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ABSTRACT

Spillovers and Long-Run Effects of Messages on Tax Compliance: Experimental Evidence from Peru*

We carry out a randomized controlled trial to evaluate the effect of three different types of messages sent to taxpayers on their compliance with the rental income tax (direct effect) and the spillovers produced on payments related to the capital gains and the self-employment income taxes. One message highlights detection, another appeals to social norms, and the third type appeals to altruism. This is the first study to evaluate if these messages can produce spillovers across taxes and to perform a long-term follow-up. This is important to determine if the treatment increases tax revenues. We find that the message addressing detection produces a positive and permanent direct effect and a negative but transitory spillover on the other two taxes. Overall, it increases tax revenues by US\$3.92 per dollar spent in the long run. The message appealing to social norms has no direct effect but produces a permanent negative spillover on the capital gains tax. Ignoring this spillover would have lead one to conclude that this message is innocuous when in fact produces a loss of US\$ 5.20 per dollar spent in the long run. The message appealing to altruism produces a transitory negative effect and no spillovers, and has no effect on tax revenues in the long run.

JEL Classification: D91, K42, H24, H26, H41

Keywords: social norms, altruism, tax evasion, randomized controlled trial, Latin America

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1 Introduction

Developing countries typically experience high evasion rates that greatly hinder their ability to provide public goods and services (Besley and Persson, 2014). These countries rely on a sales tax rather than on income-based taxes as the latter are more difficult to administrate in contexts of high informality. However, because of high evasion rates there could be large benefits from improving the collection of income taxes.

There is a large body of research about income tax evasion and, in particular, on field experiments designed to increase tax compliance by sending messages that appeal to different potential drivers of taxpayers' behavior. Messages inspired in the traditional theory of tax evasion (e.g., those that remind taxpayers about the costs of trying to cheat) appear to be effective in many settings.¹ Evidence on messages that appeal to moral considerations and social norms is mixed, and several studies have even shown that these messages can backfire.² As a result, there is no consensus about the mechanisms that explain the outcomes found in the literature so far.

Furthermore, the research provides little evidence on the indirect effects of sending these messages on compliance with taxes other than the one addressed in the message. In fact, there is only one study that addresses the spillovers in compliance across different taxes (Lopez-Luzuriaga & Scartascini, 2019; henceforth LLS (2019)). These authors focus on the spillovers from messages that highlight penalties and detection. They propose a model that predicts that an increase in penalties will produce a positive spillover but an increase in detection will produce a negative spillover if taxpayers assume that higher detection in one tax means lower enforcement in other taxes because the tax administration has limited resources. The authors find evidence consistent with the positive spillover produced by messages that highlight penalties.

In this study, we carry out a randomized controlled trial in six districts of Lima, Peru, to evaluate the short- and long-term direct and indirect effects of three different types of messages that address the payment of the rental income tax. The direct effect refers to

¹For example, see Slemrod (2019).

²See Fellner et al. (2013).

the payment of the rental income tax which taxes the income that comes from leasing real properties and goods. The indirect effects (or spillover) refer to the payment of the capital gains tax and the self-employment income tax. The first is charged when individuals sell a property or securities, while the second is charged when individuals earn an income stream without having an employer. All three taxes share the characteristic of being difficult to enforce because taxpayers can easily under-report or avoid reporting their income stream.

The first type of message (henceforth “traditional message”) refers to the effectiveness of the tax authority’s control actions. The second type (henceforth “social norm message”) refers to the compliance of other taxpayers living in the same districts. The third type (henceforth “altruism message”) highlights that tax revenues can be used for the provision of public goods targeted at disadvantaged citizens. All the information presented in these messages makes explicit reference to the rental income tax. In addition, we conduct a post-intervention survey with a random subsample of the taxpayers included in our research to identify some subjective drivers of their tax paying behavior such as their social preferences and their beliefs about tax compliance, the quality of public goods, and the prevalence of corruption in public institutions.

Each message was sent once per month and four times starting in October of 2018. Using a long panel of administrative data from the Peruvian tax authority, we are able to follow taxpayers’ behavior until January 2020. Our main results can be summarized as follows: We find that the traditional message produces a permanent positive direct effect on the total amount of the rental income tax that is paid. It also produces a negative transitory spillover to the capital gains and the self-employment income taxes. This negative spillover can be explained by the LLS (2019) framework or through a cash-flow effect (taxpayers lower payments of other taxes to reduce the cash strain produced by the additional payments of the rental income tax). Overall, we can confirm this message generates new resources for the tax authority. In fact, our cost benefit-analysis shows it increased revenues by US\$ 3.92 per dollar spent in the long run.

We also find the social norm message has no direct effect but, interestingly, produces a negative and permanent spillover on the total amount paid to the capital gains tax.

While this lack of an effect could indicate that this message is innocuous, its negative spillover produces a considerable loss of US\$ 5.20 per dollar spent in the long run. We argue this negative spillover occurs because taxpayers extract a negative description of a social norm (people do not pay their capital gains tax) from a message that conveys a positive description of another norm (people pay their rental income tax). This is similar to the “innuendo effect” reported in the psychology literature (Kervyn et al., 2012).

Further, our altruism message produces a negative transitory direct effect on compliance with the rental income tax and no spillovers to the other two taxes. We argue this message backfires because it compounds the negative effect of non-altruistic preferences and the perception that public institutions are highly corrupt and ineffective. We show that taxpayers in our sample have these preferences and perceptions using the results of the post-intervention survey. Our cost-benefit analysis shows this message produces a small loss in the short run (US\$0.04 per dollar spent); however, it vanishes in the long run due to the transitory nature of the spillover.

This study makes several contributions to the literature. First, we offer new evidence about the spillovers produced by messages that appeal to the behavioral aspects of taxpayers’ responses (social norms and altruism). To the best of our knowledge, no other study has evaluated the spillovers produced by these types of messages. Second, we expand the evidence on the indirect effects of traditional messages presented in LLS (2019) by evaluating the short- and long-term spillovers of a message that focuses on detection. Third, we show that taxpayers’ social preferences and perceptions can shed light on the reasons why messages that appeal to altruism can backfire. Fourth, our long-term follow up allows us to distinguish between transitory and permanent changes in compliance. Combined with the estimation of potential spillovers, this is important for determining if a particular type of message produces additional resources for the tax administration. Fifth, we focus on taxes affected by large informational asymmetries and test messages tailored to situations where the authorities are unable to fully identify who is a debtor and to calculate an exact compliance rate. Thus, our results can be relevant to authorities in other parts of the world because of the pervasiveness of situations where the tax administration is unaware of or

cannot easily infer through third-party reporting that a taxpayer has earned an income (consider, e.g., the popularity of Airbnb).³

The rest of the study is organized as follows: In Section 2, we describe the conceptual framework and the related research. Section 3 presents the experimental design. Section 4 shows the direct and indirect effects of the messages. Section 5 concludes.

2 Conceptual Framework

In this section, we describe the theoretical framework and empirical literature that inspire the design of our experiment. We focus on three theories related to tax compliance and their corresponding results in the literature. These are the standard or traditional model, the theory of social norms, and the theory of altruism (with a focus on public goods). We use these theories to design different types of messages and test whether they produce direct effects on taxpayers' compliance with the tax addressed in the message and have indirect effects on compliance with the other taxes.

The traditional model of tax compliance shows that the taxpayer faces a trade-off between evading a tax and thereby keeping a portion of the amount due and confronting the potential costs of being detected. The extent of evasion is chosen to maximize the expected utility (Allingham & Sandmo, 1972; Yitzhaki, 1974; Alm, 2019). One prediction of this model is that tax evasion decreases when either the penalty or the probability of getting caught rises that thereby reduces the expected utility of evading. Numerous studies have successfully tested this prediction.⁴

The indirect effects across taxes produced by messages inspired in the traditional model can vary depending on whether the message highlights the penalty or the probability of being caught. LLS (2019) propose a theoretical model predicting that messages addressing

³With the pervasiveness of Airbnb, it has become more difficult for tax authorities across the globe to enforce their housing and rental laws. Airbnb has a history of playing rough with authorities. For example, see [this article](#) on how regulators in New York City have coped with Airbnb data sharing; or [this one](#) explaining a similar problem in Germany.

⁴See for instance, Dwenger et al. (2016); Bergolo et al. (2019); Kleven et al. (2011); Meiselman (2018), Fellner et al. (2013); Drago et al. (2020); Bott et al. (2020); Carrillo et al. (2017); Boning et al. (2020); Brockmeyer et al. (2019).

penalties that are uniform across taxes will produce a positive spillover. However, the messages that focus on detection can produce a negative spillover if taxpayers infer that more effort devoted to enforcement of one tax can lead to less enforcement of others. In other words, taxpayers believe the tax administration is devoting resources to detect evasion in a certain tax can expect a decline in the probability of being caught not paying other taxes and, thus, respond by reducing compliance with them. LLS (2019) present evidence consistent with the positive spillovers produced by messages focused on penalties. This evidence shows that taxpayers in one municipality in Argentina who received a message that explained the consequences of not paying their property taxes increased their gross-sales tax declarations in the short-run.

However, some predictions of the traditional model do not match what occurs in real life. For instance, the actual levels of compliance are higher than those predicted. The response of the literature to this challenge has been to extend the traditional model to incorporate several concerns raised recently by the field of Behavioral Economics (Alm, 2019). In particular, there is evidence that an individual's behavior is affected by group behavior as people are motivated by diverse concepts such as fairness, altruism, reciprocity, empathy, trust, guilt, shame, morality, alienation, patriotism, and social norms (Alm, 2019). In this research, we are particularly interested in the concepts of social norms and altruism.

A social norm is usually defined as an informal rule of behavior that individuals comply with for reasons unrelated to the likelihood of penalties themselves (Alm, 2019). The main mechanism proposed by the literature is that actors internalize observed social norms in such a way that any deviation generates guilt and other self-imposed costs (Elster, 1989; Wenzel, 2004; Hallsworth et al., 2017). This mechanism means that correcting any miss-perception about other people's compliance can increase (or decrease) an individual's compliance.

Altruism is usually attributed as an influencing factor when people make donations to public goods (Andreoni, 1989, 1990). In this regard, Dwenger et al. (2016) unifies this view with the traditional model of tax compliance (Allingham & Sandmo, 1972). They predict that deterrence efforts increase reported income for evaders but do not affect the reported income for donors, that is, those that were intrinsically motivated by altruistic ideas. These

predictions were carefully tested by Dwenger et al. (2016). There are other studies that test similar views but they tend to conflate altruistic motives with those that refer to the concept of reciprocal altruism⁵ in which taxpayers comply only if there is the possibility of reward.⁶

The studies on social norm messages have found mixed results so far. Some find that giving information about the prevalence of compliance increases individual compliance (Hallsworth et al., 2017; Del Carpio, 2014; Kettle et al., 2016), while others find that this strategy can backfire or have no effect at all (Cranor et al., 2020; Castro & Scartascini (2015), Fellner et al., 2013; Dwenger et al., 2016; Chirico et al., 2019; De Neve et al., 2019), albeit there is considerable heterogeneity in the response of taxpayers.⁷ The studies related to the effect of altruism or reciprocal altruism messages also show mixed results. Some find that this type of message increases compliance (Bott et al., 2020; Bergolo et al., 2019; Hallsworth et al., 2017), while others find that it backfires or has no effect (De Neve et al., 2019; Chirico et al., 2019; Castro & Scartascini, 2015). Furthermore, to the best of our knowledge, there are no other studies that address the potential spillovers to other taxes from social norm or altruism messages.

