

*Do Rewards Work to Maintain and Increase Tax Compliance?
Evidence from the Randomization of Public Goods[Ⓢ]*

Paul Carrillo*
Edgar Castro**
Carlos Scartascini**

* Department of Economics, George Washington University

** Research Department, Inter-American Development Bank

Abstract

Do citizens react to positive inducements? Are the effects long lasting? Are prizes an appropriate incentive for rewarding good behavior? What types of rewards help to crowd in moral incentives? These questions are common in the behavioral economics literature but have been hardly looked at in the empirical tax compliance literature. In this paper, we test the effect of positive inducements and rewards for compliers, by making use of a randomized experiment in which a Municipality of Argentina awarded randomly the construction of 400 individual sidewalks among the more than 72,000 taxpayers who had complied with the payment of their property tax during the previous year. Results indicate that rewarding taxpayers for good behavior with a durable and visible public good has large positive effects. First, we find that conditional on construction the taxpayers who receive the reward were about 7 percentage points more likely to continue paying on time over the next few years. Second, we find that results tend to fade over time but at a slow pace. There are still differences between the treatment and control group after more than 30 months have passed since construction. Third, effects are heterogeneous across winners. Results are larger for people leaving in areas where the provision of public goods is lower. Fourth, we find small spillover effects for some of the neighbors of those who received the reward. These effects are not universal but seem to depend on the salience of the reward. Overall, these results have relevant implications for the literature and for policymakers.

(Very) Preliminary First Draft – This version March 2016
Prepared for presentation at the 2016 ABCDE "Data and Development Economics"
Conference at the World Bank
Please, do not quote

[Ⓢ] The authors are extremely grateful to the authorities of the City of Santa Fé for providing the data necessary for conducting the experiment and to the team headed by Lucio Castro at CIPPEC for their assistance during data collection. We thank the financial support of the Institutional Capacity Strengthening Fund (ICSF) of the Inter-American Development Bank, funded by the Government of the Popular Republic of China. The opinions presented herein are those of the authors and thus do not necessarily represent the official position of the institutions they belong to.

1. Introduction

Be it exercising more, cutting down on certain foods, or kicking out some old habits most people tend to renege on their New Year resolutions after only a couple of weeks into the new year. Rewards may help to curb some unhealthy behaviors and promote the provision of public goods. For example, financial incentives may induce people to attend a gym (Aclan and Levy, 2013) and have a positive effect on inducing weight loss (John et al, 2011). Non-cash rewards may also induce people to donate blood (Lacetera et al, 2012, 2013). The effectiveness of these positive incentives is not independent of their design. On the one hand, the effect of these financial incentives tends to fade away as the incentives are removed (Aclan and Levy, 2013; John et al, 2011).¹ On the other, they may even backfire if the financial incentives crowd out intrinsic motivations (Gneezy, Meier, and Rey-Biel, 2011).

While studying the effect of rewards has become noticeable in the behavioral economics literature, it has been mostly absent from the burgeoning experimental empirical literature on tax compliance. This literature has advanced steadily in the last few years in trying to explain what motivates individuals to pay their taxes in full and on time, and what is the best way to deal with those who do not declare the full tax amount or are late with their payments. A large part of this literature has focused on evaluating the effects of deterrence measures, following the standard models that founded this literature Allingham and Sandmo (1972) and Yitzhaki (1974).² Most studies to date have found a positive effect for reducing tax evasion by increasing the salience of penalties and audits (e.g., Slemrod, et al. 2001, Kleven et al. 2011, Hallsworth, et al. 2014, Ortega and Sanguinetti, 2013). The literature has also expanded on evaluating the effect of moral suasion messages (such as those focused on stressing *reciprocity* and *peer effects*). Results are not as uniform for the effect of messages that appeal to moral considerations, social norms, and the use of public monies by the government. For example, while

¹ Alcott and Rogers (2014), Rogers and Frey (2014), and Kessler and Zhang (2014) provide comprehensive surveys to the literature.

² The tax evasion literature is extremely vast to be summarized in this paper. For comprehensive overviews, of the theoretical literature see Traxler (2010), and Hashimzade, Myles and Tran-Nam (2012). Dell'Anno (2009) and Luttmer and Singhal (2014) review the literature on the moral determinants of compliance. Hallsworth (2014), Mascagni (2014), and Slemrod (2015) present broad overviews of the use of field and laboratory experiments for increasing tax compliance.

Coleman (1996, 2008), Torgler (2003), Hallsworth et al (2014), Del Carpio (2014), and Chirico et al. (2015) find some confirmatory evidence, Blumenthal et al. (2001), Torgler (2004, 2013), Dell’Anno (2009), Fellner et al. (2013), and Castro and Scartascini (2015), do not find statistically significant effects across all types of taxpayers. Consequently, while providing information about what the government does with the money it collects and what other people are doing seems to have a strong theoretical support, its effectiveness as a tool to change people behaviors remains to be confirmed. Part of the reason behind the mixed results may lie on the use of messages and the content of those messages. However, field studies that look at actual public works (instead of messages) and to rewards are still very few.

Gonzalez-Navarro and Quintana-Domeque (2015) show that the connection between public goods provision and tax compliance can be relevant. In their work, provision of pavement seems to increase compliance by about 7 percentage points. Dwenger et al. (2015) find that the offer of rewards can significantly impact tax compliance but the effect depends on the taxpayer’s underlying motivation. Rewards seem to increase compliance among the intrinsically motivated individuals but decrease compliance among the extrinsically motivated. The type of rewards (monetary; non-monetary) seems to play no role. Dunning et al. (2015) do not find positive effects for a policy implemented in Uruguay in which taxpayers are rewarded with a “tax holiday”. The promise of the reward did not increase compliance and compliance dropped for those who were awarded the tax holiday. There are several reasons that could explain this behavior. One reason could be that the taxpayers who won the lottery lost the habit of paying. Another reason could be that the type of reward chosen may have had some crowding out effect on intrinsic motivation.

These results, while they provide a first glimpse about the effect of rewards, leave many open questions.³ In particular, whether there is a reward system that by appealing to reciprocity and peer effects could crowd in intrinsic motivations, have a long run effect, and sway others to comply too. Making use of a policy innovation introduced by the

³ Feld, Frey and Torgler (2006) shows strong support for testing this policy on the field based on results in laboratory experiments, and the fact that while positive rewards may crowd in intrinsic motivation, the threat of punishment may produce the opposite effect.

Municipality of Santa Fé (Argentina), we try to answer these questions. The city government awarded randomly the construction of 400 individual sidewalks among the more than 70,000 taxpayers that were up-to-date with the payment of their property tax. This reward system has several benefits. First, using a non-monetary reward, particularly the provision of a public good, may crowd in intrinsic motivations by enhancing reciprocity. Now, both the taxpayers who receive the reward and the neighbors who walk on those sidewalks can witness the government in action and the use it makes of public monies. Second, because the reward is a highly visible and durable public good, it may not only increase reciprocity but it may also affect compliance through another one of the moral channels: peer effects. Because the reward can only be received by those in good standing, neighbors have direct and concrete evidence that people around them are paying the tax. As such, the rewards may increase the sense of duty for those who received the reward (moral responsibility), and it can also have spillover effects on the non-winners. Third, compared to most reward programs that provide private and low visibility prizes, this type of reward may generate a longer lasting effect.⁴ Consequently, the program would allow us to evaluate at the same time the effect of rewards on compliance through its effect on the reciprocity and peer effect channels.

Results indicate that rewarding taxpayers for good behavior has large effects. First, we find that conditional on construction the taxpayers who receive the reward were 7 percentage points more likely to continue paying than those previously compliant taxpayers who didn't receive the reward. Given the high level of persistence shown by tax compliance (those who pay keep doing it and those who didn't hardly ever change their behavior) the estimates are very large.⁵ Second, we find that results tend to fade over time but at a relatively slow pace. After more than 3 years individuals in the treatment group still have a higher probability of paying on time than taxpayers in the control group. Third, effects are heterogeneous across winners. Results are larger for

⁴ Because we are working with property tax instead of a tax that relies on self-declaration there was no chance of rewarding somebody who could be evading.

