

The Direct and Indirect Effects of Messages on Tax Compliance: Experimental Evidence from Peru

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Abstract: We carry out a randomized controlled trial to evaluate the effect of three types of messages sent to taxpayers on their compliance with the rental income tax (direct effect) and the spillovers produced on the capital gains and the self-employment income taxes (indirect effects). One message highlights detection, other appeals to social norms, and the third appeals to altruism. We also perform a 15-month follow-up to determine if the treatment increases tax revenues in a sustained manner. We find that the message addressing detection produces a positive and sustained direct effect and a negative spillover on the other two taxes. The “social norms” message has no direct effect but produces a sustained negative spillover on the capital gains tax. The message appealing to altruism produces a transitory negative effect and no statistically significant spillovers. We show there is substantial risk of overestimating the tax revenues produced by the messages if one relies only on their direct effects.

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

Keywords: Deterrence, Social norms, Altruism, Tax evasion, Spillovers, RCT, Latin America

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1 Introduction

Developing countries usually experience high evasion rates, which greatly hinder their ability to provide public goods and services (Besley and Persson, 2014). High informality across the developing world makes personal income taxes particularly difficult to monitor and enforce, leading to significant underreporting and evasion. As a result, developing countries tend to have a large share of their tax revenue collected from value added and other consumption taxes, but there are large potential gains that could come from improving the collection of personal income taxes.¹

In this regard, there is a large body of research about income tax evasion and, in particular, about field experiments designed to increase tax compliance by sending messages that appeal to different drivers of taxpayers' behavior. Messages inspired in the standard theory of tax evasion (e.g. those that remind taxpayers about the costs of trying to cheat) appear to be effective in many settings.² However, evidence for messages appealing to moral considerations and social norms is mixed and several studies have documented that these messages can backfire or have no effect.³

Targeting a single tax type is quite common in the literature⁴ but messages can have indirect effects on compliance with taxes other than the one addressed in the message. For example, targeting state taxes may have an indirect effect on federal tax compliance. Also, targeting taxes collected from a particular source of income may have an indirect effect on taxes collected from other sources.⁵ Therefore, it is important to evaluate if messages can produce indirect effects, but the literature offers little evidence on this, with the exception of a recent literature on behavioral economics studying how incentives and behavioral policy interventions affect individuals' allocation of scarce cognitive resources leading to spillovers (Nafziger, 2020; Altmann et al., 2021). To the best of our knowledge,

¹The share of total tax revenues accounted for by personal income taxes in Peru is 14%. For comparison, about 50 percent of federal revenue comes from individual income taxes in the United States.

²For example, Slemrod, Blumenthal, and Christian, (2001). See review in Slemrod (2019).

³Positive effects were documented by Del Carpio, 2014; Bergolo et al., 2017; Hallsworth et al., 2017; Meiselman, 2018; Bott et al., 2020. No effect or backfiring were documented by Blumenthal, Christian, and Slemrod, 2001; Fellner et al., 2013; Castro and Scartascini, 2015; Perez-Truglia and Troiano, 2018; John and Blume, 2018; Chirico et al., 2019; Cranor et al., 2020; and De Neve et al., 2021.

⁴For papers studying taxpayers' responses to messages addressing a single tax type (e.g. a particular category of the income tax, or a state tax vis-a-vis a federal tax), see Blumenthal, Christian, and Slemrod (2001), Slemrod, Blumenthal, and Christian, (2001), Del Carpio (2014), Castro and Scartascini (2015), Meiselman (2018), Perez-Truglia and Troiano (2018), Bott et al., (2020), Lopez-Luzuriaga and Scartascini (2019), Ortega and Scatascini (2020), Cranor et al. (2020), and De Neve et al. (2021).

⁵Moreover, since firms are owned and managed by people, indirect effects may also be relevant to papers studying firms' responses to messages. See for example Bergolo et al. (2017), Brockmeyer, et al. (2019), Boning et al., (2020).

the main study explicitly addressing indirect impacts on compliance across different taxes is Lopez-Luzuriaga & Scartascini (2019), henceforth LLS. This study focuses on the indirect effects (or spillovers) of messages highlighting penalties and detection. The authors propose a model that predicts that an increase in penalties can produce a positive spillover but an increase in detection can 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. They find evidence consistent with the positive spillover produced by messages highlighting penalties.

In this paper, we study the direct and indirect effects of targeting a single type of income tax. We carry out a randomized controlled trial in six districts of Lima, Peru to evaluate the direct and indirect effects of three different types of messages addressing the payment of the rental income tax. The direct effect refers to the payment of the rental income tax which taxes the income that comes from leasing real properties and goods. The indirect effects 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 a particular employer. All three taxes share the characteristic of being difficult to enforce because taxpayers can easily under-report or avoid reporting their income stream.

We send three types of message and a reminder letter. The first type of message (henceforth “deterrence”) highlights the effectiveness of the tax authority’s control actions. The second type (henceforth “social norms”) informs about the compliance of other taxpayers living in the same districts. The third type (henceforth “altruism”) highlights that tax revenues can be used for the provision of public goods targeted on disadvantaged citizens. All the information presented in these messages makes explicit reference to the rental income tax, but no reference to the capital gains tax nor the self-employment tax.

The comparison group received a short reminder that was repeated in all three messages. In this way, we identify the effect of adding just a couple of lines on top of the reminder letter. In addition, we conduct a post-intervention survey with a random sub-sample of the taxpayers included in our research to identify 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 physically sent once per month between October 2018 and January 2019, for a total of four messages. Using a long panel of administrative data from the Peruvian tax authority we are able to follow around 9,000 taxpayers until January 2020. Our main results can be summarized as follows.

We find that the “deterrence” message produces a positive direct effect of between 10% and 15% on the total amount paid of the rental income tax. This effect is sustained throughout the 15-month follow-up period. It also produces a negative indirect effect on the payments related to the self-employment income and capital gains taxes. We use the post-intervention survey to produce evidence suggesting that this negative spillover can be explained by the LLS (2019) framework: taxpayers understand that increased enforcement efforts devoted to one tax will reduce efforts devoted to other taxes and, thus, reduce compliance with these other taxes.

We also find the the “social norms” message has no direct effect but, interestingly, produces a sustained negative indirect effect on the total amount paid of the capital gains tax of between 13% and 16%. One possible explanation for this pattern is that the message did not induce an update in the taxpayers’ beliefs regarding compliance with the rental income tax (nor the self-employment income tax) but was able to induce a *downward* update in the taxpayers’ beliefs regarding compliance with the capital gains tax. We note that our results point out the need to improve our understanding on how messages addressing beliefs about compliance with a certain tax type may nudge individuals to update their beliefs about compliance with other tax types.

Further, the “altruism” message produces a negative transitory direct effect on compliance with the rental income tax of between 10% and 14%, and no statistically significant effects on 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.

As an illustration of the quantitative importance of the indirect effects relative to the direct effects, we simulate the distribution of direct and total gains for each type of message using 1,000 bootstrapped samples. The direct gains consider the effect on the rental income tax. The total gains consider the direct gains plus the additional resources coming from the capital gains and self-employment income taxes. This exercise shows that there is substantial risk of overestimating the additional tax revenues produced by the messages if one overlooks their indirect effects. In fact, in terms of tax revenues, these indirect effects render the “deterrence” message ineffective, turn an apparently innocuous “social norms” message into a clearly bad policy option, and reinforce the negative effect of the “altruism” message.

This paper makes several contributions to the existing literature. First, we document the existence of indirect effects or spillovers produced by messages that appeal to 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 show that ignoring the indirect effects of messages can lead to a significant underestimation of their effects in terms of tax revenues. Third, 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. This context is particularly relevant across developing countries (Benedek et al., 2022) mainly due to pervasive informality (Auriol and Warlters, 2005; Tanzi and Zee, 2000).

Fourth, we expand the evidence for the indirect effects of “deterrence” messages presented in LLS (2019) by focusing on detection (in LLS, messages appealed to penalties) and by performing a 15-month follow-up (LLS evaluated the short-term effects only). Finally, we use a post-intervention survey to document taxpayers’ social preferences and perceptions and shed light on the potential mechanisms behind our results.⁶

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 and Literature Review

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: (i) the deterrence model, (ii) the theory of social norms, and (iii) the theory of altruism. We use these theories to design three different types of messages and test whether they produce direct effects on taxpayers’ compliance with the tax addressed in the message (the rental income tax) and indirect effects on payments related to other taxes (the capital gains and self-employment income taxes).

Deterrence model. The deterrence model of tax compliance suggests that the taxpayer faces a trade-off between evading and thereby keeping a portion of the due money 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). This model

⁶We registered our plan for the analysis of the direct effects of the three types of messages in December 18, 2018, within the first three months since the start of the intervention, but before collecting the survey data. Survey data was collected in August 2019. Initially, the plan was to collect enough survey data to have a reliable and adequately powered way of testing mechanisms. Because of budget restrictions, however, we were unable to collect enough observations. At this point we also learned that the tax authority was willing to share administrative data regarding other income tax payments. Thus, we shifted our attention to testing the existence of spillover effects. The initial plan can be found in <https://doi.org/10.1257/rct.3596-1.0>.

predicts that a message highlighting the penalty or the probability of getting caught can produce a positive direct effect on compliance by reducing the expected utility of evading the tax addressed in the message. This model also predicts that a message highlighting penalties or the probability of detection can produce indirect effects, but their direction is less clear. LLS (2019) propose a framework based on the deterrence model predicting that messages addressing penalties that are uniform across taxes will produce a positive spillover (they will increase compliance with other taxes). However, messages that focus on detection can produce a negative spillover (reduce compliance with other taxes) if taxpayers infer that more efforts devoted to enforce payment of the tax addressed in the message can lead to lower enforcement in other taxes.

Numerous studies have successfully tested the positive direct effect of messages inspired by the deterrence model.⁷ Evidence about indirect effects is much more limited. In one study for a municipality in Argentina, LLS (2019) present evidence consistent with the positive spillovers produced by messages focused on penalties. They found that taxpayers who received a message that highlighted the consequences of not paying their property tax increased their gross-sales tax declarations in the short-run.

In our study, we test the deterrence model by estimating the direct and indirect effects of a message that focuses on the probability of detection rather than on penalties. As detailed in Section 3.2, this message highlights the results of the enforcement actions carried out by the tax authority to increase compliance with rental income tax obligations.

Social norms. A social norm is usually defined as an informal rule of behavior that individuals comply with for reasons unrelated to the likelihood of penalties or 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 predicts that a message informing about the degree of compliance with a certain tax can induce (discourage) an individual to pay this tax if it produces an upward (downward) correction in his/her perception about other taxpayers' compliance. The social norms mechanism can also produce an indirect effect if individuals are able to extract information and update their beliefs about compliance with other taxes from a message conveying information about a particular tax.

Studies related to social norms messages have found mixed results so far. Some find that

⁷See for instance, Kleven et al., 2011; Fellner et al., 2013; Dwenger et al., 2016; Bergolo et al., 2017; Carrillo et al., 2017; Meiselman, 2018; Brockmeyer et al., 2019; Boning et al., 2020; Bott et al., 2020; Drago et al., 2020.

giving information about the prevalence of compliance increases individual compliance,⁸ while others find that this strategy can backfire or have no effect at all,⁹ albeit there is considerable heterogeneity in the response of taxpayers.¹⁰ To the best of our knowledge there is no paper testing indirect effects across taxes of social norms messages.