3 The Experiment

We contacted the Peruvian tax authority and they agreed to send different types of messages to a sample of potential rental income taxpayers in the context of a randomized trial. In particular, they agreed to test messages that refer to the three theories. We also conducted a post-intervention survey on a small subsample to shed light on taxpayers' social preferences and perceptions and beliefs that might affect their behavior such as the quality of public goods and the degree of corruption in public institutions.

⁵See, e.g., De Neve et al. (2019); Chirico et al. (2019); Castro & Scartascini (2015); Bergolo et al. (2019); Bott et al. (2020) and Hallsworth et al. (2017).

⁶At this point a distinction between pure and impure altruism is useful. The former refers to a situation in which taxpayers are motivated by the desire to provide, while the latter describes a situation in which taxpayers pay because they selfishly experience a sense of joy when helping others.

⁷Hallsworth et al. (2017) find that the way these messages are framed can influence payment decisions. For instance, providing information about norms that are more specific to the individual are more effective.

3.1 Institutional Background: the Peruvian Income Tax

The Peruvian income tax is divided into five categories that depend on the source of income. These categories are (i) rental income tax, (ii) capital gains tax, (iii) corporate income tax, (iv) self-employment income tax, and (v) employee income tax. We focus this study on three categories that share the characteristic of having low compliance rates due to the existence of large informational asymmetries. The three taxes considered here are the rental income tax, the capital gains tax, and the self-employment income tax.

The direct effects of the messages are measured in terms of the compliance with the rental income tax. This tax is based on the income earned by the leasing of real properties and goods. It is paid monthly according to a personal schedule defined by the tax authority. The amount to be paid each month is equivalent to 5% of the monthly income earned through leasing activities. Landlords have to pay it regardless of whether their tenants have paid their rent or not. To prove they are reporting the correct amount of income earned, taxpayers have to present the leasing contract.

The indirect effects of the messages are evaluated on compliance with the capital gains tax and the self-employment income tax. The first is charged when an individual (i) sells a property, (ii) sells securities, (iii) receives dividends, or (iv) receives royalties or payments for transferring rights (e.g., trademark rights or patents). In all cases, individuals are required to pay a 5% tax. The payment schedule varies according to the type of transaction. In the case of properties, individuals are required to pay the tax within a month after the sale. In the case of securities, individuals have to pay the tax annually. In the case of dividends, the investment fund must retain the tax when the transaction is executed. The self-employment income tax is charged when an individual earns an income without having a particular employer. Tax rates fluctuate between 8% and 30% depending on the total yearly income. Individuals are required to make monthly payments in advance, and at the end of the year, they must declare and pay the difference between the total tax due and the amount already paid. ⁸

⁸Monthly payments are collected in two ways: through an 8% retention made by the client for transactions that exceed 1,500 soles (around \$450), and through direct payments made by the income earner to cover the difference between the 8% of the total income earned and the retentions made by his/her clients, in case

Taxpayers who fail to comply with their income tax obligations are subject to penalties. For each of the three taxes considered here, there is a penalty of 2,150 soles (around \$630) each time a taxpayer delays his or her payments. This penalty is large and is equivalent to the second largest penalty given to traffic offenders. However, if taxpayers regularize their payments before they are notified by the tax authority, they have to pay only 10% of the penalty. Furthermore, any unpaid tax liability accrues interest at the daily rate of 0.04%.

Compliance with the three taxes is, in general, relatively low although there is some heterogeneity. In fact, enforcement of the rental income and the self-employment income taxes is particularly difficult because many leasing activities and services provided by self-employed individuals are carried out under informal agreements that do not require an official contract or receipt. Thus, landlords and self-employed individuals can easily under-report their income or even avoid reporting it at all. According to the tax authority's estimations, the compliance rate for these taxes is around 50%. Compliance with the capital gains tax is estimated to be larger (reaching around 5

3.2 The Messages

We sent four different types of messages. One of them was simply a reminder message, while the other three messages, which we refer as the treatment messages, were inspired by each of the three theories. The content of each treatment message was a small variation of the reminder message as the idea was to estimate the effect of adding just a few lines of information. This information was designed to persuade the message recipients to pay the amount that they owed (if any) and the information varied accordingly to the type of message. Thus, the reminder message served as a baseline or control group as we compared the effect of the treatment messages against it. The contents of the messages are shown in Table 1 (the original messages in Spanish are included in the Appendix A.1).

For the traditional theory, the text inside the brackets read: *“Be informed that the SUNAT is striving to detect those who do not pay their taxes. We have already identified 78 thousand persons in the districts of Barranco, La Molina, Miraflores, San Isidro, San*

total income exceeds 3,135 soles (around \$940)

Borja, and Surco.”. The purpose of this message was to indicate that the probability of being caught was large. Therefore, its objective was to discourage tax evasion. As noted in Bergolo et al. (2019), this type of message can also increase compliance by inducing fear, which could cause taxpayers to overreact to the threat of being penalized (Bergolo et al., 2019).

Table 1: Structure of messages

Mr(s) taxpayer,

If you receive any rental income, remember to pay your tax.

[small added text]

Find out how to declare and pay this type of income in

<http://personas.sunat.gob.pe/alquilo-mi-casa-o-auto>.

For general inquiries, you can call our Consultation Center from your landline at 0801-12-100 or from your mobile phone at (01) 315-0730, by typing the option 3, from Mondays to Fridays from 8.30 a.m. to 6:00 p.m., and Saturdays from 9:00 a.m. to 1:00 p.m. You can also contact any of our Taxpayer Service Centers.

If you receive any rental income and have already paid your tax, congratulations!

Sincerely,

Regarding the message inspired by the theory of social norms, the text inside the brackets read “*Be informed that the majority of the residents of Barranco, La Molina, Miraflores, San Isidro, San Borja, and Surco do comply with the payment of their rental income taxes.*” The idea was to inform taxpayers that the social norm was to comply by making the payment. Because deviations from the social norm generate self-inflicted costs, this treatment should increase compliance. According to previous experiments, the effect is greater when the

norm refers to people that are socially close to the message recipients (Hallsworth et al., 2017). Thus, to reduce the “psychological distance” to the norm, the messages referred to the people that lived in similar districts as the individuals included in the experiment (Trope & Liberman, 2010).

Regarding the message inspired by the theory of altruism, the text inside the brackets read “*Be informed that if all the residents of Barranco, La Molina, Miraflores, San Isidro, San Borja, and Surco pay their rental income taxes, more than 90 Health Centers could be built in the poorest regions of Peru.*” With this message our objective was to highlight the importance of paying taxes to provide public goods that benefit the poorest population of the country. We expected this message to be persuasive if redistribution and social justice were important for the sample of individuals studied.

Further, all our messages addressed their recipients in a neutral way (i.e., we did not address them as debtors). This was because our sample comprised *potential* rental income taxpayers as we could not be completely sure that they were leasing a property (we explain in detail how we built the sample in Section 3.4).

Furthermore, the contents of our messages varied with respect to those already tested in the literature. Regarding the traditional theory of tax compliance, most of the other studies have focused on highlighting the probability of being caught by using different strategies. Some of them have directly mentioned the probability of being audited (e.g., Dwenger et al., 2016; Bergolo et al., 2019; Kleven et al., 2011; and Del Carpio, 2014), while others have threatened taxpayers with an audit or have disclosed (third-party) information about their income (e.g., Meiselman, 2018; Fellner et al., 2013; Drago et al., 2020; Bott et al., 2020; Carrillo et al., 2017; Boning et al., 2020; Brockmeyer et al., 2019). In contrast, our message only points out that there is a large number of cases being processed by the tax authority without stressing the exact probability of an audit nor threatening taxpayers with one. If this strategy proves to be effective, other authorities could try to replicate it in contexts of uncertainty regarding who has a tax liability.⁹

⁹Studies that highlight the size of the penalty are, for example, Cranor et al. (2020), De Neve et al. (2019), Castro and Scartascini (2015), Chirico et al. (2019), Perez-Truglia and Troiano (2018), Gemmill and Ratto (2018), and Bergolo et al. (2019).

With respect to social norms, most of the literature has used the exact compliance rate to inform taxpayers. This wording may be especially helpful when tax compliance is high and easy to calculate.¹⁰ However, in developing countries tax compliance tends to be just above 50%. For example, in Kettle et al. (2016) tax compliance was at 64.5%. In our context, according to some estimations provided by the tax authority, compliance was just above 50%. Hence, we preferred to describe the norm in a general fashion as in Del Carpio (2014) and Hallsworth et al. (2017). This method means that our results may be informative to authorities trying to assess the effectiveness of social norms in a setting of low compliance such as ours.

In the case of messages referring to the provision of public goods, there are fewer studies in the literature that test this topic (see De Neve et al., 2019; Chirico et al., 2019; Castro & Scartascini, 2015; Bergolo et al., 2019; Bott et al., 2020; Hallsworth et al., 2017). Perhaps, the messages in Bergolo et al. (2019) are the most similar to ours as we both refer to a counterfactual scenario in which compliance is hypothetically changed.¹¹ This is in contrast with other studies that describe how taxes already contribute to the funding of public goods.¹² Also, our message focuses on altruism as it refers to public goods that are only provided to people out of the sample. Other studies have conflated altruistic motives (i.e., people may be more willing to pay if they value redistribution) with those regarding reciprocity (i.e., people will be more willing to pay if they know that they will receive more or better public goods), because in their messages they refer to public goods that everybody could potentially use and enjoy, including in-sample taxpayers.

3.3 Mode of delivery and timeline

Because of administrative and legal reasons, the tax authority had to send a message to everybody in the sample as in Hallsworth et al. (2017). Each individual from the four

¹⁰For studies that use the exact compliance to describe the norm, see Cranor et al. (2020), De Neve et al. (2019), Castro & Scartascini (2015), Chirico et al. (2019), and Fellner et al. (2013).

¹¹Actually, Bergolo et al. (2019) refer to a scenario in which evasion is hypothetically decreased.

¹²For instance, Bott et al. (2020) tests the following message: *“our tax payment contributes to the funding of publicly financed services in education, health and other important sectors of society.”* Castro & Scartascini (2015) test the following message: *“In the first 6 months of this year, CVP’s collection contributed to placing 28 new streetlights, water connections in 29 streets and sewerage networks in 21 blocks.”*

message groups received exactly the same message four times, once per month.¹³

The tax authority sent these messages through four different channels to increase the probability that message recipients would read them. They sent them through: (i) the e-mail address that taxpayers reported to the tax authority; (ii) a special web interface that is normally used by the tax authority to send special communications; (iii) a physical letter to the home address taxpayers had reported to the tax authority; and (iv) a SMS message to the cellphone number taxpayers had reported to the tax authority.

Within each message type, we randomly varied the timing at which the tax authority issued the messages. For a random subsample of individuals, we delayed the issue of the messages by two weeks. So, for example, within the group of individuals that received the reminder message, a subgroup always received a reminder message two weeks earlier than the other subgroup. These subgroups of individuals were randomly selected at the beginning of the experiment and stayed the same throughout all of it. Our goal is to compare those that received an early letter against those that received a late letter to identify the short-term effect of receiving the reminder letter, as in Hallsworth et al. (2017).

In Appendix A.2 we provide the timeline of the experiment. In sum, we sent a message each month starting in October 2018 until January 2019. We carried out the post-intervention survey in August of 2019. We measured tax-related behavior by using the administrative data available from January 2018 to January 2020.