⁵ In Castro and Scartascini (2015), the probability of paying in period t given that the taxpayer had paid in $(t-1)$ was about 100%; similarly, Dwenger et al (2014) find that those who evaded in 2010 were 87 times more likely to evade in 2011. Running an autoregressive model we find that the probability of not paying on t given no payment on $(t-1)$ is 90%. For those who paid in time, 64%, 55% for payment within 3 months, and 80% for payment within 6 months.

people leaving in areas where the provision of public goods was lower. Fourth, we find small spillover effects for some of the neighbors of those who received the reward. These effects are not universal but seem to depend on the *saliency* of the reward.

Overall, these results have relevant implications for the literature and for policymakers. First, rewards seem to matter for maintaining “good behavior”. Consequently, both theoretical and empirical papers, particularly those working on tax compliance, would benefit from including positive inducements more fully into the models. Second, finding a positive effect may not be independent of the type of reward that is implemented. As is the case in related literatures that compare monetary and non-monetary rewards, rewards may work better when they reinforce the moral mechanisms behind compliance; in this case, reciprocity and peer-effect. Third, using a highly visible public good may have contributed to find some persistence of the intervention and spillovers. Fourth, results reinforce the appropriateness of using property taxes as the tax of choice for conducting field experiments on compliance. On the one hand, because there is no self-declaration, property taxes have the advantage of providing a direct measure of evasion, reduce the probability of rewarding an evader, and making it easier to evaluate persistence. On the other, because the connection between paying taxes and the provision of public goods is more evident for the taxpayer, it becomes easier to evaluate the effect of reciprocity and peer-effects. Fifth, while most papers that have tried to estimate reciprocity have relied on messages, we can measure the effect of the actual provision of public goods. Finally, given that providing a public good seems to affect the relationship between the taxpayer and the government, public goods targeting may have implications beyond taxation: targeting may help improve other outcomes such as increasing trust, and reducing corruption and crime. Overall, as Feld et al (2006, 20) argued before us “Rewards could be an effective tool to increase compliance”. In this paper, we show how effective they are.

The paper is organized as follows. Section 2 presents the analytical framework, Section 3 presents the institutional background, Section 4 presents the data, and Section 5 presents the empirical results. Finally, Section 6 concludes.

2. Literature review and framework

Why do people pay taxes? Most people do it because of a combination of extrinsic and intrinsic motivations. On the one hand, the probability of being caught and being forced to pay a fine serves as deterrence to evading. On the other, people pay their taxes because they derive utility from doing so. Cultural factors play a role on this, but also the individual's relationship to the state (reciprocity), and the relationship and behavior of other people (peer effects or social influence). People tend to comply more if they believe that others comply as well, and if they believe that the government makes good use of the money it collects (Alm and Torgler, 2006; Luttmer and Singhal, 2014; Scholz and Lubell, 1998; Scholz and Pinney, 1995; Torgler, 2005; Torgler et al., 2008).

Rewards to taxpayers who comply can affect an individual's decision by increasing the value of complying, which may sway some taxpayers in the margin. Which channels do rewards influence would depend on the characteristics of the rewards. Monetary rewards may only work through financial incentives (and may crowd out some intrinsic motivations) (Bonner and Sprinkle, 2002). Now, those who pay, in addition to avoiding a potential penalty may receive a prize, but engaging in this transaction may affect the value of compliance on the feeling of pride that accompanies honesty and the fulfillment of civic duties. Non-monetary rewards may work better at influencing the moral determinants of compliance (for example, reciprocity and peer-effects.)

Willingness to pay taxes may depend on the individual relationship with the state. Most of the evidence supporting the role of reciprocity comes either from laboratory experiments or field experiments that have relied on sending messages to the taxpayers regarding the use of money by the government. For example, Hallsworth et al (2014) find a positive effect of reminding people the relationship between taxes and public goods received. Still, these results are not universal (Hallsworth, 2014; Luttmer and Singhal, 2014). One reason may be that different people update their beliefs differently and average effects mask valuable heterogeneous responses (Castro and Scartascini, 2015). Another reason may be that text in a letter may just not be enough to cause taxpayers to change their beliefs, or their change in beliefs may not be sufficiently large as to cause changes in behavior. An alternative setting to mailing letters or giving a cash reward includes providing a (divisible) public good directly to taxpayers. That is, a public good

that, while it can be enjoyed by everybody (non-excludable), can be assigned to an individual. As we describe later, constructing an individual's sidewalk has that characteristic.

Regarding peer effects, people tend to comply more if they know that other people are complying too, and if they can signal their own compliance. Evidence so far has been mixed (Luttmer and Singhal, 2014). Again, part of the reason may have to do with the design of the treatments. Providing a visible reward to compliers could serve as a potential source of information regarding peers behavior. Having received an award sends a clear signal about the winners' compliance to the group may serve to maintain compliance. The fact that a neighbor living in the block won provides information regarding compliance to the group (which may serve to increase compliance of the neighbors).

The following simple model incorporates these effects into the analysis. Taxpayers earn income Y and are billed property taxes T . Individuals get utility from consumption c and also from paying taxes on time (*moral*). Individuals who pay taxes on time receive nonpecuniary benefits to their utility. Letting $I = 1$ if taxes are paid on time and zero otherwise, we define individual's utility $u(c, I * s)$ where, as in Dwenger et al. (2014), s is a parameter that measures the strength of the relationship between paying taxes on time and utility. It is also assumed that $u' > 0$ and $u'' < 0$.

Unlike income taxes, property tax liabilities are calculated by the municipality: individuals play no role in its determination. However, taxpayers can choose between complying (paying the tax bill) and not complying. The value of having an opportunity to pay her property tax bill is equal to

$$\pi = \max[u(Y - T, s), (1 - \theta) u(Y, 0) + \theta u(Y - \tau T, 0)] \quad (1)$$

where θ is the detection-and-enforcement probability and $\tau > 1$ is a penalty. While the enforcement probability is a deterministic number known only to the tax authority, we assume that individuals' perceptions about θ are heterogeneous ($\theta \sim F$).

Individuals will choose to pay their tax bill on time if the left side of the maximum operator in equation 1 is no less than the right side. The optimal choice can be illustrated in Figure 1.

Individuals with perceptions about $\theta > \theta_{\sim}$ will pay the tax and vice versa. Before the intervention, the proportion of individuals who pay the property tax on time is equal to $F(\theta)$. An intervention that increases the amount of public services that taxpayers receive increases s to s' (with $s' > s$) through two mechanisms. First, taxpayers witness the “government in action” providing a highly durable and visible public good, which increases reciprocity. Second, neighbors of the winner can update their beliefs regarding compliance in the neighborhood (*peer effect*).⁶ As summarized in the Figure, compliance rate would go up as a result of the intervention.

We don't expect the effect to be homogenous across taxpayers but to affect more those for whom the intervention is more salient. First, taxpayers who regularly receive more public goods from the municipality can witness the workings by the municipality up close, hence will be less likely to update their beliefs about the workings and efficiency of government. Second, similarly would happen regarding peer effects. People in low compliance areas may update their beliefs more readily than people in high compliance areas.⁷

3. Institutional Background and Intervention

3.1. Property Taxes in Santa Fe

The Municipality of Santa Fé is the eight largest city in Argentina (about 391 thousand residents). It is the capital city of the Province of Santa Fe (third province in terms of population in the country). The Municipality of Santa Fe collects real estate property taxes (which are locally known as “Tasa General de Inmuebles”). Almost all real estate properties are taxed, including homes, vacant lots, and business premises. Taxes are proportional to the properties assessed values. The public assessor office (Servicio de Catastro e Información Territorial) assesses the value of all real estate properties in the Province, including those in the city of Santa Fe. The Municipality of Santa Fe then

⁶ Drago, Mengel, and Traxler (2015) make a good analysis of dissemination of information in networks in the context of a tax compliance field experiment.