In this study, we test the social norms theory by estimating the direct and indirect effects of a message informing that the majority of taxpayers' neighbors comply with their rental income tax obligations. Please refer to Section 3.2 for more details about the content of this message.

Altruism. Altruism refers to a behavior that benefits others at a personal cost to the individual and is usually attributed as an influencing factor when people make donations to public goods (Andreoni, 1989, 1990).

To the extent that individuals are altruistic or have strong preferences for redistribution,¹¹ messages highlighting that tax revenues are used for the provision of public goods targeting disadvantaged citizens can be expected to generate positive effects on tax compliance. However, if individuals are not altruistic or have weak preferences for redistribution, this message can backfire because it makes more salient the fact that money collected through taxes can be used to provide public goods that taxpayers do not enjoy. Moreover, regardless of altruistic preferences, a message appealing to altruistic feelings may backfire in an environment where corruption is pervasive if it makes more salient to taxpayers that tax revenues are being wasted or appropriated by corrupt bureaucrats instead of being used to provide public goods.

A message highlighting that revenues produced by a particular tax are used to benefit disadvantaged citizens can produce indirect effects if taxpayers infer that this characteristic is shared by other tax types. These indirect effects can be positive or negative depending on whether taxpayers have altruistic preferences or not. In addition, one can also expect negative indirect effects if taxpayers believe that the money they pay to other taxes is going

⁸See Del Carpio, 2014; Kettle et al., 2016; Hallsworth et al., 2017

⁹See Blumental, Christian, and Slemrod, 2001; Fellner et al., 2013; Castro & Scartascini, 2015; Dwenger et al., 2016; Perez-Truglia and Troiano, 2018; John and Blume, 2018; Chirico et al., 2019; Cranor et al., 2020; and De Neve et al., 2021.

¹⁰Hallsworth 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 tends to be more effective.

¹¹Preferences for redistribution usually refer to the extent of support to policies limiting inequalities. The main difference between this concept and altruism is that the latter comes at a personal cost, whereas preferences for redistribution might not. That is, one can have strong preferences for redistribution even if one is not altruistic. However, altruism should imply preferences for redistribution to some extent. Although preferences for redistribution seems to be a broader concept, we decided to call the related message "altruism message" for simplicity and ease of writing.

to be appropriated by corrupt bureaucrats.

Studies that have tested messages highlighting that taxes are used to benefit disadvantaged citizens or to provide public goods show mixed results. Some find that this types of messages increases compliance,¹² while others find that it backfires or has no effect.¹³ It is important to distinguish between messages appealing to altruistic motives and those that appeal to reciprocal altruism, in which taxpayers comply only if there is the possibility of a reward. Messages highlighting the provision of public goods that benefit taxpayers who receive the message appeal to reciprocal altruism.

In this study, we test the altruistic motive by estimating the direct and indirect effects of a message that highlights how revenues produced by a particular tax can be used to finance health services for poor individuals living in a different region (please see Section 3.2 for more details about the wording of this message). We should note that, to the best of our knowledge, there are no previous studies that address the potential spillovers to other taxes coming from a message inspired by altruistic motives.

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 described above. We also conducted a post-intervention survey on a small sub-sample to shed light on taxpayers' social preferences, perceptions and beliefs that might affect their behavior such as those regarding the quality of public goods and the degree of corruption in public institutions.

3.1 Institutional Background: the Peruvian Income Tax

The Peruvian personal income tax is divided into four categories that depend on the source of income. These categories are (i) rental income tax, (ii) capital gains tax, (iii) self-employment income tax, and (iv) dependent work income tax. Revenues from personal income taxes represent only around 14% of total tax revenues in Peru. Pervasive informality leads to significant underreporting and evasion, so large potential gains could come from improving personal income tax collection.

We focus this study on the three categories for which the tax authority was willing to

¹²For example, Bergolo et al., 2017; Hallsworth et al., 2017; Meiselman, 2018; Bott et al., 2020.

¹³See: Blumental, Christian, and Slemrod, 2001; Castro and Scartascini, 2015; Chirico et al., 2019; and De Neve et al., 2021.

share information and 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.¹⁴

Since our messages address the rental 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.

Indirect effects are measured in terms of the taxes that were not addressed directly on the messages. The indirect effects of the messages are measured considering the payments related to 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 due to an investment in a mutual or investment fund, 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, according to a personal schedule. 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.^{15,16}

¹⁴For these tax categories, the tax authority is unable to fully identify who is a debtor and calculate an exact compliance rate. This is less of a problem for the dependent work income tax, for which employers are responsible of providing information and making payments in advance to the tax authority.

¹⁵Monthly 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 retention made by his/her clients, in case total income exceeds 3,135 soles (around \$940). Our data include the sum of the two.

¹⁶One may worry that the payment schedules are not similar across tax types, especially in the case of capital gains. However, in Figure A.1, we show that payments in all tax types tend to be uniformly distributed across months, suggesting that payments are mostly monthly (albeit there is some cyclicity present in the capital gains tax). More importantly, if schedules are somewhat different across tax types, this should not generate any bias in our estimation since all treatment effects were estimated by comparing

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) every time a taxpayer fails to declare an income flow on time and pay the corresponding tax. 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 audited by the tax authority,¹⁷ 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 just over 50%. Compliance with the capital gains tax is estimated to be larger (reaching around 75%) because transactions are less informal, although taxpayers can still under-report their incomes.

3.2 The Messages

We sent four different types of messages. One of them was simply a reminder letter, while the other three messages, which we refer as the treatment messages, were inspired by each of the three theories discussed in Section 2. The content of each treatment message was a small variation of the reminder message as the objective 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 of rental income tax owed (if any) and the information varied according 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 basic contents of the letters are shown in Table 1.¹⁸

For the “deterrence” message, the text inside brackets reads: “*Be informed that SUNAT is striving to detect those who do not pay this tax in your district. We have already identified 78 thousand persons in the districts of Barranco, La Molina, Miraflores, San Isidro, San Borja, and Surco.*” This message starts by indicating that the tax authority is making a

outcomes against a randomly assigned control group that share the exact same schedule by definition.

¹⁷It is not infrequent that taxpayers receive letters from the tax authority pointing out potential inconsistencies in income tax declarations. However, audits do not occur often due to limited resources of the tax authority.

¹⁸The original messages in Spanish are included in Figure A.2.

special effort to detect individuals who do not pay their rental income tax and live in the same district as the taxpayer receiving the message. The sentence that follows presents evidence of the results of this effort in terms of the number of people already detected in a group of districts that includes the district where the taxpayer lives. Thus, the purpose of this message was to convey the notion that the probability of being caught was large and to discourage tax evasion by increasing its expected cost.

Table 1: Structure of letters

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 perceive any rental income and have already paid your tax, congratulations!

Sincerely,

Regarding the letter inspired in the theory of social norms, the text inside the brackets reads “*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 is to comply with these payments, produce an upward correction in their perception about other taxpayers’ compliance, and induce them to pay their rental income tax based on the notion that deviations from the social norm generate self-inflicted costs. 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).

We acknowledge that the information provided by the “social norms” message was not very specific in terms of the rate of tax compliance and that this might hinder its effectiveness.¹⁹ The tax authority cannot identify all the property owners who have an outstanding debt for rental income tax as many lease agreements are informal. Their estimates indicate that compliance is just over 50% and, therefore, we chose to inform that “the majority” comply. We argue this content allows us to test a “social norms” message in a context where the tax authority lacks precise information about compliance. This context is quite common in developing countries (Benedek et al., 2022; Auriol and Warlters, 2005; Tanzi and Zee, 2000).

Regarding the letter inspired on 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 finance public goods that benefit the poorest population of the country. We expected this message to be persuasive if altruism or redistribution are important for the sample of individuals studied

It is worth noticing that our “altruism” message distinguishes from others that also have made reference to public goods because it explicitly refers to services provided to (poor) people out of the sample. This differs from other studies, which have tended to describe how taxes contribute to the funding of public goods that everybody could potentially use and enjoy, including in-sample taxpayers.²⁰

Finally, notice that 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).

3.3 Mode of Delivery and Timeline

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

¹⁹For papers using the exact compliance to describe the norm, see Fellner et al. (2013), Castro and Scartascini (2015), Chirico et al. (2019), Cranor et al. (2020), and De Neve et al. (2021).

²⁰For 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 and Scartascini (2015) tests 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.*”

the same letter four times, once per month.²¹

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.²²

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 (at the beginning of the experiment) to identify the short-term effect of receiving the reminder letter, as in Hallsworth et al. (2017).

In Figure A.3 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

With the help of the tax authority, we identified those who ex-ante had a higher chance of owing rental income tax. In particular, we included in the experiment individuals who satisfied the following three conditions:²³

- lived in the municipalities of Barranco, La Molina, Miraflores, San Borja, San Isidro, or Surco that are the richest municipalities of the city;

²¹Evaluating the effect of this type of treatment can be informative as sending too many letters may have a crowding-out effect (i.e. by ‘suffocation’). Also, the impact of “one shot” messages may be limited if there is no follow-up by the tax authority.

²²We use several channels to increase compliance, since not all taxpayers read the messages they receive in the special web interface that is normally used by the tax authority to send special communications. The tax authority suggested sending an email and a SMS message in addition to the physical letter to maximize readership. This is because the tax authority already contacts taxpayers rather frequently. Moreover, since rental income tax payments are due monthly, we agreed that sending messages monthly was reasonable. Finally, to minimize the risk of backfiring, all our messages addressed their recipients in a neutral way (i.e., we did not address them as debtors).

²³Firms were not included.

- owned three or more properties with different addresses within the region of Lima or Callao²⁴;
- 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 between 2013 and 2017. Thus, for this period 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 2,300 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 1,128 individuals per subgroup. We controlled this randomization based on the individuals' age and sex, income dummies, a dummy that indicates whether they have made a previous rental income tax payment, previously paid amounts and their years, and the number of properties and their self-assessed values. In particular, we ran 1,000 repetitions of the randomization and chose the first one that showed no statistically significant t-statistics when comparing groups across the above variables. These variables are reported in Table 2.

As a result of the randomization, 2,256 individuals received a reminder message, 2,256 received a message inspired by the deterrence theory, 2,256 received a message on social norms, and 2,256 received a message on altruism (see Figure 1). Assuming a base compliance

²⁴Peru 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 more than 30% of the country's population.

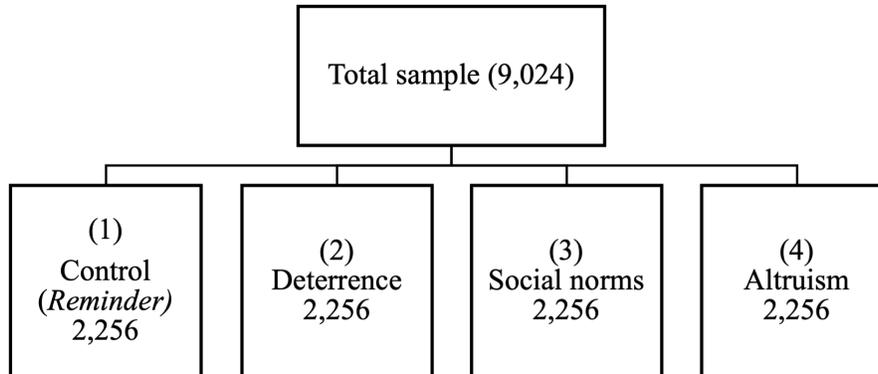
Table 2: Characteristics of final sample

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

of 5%, we have a statistical power of 80% to identify a difference of 2 percentage points²⁵. This is a 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.

