenger et al. (2016) explained a related finding suggesting that financial rewards signal the voluntary aspect of a poorly enforced tax system and thereby act on effective motivations.¹⁸ While Dwenger et al. (2016) base their interpretation solely on the difference in compliance results, the post-experimental survey in this study provides additional evidence consistent with that interpretation. In particular, fulfilling civic duties lost importance as reported reason to join the registry for the lottery relative to the simple request e-mail group. This is consistent with the request alone conveying a sense of duty to register that is forestalled when an additional reward signals that registration is voluntary and not enforced. In addition, the facts that lottery participants mention simplifying tax procedures less often as a reason to join the registry and rate registering as slightly more disadvantageous is consistent with the financial reward changing perceived costs and benefits beyond the financial incentive itself. Had the incentive been more substantial, such negative effects may have been outweighed by a positive price effect, although at a higher cost. Scoping the boundary conditions of the backfiring effect and associated costs and benefits is a topic for further research.

We conclude by offering some policy implications. First, tax administrations should consider what signals the use of rewards and other actions might send to taxpayers. For instance, if taxpayers infer that compliance is voluntary or poorly enforced, compliance might drop rather than increase. Second, tax administrations could be well-advised to use a layered approach to increasing registration. Prompting voluntary registration through e-mails can be a cost-effective intermediate step. Further actions are needed to achieve full registration. Third, tax administrations might want to consider a mix of communication methods and targeting to different types of taxpayers, considering also the heterogeneous effects by age, gender, compliance status and property values.¹⁹ Finally, the use of incentives and enforcement requires further consideration. If, unlike in the present case, registration is a legal requirement, credibly communicating enforcement can increase compliance. Arguably the most sustainable and beneficial incentive would be if the tax administration can increase the functionality and net benefits associated with the online tax registry and services tool. Future research could identify the optimal mix of functionality, communications, incentives, and enforcement for achieving a reliable, up-to-date tax registry.

¹⁸Such signaling might also explain negative non-deterrence effects on formalization e.g. in Andrade, Bruhn, and McKenzie (2014).

¹⁹More expensive forms of communications such as letters, calls or personal visits can send different signals and be more effective (Ortega and Scartascini, 2020). The tax administration could further consider the preference of the survey respondents for Whatsapp, taking into account possible risks. The success of each channel depends on the accuracy of the contact information.

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Appendices

A. Translation of Treatment E-mails

T2 only T3 only

Carry out or update your registry!

Do not lose the opportunity to win prizes of up to R\$ 30K by registering or updating in SEFIN-Fortaleza!

The Municipal Secretary of Finances of Fortaleza is carrying out a process of cadastral updating. We ask you to register or update your registry information in the e-SEFIN – Taxpayer Service Portal system until 31/10/2019.

Registration has to be done using this link: <http://esefin.sefin.fortaleza.ce.gov.br>

By means of this simple updating*, you are already participating in the raffle of the Nota Fortaleza program, with 114 prizes between R\$500 and R\$300.

More information on the SEFIN website (www.sefin.fortaleza.ce.gov.br)

* The updating requires approval to be valid.

B. Additional Tables

Table A.1: Geographical Balance

	T1	T2-T1	T3-T1	T3-T2	p-value	N
coastal region (SER I)	7.91 (26.99)	-0.17 (0.16)	-0.22 (0.16)	-0.04 (0.16)	0.37	161,253
coastal region (SER II)	25.49 (43.58)	0.02 (0.27)	0.36 (0.27)	0.34 (0.27)	0.31	161,253
southwest region (SER III)	8.77 (28.29)	0.02 (0.17)	-0.12 (0.17)	-0.14 (0.17)	0.69	161,253
southwest region (SER IV)	12.11 (32.63)	0.09 (0.20)	0.04 (0.20)	-0.05 (0.20)	0.90	161,253
southwest region (SER V)	11.25 (31.59)	-0.07 (0.19)	-0.19 (0.19)	-0.11 (0.19)	0.62	161,253
southeast region (SER VI)	19.35 (39.51)	0.49** (0.24)	0.48** (0.24)	-0.01 (0.24)	0.07	161,253
central region	3.06 (17.22)	-0.22** (0.10)	-0.11 (0.10)	0.11 (0.10)	0.09	161,253
outside Fortaleza	12.06 (32.56)	-0.14 (0.20)	-0.25 (0.20)	-0.10 (0.20)	0.46	161,253

Notes: Column T1 shows the mean and standard deviation (in parentheses below) of the variables on the left for treatment group T1 (Status Quo). Column T2-T1 shows the difference in means between treatment group T2 (Request) and T1, with heteroscedasticity-robust standard errors in parentheses below. Similarly, columns T3-T1 and T3-T2 show the difference in means between treatment group T3 (Request+Reward) and T1 and T2 respectively. All variables are indicators for geographic regions in which a taxpayer resides and the means displayed are percentages. The next column shows the p-values of F-tests for the equality of means across T1, T2, and T3 for each region indicator. Column N gives the number of observations for each variable. Stars indicate significance levels of t- and F-tests (heteroscedasticity-robust standard errors): * $p < .1$, ** $p < .05$ and *** $p < .01$.