⁷ Castro and Scartascini (2015) find heterogeneous effects for the reciprocity and peer effect treatments. Taxpayers in areas where there is lower provision of public goods seem to update their perceptions (and change their behavior) more than people residing in high public provision areas. Similarly, taxpayers who didn't pay before were more likely to change their behavior following a treatment informing about average compliance.

applies a fixed tax rate to the properties' assessment.⁸ Property tax rates are identical for all properties within the city. Santa Fe also imposes a minimum property tax that varies within the city.⁹

Assessed values remained virtually constant between 2008 and 2011. Tax rates and minimum taxes, however, experienced some changes. During the first semester of 2008, the average and median taxpayer paid ARG \$20 (USD \$5.9) and ARG \$21 (USD \$6.0), respectively each month.¹⁰ In January 2009, tax rates increased and mean and median tax payments almost doubled. The range of taxes went from ARG \$14 (USD \$4.1) for the 10th percentile to ARG \$84 (USD \$24.9) for the 90th percentile. Tax rates and minimum taxes experienced moderate but not drastic changes during our period of interest –January 2009 to December 2011.

Taxpayers are billed monthly. The bill is delivered to the owners' address every 3 months (every trimester each taxpayer receives at the same time the bills necessary to pay the following 3 months). From the moment they receive the bills they have approximately 10 days to pay before the first due date. Late payments are charged a monthly interest rate of 3%. Late fees cannot be larger than 3 times the original tax liability. During 2008, our pre-treatment period, 75% of tax bills were paid on time. Payment and non-payment tends to present high persistence. 64% of those who paid on time any given month do also pay it on time the following month. On the contrary, those who don't pay any given month are highly unlikely to pay the following month (91%).

3.2. Intervention

In an effort to reward good taxpayers and improve property tax compliance, in January 2009, the municipal government of Santa Fe organized a lottery (called "Premio al Buen Contribuyente"), where winners were awarded a full sidewalk construction or

⁸ We describe the system during the period of analysis. The tax system in the city underwent an important overhaul in 2012.

⁹ The city is divided into 10 "tax districts," and each of them features its own minimum tax. In 2008, about one quarter of taxpayers were billed the minimum tax.

¹⁰ The average annual tax rate during the first semester of 2008 corresponded to 25% of a monthly minimum wage.

renovation.¹¹ The prize had an additional purpose, to showcase a “model” sidewalk as an enticement for residents to adopt it.¹² The sidewalk renovations included the removal of the old sidewalk, sewerage adjustments, and convenient features such as a trash receptacle that would not be accessible to animals. The main distinctive characteristic of this sidewalk is that it contained a “green line”, a section of the sidewalk that could be neither covered nor asphalted and dedicated to plants and trees (also provided by the Municipality). This type of sidewalk increases the amount of water absorbed, a relevant feature in a city prone to torrential precipitation. How much of a green line each sidewalk could have depends on the size of the property given that by regulation at least 1.6 meters from the house to the street should be paved for pedestrian circulation.¹³ The city estimated that the average sidewalk renovation would cost ARG \$5,250 (approx. USD \$1,553) (Decree 1716). This is equivalent to 14.4 times the average yearly tax payment (ARG \$363.5) in 2008 and 9.7 times the average yearly tax payment of 2009 (ARG 539.5).

The rules of the lottery were officially announced on December 16, 2008 (Decree 1716). Lottery rules were straightforward. Owners of residential units, commercial properties and/or vacant lots were eligible to participate in the lottery as long as they had paid their property tax liabilities by January 12, 2009. Each eligible property received a unique number, and 400 properties were randomly chosen from a set of 72,742. The lottery took place on February 27, 2009. City officials contacted each of the winners and also announced lottery results in local newspapers.¹⁴

There are no concerns about potential biases in the lottery. It was conducted by Santa Fe’s Provincial Lottery using standard procedures: eligible properties received a unique number and 400 numbers were chosen at random. A public notary was present at

¹¹ Rewards for good compliance are common at the local level in Argentina. Giarrizzo and Brudersohn (2013) identified more than 25 programs. Most of them take the form of a monetary reward either in terms of discounts of future taxes or lotteries with cash prizes, travels, cars, etc.

¹² In Argentina, the owner of the property is required to build and maintain the sidewalk in spite of being a public good. The minimum characteristics of the sidewalk are stipulated in the city regulations.

¹³ In the appendix, we show two types of sidewalk. One of the pictures shows a property with the “green line” and another one, generally in the center of the city, in which the width of the sidewalk doesn’t allow it.

¹⁴ The list of eligible participants and winners could also be found on the municipality’s website.

the time of the lottery to guarantee that the process was fair.¹⁵ Moreover, in the next section we will show that there are no statistically significant differences in observed characteristics between lottery winners and losers.

Lottery winners had the option to accept or reject the sidewalk renovation, and almost half of lottery winners (177) did not accept the prize. Winners had also the option to choose any other eligible taxpayer to receive the prize or to donate it to any school or non-profit organization. 101 sidewalk renovations were given away.

Sidewalk renovations could not take place all at the same time, mostly due to resource constraints and public procurement procedures. Table 1 shows the number of renovations by quarter in 2009 and 2010. The second and third column shows the number of projects that started and were completed during each quarter, respectively. The construction of new sidewalks started after the lottery, peaked in June 2009 and lasted for a little over a year. The average duration of a renovation is 11 days.¹⁶ At the time we collected our data, 223 sidewalks had been build, 16 projects were not completed,¹⁷ and 60 more were never started.¹⁸

4. Data and Empirical Strategy

4.1. Sources

We have access to administrative data from the Municipality of Santa Fe. We work with three sets of data. The first data set contains the roster of all properties in the city. For each property, we observe its address and some characteristics about the building such as the construction size and the land area. We can also observe what type of public services each property receives. For example, records show if (a) a unit is connected to the public water, gas and sewerage networks, (b) street lightning is available, (c) the street surface is asphalt, concrete, gravel or dirt, and (d) public garbage recollection services are available.

¹⁵ Lottery rules specify that individuals who own more than one property cannot receive multiple prizes. None of the 400 properties selected in the initial draw belonged to the same owner. This is not surprising given that the percentage of individuals who own more than one property is very low (14.2%).

¹⁶ We have checked that the order of construction and length of time it takes for the work to be completed is exogenous.

¹⁷ In all of these cases, the date when the projects were completed are not reported.

¹⁸ From the database we cannot differentiate sidewalks that were not constructed because the winners donated the construction or because other reasons.

The second data set contains information about property tax payments. For every month between January 2008 and December 2012 and for every property in the city, we observe the monthly property tax liability (as it appears on the bill), and its due date. The data also include information about each individual's payment history. This information is used to compute a series of variables that measure individuals' tax compliance. In particular, we compute three indicator variables that equal to one if a payment (a) was made on time, (b) was made within three months, and (c) was made within six months. These are the outcome variables we analyze in the empirical section.

The third data set includes details about the lottery. We can identify all taxpayers that participated in the lottery as well as lottery winners.¹⁹ The data also contain information on each sidewalk renovation start and completion dates. These data are used to compute the treatment variables.

4.2. Descriptive Statistics

We focus on all properties in the payment database that received a tax bill in the month before the lottery was announced (November, 2008). Some of these records feature unusually low or unusually high tax liabilities. These unusual values are likely due to measurement error and/or very specific tax exemption rules.²⁰ To avoid biases due to outliers, we trim the top and bottom 1 percentile from the sample.

We then identify the properties that were eligible to participate in the lottery. That is, within the group of properties that received a tax bill during November, 2008, we pick those that had no tax obligations due by January 12, 2009. About 78% of properties in Santa Fe fall into this category. Notice that the group of properties that are eligible to participate in the lottery is clearly not representative of the population, because, by definition, it features higher tax compliance rates. This is an important point that we discuss later when we analyze the external validity of our results.

Table 2 presents the number of observations in each group. During 2008, the pre-treatment period, our sample includes a little over 90 thousand properties and 71,346

¹⁹ The sample of properties eligible to receive the prize is found by identifying all properties that had no pending tax obligations as on January 12, 2009. Winners were identified from publicly available lists.

²⁰ For example, some churches and other charities are exempt from paying property taxes. The municipality also grants exemptions under exceptional situations.

properties eligible to participate in the lottery. We can match 378 lottery winners to this sample. The number of properties that could be followed up during the subsequent years is slightly smaller.