²⁵This was computed using a two-sample proportions power calculation. We use 5% as base compliance considering that, in five years, only 26% made a payment. If we assume a base compliance of 10%, we have 80% power to identify a difference of 2.65 percentage points. If we assume a base compliance of 26%, we have 80% power to identify a difference of 3.75 percentage points. An ex-post analysis suggests that we are adequately powered. Compliance in the control group (those who received a reminder later) was 6% in the first month since the start of the experiment. This would imply a power of 80% to identify a difference of 2.15 percentage points given our sample size. It should be noticed, however, that we lose power progressively as time goes by and as compliance increases in the control group.

Figure 1: The Experiment Arms



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 on the payment of the capital gains and self-employment income taxes (indirect effects).

4.1 Empirical Strategy

Data. We were provided with a database at the individual-day level that indicated the amount 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 sub-sample of 867 individuals. The survey consisted of several questions regarding individuals’ social preferences and beliefs. More information is available in Appendix B.

Outcomes. 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.²⁶ Second, we define a dummy variable that equals one if the individual has made a tax payment since the start of the

²⁶Some authors argue that this transformation is better than using a log transformation such as $\log(x+1)$, especially when there are many zeros. Since there are many zeros in our context, we use this transformation. For more on the inverse hyperbolic sine function, refer to Friedline et al. (2015) and Bellemare and Wichman (2019). Results are robust to the use of $\log(x+1)$. Results are available upon request.

intervention until a particular month. The tax administration also provided us with data on taxpayers’ characteristics that were described in Table 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. To account for multiple hypothesis testing, an F-test also shows balance for each message ($F_1 = 0.655$, $F_2 = 0.312$, $F_3 = 0.675$). This is consistent with the random assignment.

Pre-treatment trends. 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 (this includes *any* tax). In other words, randomization should assure internal validity when evaluating the impact of the message on the rental income tax, the self-employment tax or the capital gains tax. 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 “deterrence”, “social norms”, and “altruism” messages in Figures A.4, A.5 and A.6, 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 norms” 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.

Table 3: Balance in pre-treatment characteristics

	Age	Female	Number of properties	Value of properties	Yearly Income (bins, thousand \$)				F-statistic
					0-15	15-30	30-150	≥ 150	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
“Deterrence” message	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)	0.655 [0.710]
“Social norms” message	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)	0.312 [0.949]
“Altruism” message	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)	0.674 [0.694]
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. Column 9 indicates p-values for the overall F-test in square brackets. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. One individual did not have a record for their yearly income, hence columns (5) - (8) show one fewer observation.

4.1.1 The effect of the treatment letters relative to the reminder letter

We estimate the following equation at different points in 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 either as the probability of paying a tax or the total amount paid 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 “deterrence” (i.e., $m = 1$), “social norms” (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.

4.1.2 Extensive and intensive margin

We estimate the contribution of the extensive and intensive margin using the methodology in Staub (2014). This decomposition represents the total effect as a population-weighted sum of the effects for two groups: those induced to participate by the treatment and those participating regardless of it. To get full identification, we assume a Tobit form:

$$\begin{aligned} y_{ist} &= \max[0, \alpha + \beta_1 T_{i,1} + \beta_2 T_{i,2} + \beta_3 T_{i,3} + \gamma' X_i + \varphi_{ist}] \\ \varphi_{ist} &\sim N(0, \sigma^2) \end{aligned} \quad (2)$$

Reapplying Staub (2014) to our study, the treatment effect of each letter on the intensive margin, or TE^{In} , would be β_1 , β_2 , or β_3 , respectively. Moreover, Staub demonstrates that the treatment effect on the extensive margin, or TE^{Ex} , is $TE_k^{Ex} = \alpha + \beta_k + \sigma \frac{\phi_k - \phi_0}{\Phi_k - \Phi_0}$, where $\Phi(\cdot)$ is the standard normal cdf, $\phi(\cdot)$ is the standard normal pdf, and k indexes the treatment

group.²⁷

To complete the decomposition, note that the total effect is a weighted average of the effects for two groups:

$$TE = \underbrace{\pi_k^{Ex} TE_k^{Ex}}_{\text{Extensive margin}} + \underbrace{\phi_k^{In} TE_k^{In}}_{\text{Intensive margin}} \quad (3)$$

where population shares are $\pi_k^{In} = \Phi_0$ and $\pi_k^{Ex} = \Phi_k - \Phi_0$.

4.1.3 The effect of the *reminder* letter

In the previous subsections 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.

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:

$$y_{ist} = \alpha + \delta_0^{1st} T_{i,0}^{1st,early} + \gamma' X_i + \varepsilon_{ist} \quad (4)$$

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.²⁸

4.2 Results

4.2.1 The effect of the treatment letters relative to the reminder letter

Deterrence. Figure 2 presents the direct effect of the “deterrence” message on compliance with the rental income tax and the indirect effects of this message on payments related

²⁷In particular, $\phi_k = \phi((\alpha + \beta_k + \gamma' \bar{X}_i)/\sigma)$, and $\phi_0 = \phi((\alpha + \gamma' \bar{X}_i)/\sigma)$. Analogous definitions are used for $\Phi(\cdot)$.

²⁸To 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.

to the capital gains and the self-employment income taxes. In Table A.1 we report the corresponding table from which these figures were constructed.

Panel A in Figure 2 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. Panel A in Figure 2 shows that the “deterrence” message had a direct effect on the total amount paid of rental income tax that was sustained throughout the 15-month follow-up. In fact, this message produced a sustained increase of between 10% and 15% in the amount paid of the rental income tax with respect to the reminder.²⁹

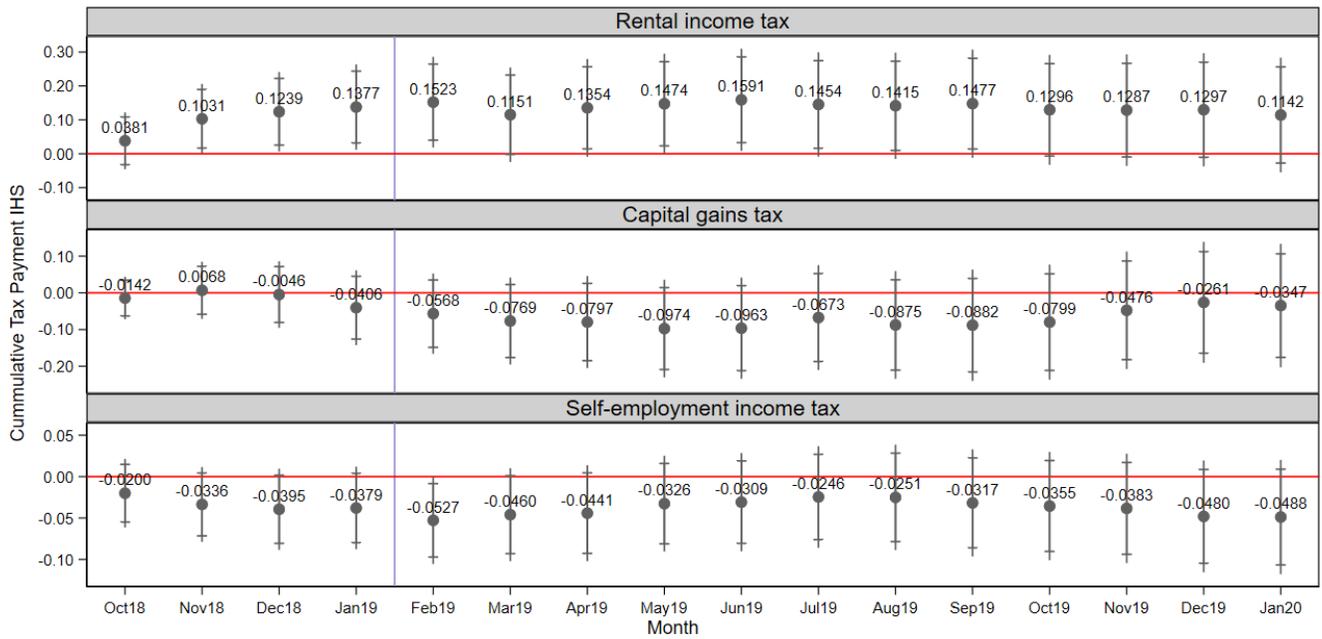
These results suggest that the “deterrence” message generated new resources for the tax authority. This assessment, however, would be incomplete if we ignore the effect of this treatment on other taxes. The results for the indirect effects of the “deterrence” message show that it produced a decline of around 5% in the total amount of the self-employment income tax that was paid by the time the experiment was phased out and at the end of the evaluation period (see Panel A). Although the results are not statistically significant, Panels A and B in Figure 2 provide suggestive evidence that the “deterrence” 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.

There are two potential explanations for the negative spillover described above. The first was described in Section 2 and stems from the theoretical model of LLS (2019). This model predicts that messages that appeal to enforcement actions can provoke a negative indirect effect on compliance with other taxes if taxpayers understand that increased enforcement efforts devoted to the tax addressed in the message will reduce efforts devoted to other taxes. The second explanation relies on a cash-flow effect. In particular, taxpayers reduce the cash strain produced by the additional payments made to the rental income tax 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.