3.4 Final Sample of Taxpayers

Because of the nature of the rental income tax, it is impossible to know with 100

- lived in the municipalities of Barranco, La Molina, Miraflores, San Borja, San Isidro, or Surco that are the richest municipalities of the city;
- owned three or more properties with different addresses within the region of Lima or Callao¹⁴;

¹³Evaluating the effect of this type of treatment can be informative as sending too many messages may have a crowding-out effect (i.e., suffocation).

¹⁴Peru is comprised of 24 regions and one constitutional province (Callao) which belongs to the metropolitan area of the city of Lima. The region of Lima is by far the largest in terms of population as it harbors

- had not reported any rental income for the year 2018 by June 2018.

These criteria led to a sample of 9,024 individuals. Table 2 shows the characteristics of this sample based on the data that was provided by the tax authority. First, individuals are on average 54.8 years old, and women are underrepresented in this sample (36%). Furthermore, the average number of owned properties is 3.9. On average, these properties are valued at 131,000 US\$ according to taxpayer reports.

Compliance is low in this sample: only 26% of the sample had paid rental income tax at least once from 2013 to the end of 2017. Thus, for this period the tax compliance was at least 5% per year ($=26\%/5$). This number is a lower bound of the true tax compliance, since not everybody in the sample necessarily had leased his or her properties. Some individuals may have made more than just one payment as well. On average, the last year they made a payment, they paid a total amount of 23,000 US\$ for the whole year. Table 2 shows that the median individual earns between 15,000 and 30,000 US\$ per year. Considering that the minimum wage is around 4,000 US\$ per year, this income means that these individuals are particularly wealthy.

3.5 Randomization and power

We randomly allocated our final sample of 9,024 individuals to eight subgroups (considering those receiving the early and late messages) that equals 1,129 individuals per subgroup. We stratified this randomization based on the individuals' age and sex, income dummies, a dummy that indicate whether they have paid before, previously paid amounts and their years and number of properties and their self-assessed values. These variables are reported in Table 2.

The groupings indicate that 2,256 individuals received a reminder message, 2,256 received a message inspired by the traditional theory, 2,256 received a message on social norms, and 2,256 received a message on altruism. Assuming a base compliance of 5%, we have a statistical power of 80% to identify a difference of 2 percentage points.¹⁵ This is a more than 30% of the country's population.

¹⁵This was computed using a two-sample proportions power calculation. If we assume a base compliance of 10%, we have 80% power to identify a difference of 2.65 percentage points.

Table 2: Characteristics of final sample

Variable	Average	p25	p50	p75	Min	Max	N
Age	54.8	45.0	54.0	64.0	18.0	103.0	9,024
Female	0.36	0.00	0.00	1.00	0.00	1.00	9,024
Number properties	3.9	3.0	3.0	4.0	3.0	81.0	9,024
Properties' value (thousand \$)	131.1	39.9	71.8	127.0	0.0	36,800	9,024
Paid rental income tax? (years 13-17)	0.26	0.00	0.00	1.00	0.00	1.00	9,024
Date of last payment (year)	2015.8	2015	2016	2017	2013	2017	2,385
Amount paid (thousand \$)	2.3	0.5	0.8	1.7	0.0	752.5	2,385
Yearly income (0-15 thousand \$)	0.37	0.00	0.00	1.00	0.00	1.00	9,023
(15-30 thousand \$)	0.16	0.00	0.00	0.00	0.00	1.00	9,023
(30-150 thousand \$)	0.37	0.00	0.00	1.00	0.00	1.00	9,023
(\geq 150 thousand \$)	0.10	0.00	0.00	0.00	0.00	1.00	9,023

reasonable minimum detectable size of the effect considering that in the literature, these types of treatments tend to have a total effect of 0.0 to 10.0 percentage points when compared to a control group that did not receive any message. However, we recognize that outcome variables are different across studies and institutional contexts.

4 The Direct and Indirect Effects of Messages

In this section, we report the effect of the treatment messages on the payment of the rental income tax (direct effect) and the payment of the capital gains and self-employment income taxes (indirect effects).

4.1 Data, outcome variables, and empirical strategy

4.1.1 Data and outcome variables

We were provided with a database at the individual-day level that indicated the size of the rental income tax payments and to which date the payments are referring to. Note

that individuals can pay in advance or catch up with their due payments. The database also included tax payments related to capital gains and self-employment activities. We also collected survey data on a random subsample of 867 taxpayers. The survey consisted of several questions regarding individuals' social preferences and beliefs. More information is available in Appendix B.

Our main results are based on two outcome variables. First, the total amount paid of each type of tax since the start of the experiment until a particular month. We transform this amount using the inverse hyperbolic sine function, which allows us approximate the natural logarithm retaining zero-valued observations.¹⁶ Second, we define a dummy variable that equals one if the individual has made a tax payment since the start of the intervention and by a particular month. The tax administration also provided us with data on taxpayers' characteristics that were described in Table 2.

Our main results are based on these two outcome variables because they convey complementary information about the nature of the treatment effect. First, one can distinguish between effects that operate in the intensive or extensive margin. Consider a positive shift in the total amount paid. If it is accompanied by a positive shift in the probability of making a payment, it means that the treated group is paying more by making new payments (extensive margin). However, if the probability of making a payment does not change, it means that the treated group is paying more by making only larger payments (intensive margin) but not new ones. The converse logic applies to a negative shift on the total amount paid. A decline in the probability of making a payment means that the treated group is paying less by making fewer payments. However, if the probability of making a payment does not change, it means that the treated group is paying less by reducing the size of their payments.

In addition, one can learn about the dynamic nature of treatment effects. Consider a transitory positive shift in the total amount paid accompanied by a positive shift in the probability of making a payment. The transitory nature of the shift in the total amount paid means that either the treatment induced more payments today at the expense of fewer

¹⁶For more on the inverse hyperbolic sine function, refer to Friedline et al. (2015).

or smaller payments in the future, or it induced taxpayers to pay current obligations that they would have otherwise paid in the future (the additional payments made by the treated group were equated later by additional payments made by the control group). Importantly, one can distinguish between these two situations. In fact, if the shift in the probability of making a payment is permanent, this shift indicates that the additional payments made by the treated group were compensated later by smaller or less payments (first situation). If the shift in the probability of making a payment is transitory, it means that the additional payments made by the treated group were equated later by additional payments made by the control group (second situation).

Another interesting case to consider is a transitory decline in the total amount paid accompanied by a decline in the probability of making a payment. This combination means that in the short run, the treatment has induced taxpayers to pay less by making fewer payments. Also, the transitory nature of the decline in the total amount paid means that the treatment has induced fewer payments today that were compensated later by more or larger payments (i.e., taxpayers are delaying their payments), or it has brought forward future defaults (i.e., the smaller number of payments made by the treated group is equated later by a smaller number of payments made by the control group). Although this last situation is unlikely, the two scenarios can be differentiated by looking at the decline in the probability of making a payment. If this decline is transitory, then the treatment has induced a delay in payments (first case). If the decline is permanent, then the treatment has brought forward future defaults (second case). There are, of course, more cases but we focus on these for illustrative purposes.

4.1.2 The effect of the treatment messages relative to the reminder messages

To estimate the marginal effect of adding a small clause of text that refers to a particular theory, we estimate the following equation at different points of time:

$$y_{ist} = \alpha + \beta_1 T_{i,1} + \beta_2 T_{i,2} + \beta_3 T_{i,3} + \gamma' X_i + \varepsilon_{ist} \quad (1)$$

where y_{ist} is the tax compliance of i measured by one of the two outcomes described above computed since date s and until date t , where s is the beginning of the experiment (October 2018) and t any month between October 2018 and January 2020. X_i is a set of covariates that includes age, sex, the number of properties and their total value, a dummy indicating if a rental income tax payment was made between 2013 and 2017, income dummies, and a set of district fixed effects (see Table 2). Even though these covariates are not required for identification, we control for them to increase statistical power. We also include the pre-intervention level of compliance with the corresponding tax, that is, the average measure of y_{ist} computed for the period between January (s) and September of 2018 (t). Finally, $T_{i,m}$ is a dummy that equals one if the individual i received the traditional (i.e., $m = 1$), social norm (i.e., $m = 2$), or altruism (i.e., $m = 3$) message. The dummy equals zero if i received the reminder message or if i received a treatment message different than m . Our parameters of interest are β_m as they describe the effect of sending four messages of type m relative to the effect of sending four reminder messages.

4.1.3 The effect of the reminder message

In the previous subsection we explained how we estimate the effect of each treatment message relative to the reminder. Here we describe how we estimate the effect of the reminder message. This estimation is important to account for the total effect of each type of message and to perform a cost-benefit analysis. To approximate the size of the effect of the reminder message, we exploit the random assignment of the time intervals in which we sent the messages. In general terms, we compare those that received an early reminder message against those that received a late message at a point in time when only the early messages were sent.

Hence, we estimate the following regression:

$$y_{ist} = \alpha + \delta_0^{1st} T_{i,0}^{1st,early} + \gamma' X_i + \varepsilon_{ist} \quad (2)$$

where, $T_{i,0}^{1st,early}$ is a dummy that equals one if the individual i received the early reminder messages and zero if i received the late messages. The window of analysis is the days

between October 5 (s) and October 18, 2018 (t). This exercise allows us to estimate the short-term effect of sending one reminder message with respect to sending no message at all.¹⁷

4.2 Pre-treatment balance

We use the administrative records provided by the tax authority to first test if the observable characteristics are equal across treatment groups. For this, we run multiple regressions of each of these characteristics on the treatment dummies defined above. We report our results in Table 3. We confirm that in terms of age, sex, number of properties, value of properties, and income, individuals in each treatment group and in the group receiving the reminder message are similar. This is consistent with the random assignment of each type of message.

¹⁷To evaluate the effect of the first wave of reminder messages, we pool together the other types of *late* messages to increase the power. The results are almost unchanged if we compare those that received an early reminder against those that received a late reminder message only.

Table 3: Balance in pre-treatment characteristics

	Age	Female	Number of properties	Value of properties	Yearly Income (bins, thousand \$)			
					0-15	15-30	30-150	≥ 150
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Traditional	0.2903 (0.4024)	-0.0040 (0.0143)	0.0355 (0.0510)	-20,208.9989 (30,281.6831)	-0.0021 (0.0144)	-0.0092 (0.0110)	0.0170 (0.0144)	-0.0057 (0.0090)
Social Norms	0.0891 (0.4078)	-0.0098 (0.0143)	0.0013 (0.0478)	7,148.2104 (35,939.3365)	-0.0084 (0.0143)	-0.0093 (0.0110)	0.0151 (0.0143)	0.0027 (0.0091)
Altruism	0.0182 (0.4012)	0.0027 (0.0144)	0.0949 (0.0612)	32,584.1764 (62,049.3090)	-0.0062 (0.0144)	-0.0080 (0.0110)	0.0084 (0.0143)	0.0058 (0.0092)
Constant	54.7070 (0.2843)***	0.3666 (0.0101)***	3.9065 (0.0329)***	427,907.9785 (23,973.0966)***	0.3701 (0.0102)***	0.1676 (0.0079)***	0.3586 (0.0101)***	0.1037 (0.0064)***
N	9,024	9,024	9,024	9,024	9,023	9,023	9,023	9,023

Robust standard errors between parenthesis. The ***, **, * denote significance at the 1, 5, and 10

We also construct several pre-treatment outcome variables to verify if the pre-treatment tax behavior was similar across groups. For each month in 2018 before the start of the experiment (i.e., between January 2018 and October 2018), we compute the probability of making a payment and the amount paid for each type of tax. Thanks to the randomization, the pre-treatment tax behavior should be similar across treatment arms. To test this, we run multiple regressions akin to equation (1) for each pre-treatment month, that is, defining the dependent variables for the starting period s =January 2018 and the end period t , where t is a particular month between January and September of 2018. We report our results for the traditional, social norm, and altruism messages in [A.3](#), [A.4](#) and [A.5](#), respectively. For most taxes, we cannot reject the null hypothesis that the pre-treatment tax behavior is equal across treatment arms. The only exception is that by September of 2018, we find that individuals who receive the social norm message made larger payments of the self-employment income tax. To account for this, we control for either the total amount paid or the probability of making a payment of the corresponding tax between January and September of 2018 in all our regressions. Overall, we interpret this evidence as indicating that randomization was performed correctly and that the results described in the following sections can be interpreted as causal.