Table 3 shows descriptive statistics for the sample of eligible properties during 2008, the pre-treatment period. The typical property in our sample has 123 m² of interior space and a lot area of 270 m². Most properties are connected to water, gas and sewerage networks, and about 19% face a dirt or a gravel road. The City also computes a Public Service Index for each property that summarizes how many services it receives. The index is bounded between 0 and 1. A property with an index of 1 is located in a neighborhood with asphalt pavement and street lightning, has access to the public water, sewerage and gas networks, and receives garbage collection services; a property with an index of zero receives no services.²¹ The average index in our sample is 0.79. Tax compliance is high in our sample. During 2008, 85% of tax bills were paid on time and 99% were paid within 6 months.

The second and third column of Table 3 compute descriptive statistics for lottery winners and losers. As it can be observed, the sample is balanced as there are no statistically significant differences between these groups. Figure 3 plots the spatial distribution of lottery winners. There is a concentration of winners in the South of the city, but this is precisely the downtown area where population density is the highest. We use a chi-square test to test if the spatial distribution of “winners” is the same as the spatial distribution of all properties. Results from a Pearson chi-square test do not allow us to reject the null that these two distributions are the same (p-value longitude = 0.953, p-value latitude = 0.238).²² The combined evidence above reassures that the lottery outcome was truly random.

4.3. Identification

²¹ The index is the sum of several components. Each property receives 0.5 points if garbage collection services are available. If a property is connected to the water, sewerage and gas network, it receives 0.1, 0.125 and 0.1 points respectively. When the street’s pavement is asphalt or concrete (gravel), 0.125 (0.05) points are added. Finally, properties with street lightning receive 0.05 points.

²² The Municipality of Santa Fe is divided into 10 districts. To perform the test, we estimate the distribution of properties across districts and compare it with the distribution of winners’ properties. A standard Pearson chi-square test is used to test if these two distributions are the same.

Assessing the effects of winning the lottery on tax compliance is straightforward. Because treatment (lottery assignment) was randomized, the causal effect of the lottery can be simply assessed by comparing average outcomes of treated and non-treated groups during the post-treatment period (February 2009 - December 2010). Formally, we estimate the following linear probability model

$$Y_{it} = \alpha D_i + X_i \delta + Z_{it} \gamma + \lambda_t + \mu_{it}, \quad (2)$$

where X_i is a vector of time-invariant characteristics of property i , the variable Z_{it} includes the tax liability of property i in month t , D_i is an indicator that takes the value of one if the property was awarded a sidewalk renovation and zero otherwise, λ_t are time fixed effects, and μ is an unobserved random term. Y represents each of the outcome variables described in the previous section. The coefficient α measures the causal effect of the lottery, or the “intent-to-treat” ITT effect of the program.

To evaluate the effect of a sidewalk renovation on tax compliance we estimate a similar linear model during the post-treatment period

$$Y_{it} = \beta T_{it} + X_i \Phi + Z_{it} \zeta + \lambda_t + \mu_{it} \quad (3)$$

Here T_{it} equals one if property i featured a renovated sidewalk in period t . The coefficient β measures the causal effect of a sidewalk renovation on outcome variable Y . Unlike the lottery assignment, however, T may be endogenous for the following reasons: (a) a substantial share of lottery winners did not accept the prize; and (b) some renovated sidewalks correspond to properties that did not win the lottery. To alleviate endogeneity concerns we instrument the treatment variable by the assignment to treatment (TOT/LATE estimates).

5. Results

5.1. Direct Effects

Using our post-treatment sample (February 2009 - to December 2011), we estimate equation 2 with OLS and report results in Table 4. The first row in the table displays the estimate of α , when the first outcome variable Y_a (*paid on time*) is regressed on different sets of covariates. Each column represents a different specification. Consequently, each cell shows the results for the particular dependent variable identified on the row header using the specification indicated by the column. Column (1) includes only the treatment

effect D ; columns (2) and (3) add property and tax bill characteristics; column (4) includes time fixed effects. The second and third rows in this table display α when Y_b (*paid within 3 months*) and Y_c (*paid within six months*) are regressed on the same set of covariates.

All estimates of α are positive, statistically significant, and robust across specifications. Results suggest that the lottery had a positive and statistically significant effect on tax compliance. The lottery increased the likelihood that winners pay their tax obligations on time by about 2.6 percentage points, and it raised the probability that property taxes are paid within 3 (6) months by 1.9 (1.6) percentage points. It is notable to observe such a positive effect considering that compliance rates in our sample are very large to begin with: during the post treatment period, 82% of lottery non-winners paid their tax liability on time, 87% paid within 3 months and 96% within the next 6 months.

As mentioned, there are noncompliance issues with the assignment to treatment as some people did not accept the sidewalk and others who had not received the prize were awarded a sidewalk (original winners could donate the sidewalk). Consequently, in order to estimate the TOT we instrument the construction of the sidewalk (Treatment) with the lottery assignment and use Two Stage Least Squares (2SLS) to estimate equation 3. Results are displayed in Table 5. The table shows β , the causal effect of a sidewalk renovation on tax compliance. As before, each row features a model with a different outcome variable, and each column a different specification. The evidence indicates a large and statistically significant effect of a sidewalk renovation on tax compliance.

Concentrating on the results in the last column, renovating a sidewalk increases timely payment rates by almost 7 percentage points, and both the likelihood that the tax bill is paid within 3 and 6 months increase each by about 4 percentage points. All estimates are notably robust across specifications. Again, the estimates are very large for the actual range they could take. For example, as mentioned before, about 96% of the eligible taxpayers that did not win the lottery continue paying their bills within a 6 month period.

Because a substantial share of lottery winners did not receive a sidewalk renovation, it is not surprising that α is much smaller than β . Differences between them

are proportional to the number of taxpayers that were awarded the sidewalk (about 400) and the number of people whose sidewalk was completed (about 200).

Summarizing, the reward was highly successful for maintaining compliance among taxpayers. Our main assumption is that the mechanism behind the results is mostly reciprocity and peer effects. Are the effects homogenous across taxpayers? Was the effect stronger for some taxpayers? As we discussed previously, the expectation is that if the mechanisms are those the effect should be heterogeneous as some people should be more likely to update their beliefs than others, or alternatively, that the size of the update should be different across taxpayers. We check that in the next section.

An alternative potential mechanism would be a “gambling effect” either for the winners or for the eligible non-winners. That is, winners keep paying because they overestimate the probability of winning. Given that those who won once could not be eligible a second time, it is highly unlikely. This effect, however, could be present for the eligible neighbors, who decide to keep paying for the possibility of winning the sidewalk. If this were the case, as well as with any other source of spillover, our estimates would be a lower bound of the potential effect of the program on the winners.

5.2. Heterogeneous Effects

In this section we investigate if the effect of a sidewalk renovation on tax compliance depends on the overall provision of public services. All other things equal, a property owner who lives in poorly served neighborhoods (without access to the water, gas and sewerage networks) and obtains a sidewalk renovation may react differently than her counterparts who receive more public services. If people make their assessment about the quality of public services at least in part according to the public goods they receive it is highly probable that the range over which they can update their beliefs after the construction of the sidewalk would be wider for people living in poorly serviced areas of the city than those living in the better served areas.²³ We assess this question by including an interaction term between the public service index and the treatment indicator in equations 2 and 3.²⁴

²³ Castro and Scartascini (2015) follow a similar strategy and explain the heuristics behind it.

²⁴ We also interact treatment with each component of the index and results are qualitatively similar. Results

Table 6 displays results from an OLS regression, where each of the outcome variables is regressed on the lottery assignment D , the Public Service Index I , the interaction between these two variables and a set of covariates. Each column of this table represents a different specification. The coefficient on the interaction term is always negative and notably robust across specifications. The estimates are statistically significant in most cases. Results suggest that the effect of the lottery is heterogeneous: it increases tax compliance the most among those who receive fewer services. For example, among property owners who get the lowest level of public services in our sample ($I = 0.5$), the lottery increases the probability that taxes are paid on time by as much as 8.7 percentage points ($0.195 - 0.5 * 0.213 = 0.087$); when the public service index is at its highest ($I = 1$), there are no statistically significant effects.