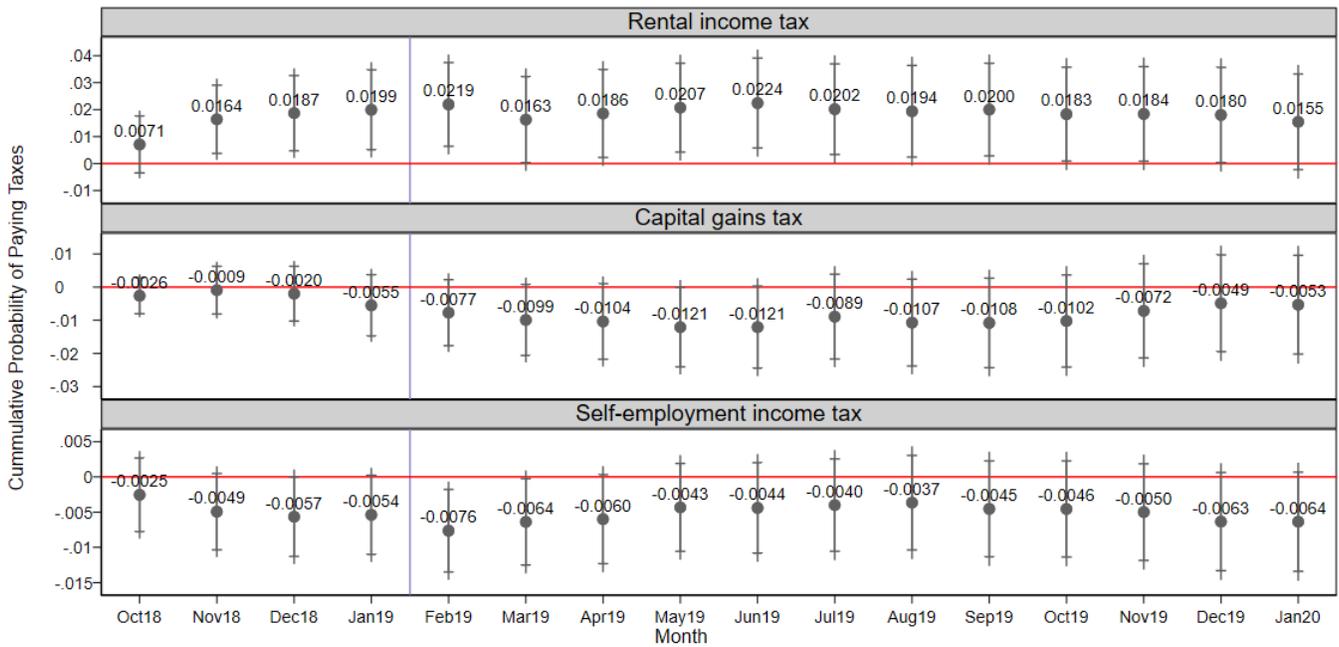
²⁹To compute semi-elasticities from the inverse hyperbolic sine function one can use the following expression: $\exp(\hat{\beta} - 0.5\widehat{Var}(\hat{\beta})) - 1$ as derived in Bellemare and Wichman (2019). For simplicity, we focus on the coefficients reported in the figures which provide good approximations of these semi-elasticities. Conclusions are not affected if we focus on the exact semi-elasticities instead.

Figure 2: Direct and indirect effects of the “deterrence” 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. Violet line indicates the end of the treatment period. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

We present evidence that favors the mechanism in LLS (2019). First, we find that negative indirect effects are larger among high-income individuals, which contradicts the cash-flow hypothesis. If the cash-flow effect is important, we should observe the opposite: i.e. greater negative indirect effects among low-income individuals, as they are more likely to be constrained. In particular, we estimate equation (1) using first the sample of taxpayers belonging to the upper half of the distribution of income. Then, we estimate equation (1) using the lower half. We use pre-experiment data to make the assignment into these income brackets. Standard errors were bootstrapped. Effects are reported in Figure A.7. Our results reveal that taxpayers in both income groups increased their payments to the rental income tax (direct effect, Panel A). However, indirect effects were only present for the richest taxpayers (Panel B), contradicting the cash-flow hypothesis.

Second, with the aid of our survey data, we find that high-income individuals are more likely to report that they know all relevant procedures and issues related to the payment of taxes. This suggests that high-income individuals are more likely to behave as predicted in LLS (2019) which hinges on sophisticated agents predicting the tax authority’s behavior. In particular, they understand that increased enforcement efforts devoted to one tax will reduce efforts devoted to other taxes. In our survey, we asked individuals to self-report, on a scale of 1 to 5, their knowledge regarding procedures required to pay income taxes. A value of one means ‘Not informed at all’, whereas a value of 5 means ‘Well-informed’. Our results in Figure A.8 reveal that among the richest half, 31.3% of taxpayers report a knowledge of 5. Among the poorest half, only 17.0% report a knowledge of 5. Similarly, 37.5% of taxpayers in the richest half reported a knowledge of 4, whereas 33.7% of taxpayers in the poorest half reported a knowledge of 4.

Social norms. Figure 3 shows the direct effect of the “social norms” message on compliance with the rental income tax as well as its indirect effects on payments related to the capital gains and the self-employment income tax. In Table A.2 we report the corresponding table from which these figures were constructed.

The “social norms” message produced no direct effects. This message informed that the majority of the taxpayers’ neighbors comply with their rental income tax. Therefore, the absence of a direct effect is consistent with the message failing to produce an update in taxpayers beliefs regarding compliance with the rental income tax or with taxpayers disregarding this norm as relevant.

Interestingly, however, the “social norms” message produced a negative indirect effect on the amount paid of the capital gains tax of between 13% and 16% and on the probability of

making a payment of around 1.5 percentage points. These effects were sustained throughout the 15-month follow-up period. There was no indirect effect on the self-employment income tax. Hence, these results are not consistent with the hypothesis that the message failed to convey relevant information. It conveyed relevant information regarding other taxes, in particular, the capital gains tax.

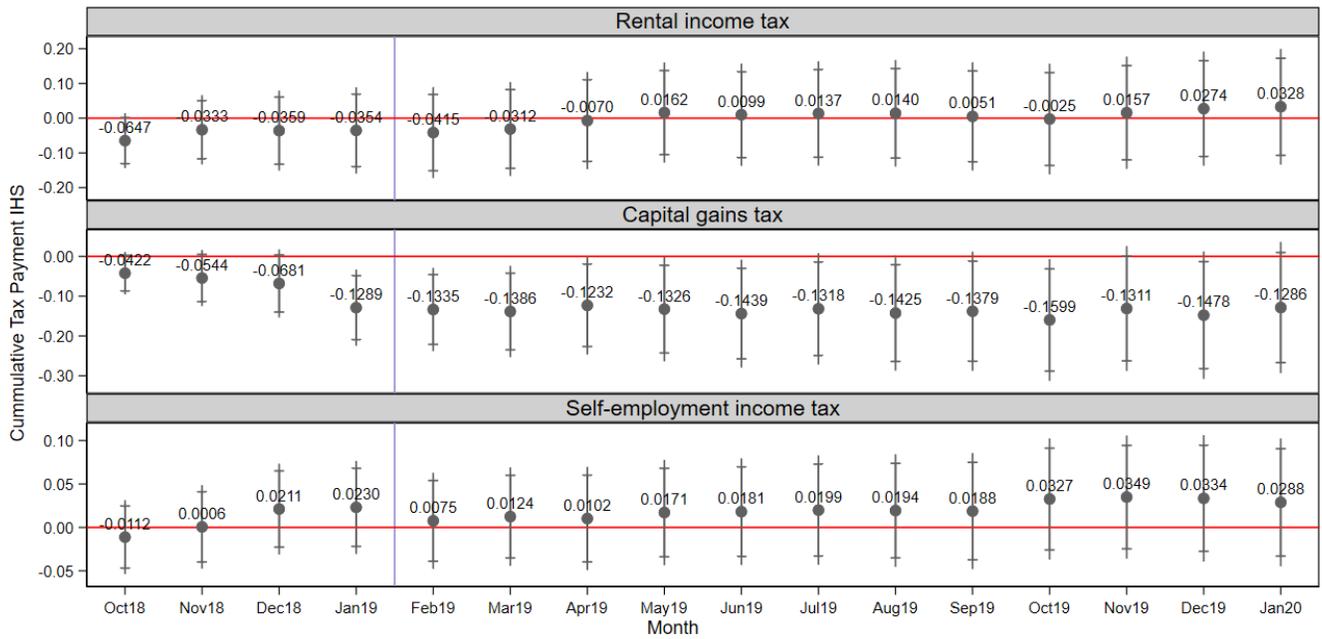
One possible explanation for the negative indirect effect reported above is that individuals are able to extract a negative description of a social norm ('people do not pay their capital gains tax') from a message conveying a positive description of another norm ('people pay their rental income tax'). 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 a particular 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 are providing information about the norm on rental income tax, but we are omitting information about the norm on capital gains tax and self-employment income tax. Thus, individuals are extracting a negative belief about the social norm related to the compliance of the capital gains tax and the self-employment income tax.

Therefore, to rationalize the absence of a direct effect and the presence of a negative indirect effect on the capital gains tax, taxpayers in the sample must believe that a significant proportion of their neighbors comply with their capital gains tax obligations (a belief that is updated in a downward direction due to innuendo) but that the same is not true for the self-employment income tax obligations (so no update in beliefs occurs despite innuendo). In fact, taxpayers in the sample must believe that the majority of their neighbors comply with rental income and capital gains taxes obligations but that only a minority complies with self employment income obligations.

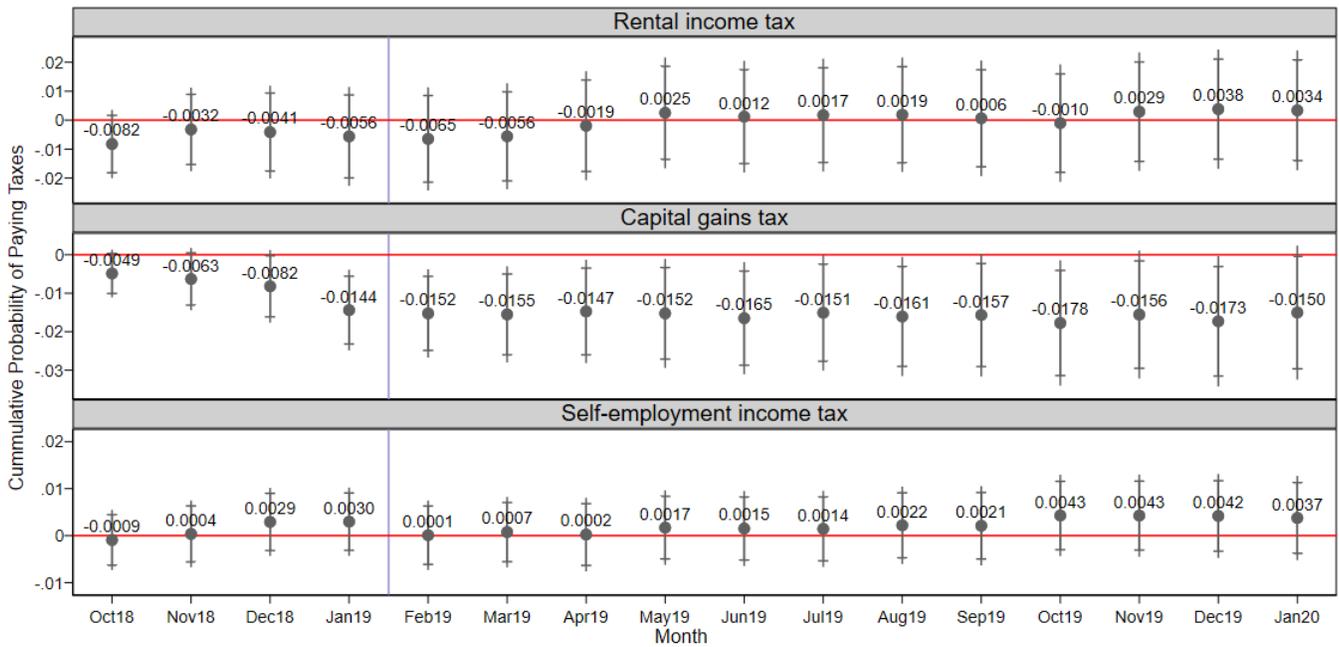
This is consistent with the evidence collected through the post-treatment survey. In fact, the average individual in our sample believes that around 60% of taxpayers in his/her district comply with their income tax obligations in general (which includes the three types of taxes analyzed here) but, at the same time, 74% of the individuals surveyed consider that self employment income earners are among the top three most likely to underreport their income stream.