4.3 Results

4.3.1 Direct and indirect effects

Traditional theory. Figure 1 presents the direct effect of the traditional message on compliance with the rental income tax and the indirect effects of this message on compliance with the capital gains and the self-employment income taxes. Panel A shows the effect on the total amount paid, and Panel B shows the effect on the probability of making a payment. These cumulative effects are calculated for every month after the start of the experiment up to January 2020. As described in Section 3.2, the traditional message highlights the results of the enforcement actions carried out by the tax administration to increase compliance with the rental income tax.

Panel A in Figure 1 shows that the traditional message had a permanent direct effect on

the total amount of rental income tax that was paid. In fact, by the time the experiment was phased out, the taxpayers who received this message had made a total payment around 15% larger than those who received only the reminder message.¹⁸ This positive effect persisted in the months that followed up to January 2020 (a year after the last message was sent) as taxpayers who received the traditional message still had a total amount paid around 11 percentage points larger than the control group.

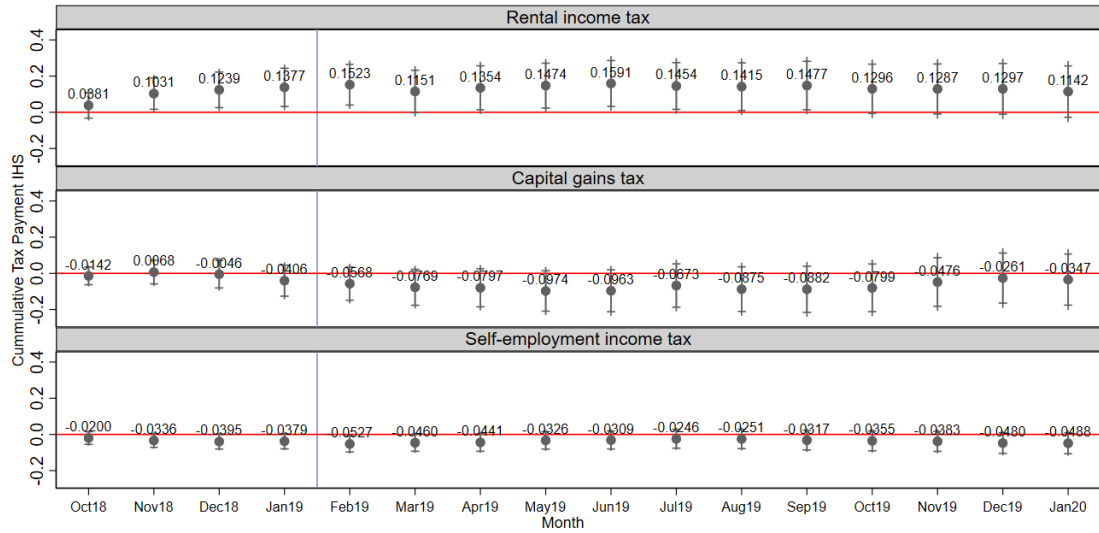
In Panel B we observe a permanent increase of around 2 percentage points in the probability of making a rental income tax payment. As explained in Section 4.1.1, this increase means that the message has induced taxpayers to increase the amount they pay by making new payments and not by making larger payments only. Moreover, because the shifts are permanent one can assert that the additional payments induced by the traditional message were not later offset by fewer or smaller payments made by the treated group or equated by more or larger payments made by the control group (i.e., the message did not just induce payments that taxpayers would have otherwise made in the future).

These results suggest that the traditional message generated new resources for the tax authority. This assessment, however, would be incomplete if we ignore the effect of this treatment on other taxes. The results for the indirect effects of the traditional message show that it produced a transitory decline of around 5% in the total amount of the self-employment income tax that was paid by the time the experiment was phased out (see Panel A). The results in Panel B show it also produced a transitory decline in the probability of making a payment. Combined, this evidence indicates that the message induced taxpayers to delay their self-employment income tax payments. In particular, taxpayers made fewer payments and contributed a smaller amount at first, but this amount was later compensated for by making more payments. Although the results are not statistically significant, Panels A and B in Figure 1 provide suggestive evidence that the traditional message also had a negative and transitory indirect effect on the total amount paid of the capital gains tax due to a delay in payments.

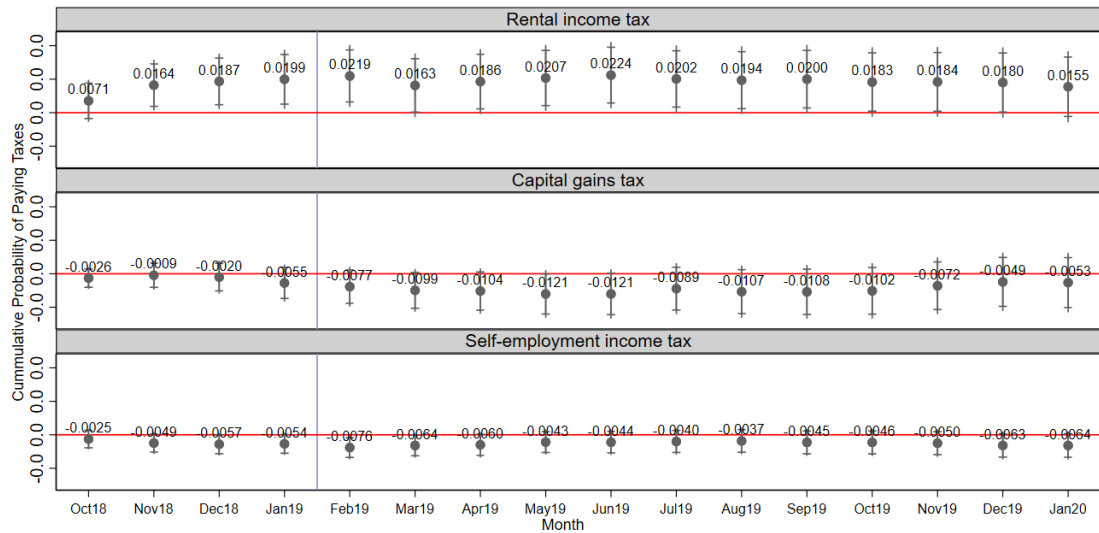
¹⁸To compute the semi-elasticities from the inverse hyperbolic sine function one can use the following expression: $\exp(\hat{\beta} - 0.5\hat{Var}(\hat{\beta})) - 1$ as derived in Bellemare and Wichman (2019). For simplicity, we focus on the coefficients reported in the figures that provide good approximations of these semi-elasticities. Conclusions are not affected if we focus on the exact semi-elasticities instead.

Figure 1: Direct and indirect effects of the traditional message on tax compliance

Panel A: IHS transformation of amount paid between Oct 18 and month X



Panel B: Likelihood of paying taxes between Oct 18 and month X



Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline et al. (2015). All regressions include a set of covariates that comprises the age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects. We also control for the initial value of the dependent variable between January 18 and September 18, that is, before the intervention.

There are two potential explanations for the negative spillover described above. The first stems from the theoretical model of LLS (2019) which predicts that messages that appeal to enforcement actions can provoke a negative spillover on compliance with other taxes if taxpayers understand that increased enforcement efforts devoted to one tax will reduce efforts devoted to other taxes. The second explanation relies on the cash-flow effect. Taxpayers reduce their cash strain by cutting down payments related to other taxes. This behavior, but at the firm level, has already been suggested by Boning et al. (2020) to explain why subsidiaries of treated firms remitted less tax in a large field experiment carried out in the US.

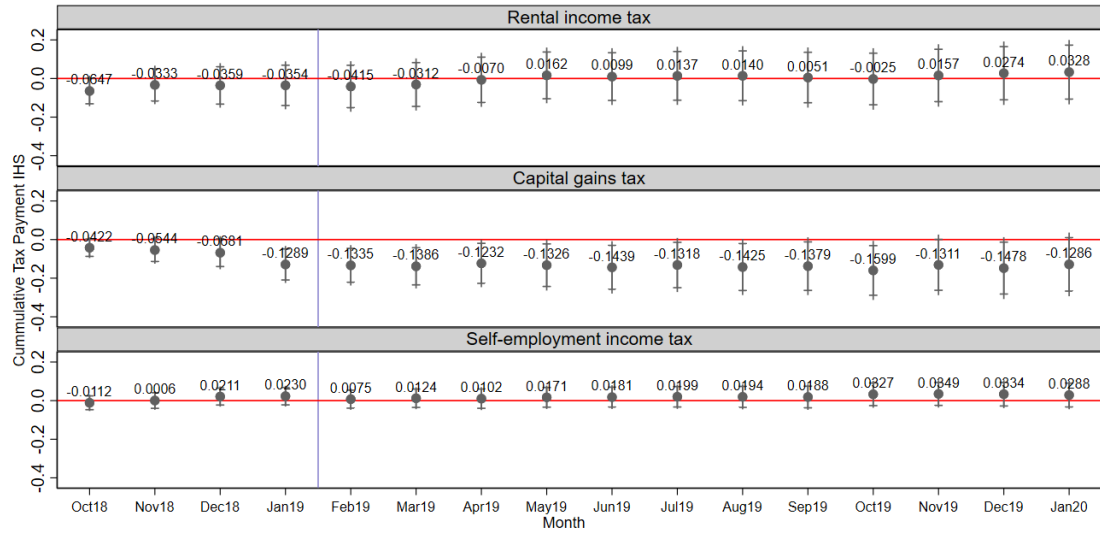
Social norms. Figure 2 shows the direct effect of the social norm message on compliance with the rental income tax as well as its indirect effects on compliance with the capital gains and the self-employment income tax. This message indicates that the majority of the taxpayers' neighbors comply with their rental income tax.

Interestingly, this message has no direct effect but produces a negative and permanent indirect effect on the amount paid to the capital gains tax of around 13% and on the probability of making a payment of around 1.5 percentage points. Combined, this evidence means that the social norm message induces taxpayers to contribute less by making fewer payments to the capital gains tax and that this was not later compensated for by making more or larger payments. Notice that there was no indirect effect on the self-employment income tax.