Similar findings appear when we evaluate the heterogeneous effect of the sidewalk renovation on tax compliance. Results from a 2SLS regression shown in Table 7, where the instruments for the treatment (T) are the lottery assignment (D) and its interaction with property characteristics, strongly suggest that sidewalk renovations have a larger effect among those property owners who receive fewer public services. The negative coefficient on the interaction term is negative and statistically significant for all outcome variables and all specifications. The magnitude of the heterogeneity is also large. For instance, the effect of a sidewalk renovation on timely tax compliance (Ya) for the average taxpayer ($I = 0.8$) is close to six percentage points ($0.56 - 0.8 * 0.63 = 0.06$). The same effect for a taxpayer with an index one standard deviation below the mean is twice as large ($0.56 - 0.7 * 0.63 = 0.12$). Figure 6 shows these results graphically.

5.3. Permanent vs. Transitory Effects

To assess if the effect of the lottery on compliance declines with time, we interact the treatment with the number of months since treatment. OLS and 2SLS estimates are shown in Tables 8 and 9, respectively.

In Table 9 the outcome variables are regressed on the construction of the sidewalk (T), the number of months since the lottery (M), and their interaction term. Once more,

are available upon request.

the assignment to the treatment (D) and its interactions with the time variable are the instruments. As it can be observed in the Table and Figure 5, the coefficient on the interaction term suggests that the effect of the lottery decline slowly with time. It would take approximately 30 months for the effect to dissipate. This is surely a long-term effect, which has been hardly found in the related literature, particularly the papers relying on informational mechanisms.

5.4. Spillover Effects for eligible neighbors

So far we have evaluated the effect of the lottery and the construction of the sidewalk on the winners. Results indicate that lottery winners maintained a higher compliance rate than the rest of eligible taxpayers, and this result lasted over time for almost 3 years. They also show that effects tend to be heterogeneous, having a higher impact on those people who may have had relatively lower appreciation for the quality of the local government. What happens with the eligible neighbors who are witness to the results of the lottery and the construction of the sidewalk? Do they change their behavior?

[TO BE COMPLETED]

5.5. Spillover Effects for non-eligible neighbors

So far we have evaluated the effect of the lottery and the construction of the sidewalk on people who used to comply before the lottery took place. Is there any spillover to non-eligible for the lottery neighbors?

[TO BE COMPLETED]

5.6. Robustness Checks

[TO BE COMPLETED]

6. Conclusion

There is very little work on evaluating the effect of rewards on tax compliance (mostly lab experiments). The papers that have been written show mixed results. The evidence indicates that results may not be independent of the design of the reward system. This

mimic what happens in other literatures, where rewards have a positive effect particularly when they crowd in intrinsic motivations.

Two mechanisms have been usually considered in the literature as a way to increase intrinsic motivation: reciprocity and peer effects. Field experiment results show mixed results, probably because they have relied on the use of messages to taxpayers. Hence, results are not independent of the message content and the elasticity of behavior to beliefs. These interventions have usually focused on non-compliers.

In this paper we evaluate the effect of a reward, which provides a durable and visible public good to compliers. As such, we can evaluate the effect of a reward mechanism and the effect of affecting reciprocity and peer effects directly. Now, taxpayers can see the government in action (reciprocity) and evaluate the use of public monies, and they can update their beliefs about compliance (peer effect). Evidence indicates a high positive effect on compliance, which tends to fade only slowly over time, and is heterogeneous on the previous access to public goods.

Overall, these results have relevant implications for the literature and for policymakers. First, rewards seem to matter for maintaining “good behavior”. Consequently, both theoretical and empirical papers, particularly those working on tax compliance, would benefit from including positive inducements more fully into the models. Second, finding a positive effect may not be independent of the type of reward that is implemented. As is the case in related literatures that compare monetary and non-monetary rewards, rewards may work better when they reinforce the moral mechanisms behind compliance; in this case, reciprocity and peer-effect. Third, using a highly visible public good may have contributed to find some persistence of the intervention and spillovers. Fourth, results reinforce the appropriateness of using property taxes as the tax of choice for conducting field experiments on compliance. On the one hand, because there is no self-declaration, property taxes have the advantage of providing a direct measure of evasion, reduce the probability of rewarding an evader, and making it easier to evaluate persistence. On the other, because the connection between paying taxes and the provision of public goods is more evident for the taxpayer, it becomes easier to evaluate the effect of reciprocity and peer-effects. Fifth, while most papers that have tried to estimate reciprocity have relied on messages, we can measure the effect of the actual

provision of public goods. Finally, given that providing a public good seems to affect the relationship between the taxpayer and the government, public goods targeting may have implications beyond taxation: targeting may help improve other outcomes such as increasing trust, and reducing corruption and crime. Overall, as Feld et al (2006, 20) argued before us “Rewards could be an effective tool to increase compliance”. In this paper, we show how effective they are.

References

- Aclan, D. and M. Levy. 2013. "Naiveté, Projection Bias, and Habit Formation in Gym Attendance". Unpublished Manuscript. University of California, Berkeley.
- Alcott, H. and T. Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation". *American Economic Review* 2014, 104(10): 3003–3037
- Allingham, M.G., and A. Sandmo. 1972. "Income Tax Evasion: A Theoretical Analysis." *Journal of Public Economics* 1(3–4): 323–38.
- Alm, J., and B. Torgler. 2006. "Culture Differences and Tax Morale in the United States and in Europe." *Journal of Economic Psychology* 27(2): 224–46.
- Blumenthal, M., C. Christian and J. Slemrod. 2001. "Do Normative Appeals Affect Tax Compliance? Evidence from a Controlled Experiment in Minnesota." *National Tax Journal* 54(1): 125–38.
- Bonner, S., and G.B. Sprinkle. 2002. "The effects of monetary incentives on effort and task performance: theories, evidence, and a framework for research." *Accounting, Organizations and Society* 27: 303–345.
- Castro, L., and C. Scartascini. 2015. "Tax Compliance and Enforcement in the Pampas: Evidence from a Field Experiment." *Journal of Economic Behavior and Organization* 116: 65–82.
- Chirico, M., R. Inman, C. Loeffler, J. MacDonald, and H. Sieg. 2015. "An Experimental Evaluation of Notification Strategies to Increase Property Tax Compliance: Free-Riding in the City of Brotherly Love." In: J.R. Brown, editor. *Tax Policy and the Economy*. Volume 30. Chicago, United States: National Bureau of Economic Research and University of Chicago Press.
- Coleman, S. 1996. "The Minnesota Income Tax Compliance Experiment: State Tax Results." MPRA Paper 4827. Munich, Germany: Munich University Library.
- Coleman, S., 2007. "The Minnesota Income Tax Compliance Experiment, Replication of the Social Norms Experiment." MPRA Paper 5820. Munich, Germany: Munich University Library.