Table A.2: Treatment Effects (OLS)

DV:	(1) attempt	(2) attempt	(3) success	(4) success
T2 (Request)	5.64*** (0.119)	5.78*** (0.151)	1.48*** (0.065)	1.34*** (0.079)
T3 (Request+Reward)	2.84*** (0.098)	3.07*** (0.125)	0.69*** (0.053)	0.59*** (0.064)
Difference (T3-T2)	-2.80*** (0.139)	-2.71*** (0.176)	-0.78*** (0.074)	-0.76*** (0.089)
T1 mean	1.31	1.27	0.41	0.40
Control variables	No	Yes	No	Yes
Observations	163,198	101,539	163,198	101,539

Notes: Control variables in columns 2 and 4: already registered, Nota Fortaleza registered, female, age, apartment, house, property value, IPTU debt amount, debt exempt, prepaid, regional fixed effects. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.3: Treatment Effects (Probit Average Marginal Effects)

DV:	(1) attempt	(2) attempt	(3) success	(4) success
T2 (Request)	7.76*** (0.211)	7.99*** (0.270)	2.03*** (0.120)	1.75*** (0.138)
T3 (Request+Reward)	4.96*** (0.205)	5.17*** (0.261)	1.25*** (0.117)	0.97*** (0.133)
Difference (T3-T2)	-2.08*** (0.100)	-2.09*** (0.127)	-0.59*** (0.054)	-0.59*** (0.065)
T1 mean	1.31	1.27	0.41	0.40
Control variables	No	Yes	No	Yes
Observations	163,198	101,539	163,198	101,539

Notes: Control variables in columns 2 and 4: already registered, Nota Fortaleza registered, female, age, apartment, house, property value, IPTU debt amount, debt exempt, prepaid, regional fixed effects. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.4: Heterogeneous Treatment Effects (OLS)

DV:	(1) attempt	(2) attempt	(3) attempt	(4) attempt
T2 (Request)	6.122*** (0.166)	-0.457 (0.957)	5.194*** (0.266)	4.352*** (0.300)
T3 (Request+Reward)	2.810*** (0.134)	-1.265 (0.807)	2.743*** (0.224)	2.171*** (0.246)
female	-0.460*** (0.0959)			
T2 (Request) × female	-1.101*** (0.237)			
T3 (Request+Reward) × female	0.0798 (0.197)			
age		0.0564** (0.0205)		
age ²		-0.000562** (0.000217)		
T2 (Request) × age		0.283*** (0.0436)		
T2 (Request) × age ²		-0.00295*** (0.000468)		
T3 (Request+Reward) × age		0.212*** (0.0364)		
T3 (Request+Reward) × age ²		-0.00244*** (0.000385)		
property value (R\$ 1,000)			0.00327* (0.00134)	
property value (R\$ 1,000)) ²			-0.000000440 (0.00000239)	
T2 (Request) × property value			0.00818** (0.00290)	
T2 (Request) × property value ²			-0.0000141** (0.00000453)	
T3 (Request+Reward) × property value			0.00513* (0.00258)	
T3 (Request+Reward) × property value ²			-0.00000905* (0.00000424)	
compliant				0.311 (0.159)
T2 (Request) × compliant				1.897*** (0.394)
T3 (Request+Reward) × compliant				1.243*** (0.325)
Constant	1.503*** (0.0690)	0.0370 (0.452)	0.865*** (0.109)	1.032*** (0.124)
Observations	163,096	159,492	101,347	59,269

Notes: Property values according to the municipal register, in multiples of 1,000 Brazilian Reais. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.5: Treatment Effects by Nota Fortaleza Registration (OLS)

	(1)	(2)	(3)	(4)
Sample:	NNF	NF	NNF	NF
DV:	attempt	attempt	success	success
T2 (Request)	4.42*** (0.125)	10.80*** (0.343)	1.07*** (0.066)	3.15*** (0.198)
T3 (Request+Reward)	1.25*** (0.093)	9.21*** (0.323)	0.22*** (0.048)	2.51*** (0.182)
Difference (T3-T2)	-3.16*** (0.137)	-1.59*** (0.436)	-0.84*** (0.070)	-0.64*** (0.247)
T1 mean	1.22	1.77	0.38	0.62
Observations	124,328	32,756	124,328	32,756