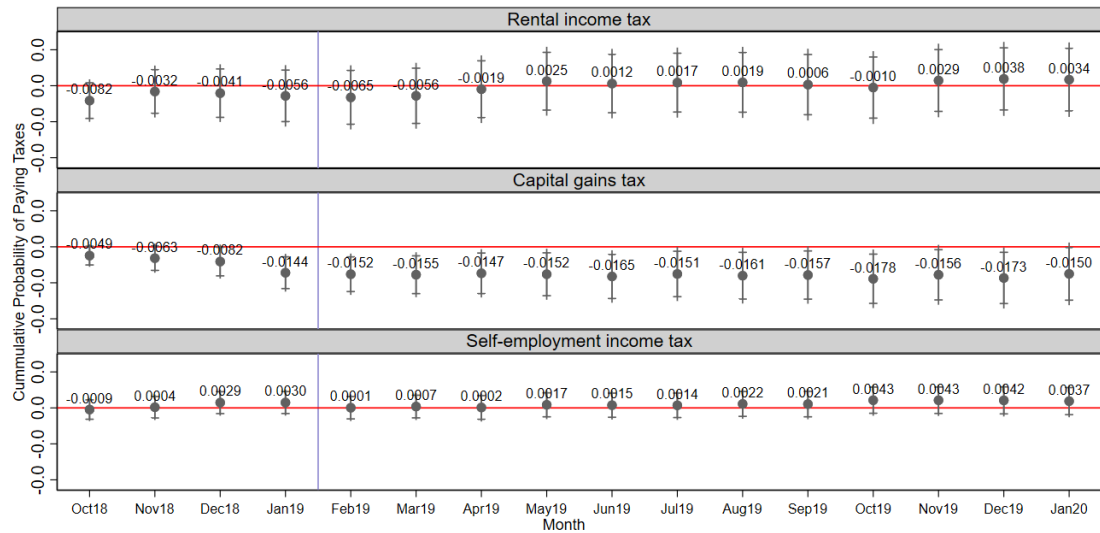
It is puzzling that the social norms treatment had no direct effect but had a permanent indirect effect only on the capital gains tax. One possible explanation for this pattern is that the treatment message did not induce an update in the taxpayers' beliefs regarding compliance with the rental income tax or the self-employment income tax but was able to induce a downward update in the taxpayers' beliefs regarding compliance with the capital gains tax. Further, if people previously thought that the capital gains tax payments were more prevalent and our message conveyed the idea that in fact, they were not, then the social norms theory predicts that one would observe the negative effect reported above.

Figure 2: Direct and indirect effects of the social norm message on tax compliance

Panel A: IHS transformation of amount paid between Oct 18 and month X



Panel B: Likelihood of paying taxes between Oct 18 and month X



Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline et al. (2015). All regressions include a set of covariates that comprises age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects. We also control for the initial value of the dependent variable between January 18 and September 18, that is, before the intervention.

For this explanation to be true, two conditions must be met. First, individuals should be able to update their beliefs about compliance with a certain tax from messages that address compliance with other taxes. Moreover, individuals should be able to extract a negative description of a social norm (“people do not pay their capital gains tax”) from a message conveying a positive description of another norm (“people pay their rental income tax”). This is akin to what the psychology literature describes as the “innuendo effect” (Kervyn et al., 2012). The innuendo effect is the tendency for individuals to draw negative conclusions from descriptions that omit certain information. In this way, innuendo allows one to convey negative information on a relevant dimension by omitting information on this dimension. In our context, we provided information about the norm on rental income tax, but we omitted information about the norm on capital gains tax and self-employment income tax.

Once we allow for a response similar to the innuendo effect, the second condition is heterogeneity in the ex-ante social norm of each tax. Consider a situation where taxpayers believe that the share of individuals that comply with rental income, capital gains, and self-employment income taxes are “ x ”, “ y ”, and “ z ”, respectively, where $y \geq x > z$. If our message conveys that a share x of individuals are in fact paying their rental income tax, but only a share $x - \alpha$ are paying capital gains or self-employment income taxes; then for values of α similar to $x - z$, there would be no update in the rental income tax norm (and hence no change in behavior), a downward update in the capital gains tax norm (and hence a reduction in compliance), and no update in the self-employment income tax norm (and hence no change in behavior).¹⁹ Of course, there could be other explanations that could be considered in future research once the data needed to test them become available.

Altruism. Figure 3 shows the direct effect of the altruism message on compliance with the rental income tax as well as its indirect effects on compliance with the capital gains and the self-employment income taxes. These results show that our altruism message has a

¹⁹This heterogeneity in expected compliance is reasonable given that failing to comply with the rental and self-employment income tax is easier than failing to comply with the capital gains tax. The reason is that the transactions that are subject to the capital gains tax are usually carried out under formal agreements; and, in contrast, many transactions that are subject to the rental and self-employment income taxes are carried out under informal agreements.

transitory negative effect on the size of rental income tax payments and on the probability of payment. We do not observe any spillover to other taxes.

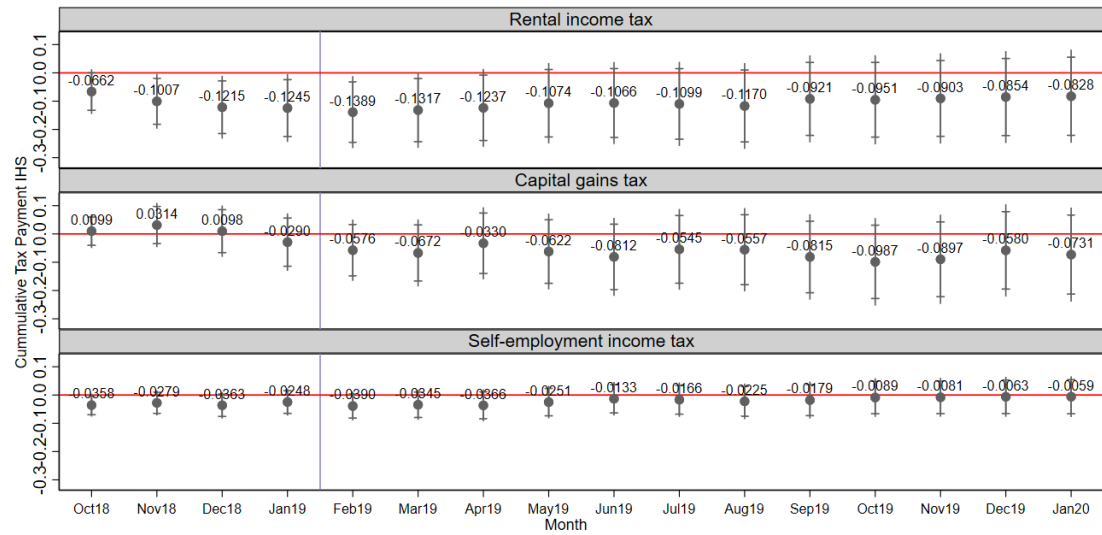
It is important to recall that these messages highlighted how complying with the payment of the rental income tax could result in the construction of health centers in the poorest areas of the country. That is, our messages highlighted redistribution, since the beneficiaries would be the poor and not the taxpayers from our sample. Other studies have conflated altruistic motives (i.e. people may be more willing to pay if they value redistribution) with those regarding reciprocity (i.e. people will be more willing to pay if they know that they will receive more or better public goods), because in their messages they referred to public goods that everybody could potentially use and enjoy, including in-sample taxpayers.

This treatment message does not aim at shifting taxpayers' altruism but to augment the effect of an altruistic preference for tax compliance by making more salient the fact that tax revenues can be used to provide public goods to the poor. Based on this, one possible explanation as to why this treatment message backfired could be that taxpayers in our sample are not altruistic or have a low inequality aversion. In this case, the message could backfire because it made more salient the fact that the money collected through the rental income tax was used to provide public goods that the taxpayers did not enjoy.

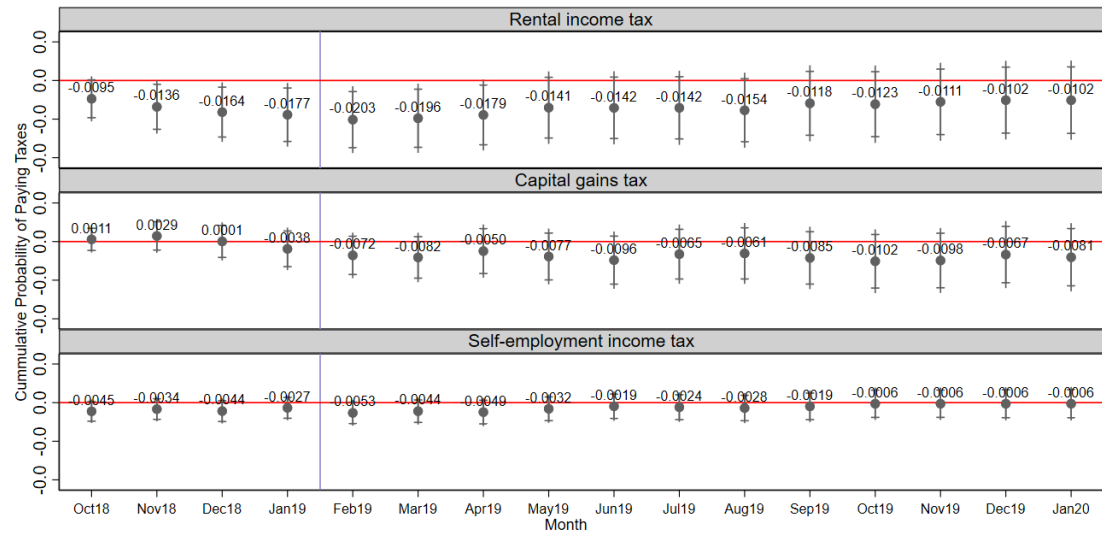
In this regard, the available evidence indicates that taxpayers in our sample have non-altruistic preferences and a low inequality aversion. In fact, the majority of taxpayers appear unwilling to share the money they earn either because of luck or through their own effort. In fact, most taxpayers totally disagreed (9.5%), disagreed (37.9%), or neither agreed nor disagreed (19.4%) with the statement: "If I earn money because I was lucky, I should share it with someone else apart from my family". If the source of money is their own effort, then individuals are even less willing to share it with others. The corresponding numbers are 13.7, 42.7, and 14.7%, respectively. Moreover, a significant share of taxpayers in the control group either totally disagreed (5.2%), disagreed (25.6%), or neither agreed nor disagreed (17.8%) with the statement "income should be more equal".

Figure 3: Direct and indirect effects of the altruism message on tax compliance

Panel A: IHS transformation of amount paid between Oct 18 and month X



Panel B: Likelihood of paying taxes between Oct 18 and month X



Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline et al. (2015). All regressions include a set of covariates that comprise age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects. We also control for the initial value of the dependent variable between January 18 and September 18, that is, before the intervention.

Furthermore, the perception of taxpayers that they had already paid high income taxes and that tax compliance was low in areas other than their districts could have compounded the negative response triggered by the altruism message. In fact, our survey shows that a good share felt that they paid either very high (19.5%) or high (29.2%) income taxes. In addition, taxpayers perceived that around 60% of those living in their neighborhoods complied with their taxes, while the perceived average tax compliance of those living in Lima and in the Peru was 38 and 31%, respectively.

Another possible explanation is related to taxpayers' perceptions regarding the high levels of corruption and the inefficacy of the government. In this case, the message can backfire by making more salient that tax revenues should be used to provide public goods (but are not) which compounded the effect of taxpayers' perceptions about government corruption and inefficacy on tax compliance. In this regard, our survey data showed that 63% of the control group believed that corruption was the main problem in the country.²⁰ Furthermore, corruption in public hospitals was perceived to be very high, high, or moderate by 79% of the sample. We find similar patterns when asking individuals about their satisfaction and the efficacy of this institution.

To differentiate between these competing hypotheses is difficult. Understanding which mechanism is the most important to explain why the altruism message can backfire is an avenue for future research.

4.3.2 The effect of the reminder message

We report the results of estimating equation (2) in Table 4. We find that the reminder message by itself increases compliance with the rental income tax. In fact, it increases the likelihood of compliance with this tax by 2.14 percentage points and the size of the payments by 15.04% in the short run. We do not find a short-run effect of the reminder on compliance with the capital gains tax or the self-employment income tax.