- Del Carpio, L. 2014. “Are the Neighbors Cheating? “Evidence from a Social Norm Experiment on Property Taxes in Peru.” Princeton University Manuscript.
http://scholar.princeton.edu/sites/default/files/Are_the_neighbors_cheating_Apr2014_0.pdf
- Dell’Anno, R. 2009. “Tax Evasion, Tax Morale and Policy Maker’s Effectiveness.” *Journal of Socio-Economics* 38(6): 988–97.
- Dwenger N., H. Kleven, I. Rasul, and J. Rincke. 2014. “Extrinsic and Intrinsic Motivations for Tax Compliance: Evidence from a Field Experiment in Germany.” Unpublished manuscript. Available at: http://www.tax.mpg.de/files/pdf3/dwenger-kleven-rasul-rincke_oct2014_full1.pdf
- Dunning, T., F. Monestier, R. Piñeiro, F. Rosenblatt, and G. Tuñón. 2015. Positive vs. Negative Incentives for Compliance: Evaluating a Randomized Tax Holiday in Uruguay. Prepared for presentation at the Meeting on Political Geography, Harvard University, May 8-9, 2015
- Feld, L., B. Frey, and B. Torgler. 2006. Rewarding Honest Taxpayers? Evidence on the Impact of Rewards from Field Experiments. CREMA: Working Paper No. 2006 – 16.
- Fellner, G., R. Sausgruber and C. Traxler. 2013. “Testing Enforcement Strategies in the Field: Threat, Moral Appeal and Social Information.” *Journal of the European Economic Association* 11(3): 634–60.
- Giarrizzo, V. and S. Brudersohn. 2013. Premiar al Buen Contribuyente. Un Recorrido por los “Incentivos Positivos” Aplicados en Argentina Para Mejorar el Cumplimiento Tributario. DAAPGE 13(20), 7-48.
- Gneezy, U, S. Meier, and P. Rey-Biel. 2011. When and Why Incentives (Don’t) Work to Modify Behavior. *Journal of Economic Perspectives—Volume 25, Number 4—Fall 2011—Pages 191–210*
- Gonzalez-Navarro, M. and C. Quintana-Domeque. 2015. Local Public Goods and Property Tax Compliance: Evidence from Residential Street Pavement. Working Paper WP15MG1. Lincoln Institute of Land Policy.
- Hallsworth, M., J. List and I.V. Metcalfe. 2014. “The Behavioralist as Tax Collector: Using Natural Field Experiments to Enhance Tax Compliance.” NBER Working Paper 20007. Cambridge, United States: National Bureau of Economic Research.

- Hallsworth, M. 2014. "The Use of Field Experiments to Increase Tax Compliance." *Oxford Review of Economic Policy* 30(4): 658-679.
- Hashimzade, N., G.D. Myles and B. Tran-Nam. 2012. "Applications of Behavioural Economics to Tax Evasion." *Journal of Economic Surveys*. Published online, 24 May 2012. DOI: 10.1111/j.1467-6419.2012.00733.x
- John, L., G. Loewenstein, A.B. Troxel, L. Norton, J.E. Fassbender, and K.G. Volpp. 2011. Financial Incentives for Extended Weight Loss: A Randomized, Controlled Trial. [Journal of General Internal Medicine](#) June 2011, Volume 26, [Issue 6](#), pp 621-626
- Kessler, J.B., and C.Y. Zhang. 2014. "Behavioral Economics and Health." Paper for *Oxford Textbook of Public Health*. Available at: http://assets.wharton.upenn.edu/~czhan/KesslerZhang_BehavioralEconomicsHealth.pdf
- Kleven, H.J., M. Knudsen, C. Kreiner, S. Pedersen, and E. Saez. 2011. "Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark." *Econometrica* 79(3): 651–92.
- Lacetera, N., M. Macis, and R. Slonim. 2013. Economic Rewards to Motivate Blood Donations. *SCIENCE* 340, 927-928
- Lacetera, N., M. Macis, and R. Slonim. 2012. Will There Be Blood? Incentives and Displacement Effects in Pro-Social Behavior. *American Economic Journal: Economic Policy*, 4, 1, 186-223, 2012.
- Luttmer, E.F.P., and M. Singhal. 2014. "Tax Morale." *Journal of Economic Perspectives* 28(4): 149-168.
- Mascagni, G. 2014. "A Review of Tax Experiments: From the Lab to the Field." Evidence Report 97. Essex, United Kingdom: Institute of Development Studies.
- Ortega, D., and P. Sanguinetti. 2013. "Deterrence and Reciprocity Effects on Tax Compliance: Experimental Evidence from Venezuela." CAF Working Paper 2013/08. Caracas, Venezuela: CAF.
- Rogers, T. and E. Frey. 2014. Changing Behavior Beyond the Here and Now. RWP14-014. HKS Faculty Research Working Paper Series. Harvard University
- Scholz, J.T., and M. Lubell. 1998. "Trust and Taxpaying, Testing the Heuristic Approach to Collective Action." *American Journal of Political Science* 42(2): 398–417.

- Scholz, J.T., and N. Pinney. 1995. "Duty, Fear, Tax Compliance: The Heuristic Basis of Citizenship Behavior." *American Journal of Political Science* 39(2): 490–512.
- Slemrod, J., M. Blumenthal and C. Christian. 2001. "Taxpayer Response to an Increased Probability of Audit: Evidence from a Controlled Experiment in Minnesota." *Journal of Public Economics* 79(3): 455–83.
- Slemrod, J. 2015. "Tax Compliance and Enforcement: New Research and its Policy Implications." Working draft prepared for the conference "The Economics of Tax Policy", December 3-4, 2015.
- Torgler, B. 2003. "Tax Morale, Theory and Empirical Analysis of Tax Compliance." Basel, Switzerland: University of Basel. Ph.D. dissertation.
- Torgler, B. 2004. "Moral Suasion, An Alternative Tax Policy Strategy? Evidence from a Controlled Field Experiment in Switzerland." *Economics of Governance* 5(3): 235–53.
- Torgler, B. 2005. "Tax Morale in Latin America." *Public Choice* 122(1/2): 133–57.
- Torgler, B. 2013. "A Field Experiment in Moral Suasion and Tax Compliance Focusing on Underdeclaration and Overdeduction." *Public Finance Analysis* 69(4): 393-411.
- Torgler, B., A. Macintyre and M. Schaffner. 2008. "Causes and Consequences of Tax Morale: An Empirical Investigation." *Economic Analysis and Policy* 38(2): 313–39.
- Traxler, C. 2010. "Social Norms and Conditional Cooperative Taxpayers." *European Journal of Political Economy* 26(1): 89–103.
- Yitzhaki, S. 1974. "A Note on Income Tax Evasion: A Theoretical Analysis." *Journal of Public Economics* 3(2): 201–02.

Tables and Figures

Table 1

Table 1:
Number of Sidewalk Renovations in Santa Fe

Year-Quarter	Number of Renovations	
	Started	Completed
2009.q1	1	0
2009.q2	16	14
2009.q3	57	56
2009.q4	40	40
2010.q1	66	58
2010.q2	24	22
2010.q3	19	5
2010.q4	0	1
Total	223	207

Table 2

Table 2:
Number of Properties in Sample

Year	All Properties	Lottery Participants	Winners
2008	90,615	71,346	378
2009	89,329	70,528	376
2010	88,795	70,318	372
2011	88,657	70,213	371

Table 3Table 3:
Descriptive Statistics of Lottery Participants (Year 2008)

Variables	All	Winners	Losers	Diff	p-val
Y^a : 1(Tax bill paid on time)	0.856 (0.351)	0.868 (0.339)	0.856 (0.351)	0.012	0.316
Y^b : 1(Bill paid within 3 months)	0.892 (0.311)	0.903 (0.296)	0.892 (0.311)	0.012	0.132
Y^c : 1(Bill paid within 6 months)	0.989 (0.105)	0.989 (0.106)	0.989 (0.105)	-0.000	0.940
Y^d : 1(Bill never paid)	0 (-)	0 (-)	0 (-)	0	-
Tax Liability (ARG \$)	33.4 (29.2)	33.3 (31.20)	33.4 (29.20)	-0.100	0.911
Interior space (m ²)	123.0 (122.5)	123.38 (115.5)	123.042 (122.5)	0.336	0.956
Lot area (m ²)	270.5 (2400.3)	194.2 (198.8)	270.861 (2406.6)	-76.648	0.803
1(Access to Water Network)	0.885 (0.319)	0.862 (0.345)	0.885 (0.319)	0.-227	0.216
1(Access to Sewerage Network)	0.733 (0.442)	0.700 (0.458)	0.734 (0.442)	-0.033	0.165
1(Access to Gas Network)	0.844 (0.363)	0.839 (0.367)	0.844 (0.327)	-0.047	0.809
1(Street Lightning)	0.836 (0.370)	0.812 (0.310)	0.836 (0.370)	-0.0240	0.235
1(Street Surface: Asphalt or Concrete)	0.815 (0.389)	0.787 (0.410)	0.815 (0.388)	0.028	0.195
Public Service Index	0.796 (0.099)	0.790 (0.102)	0.796 (0.099)	-0.006	0.257
Number of properties	71,346	378	70,968		

Notes: Table shows the average and standard deviation (in parenthesis) of variables during the pre-treatment period. The indicator function $1(\cdot)$ equals to one if the condition inside the parenthesis is true and zero otherwise.