Figure 3: Direct and indirect effects of the “social norms” 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. Violet line indicates the end of the treatment period. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

Of course, the above explanation should be taken with caution and more research is needed in order to fully understand the underlying mechanisms. We stress that it is possible to rationalize these findings using only the social norms theory and the possibility of innuendo, albeit other mechanisms might be in place as well. Hence, our results point out the need to improve our understanding on how messages addressing beliefs about compliance with a certain tax type may nudge individuals to update their beliefs about compliance with other tax types.

Altruism. Figure 4 shows the direct effect of the “altruism” message on compliance with the rental income tax as well as its indirect effects on payments related to the capital gains and the self-employment income taxes.³⁰ These results show that our “altruism” message has a transitory negative effect on the size of rental income tax payments of between 10% and 14% and on the probability of payment of around 2 percentage points. We do not observe a statistically significant spillover to other taxes.

It is important to recall that the “altruism” message 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 appealed to altruism or preferences for redistribution, since the beneficiaries would be the poor and not the taxpayers from our sample. Notice, however, that this treatment message did not aim at shifting taxpayers’ altruism but sought to leverage on 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 weak preferences for redistribution. 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 evidence collected through the survey indicates that taxpayers in our sample have non-altruistic preferences and weak preferences for redistribution. In fact, the majority of taxpayers appear unwilling to share the money they earn because of luck of through their own effort. 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

³⁰In Table A.3 we report the corresponding table from which these figures were constructed.

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”.

Furthermore, taxpayers perceive their payments of the income tax to be high relative to payments by individuals from other districts. This may have compounded the negative response triggered by the “altruism” message. In fact, our survey shows that a good share felt that they pay 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 Peru was 38 and 31%, respectively.

Another possible explanation for the negative effect produced by the “altruism” treatment 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 compounds 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 believes that corruption is the main problem in the country.³¹ Furthermore, the “altruism” message made reference to the provision of health centers and corruption in public hospitals is 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 publicly provided health services.

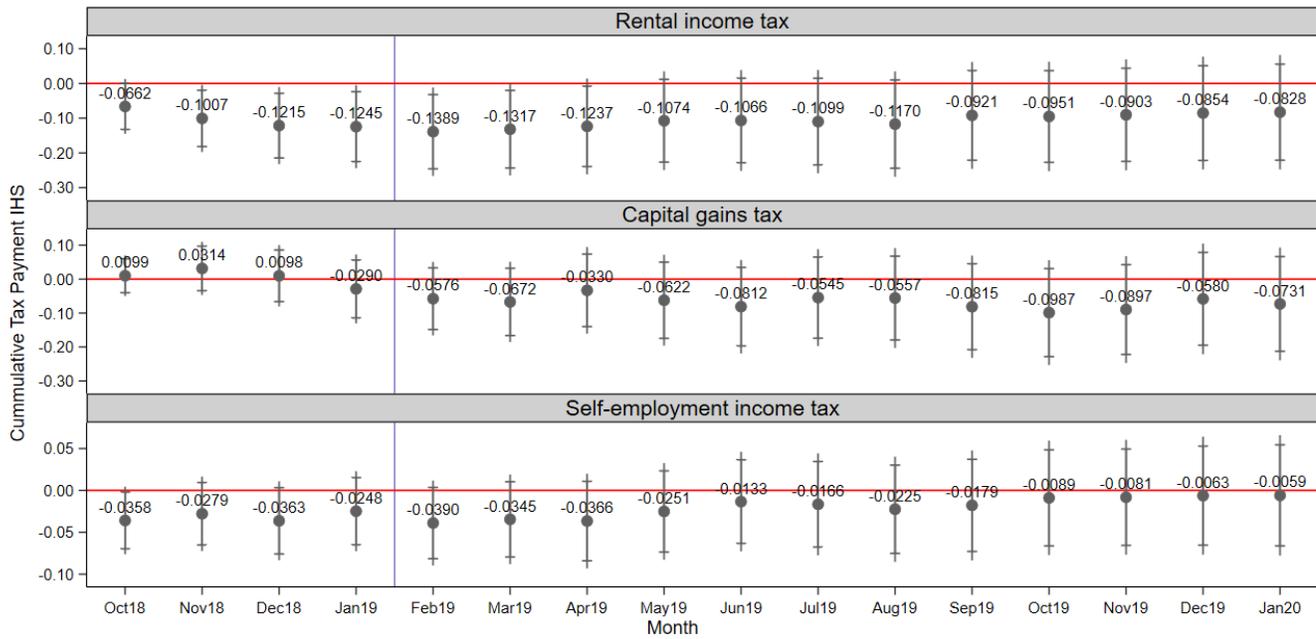
Robustness check. To check the robustness of our results, we performed an exercise similar to that performed in Chetty, Looney, and Kroft (2009). In particular, we drew 5,000 bootstrap samples to produce a distribution of placebo coefficients. For this, in each draw, we randomly reassigned the treatment status of each taxpayer. In addition, we randomized the timing of his/her payments within the 10 month-window comprising five months prior to treatment and five months after treatment. Finally, we ran the regression given in (1) for the accumulated payments until month five and produced a new coefficient for each type of message.

Figure 5 shows the distribution of these placebo coefficients for each type of message, the value of the original treatment effect, and its corresponding p-value. These results confirm the size and significance of our direct effects: (i) a positive and significant direct effect of the “deterrence” message (size = 0.1523; p-value = 0.038); (ii) no direct effect of the “social norms” message (size = -0.0415 ; p-value = 0.3134); and (iii) negative and significant direct effect of the “altruism” message (size = -0.1389; p-value = 0.0110).

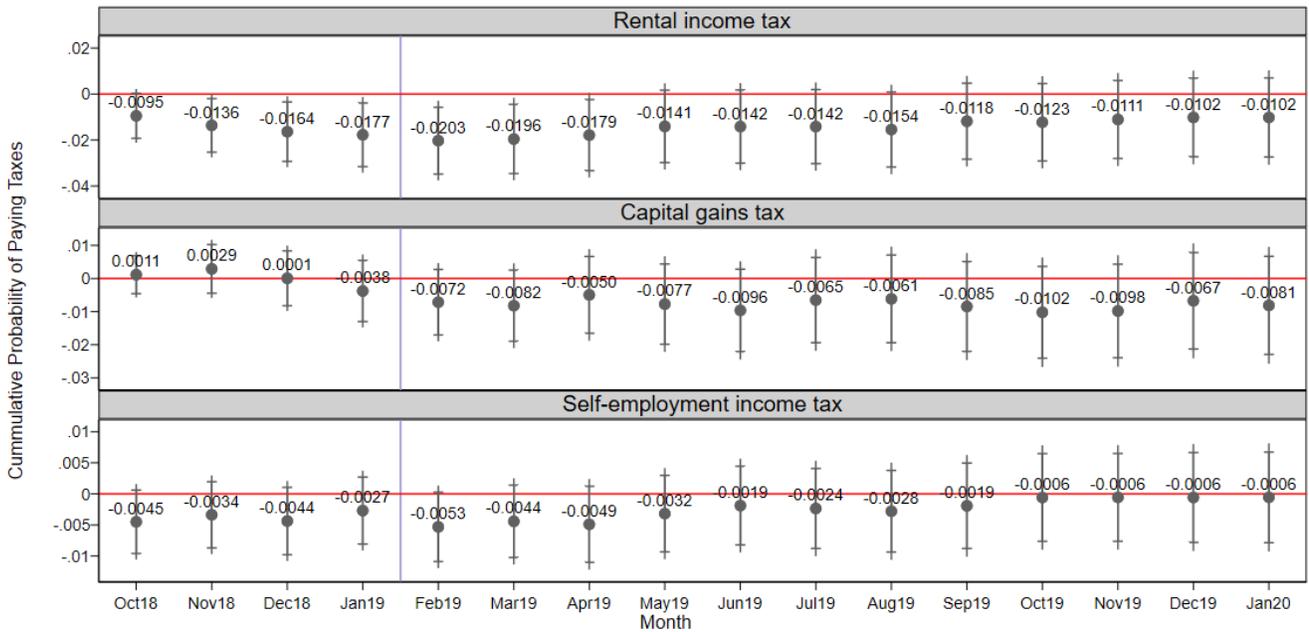
³¹Second and third place are high crime rates (43.1%) and the bad quality of public education (12.3%).

Figure 4: Direct and indirect effects of the “altruism” message on tax compliance

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

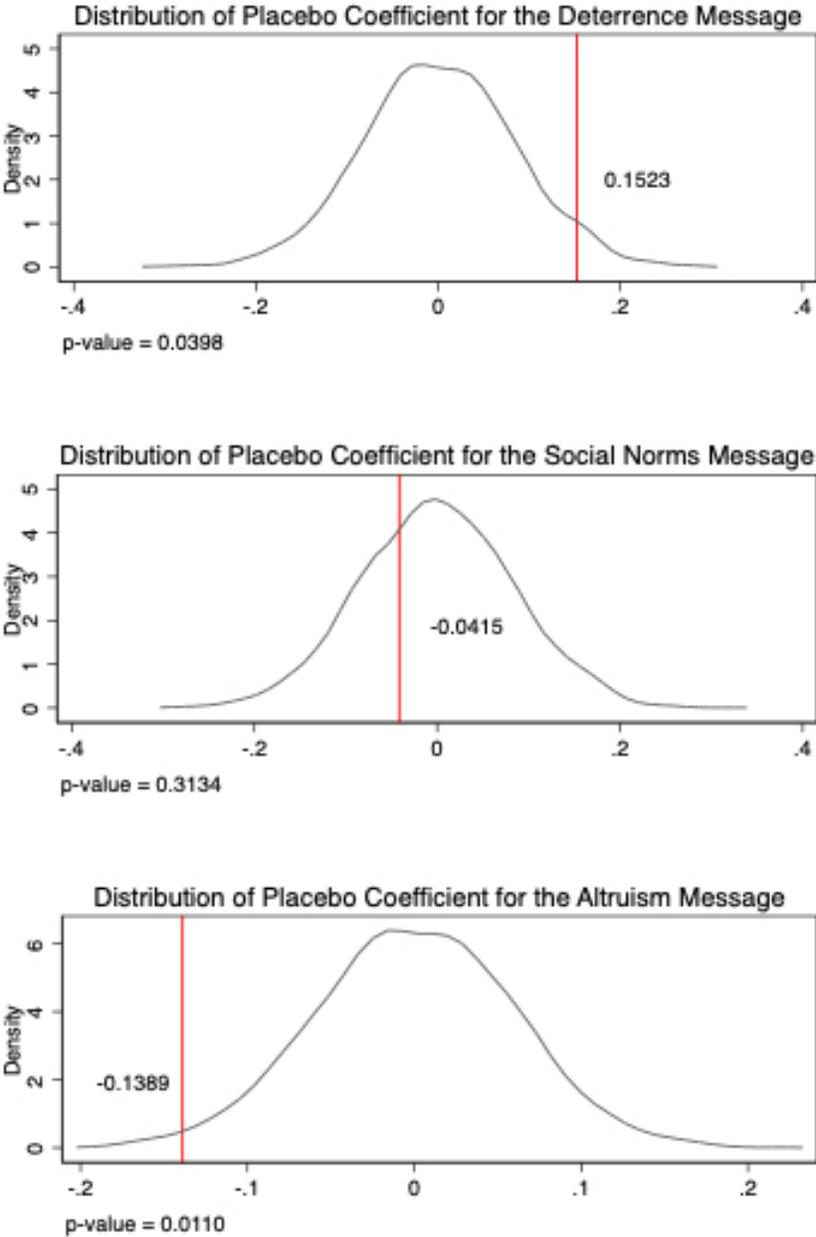


Panel B: Likelihood of paying taxes between Oct 18 and month X



Notes: 90% and 95% confidence intervals. Violet line indicates the end of the treatment period. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