We cannot test whether the increase in compliance with the rental income tax is permanent as we do not have a pure control group that received no treatment. Nonetheless,

²⁰Second and third place are high crime rates (43.1%) and the bad quality of public education (12.3%).

we believe this exercise is informative. In particular, by adding the effect of the reminder message to each of the coefficients associated with the effects up to February 2019 that are reported in Figures 1, 2, and 3, we can learn about the total short-term effect of sending these messages.

Table 4: The effect of the reminder message on tax compliance

	Likelihood of paying taxes between the 5th and 18th of Oct 2018	IHS of amount paid between the 5th and 18th of Oct 2018
	(1)	(2)
<i>Panel A: Rental income tax</i>		
Reminder	0.0214 (0.0059)***	0.1504 (0.0389)***
N	5,639	5,639
<i>Panel B: Capital gains tax</i>		
Reminder	0.0033 (0.0031)	0.0251 (0.0213)
N	5,639	5,639
<i>Panel C: Self-employment income tax</i>		
Reminder	0.0012 (0.0034)	0.0033 (0.0172)
N	5,639	5,639

Robust standard errors between parenthesis. The ***, **, and * indicate significance at the 1, 5, and 10

The total short-term effect of the traditional message on the rental income tax is 4.33 percentage points (i.e., 2.19 + 2.14), while for the social norm and altruism messages are 1.49 (i.e., -0.65 + 2.14) and 0.11 (-2.03 + 2.14) percentage points. Similarly, the effect on the payments of this tax is 31.49% (i.e., 16.45 + 15.04), 10.76% (i.e., -4.28 + 15.04), 0.38% (i.e., -14.66 + 15.04), respectively.

4.4 Cost-benefit analysis

The literature has shown that sending messages to increase tax compliance has, in many cases, a positive net benefit.²¹ However, most studies do not consider that individuals may be adjusting compliance with the tax addressed in the message at the expense of other taxes. Therefore, these studies may be underestimating the costs of their interventions. In this subsection, we perform a cost-benefit analysis on sending the three types of messages in the short and long run.

Panel A in Table 5 presents the effect of the three types of messages on the tax revenue per person collected for each tax. Panel B presents the effect on revenues per dollar spent considering only the direct effect of the message as well as its direct and indirect effects together. We calculate these numbers by dividing the effect of messages on tax revenues per person by US\$ 15.62, the cost of sending four messages to a potential taxpayer.²² In columns (1) to (3), we report the accumulated change in revenues for the period from the start of the experiment to the month immediately after the last message was sent. We consider this period the short run. In columns (4) to (6), we report the accumulated change in revenues for the period from the start of the experiment to a year after that. We consider this period the long run. To make these calculations, we assume that the effects in the very short run of the reminder message reported in Table 4 remain throughout the entire evaluation period. In addition, we impute a value of zero in those cases where the effect is not statistically significant.²³

Panel B has a summary our cost-benefit analysis. Notice that the difference between the result that considers the direct effect only and the result that factors in the indirect

²¹See, e.g., Chirico et al. 2019.

²²Physical letters account for the largest share of the cost.

²³To clarify how we compute the short- and long-run changes in tax revenues, assume that the effect of the reminder is 10% and the short-term effect of a particular treatment message is 5%. Suppose, as well, that the control group paid a total of US\$ x in the months corresponding to the short run. Therefore, the amount that they would have paid in the absence of the reminder would be $(100\% - 10\%)x$. To calculate the total revenue generated by the reminder in the short run we have to compute the following: $x - (100\% - 10\%)x = US\$10\%x$. Through a similar calculation, we obtain that the effect of the treatment message amounts to US\$ $5\%x$ in this example. Notice that the long-run changes in tax revenues can be larger than the short-run effects for two reasons. First, the long-run effect itself might be larger (e.g., it could be 7% instead than 5%). Second, the total revenues registered for the control group (x) increase in time.

effect of the message indicates the bias in which one would incur if one ignores the presence of spillovers.

We find that the traditional message increases the tax revenue by US\$ 1.35 per dollar spent in the short run and by US\$ 3.92 in the long run. In this case, we do not find major differences with respect to the scenario where we only consider the direct effect. This is because the negative spillover produced on the self-employment income tax is relatively small and transitory. The situation is different for the social norm message. In particular, this message decreases tax revenues by US\$ 1.59 per dollar spent in the short run and by US\$ 5.20 in the long run. However, if one ignores the negative spillover produced by this message, then one would conclude that it increased revenues by US\$0.69 in the short run and by US\$ 2.09 in the long run, per dollar spent (mainly through the effect of the reminder message). This increase means that if we ignore the indirect effects of the social norm message, we would greatly overestimate its net benefit. Finally, the altruism message decreases the tax revenue by US\$0.04 in the short run but produces a positive net benefit of US\$ 2.09 per dollar spent in the long run.

Table 5: Per capita changes in tax revenues caused by the messages

	Short Run (Oct-18 to Feb-19)			Long Run (Oct-18 to Jan-20)		
	Traditional	Social norms	Altruism	Traditional	Social norms	Altruism
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Changes in tax revenues caused by the messages						
<i>(i) Rental Income Tax</i>						
Reminder	10.77	10.77	10.77	32.63	32.63	32.63
Additional Lines	12.55	0.00	-11.45	28.51	0.00	0.00
<i>(ii) Capital Gains Tax</i>						
Reminder	0.00	0.00	0.00	0.00	0.00	0.00
Additional Lines	0.00	-35.67	0.00	0.00	-113.76	0.00
<i>(iii) Self-Employment Income Tax</i>						
Reminder	0.00	0.00	0.00	0.00	0.00	0.00
Additional Lines	-2.3	0.00	0.00	0.00	0.00	0.00
Panel B. Changes in tax revenues caused by the messages per dollar spent, considering:						
Only direct effects $[(i)/15.62]$	1.49	0.69	-0.04	3.92	2.09	2.09
Direct and indirect effects $[(i)+(ii)+(iii)/15.62]$	1.35	-1.59	-0.04	3.92	-5.20	2.09

All figures are expressed in US dollars and correspond to the average potential taxpayer in our sample. Reminder refers to the change in tax revenues caused by the text in the message that reminds potential taxpayers to pay their rental income tax. Additional lines refer to the change in tax revenues caused by the text in the message related to the traditional, social norm, or altruism message.

5 Concluding Remarks

In this study, we carried out a randomized controlled trial to estimate the direct and indirect effects produced on tax compliance by three different types of messages sent to a large sample of potential income taxpayers in the city of Lima, Peru. During the experiment, the tax authority sent a traditional message that highlighted the effectiveness of its control actions, a social norm message that informed taxpayers about the compliance of others, and an altruism message that highlighted that tax revenues could be used to provide public goods to disadvantaged citizens. The direct effects refer to the change in compliance with the tax addressed in the messages (i.e. the rental income tax). The indirect effects refer to the changes in compliance with the capital gains and the self-employment income taxes. These three income taxes share the characteristic of being difficult to enforce because taxpayers can easily under-report or avoid declaring their income streams.

Our results confirm that traditional messages have a positive direct effect of increasing payments. We also confirm that these messages can produce spillovers to compliance with other taxes and that they can be negative. Potential explanations for this negative indirect effect are a downward adjustment in taxpayer’s expected enforcement with other taxes (as postulated by LLS (2019)), or a cash-flow effect by which taxpayers reduce their cash strain by cutting down payments related to other taxes.

We also provide new evidence that social norm messages can produce negative spillovers. This evidence suggests that individuals can extract a negative description of a social norm from a message that conveys a positive description of another norm that is a phenomenon akin to the “innuendo effect” reported in the psychology literature.

Our results for the altruism message confirm that this type of message can backfire. We use a survey to document the context in which one can expect this negative response and find evidence that the taxpayers in our sample have non-altruistic preferences and low inequality aversion, and perceive that public institutions are highly corrupt and ineffective. This suggests that altruism messages can backfire by compounding the negative effects of these preferences and perceptions on compliance.

In this study we consider effects across different taxes as well as short- and long-run ef-

fects. This process allowed us to provide a comprehensive cost-benefit analysis for each type of message. In fact, we can confirm that the traditional message generates new resources for the tax authority in the long run (by an amount of US\$3.92 per dollar spent) because it has a permanent effect on the total amount paid and its negative spillover is relatively small and transitory. In addition, we find that the social norm message produces a loss of US\$5.20 per dollar spent in the long run that is driven by its permanent negative spillover on payments to the capital gain tax. An analysis focused solely on the short-run direct effect would have erroneously concluded that the social norms message was innocuous.

Our results are relevant to tax authorities in other parts of the world that face informational asymmetries that prevent them from fully identifying who is a debtor. Our findings also suggest new avenues for future research. In particular, further research on why social norms messages can trigger a negative spillover or on the role of altruistic preferences and the perception of corruption in government for the effect of messages that make more salient the use of tax revenues, are the most promising.

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A Appendix

Figure A.1: Experiment Messages in Spanish

Panel A: Reminder message

[Logo]

Denominación del año

Carta N° <<Número de carta >>

Lima, XX de XXX de 2018

RUC :
Nombre o razón social :
Domicilio :

Señor/a contribuyente:

Si Ud. percibe ingresos por alquileres, recuerde pagar su impuesto.¹

Entérese como declarar y pagar este tipo de renta en _____.

Para consultas generales, comuníquese con nuestra Central de Consultas, llamando desde sus teléfonos fijos al XXXX-XX-XXX o desde sus teléfonos móviles al (XX) XXX-XXXX, digitando la opción 3, de lunes a viernes, de 8:30 a.m. a 6:00 p.m. y sábados de 9:00 a.m. a 1:00 p.m. Asimismo, puede dirigirse a cualquiera de nuestros Centros de Servicios al Contribuyente.

Si Ud. percibe ingresos por alquileres y ya cumplió con el pago de su impuesto, ¡felicitaciones!

Atentamente,

¹Los alquileres son Rentas de Primera Categoría que incluyen el arrendamiento o subarrendamiento de predios (casa, departamento, habitaciones, cocheras, entre otros); la cesión de muebles (autos, máquinas, etc.), las mejoras introducidas al predio por el inquilino y la cesión gratuita o a precio no determinado de predios (terrenos o edificaciones)

(Figure A.1, continued)

Panel B: Traditional message

[Logo]

Denominación del año

Carta N° <<Número de carta >>

Lima, XX de XXX de 2018

RUC :
Nombre o razón social :
Domicilio :

Señor/a contribuyente:

Si Ud. percibe ingresos por alquileres, recuerde pagar su impuesto.

Sepa que la SUNAT está esforzándose por detectar a quienes no pagan ese impuesto en su distrito. Ya hemos identificado 78 mil personas en Barranco, La Molina, Miraflores, San Isidro, San Borja y Surco.¹

Entérese como declarar y pagar este tipo de renta en _____.

Para consultas generales, comuníquese con nuestra Central de Consultas, llamando desde sus teléfonos fijos al XXXX-XX-XXX o desde sus teléfonos móviles al (XX) XXX-XXXX, digitando la opción 3, de lunes a viernes, de 8.30 a.m. a 6:00 p.m. y sábados de 9:00 a.m. a 1:00 p.m. Asimismo, puede dirigirse a cualquiera de nuestros Centros de Servicios al Contribuyente.

Si Ud. percibe ingresos por alquileres y ya cumplió con el pago de su impuesto ¡felicitaciones!

Atentamente,

¹Los alquileres son Rentas de Primera Categoría que incluyen el arrendamiento o subarrendamiento de predios (casa, departamento, habitaciones, cocheras, entre otros); la cesión de muebles (autos, máquinas, etc.), las mejoras introducidas al predio por el inquilino y la cesión gratuita o a precio no determinado de predios (terrenos o edificaciones)

(Figure A.1, continued)

Panel C: Social norm message

[Logo]

Denominación del año

Carta N° <<Número de carta >>

Lima, XX de XXX de 2018

RUC :
Nombre o razón social :
Domicilio :

Señor/a contribuyente:

Si Ud. percibe ingresos por alquileres, recuerde pagar su impuesto.