Table 4

Effect of Lottery on Tax Compliance (OLS)

Outcome variable:	Model Specification			
	[1]	[2]	[3]	[4]
Y ^a : Tax bill was paid on time	0.024** (0.011)	0.026** (0.011)	0.026** (0.011)	0.026** (0.011)
Y ^b : Tax bill was paid within 3 months	0.017* (0.009)	0.019** (0.009)	0.019** (0.009)	0.019** (0.009)
Y ^c : Tax bill was paid within 6 months	0.015*** (0.005)	0.016*** (0.005)	0.016*** (0.005)	0.016*** (0.005)
Y ^d : Tax bill was never paid	-0.004* (0.005)	-0.005* (0.005)	-0.005* (0.005)	-0.005* (0.005)
Covariates				
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y
Number of observations:	2,503,194	2,503,194	2,503,175	2,503,175

Table 5

Effect of Sidewalk Renovation on Tax Compliance (2SLS)

Outcome variable:	Model Specification			
	[1]	[2]	[3]	[4]
Y ^a : Tax bill was paid on time	0.059** (0.028)	0.065** (0.027)	0.066** (0.027)	0.065** (0.027)
Y ^b : Tax bill was paid within 3 months	0.042* (0.022)	0.048** (0.021)	0.048** (0.021)	0.048** (0.021)
Y ^c : Tax bill was paid within 6 months	0.036*** (0.013)	0.039*** (0.013)	0.039*** (0.013)	0.039*** (0.012)
Y ^d : Tax bill was never paid	-0.011* (0.013)	-0.012* (0.013)	-0.011* (0.013)	-0.011* (0.012)
Covariates				
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y
Results from First Stage:				
LM test statistic for underidentification (Anderson or Kleibergen-Paap)	193.4	193.5	193.5	193.5
p-value of underidentification LM statistic	0.000	0.000	0.000	0.000
F statistic for weak identification (Creagg-Donald or Kleibergen-Paap)	441.8	442	442	442
Number of observations:	2,503,194	2,503,194	2,503,175	2,503,175

Table 6.

Heterogeneous Effect of Lottery on Tax Compliance (OLS)

Dependent Variable: Y^a : Tax bill paid on time				
	[1]	[2]	[3]	[4]
$D \times I$	-0.209*	-0.208*	-0.213*	-0.213*
	(0.113)	(0.112)	(0.112)	(0.111)
D : I(Lottery Winner)	0.191**	0.191**	0.195**	0.195**
	(0.090)	(0.089)	(0.089)	(0.089)
I : Public Service Index	0.398***	0.302***	0.279***	0.278***
	(0.010)	(0.011)	(0.011)	(0.011)
Dependent variable: Y^b : Tax bill was paid within 3 months				
	[1]	[2]	[3]	[4]
$D \times I$	-0.117	-0.115	-0.118	-0.117
	(0.101)	(0.101)	(0.101)	(0.100)
D : I(Lottery Winner)	0.111	0.110	0.113	0.112
	(0.082)	(0.082)	(0.082)	(0.082)
I : Public Service Index	0.324***	0.232***	0.216***	0.216***
	(0.008)	(0.009)	(0.009)	(0.009)
Dependent Variable: Y^c : Tax bill was paid within 6 months				
	[1]	[2]	[3]	[4]
$D \times I$	-0.103*	-0.101*	-0.102*	-0.101*
	(0.062)	(0.062)	(0.062)	(0.061)
D : I(Lottery Winner)	0.097*	0.096*	0.096*	0.096*
	(0.051)	(0.051)	(0.051)	(0.050)
I : Public Service Index	0.193***	0.132***	0.127***	0.127***
	(0.006)	(0.006)	(0.006)	(0.006)
Other Covariates:				
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y

Table 7.

Heterogeneous Effect of Lottery on Tax Compliance (2SLS)

Dependent Variable: Y ^a : Tax bill paid on time				
	[1]	[2]	[3]	[4]
<i>D x I</i>	-0.617*	-0.614*	-0.628*	-0.628*
	(0.333)	(0.329)	(0.329)	(0.328)
<i>D</i> : I(Renovatted Sidewalk)	0.555**	0.553**	0.565**	0.565**
	(0.270)	(0.266)	(0.266)	(0.266)
<i>I</i> : Public Service Index	0.398***	0.302***	0.279***	0.278***
	(0.010)	(0.011)	(0.011)	(0.011)
Dependent variable: Y ^b : Tax bill was paid within 3 months				
	[1]	[2]	[3]	[4]
<i>D x I</i>	-0.351	-0.345	-0.355	-0.352
	(0.292)	(0.289)	(0.290)	(0.289)
<i>D</i> : I(Renovatted Sidewalk)	0.326	0.322	0.330	0.327
	(0.239)	(0.237)	(0.237)	(0.237)
<i>I</i> : Public Service Index	0.324***	0.232***	0.216***	0.216***
	(0.008)	(0.009)	(0.009)	(0.009)
Dependent Variable: Y ^c : Tax bill was paid within 6 months				
	[1]	[2]	[3]	[4]
<i>D x I</i>	-0.307*	-0.302	-0.305*	-0.303*
	(0.186)	(0.185)	(0.185)	(0.184)
<i>D</i> : I(Renovatted Sidewalk)	0.283*	0.279*	0.282*	0.280*
	(0.153)	(0.153)	(0.153)	(0.152)
<i>I</i> : Public Service Index	0.193***	0.132***	0.127***	0.127***
	(0.006)	(0.006)	(0.006)	(0.006)
Other Covariates:				
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y

Table 8.

Persistence of the Effect of Sidewalk Renovation on Tax Compliance (OLS)

Dependent Variable: Y ^a : Tax bill paid on time				
	[1]	[2]	[3]	[4]
<i>D x M</i>	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
<i>D: l</i> (Lottery Winner)	0.028** (0.013)	0.031** (0.014)	0.031** (0.013)	0.031** (0.013)
<i>M: # Months Since Lottery</i>	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.003*** (0.001)
Dependent variable: Y ^b : Tax bill was paid within 3 months				
	[1]	[2]	[3]	[4]
<i>D x M</i>	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
<i>D: l</i> (Lottery Winner)	0.016* (0.009)	0.018** (0.009)	0.018** (0.009)	0.018** (0.009)
<i>l: # Months Since Lottery</i>	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.004*** (0.001)
Dependent Variable: Y ^c : Tax bill was paid within 6 months				
	[1]	[2]	[3]	[4]
<i>D x M</i>	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
<i>D: l</i> (Lottery Winner)	0.009** (0.004)	0.011*** (0.004)	0.011*** (0.004)	0.011*** (0.004)
<i>M: # Months Since Lottery</i>	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.001*** (0.001)
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y

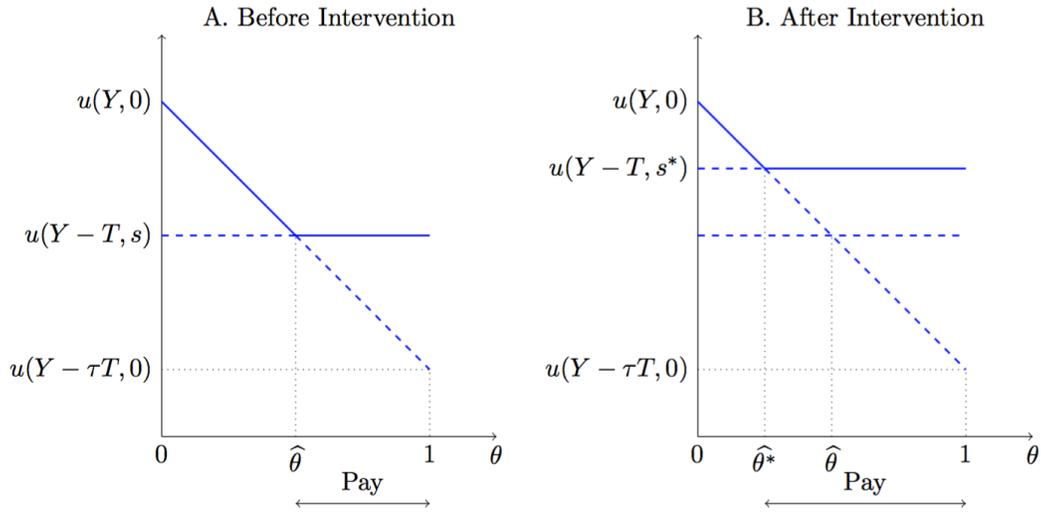
Table 9.