Notes: The likelihood to register in the online platform is higher for Nota Fortaleza participants (columns 2 and 4) than non-participants (columns 1 and 3). A greater attachment of Nota Fortaleza (NF) participants to the municipal authority and its goals might contribute to this tendency. Not being registered with NF implies a higher chance that the taxpayer does not know it. In this case, the offer of a NF lottery ticket may appear dubious, complicated or confusing. But even among NF participants, the request e-mail performs significantly better than the request and reward e-mail (see the difference between T2 and T3 coefficients in columns 2 and 4). This suggests a backfiring effect of the lottery incentive beyond the specifics of its implementation. Columns 1 and 2: dependent variable attempted registration. Columns 3 and 4: dependent variable successful registration. Heteroscedasticity-robust standard errors in parentheses, * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.6: Treatment Effects by Nota Fortaleza Registration (Probit Average Marginal Effects)

	(1)	(2)	(3)	(4)
Sample:	NNF	NF	NNF	NF
DV:	attempt	attempt	success	success
T2 (Request)	5.35*** (0.194)	16.71*** (0.626)	1.23*** (0.097)	5.31*** (0.460)
T3 (Request+Reward)	2.19*** (0.185)	15.00*** (0.611)	0.38*** (0.092)	4.62*** (0.449)
Difference (T3-T2)	-2.37*** (0.098)	-1.17*** (0.318)	-0.64*** (0.051)	-0.47*** (0.180)
T1 mean	1.22	1.77	0.38	0.62
Observations	124,328	32,756	124,328	32,756

Notes: The likelihood to register in the online platform is higher for Nota Fortaleza participants (columns 2 and 4) than non-participants (columns 1 and 3). A greater attachment of Nota Fortaleza (NF) participants to the municipal authority and its goals might contribute to this tendency. Not being registered with NF implies a higher chance that the taxpayer does not know it. In this case, the offer of a NF lottery ticket may appear dubious, complicated or confusing. But even among NF participants, the request e-mail performs significantly better than the request and reward e-mail (see the difference between T2 and T3 coefficients in columns 2 and 4). This suggests a backfiring effect of the lottery incentive beyond the specifics of its implementation. Columns 1 and 2: dependent variable attempted registration. Columns 3 and 4: dependent variable successful registration. Standard errors in parentheses, * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.7: Survey Response Rates

	all	registered	not registered
T1 (Status Quo)	1.5%	4.6%	1.4%
T2 (Request)	2.0%	8.3%	1.5%
T3 (Request+Reward)	1.7%	11.1%	1.3%
Observations	163,260	6,753	156,507

Table A.8: Co-variate Differences between All Participants and Survey Participants

Variable	(1) All	(2) Survey respondents	(3) All vs. respondents
female	42.89	41.01	-1.91**
age	44.81	46.92	2.16***
married	47.41	56.37	9.08***
single	43.23	35.29	-8.04**
already registered	4.00	6.51	2.56***
Nota Fortaleza registered	20.85	44.09	23.64***
apartment	26.70	26.19	-0.53
house	31.27	29.90	-1.39
registered property value	178.35	137.68	-41.35***
outstanding IPTU debt	1.24	1.02	-0.22***
debt exempt	13.49	13.48	-0.01
prepaid IPTU 2019	13.97	14.26	0.29
Observations	163,198	2,826	163,198

Notes: Column 3 shows the differences in means between all participants (column 1) and survey participants (column 2). All means are expressed as percentage points (and the variables are indicators) – except age (in years), registered property value (Brazilian R\$ 1,000), outstanding IPTU debt (Brazilian R\$ 1,000). Stars indicate significance levels of t-tests for equal means with heteroscedasticity-robust standard errors: * $p < .1$, ** $p < .05$ and *** $p < .01$

Table A.9: Survey Participants: Treatment Effects (OLS)

DV:	(1) attempt	(2) attempt	(3) success	(4) success
T2 (Request)	25.34*** (1.560)	28.42*** (2.191)	9.78*** (0.999)	10.91*** (1.396)
T3 (Request+Reward)	22.29*** (1.592)	22.95*** (2.070)	8.07*** (0.982)	5.77*** (1.094)
Difference (T3-T2)	-3.05 (1.997)	-5.48** (2.586)	-1.72 (1.322)	-5.14*** (1.670)
T1 mean	4.10	4.94	0.87	0.86
Control variables	No	Yes	No	Yes
Observations	2,826	1,664	2,826	1,664

Notes: Control variables in columns 2 and 4: already registered, Nota Fortaleza registered, female, age, apartment, house, property value, IPTU debt amount, debt exempt, prepaid, regional fixed effects. Heteroscedasticity-robust standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.10: Survey Results: Knowledge and Cost-Benefit (Probit/Ordered Probit)