Sepa que la mayoría de los vecinos de Barranco, La Molina, Miraflores, San Isidro, San Borja y Surco cumplen con declarar sus ingresos por alquileres.¹

Entérese como declarar y pagar este tipo de renta en _____.

Para consultas generales, comuníquese con nuestra Central de Consultas, llamando desde sus teléfonos fijos al XXXX-XX-XXX o desde sus teléfonos móviles al (XX) XXX-XXXX, digitando la opción 3, de lunes a viernes, de 8.30 a.m. a 6:00 p.m. y sábados de 9:00 a.m. a 1:00 p.m. Asimismo, puede dirigirse a cualquiera de nuestros Centros de Servicios al Contribuyente.

Si Ud. percibe ingresos por alquileres y ya cumplió con el pago de su impuesto ¡felicitaciones!

Atentamente,

¹Los alquileres son Rentas de Primera Categoría que incluyen el arrendamiento o subarrendamiento de predios (casa, departamento, habitaciones, cocheras, entre otros); la cesión de muebles (autos, máquinas, etc.); las mejoras introducidas al predio por el inquilino y la cesión gratuita o a precio no determinado de predios (terrenos o edificaciones)

(Figure A.1, continued)

Panel D: Altruism message

[Logo]

Denominación del año

Carta N° <<Número de carta >>

Lima, XX de XXX de 2018

RUC :
Nombre o razón social :
Domicilio :

Señor/a contribuyente:

Si Ud. percibe ingresos por alquileres, recuerde pagar su impuesto.¹

Sepa que si todos los vecinos de Barranco, La Molina, Miraflores, San Isidro, San Borja y Surco pagasen su impuesto por alquileres, se podrían construir mas de 90 Centros de Salud en las regiones más pobres del Perú.

Entérese como declarar y pagar este tipo de renta en _____.

Para consultas generales, comuníquese con nuestra Central de Consultas, llamando desde sus teléfonos fijos al XXXX-XX-XXX o desde sus teléfonos móviles al (XX) XXX-XXXX, digitando la opción 3, de lunes a viernes, de 8.30 a.m. a 6:00 p.m. y sábados de 9:00 a.m. a 1:00 p.m. Asimismo, puede dirigirse a cualquiera de nuestros Centros de Servicios al Contribuyente.

Si Ud. percibe ingresos por alquileres y ya cumplió con el pago de su impuesto, ¡felicitaciones!

Atentamente,

¹Los alquileres son Rentas de Primera Categoría que incluyen el arrendamiento o subarrendamiento de predios (casa, departamento, habitaciones, cocheras, entre otros); la cesión de muebles (autos, máquinas, etc.); las mejoras introducidas al predio por el inquilino y la cesión gratuita o a precio no determinado de predios (terrenos o edificaciones)

Figure A.2: Intervention Timeline

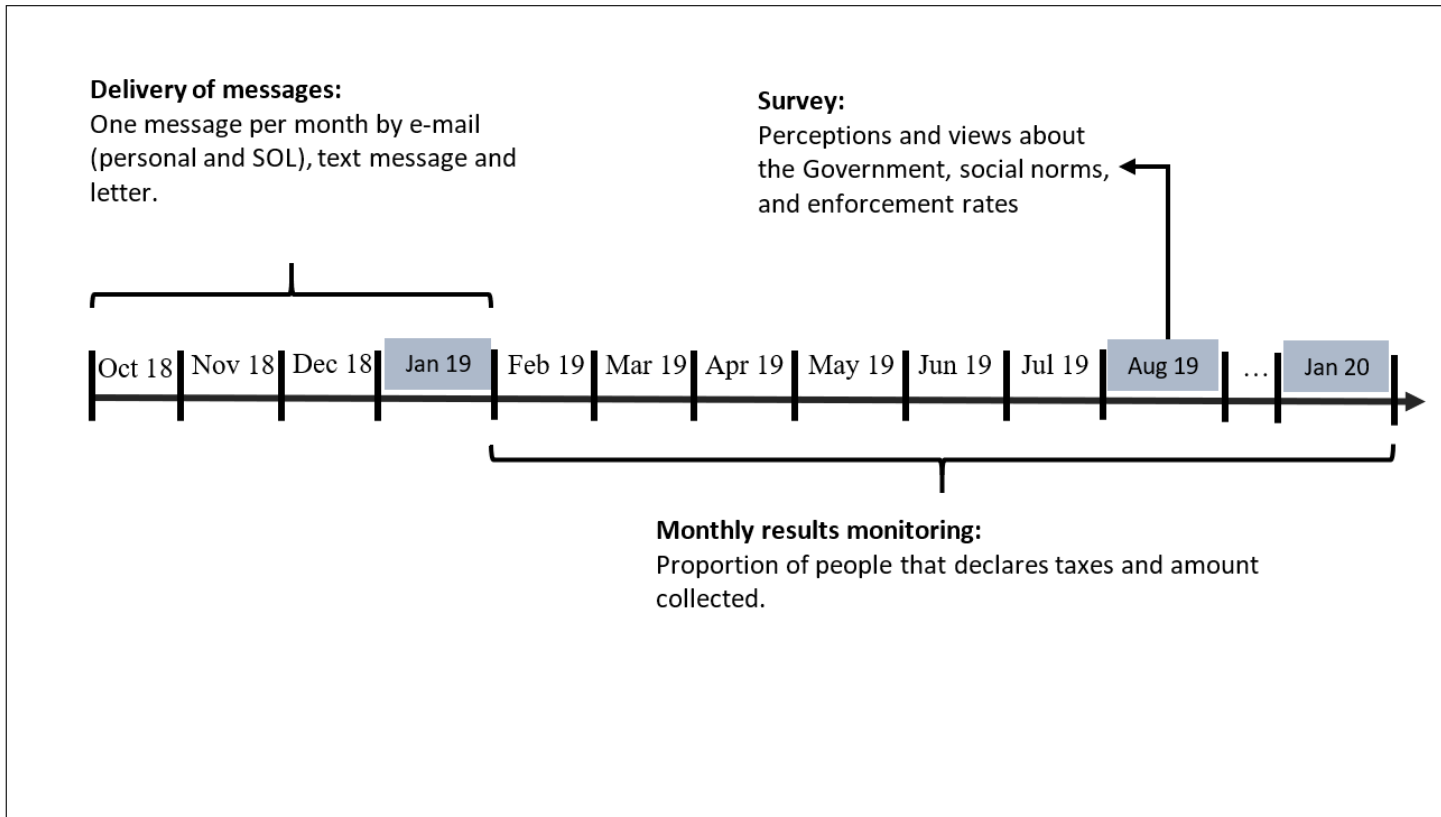
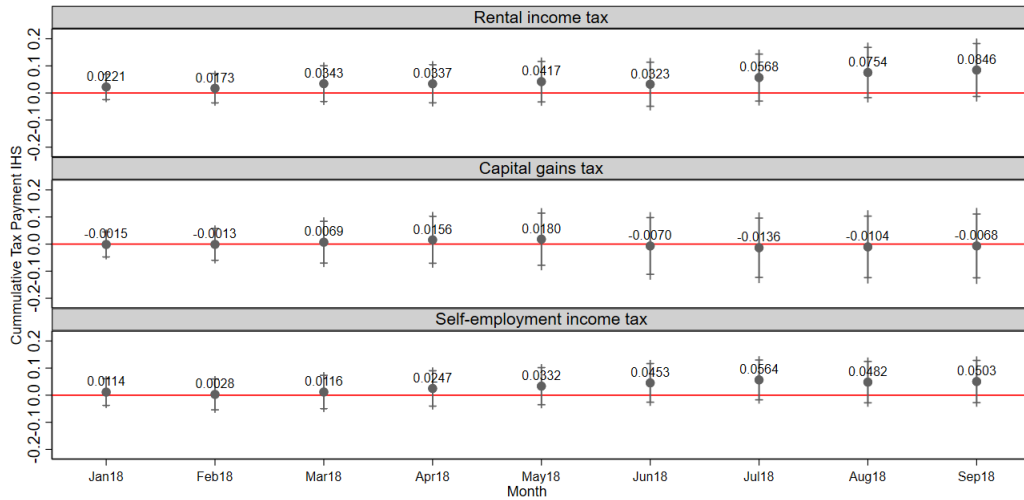
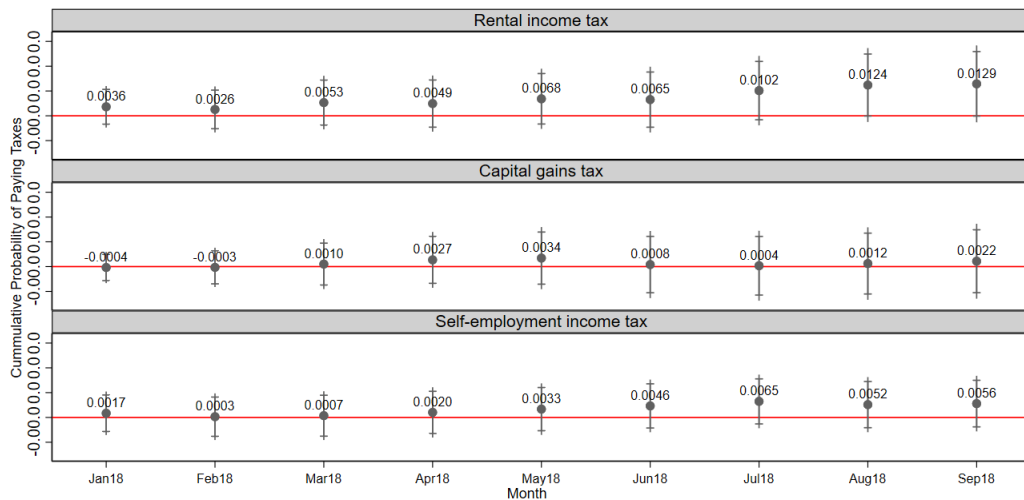


Figure A.3: Traditional message: Pre-trends in tax behavior

Panel A: IHS transformation of amount paid between Jan 18 and month X



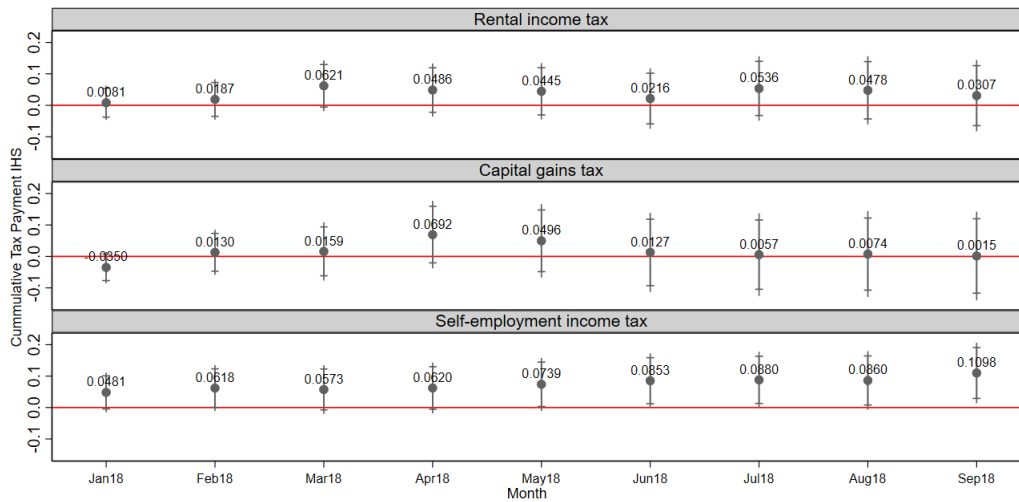
Panel B: Likelihood of paying taxes between Jan 18 and month X