Figure 5: Distribution of placebo coefficients

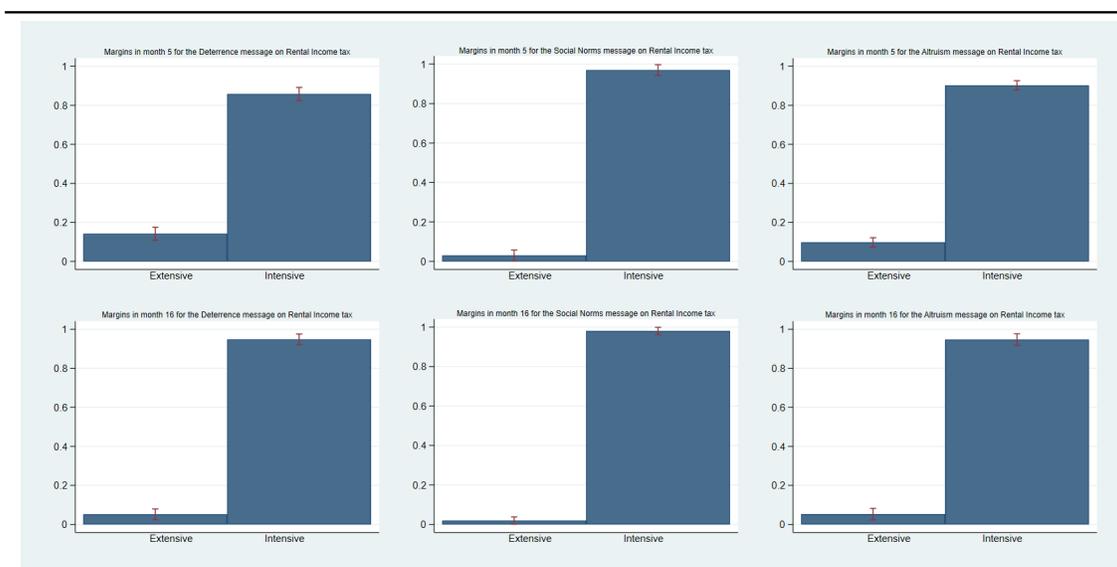


Notes: We drew 5,000 bootstrapped samples to produce a distribution of placebo coefficients. In each draw, we randomly reassigned the treatment status of each taxpayer. In addition, we randomized the timing of his/her payments within the 10 month window comprising five months prior to treatment and five months after treatment. Finally, we ran regression in (1) for the accumulated payments until month five and produced a new coefficient for each type of message.

4.2.2 Extensive vs intensive margin

Figures 6-8 present the contribution of the extensive and intensive margin to the treatment effects on the rental income tax, capital gains tax, and self-employment tax, respectively. We have done this decomposition for months 5, just after we finished sending the letters, and month 15, the end of the experiment. These are shown in the first and second row, respectively.

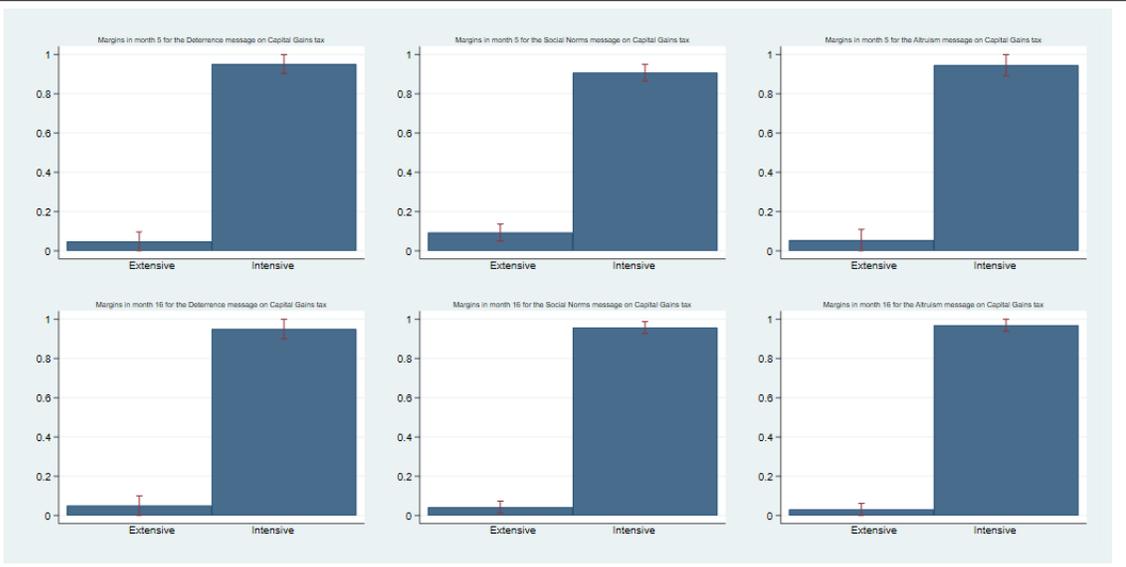
Figure 6: Contribution of the extensive and intensive margin of treatment letters on rental income tax



Notes: See Section 4.1.2 for details about the methodology.

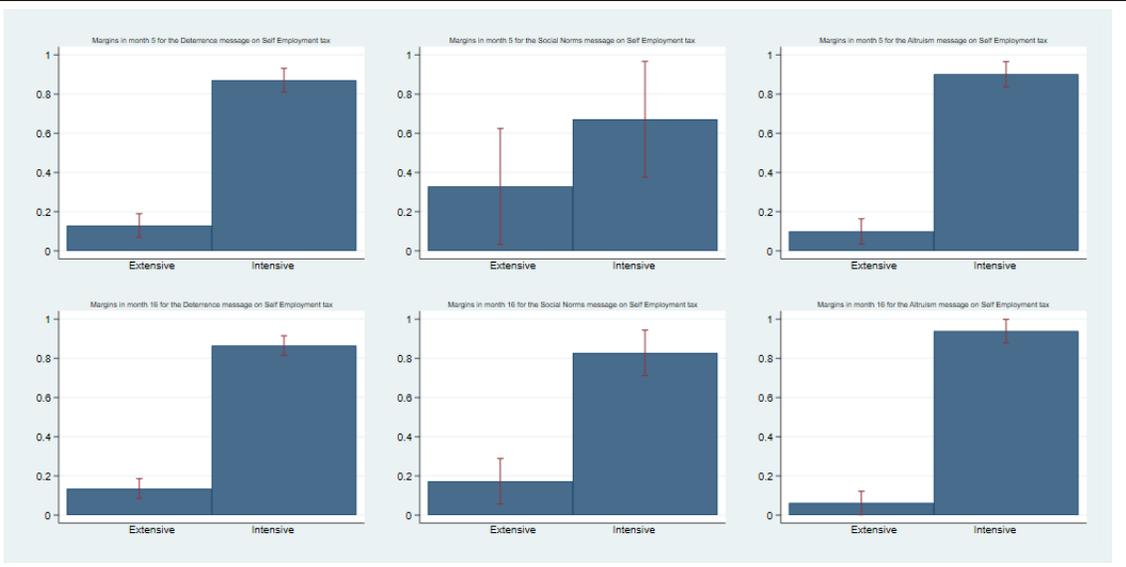
These figures reveal that most of the impact can be attributed to the intensive margin. Nonetheless, some observations are in order. First, in month 5, the role of the extensive margin tended to be higher than in month 15, especially in the case of the deterrence letter and the rental income tax. Figure 6 shows that in month 5 the role of the extensive margin was of around 20%, whereas in month 15 it was of around 5%. This means that initially, new taxpayers were drawn into paying their rental income taxes. By the end of the experiment, most of the impact was driven by people who in absence of the treatment would have complied but only partially. Another noteworthy finding is that the indirect impact of the “deterrence” letter on capital gains tax acted mainly through the intensive margin (Figure 7). However, its impact on the self-employment gave the extensive margin a sizeable role at the beginning and at the end of the experiment (around 20%, see Figure 8).

Figure 7: Contribution of the extensive and intensive margin of treatment letters on capital gains tax



Notes: See Section 4.1.2 for details about the methodology.

Figure 8: Contribution of the extensive and intensive margin of treatment letters on self-employment tax



Notes: See Section 4.1.2 for details about the methodology.

Second, we have shown that the “social norms” treatment had basically no direct impact, but a sizeable and quite sustained impact on the capital gains tax. Figure 7 reveals that this impact was driven by the intensive margin. Albeit, the role of the extensive margin was higher at the beginning of the experiment (around 10%) than at the end (around 2%). Finally, we have shown that the “altruism” treatment reduced payments of the rental income tax. Figure 6 shows that the final impact on tax collection was mainly due to taxpayers decreasing the size of their payments (i.e. intensive margin), more than due to people withdrawing from paying (i.e. the extensive margin). However, once again, the role of the extensive margin was higher at the beginning of the experiment rather than at the end (10% vs 5%).

4.2.3 The effect of the reminder letter

The results of estimating equation (2) are reported 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 payments related to the capital gains tax or the self-employment income tax.

4.3 Quantitative importance of indirect effects

The literature has shown that sending messages to increase tax compliance has, in many cases, a positive benefit, after considering the additional tax revenue produced by the messages and the cost of sending them ³² However, these studies do not consider that individuals may be adjusting compliance with other taxes in a way that offsets the additional revenue collected through the tax addressed in the message. Therefore, these studies may be overestimating the gains produced by their interventions. In this subsection, we illustrate this point by simulating the distribution of the effect of our messages on the per capita tax revenues coming from (i) the rental income tax (i.e. direct gains) and from (ii) the rental income, self-employment income and capital gains taxes (i.e. total gains). These impacts were estimated using the reminder letter as a control group, so they should be interpreted as marginal gains. For this, we took 1,000 bootstrapped samples and estimated the effect of each type of message on the amount paid of rental income tax, capital gains tax and self-employment income tax by the time the experiment was phased out (5-month follow up), and the effect of each type of message on the amount paid of rental income tax, capital

³²See, e.g., Chirico et al., 2019.

gains tax and self-employment income tax at the end of the 15-month follow-up. These effects were then applied to the average revenue collected for the corresponding tax and time period in the control group to calculate the direct gain (considering the rental income tax only) and the total gain (by adding to the direct gain the revenues coming from the capital gains and self-employment income taxes).

Table 4: The effect of the reminder letter 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. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. We report the marginal effects implied by 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 contains: age in years, a dummy for sex, the number of properties and their value, dummies for income bins, a dummy for tax payments during the period 2013 to 2017, and district fixed effects.