DV:	(1) Knowledge	(2) Lack of know-how	(3) Advantageous	(4) Disadvantageous
T2 (Request)	0.12** (0.050)	-0.24*** (0.081)	0.05 (0.050)	-0.03 (0.051)
T3 (Request+Reward)	0.12** (0.052)	-0.20** (0.082)	0.14*** (0.052)	0.01 (0.052)
Difference (T3-T2)	-0.01 (0.048)	0.04 (0.084)	0.09* (0.048)	0.04 (0.048)
T1 mean	3.62	0.49	3.82	2.28
Observations	2,826	1,412	2,826	2,826

Notes: The dependent variable (DV) in column (1) is agreement to the statement “I know what the e-SEFIN system is” on a scale from 1 (do not agree at all) to 5 (completely agree). The DV in column (2) is marking the answer option “I did not know how it works” (yes or no) in response to a multiple choice question about the reasons for not registering. The DV in column (3) is agreement to the statement “Registering in the e-SEFIN system has advantages for me” on a scale from 1 to 5. The DV in column (4) is agreement to the statement “Registering in the e-SEFIN system has disadvantages for me” on a scale from 1 to 5. Columns 1, 3, 4, are ordered probits. Column 2 is a probit model. Standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

Table A.11: Survey Results: Reasons for Registering (Probit Average Marginal Effects)

DV:	(1) Easier	(2) Contribute	(3) Nota Fortaleza	(4) Civic Duty	(5) Curiosity
T2 (Request)	-23.29** (10.552)	7.36 (13.173)	12.42 (11.233)	0.09 (12.350)	-2.99 (9.838)
T3 (Request+Reward)	-34.94*** (10.154)	3.18 (13.422)	45.68*** (11.270)	-11.01 (12.218)	-6.11 (9.558)
Difference (T3-T2)	-12.23** (4.935)	-4.19 (4.786)	33.22*** (4.823)	-11.10** (4.612)	-3.21 (3.778)
T1 mean	71.43	28.57	21.43	35.71	21.43
Observations	403	403	403	403	403

Notes: Each column refers to a response option to a multiple choice question asking for the reasons for registering in e-SEFIN. The dependent variable (DV) in column (1) is marking the answer option “to make my dealings with the municipal tax authorities easier”. Column (2): “to contribute to a modern and efficient administration”. Column (3): “to participate in the raffle of the Nota Fortaleza program”. Column (4): “to comply with civic duties”. Column (5): “to find out how it works (curiosity)”. Values are displayed as percentage points. Standard errors in parentheses. * $p < .10$ ** $p < .05$ *** $p < .01$.

C. Additional Figures

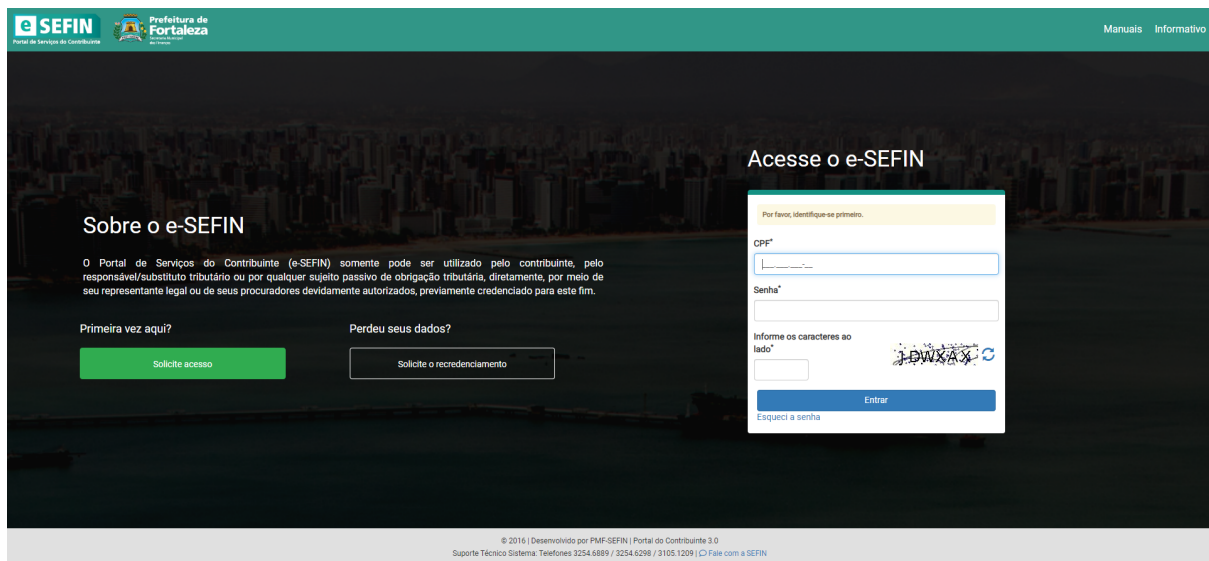


Figure A.1: e-SEFIN Home Page.

Notes: Accessed on January 15, 2020.