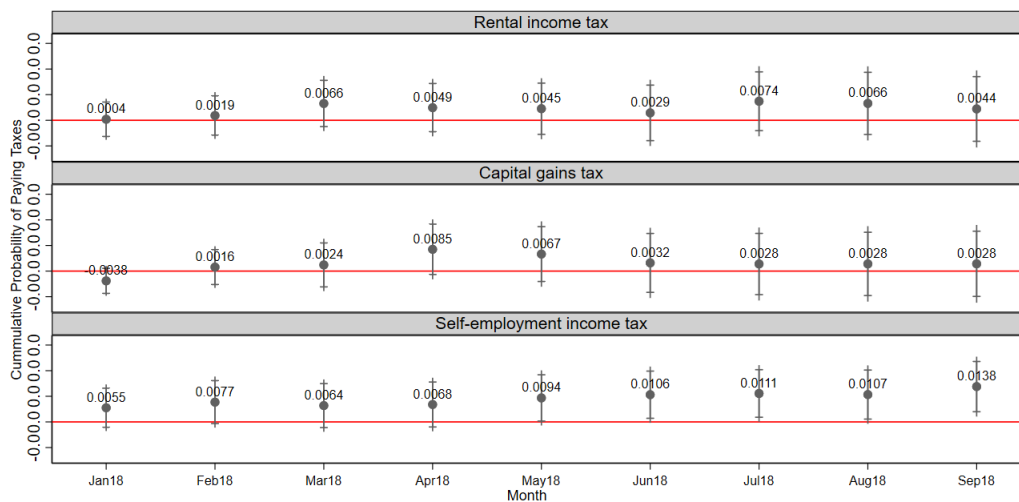
Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline et al. (2015). All regressions include a set of covariates that comprise age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects.

Figure A.4: Social norm message: Pre-trends in tax behavior

Panel A: IHS transformation of amount paid between Jan 18 and month X



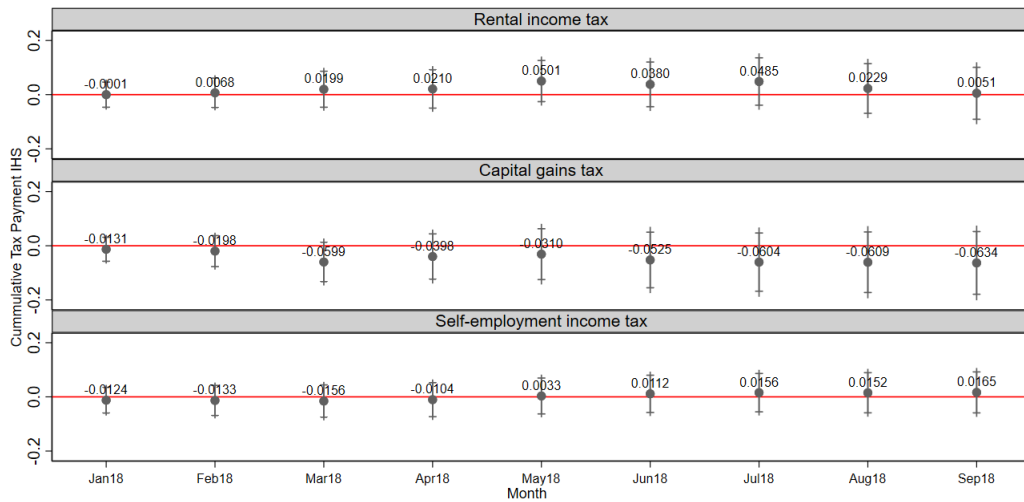
Panel B: Likelihood of paying taxes between Jan 18 and month X



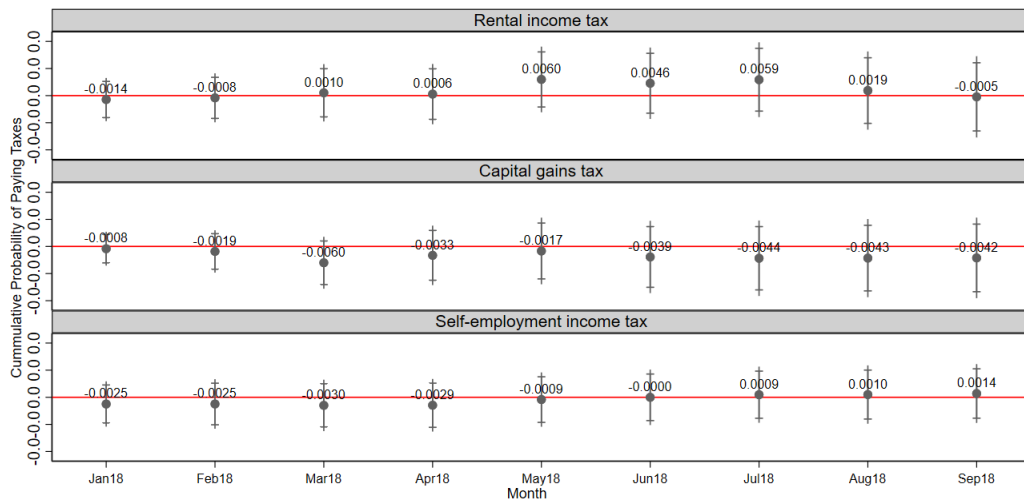
Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline et al. (2015). All regressions include a set of covariates that comprise age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects.

Figure A.5: Altruism message: Pre-trends in tax behavior

Panel A: IHS transformation of amount paid between Jan 18 and month X



Panel B: Likelihood of paying taxes between Jan 18 and month X



Notes: 90% and 95% confidence intervals. We report the marginal effects from a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the inverse hyperbolic sine function. For more information, see Friedline, et al. (2015). All regressions include a set of covariates that comprises age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for rental income tax payments during the period 2013 to 2017, and district fixed effects.

B Survey Appendix

We carried out our experiment on a sample of property owners who were potential rental income tax evaders according to the tax authority and that lived in some of the most affluent districts of Peru. To further understand how particular this sample is, we collected survey data on several characteristics and taxpayers' beliefs. In this section, we present our survey data. We also report how different or similar our sample of taxpayers is. This exercise sheds light on how generalizable our results are. Throughout the study, we also use this survey to further characterize our sample and provide a better understanding of some of the underlying mechanisms behind our results.

B.1 Survey data

In August of 2019, we sent a survey to a random subsample of 867 taxpayers who were included in the control group and each of the treatment arms of the study. We successfully surveyed 211, 197, 218, and 241 individuals in the control group, the traditional treatment arm, the social norms treatment arm, and the altruism treatment arm, respectively. The survey consisted of several questions regarding the individuals' perceived risk of being caught cheating, their belief about the overall level of compliance, their preferences for equality, their perceived quality of the public goods supplied by different governmental agencies, and several other characteristics. Even though we would be interested in testing if the treatment messages had an effect on some beliefs, we do not have enough power to detect any changes given the small sample of the survey.

Whenever possible, we compare these descriptive statistics with the ones provided by the World Values Survey (WVS) to have a better sense of the external validity of our results. The WVS is an international standardized survey with a presence in more than 60 countries where it investigates human beliefs, motivations, and values. It is representative at the national level and contains information similar and comparable to our survey, as the design of our questionnaire was partially based on the WVS questionnaire. We use the 2018 data for Peru. Even though we would like to compare our sample of taxpayers against the population of taxpayers, data on the characteristics and beliefs for the population of

taxpayers is not available, and this is the best we can do.

B.2 Results

Descriptive statistics are presented in Table B.1.²⁴ Since sometimes scales of measurement change from one survey to the other, in parenthesis we report a normalized scale that goes from 1% to 100%. The first block of variables show how taxpayers in our sample compare to the overall Peruvian population in terms of trust. In general terms they both are alike; however, taxpayers in our sample have more trust in people they first meet and people from other nationalities. The second block compare individuals in terms of corruption perceptions. These statistics show that taxpayers in our sample perceive less corruption in their local authorities than the overall population. This is consistent with the fact the individuals in our sample live in the richest districts that on average may have better local institutions. In fact, perceptions about corruption in broader levels of government are similar across the two samples. The third block of variables refer to participation in groups and association. Usually these variables are used to measure social capital *à la* Putnam as they measure the embeddedness of connections among individuals. Table B.1 shows that participation in groups and associations is more widespread in the overall population, especially in religious organizations. Finally, the last block refers to variables such as the justifiability of evading taxes, political inclination, and preferences on inequality. Taxpayers in our sample justify the possibility of cheating on taxes in a larger proportion than the overall population, which may suggest that in fact their likelihood of cheating is larger. Finally, politically, taxpayers in our sample lean to the right.

All in all, these results show that in some dimensions individuals from our sample may be similar to the overall population, but in some others they may not. If policymakers are interested in replicating this experiment and extrapolating our results to other contexts, it would be helpful to first consider how different their sample of taxpayers is with respect to that of our experiment. The information provided in this section can be used to shed light

²⁴Since in this section we want to characterize our sample in the absence of any treatment, we focus on the control group to prevent any contamination from the treatment messages as they could in principle have had an effect on some of the variables collected in the survey. Nonetheless, the results are similar if we focus on the overall sample.

on this consideration.

Table B.1: Comparison between control group and the overall Peruvian population

Experiment Survey	Average	WVS Data	Average
The majority of persons can never be trusted (% yes)	5.7%	Most people can be trusted (% no)	5.3%
How much do you trust your family (scale: 1 to 5)	4.6 (92%)	How much do you trust your family (scale: 1 to 4)	3.6 (90%)
How much do you trust your neighborhood (scale: 1 to 5)	3.0 (60%)	How much do you trust your neighborhood (scale: 1 to 4)	2.1 (53%)
How much do you trust someone you first meet (scale: 1 to 5)	2.3 (46%)	How much do you trust someone you first meet (scale: 1 to 4)	1.5 (37%)
How much do you trust someone of another nationality (scale: 1 to 5)	2.9 (58%)	How much do you trust someone of another nationality (scale: 1 to 4)	1.6 (40%)
Local authorities level of corruption (scale: 1 to 5)	2.9 (58%)	Local authorities involved in corruption (None: 1; All: 4)	3.2 (80%)
Central Government level of corruption (scale: 1 to 5)	3.7 (74%)	State authorities involved in corruption (None: 1; All: 4)	3.3 (83%)
Belongs to a group or association (% yes)	26%	Belongs to a group or association (% yes)	59%
Belongs to religious organization	20%	Belongs to religious organization	72%
Belongs to political party	3.4%	Belongs to political party	8.2%
Belongs to producers or merchants union	5.6%	Belongs to labor union	6.8%
Justifiability of evading taxes (scale: 1 to 5)	1.4 (28%)	Justifiability of cheating on taxes (scale: 1 to 10)	1.9 (19%)
Political inclination (Left: 1; Right: 5)	3.5 (70%)	Political inclination (Left: 1; Right: 10)	6.1 (61%)
The more free the economy, the more free the people (scale: 1 to 5)	3.6 (72%)	Which is more important, freedom or equality (% freedom)	41%
Income should be more equal (scale: 1 to 5)	3.2 (66%)	Income equality vs income differences (1: equal, 10: unequal)	6.0 (60%)