Figure 9 shows the distributions of these direct and total gains. For each type of message and follow-up period, direct gains are plotted in blue and total gains in red. Precision is lost when calculating the total gains and this is much more apparent in the simulations carried out for the 15-month follow up. However, our results evidence that there is a substantial risk of overestimating the additional tax revenues produced by the messages if one overlooks their indirect effects. In fact, in terms of tax revenues, these indirect effects render the “deterrence” message ineffective, turn an apparently innocuous “social norms”

message into a clearly bad policy option, and reinforce the negative effect of the “altruism” message.

Based on its direct effects only, using the “deterrence” message appears to be a good idea from a revenue perspective as it promises a sustained increase of between 10% and 15% in rental income tax collection (see Figure 2). If one factors in its indirect effects, however, our simulations for the 15-month follow up indicate that there is no evidence of a positive total gain. Consistent with this, the average total per capita revenue produced by this message after 15 months (the mean of the red distribution in Figure 5: S/. -8.01) represents a reduction of 0.21% in tax revenues (with respect to the average total tax collection in the control group).

Adding the “social norms” message to the reminder seems innocuous based on its effect on rental income tax collection (see Figure 3). However, if one factors in its indirect effects however it is clear from the results presented in Figure 5 that this message will produce a loss in tax revenues. Notice that almost the entire probability mass of total gains lies below the distribution of direct gains, and that the average total per capita revenue produced after 15 months (S/. -105.55) represents a reduction of 2.7% in tax revenues (with respect to the average total tax collection in the control group).

Finally, we knew from the analysis of its direct effect that the “altruism” message produced a transitory decline in rental income tax collection of between 10% and 14%. Simulations for the total effect confirm that this message has a negative effect on tax revenues and suggest that it could even be sustained and reinforced by the presence of a negative spillover, although we lack precision to confirm its statistical significance. The average total per capita revenue produced after 15 months (S/. -79.97) represents a reduction of 2.1% in tax revenues (with respect to the average total tax collection in the control group).

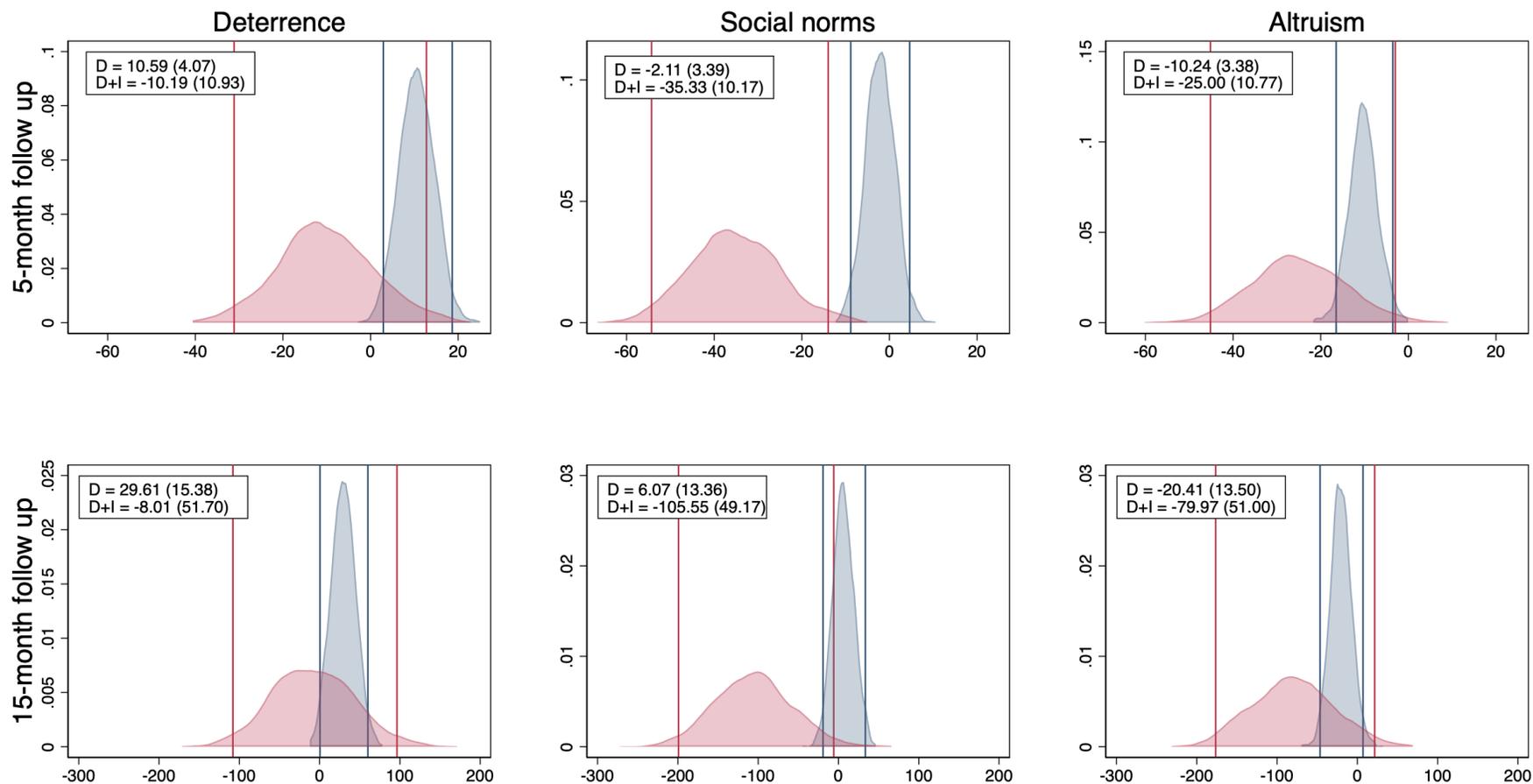
5 Concluding Remarks

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 rental income taxpayers in the city of Lima, Peru. During the experiment, the tax authority sent a “deterrence” message that highlighted the effectiveness of its control actions, a “social norms” message that informed taxpayers about the compliance of their neighbors, and a “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.

The three income taxes considered in this study share the characteristic of being affected by large informational asymmetries so we tested messages tailored to situations where the authorities are unable to fully identify who is a debtor and to calculate an exact compliance rate. This context is particularly relevant across the developing world mainly due to pervasive informality.

Figure 9: Per capita changes in tax revenues caused by the messages (*direct marginal gain* in blue, *direct + indirect marginal gain* in red)



Notes: We report bootstrapped distributions ($n=1000$) of per capita changes in tax revenues caused by the messages. Vertical lines indicate 95% confidence intervals. Estimates correspond to the average potential taxpayer of our sample, in USD. Bootstrapped standard errors are reported in parentheses. “D”: *direct marginal gain*, in blue, considers the effect on the rental income tax. “D+I”: *direct + indirect marginal gain*, in red, adds to this the additional resources coming from the capital gains and self-employment income tax. In [A.9](#) we report the empirical distribution of the messages on each particular tax type.

Our results confirmed that “deterrence” messages can have a positive direct effect on payments related to the tax addressed in the message. Importantly, we also provided new evidence consistent with the hypothesis put forward in LLS (2019) that messages highlighting enforcement actions devoted to one tax can produce negative spillovers on payments related to other taxes because taxpayers expect less enforcement devoted to these taxes. We also provided new evidence that “social norms” messages can produce negative spillovers. Moreover, our results for the “altruism” message confirmed that this type of messages can backfire. We used a survey to document the context in which one can expect this negative response and found evidence that the taxpayers in our sample have non-altruistic preferences and weak preferences for redistribution, 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 considered effects across different taxes as well as across different time periods. This allowed us to provide a comprehensive analysis of the quantitative importance of indirect impacts. Crucially, our results revealed that overlooking these indirect effects entails a substantial risk of overestimating the benefits of using these types of messages. In fact, we showed that conclusions about the effectiveness of the “deterrence” and “social norms” messages based on their direct effects have to be revised after factoring their indirect effects. These results are a cautionary tale and their main policy implication is that an adequate assessment of the effect of messages designed to raise compliance with a particular tax requires considering their effects on compliance with other taxes as well, if the objective is to increase tax revenues.

Finally, our findings also suggest new avenues for future research. In particular, further research on why messages appealing to social norms 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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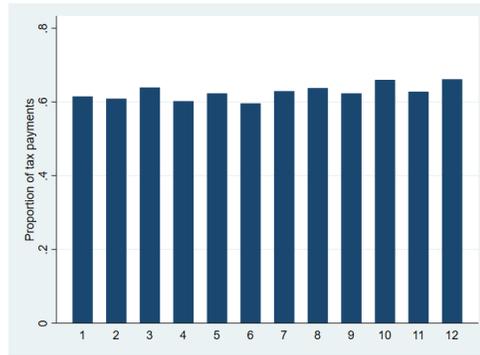
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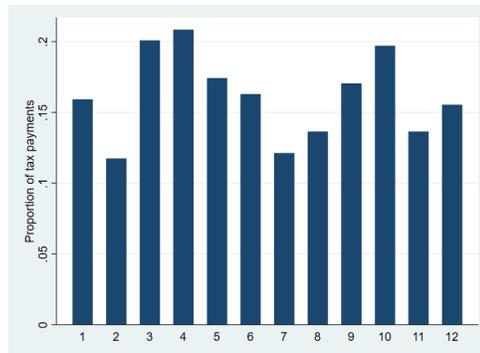
A Appendix

Figure A.1: Share of Eventual Taxpayers Paying in Each Given Month

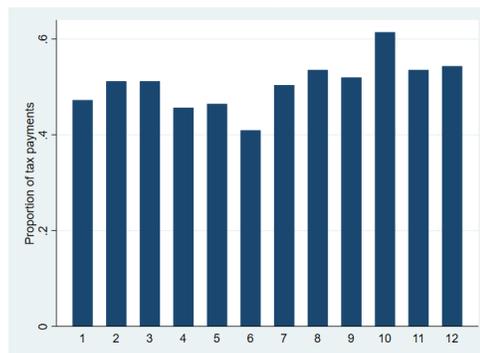
Panel A: Rental Income Tax



Panel B: Capital Gains Tax



Panel C: Self-Employment Tax



Notes: This is the average timeliness of filling/paying using the control group of our study for the year 2019 for each type of tax. The figure shows, of those who made a payment at some point, the share of taxpayers paying in each given month.