Persistence of the Effect of Sidewalk Renovation on Tax Compliance (2SLS)

Dependent Variable: Y^a : Tax bill paid on time				
	[1]	[2]	[3]	[4]
$D \times M$	-0.006* (0.003)	-0.007** (0.003)	-0.007** (0.003)	-0.007** (0.003)
D : I(Renovatted Sidewalk)	0.186** -0.09	0.207** (0.090)	0.209** (0.090)	0.208** (0.089)
I : # Months Since Lottery	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.003*** (0.001)
Dependent variable: Y^b : Tax bill was paid within 3 months				
	[1]	[2]	[3]	[4]
$D \times M$	-0.003 (0.002)	-0.004* (0.002)	-0.004* (0.002)	-0.004* (0.002)
D : I(Renovatted Sidewalk)	0.109* (0.060)	0.127** (0.059)	0.128** (0.059)	0.128** (0.059)
I : # Months Since Lottery	-0.001*** (0.001)	-0.001*** (0.001)	-0.001*** (0.001)	-0.004*** (0.001)
Dependent Variable: Y^c : Tax bill was paid within 6 months				
	[1]	[2]	[3]	[4]
$D \times M$	-0.002 (0.001)	-0.002* (0.001)	-0.002* (0.001)	-0.002* (0.001)
D : I(Renovatted Sidewalk)	0.070*** (0.026)	0.081*** (0.026)	0.081*** (0.026)	0.080*** (0.026)
M : # Months Since Lottery	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.001*** (0.001)
Characteristics of property	N	Y	Y	Y
Characteristics of tax bill	N	N	Y	Y
Time Fixed effects (35)	N	N	N	Y

Figure 1

Figure 1:
Tax-Payer Compliance Problem



Notes: The figure illustrates the tax payer problem described in Equation 1. Before the intervention (Panel A), consumers compare $u(Y - T, s)$ with a weighted average of $u(Y, 0)$ and $u(Y - \tau T, 0)$. The solid line denotes the optimal choice: it is optimal for all tax payers with $\theta > \hat{\theta}$ to pay the tax and vice versa. Panel B illustrates the effect of an increase in s . Since $s^* > s$, $u(Y - T, s^*) > u(Y - T, s)$ and tax payment rates increase.

Figure 2. Distribution of winners in the city

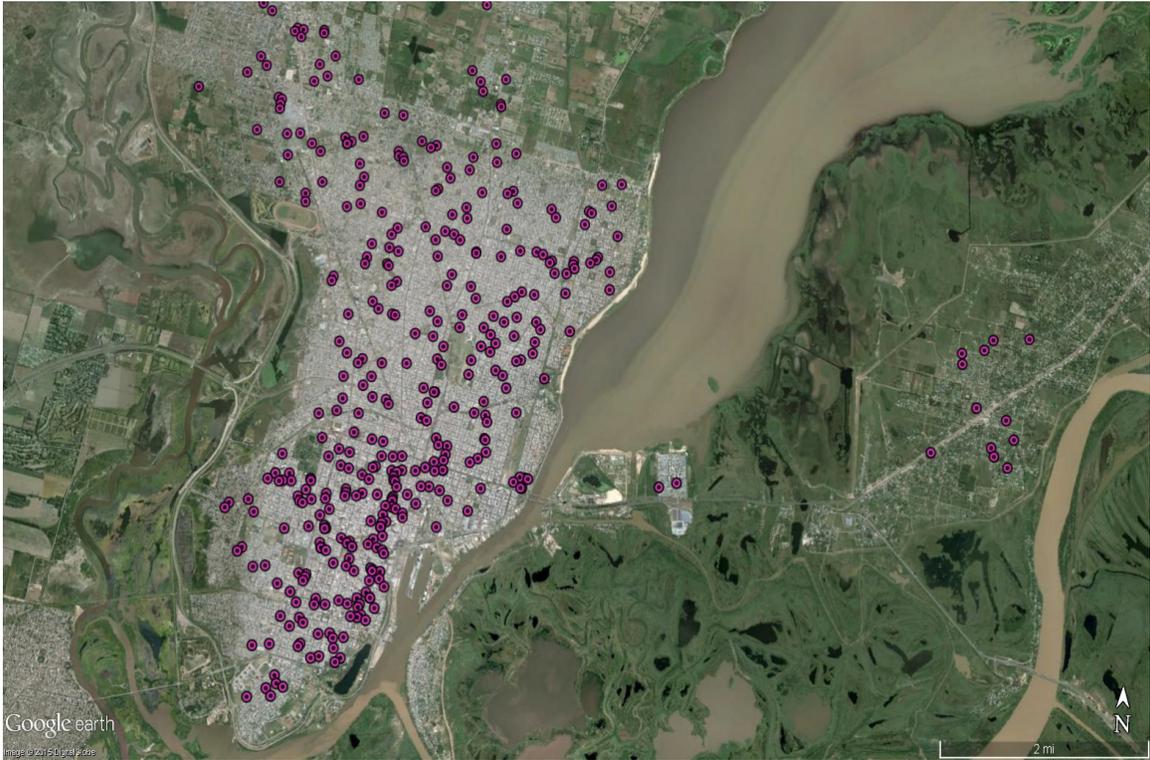


Figure 3. Sidewalk (w/ “green line”)



Figure 4. Sidewalk (w/o “green line”)



Figure 5. Persistence of the intervention

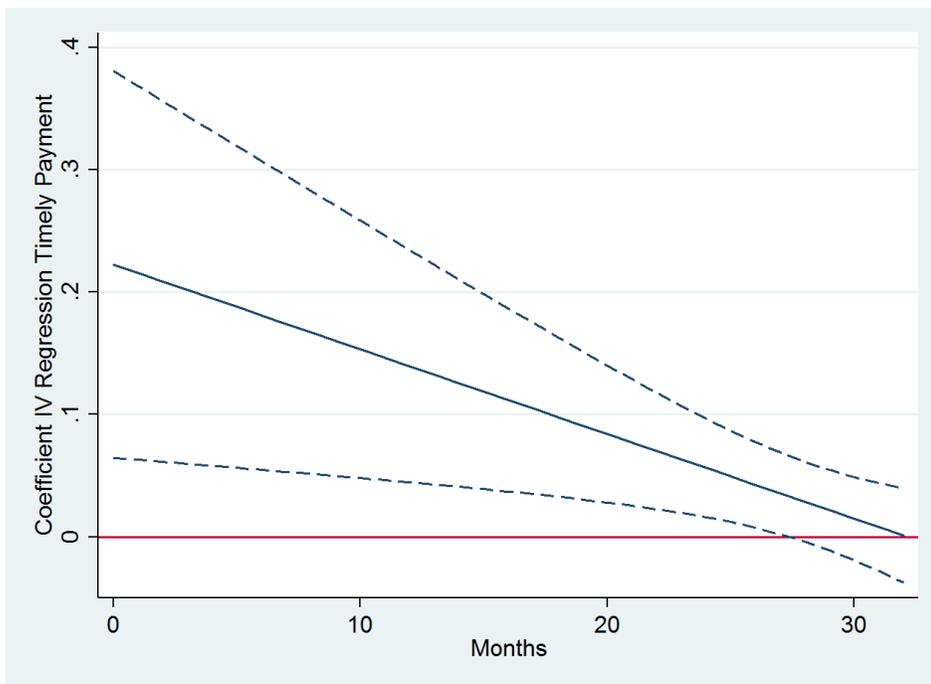


Figure 6. Heterogeneous Effects