Figure A.2: Experiment Letters 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.2, continued)

Panel B: "Deterrence" 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.2, continued)

Panel C: "Social norms" 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.2, 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.3: Intervention Timeline

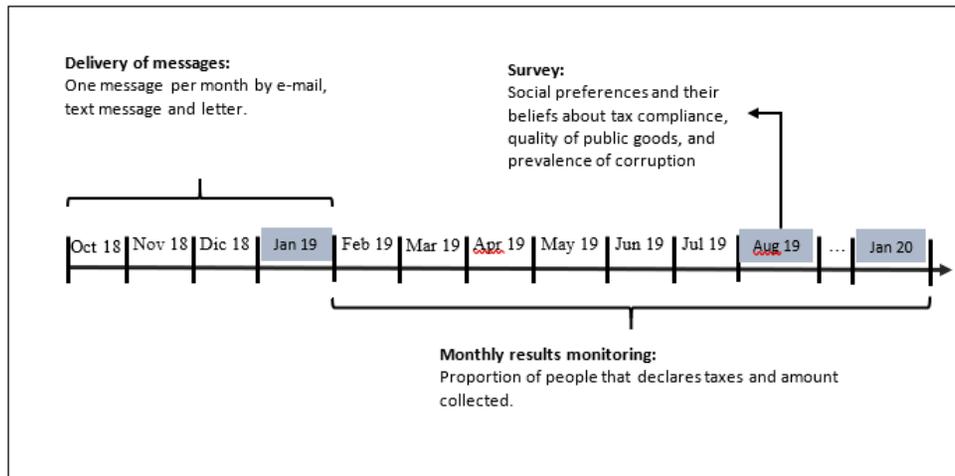
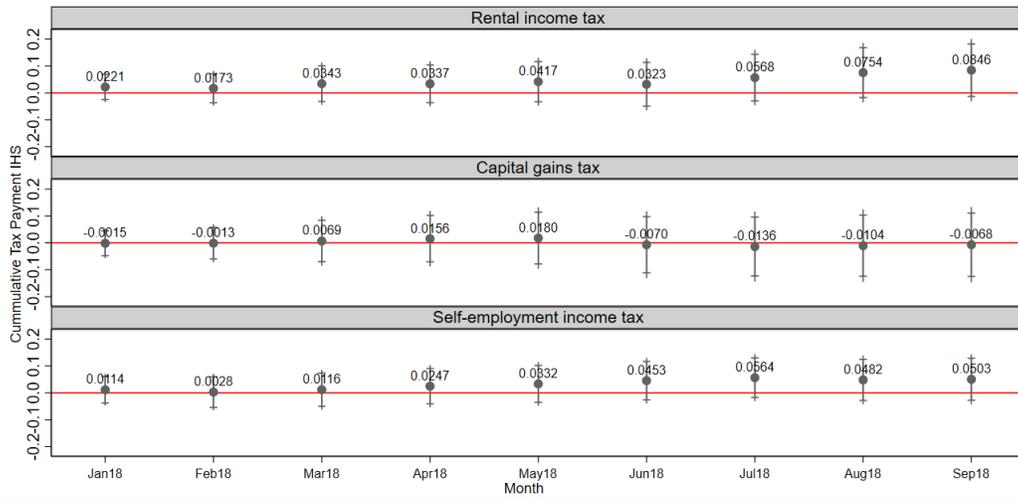
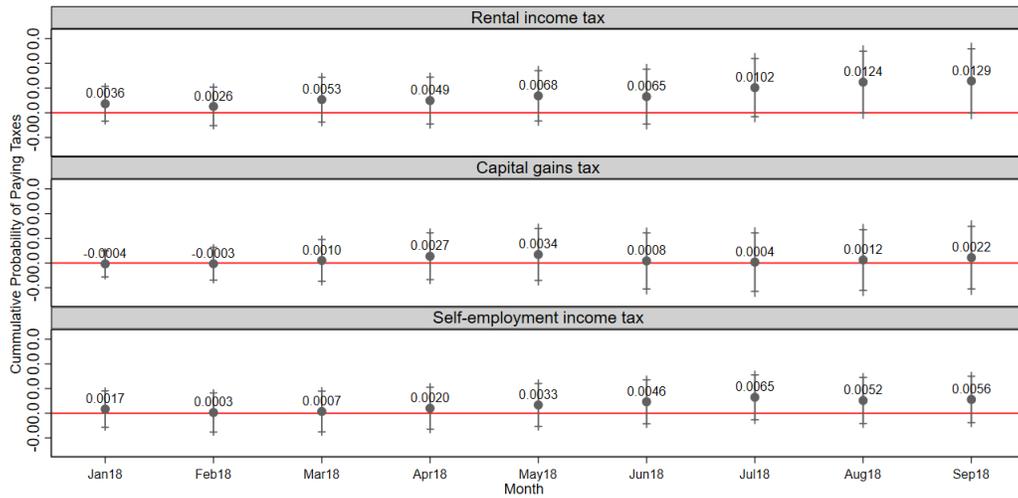


Figure A.4: “Deterrence” message: Pre-trends in tax behavior

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



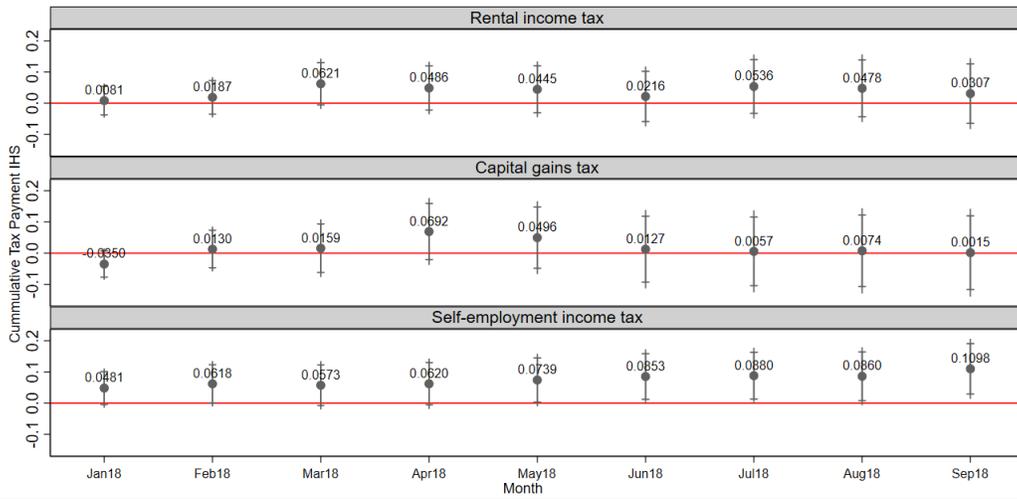
Panel B: Likelihood of paying taxes between Jan 18 and month X



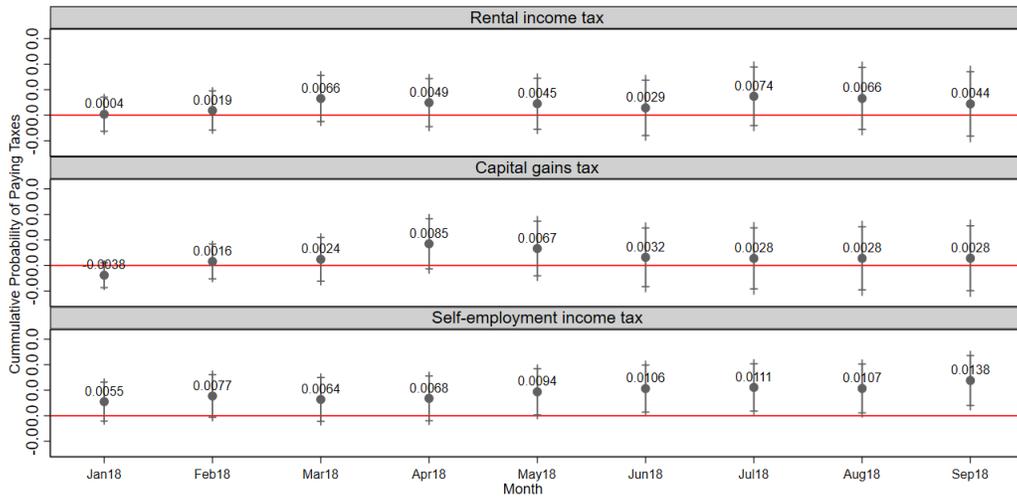
Notes: 90% and 95% confidence intervals. We report the marginal effects implied by a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the Inverse Hyperbolic Sine function. For more information, see Friedline, et al. (2015). All regressions include a set of covariates which is comprised by: 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: “Social norms” message: Pre-trends in tax behavior

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



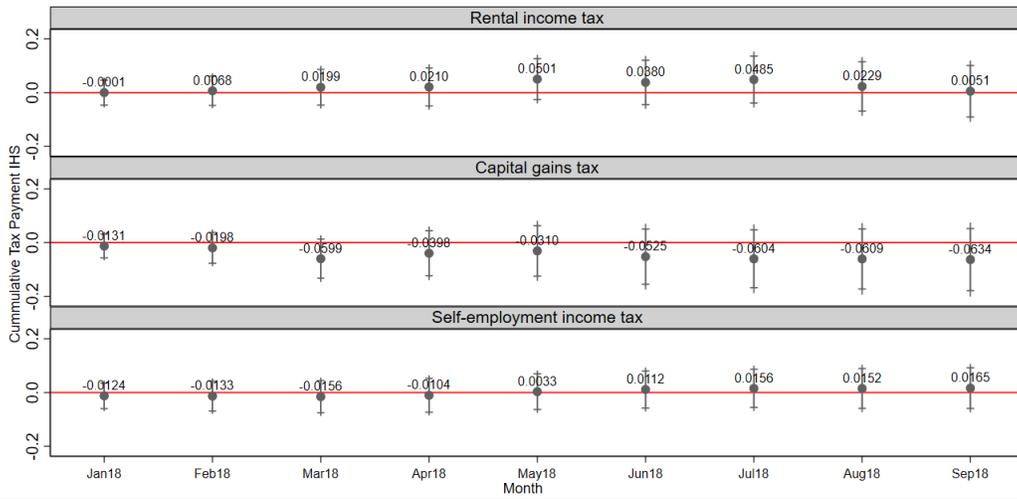
Panel B: Likelihood of paying taxes between Jan 18 and month X



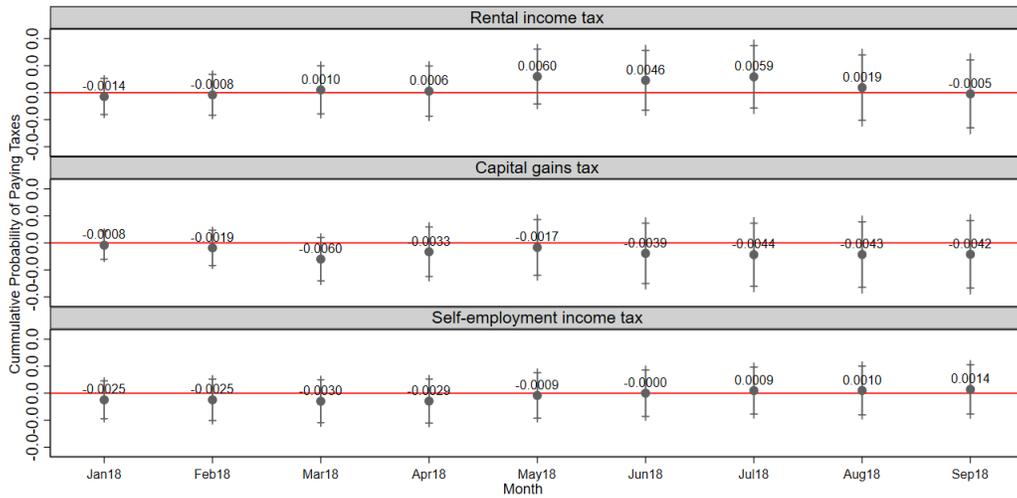
Notes: 90% and 95% confidence intervals. We report the marginal effects implied by a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the Inverse Hyperbolic Sine function. For more information, see Friedline, et al. (2015). All regressions include a set of covariates which is comprised by: 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.6: “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



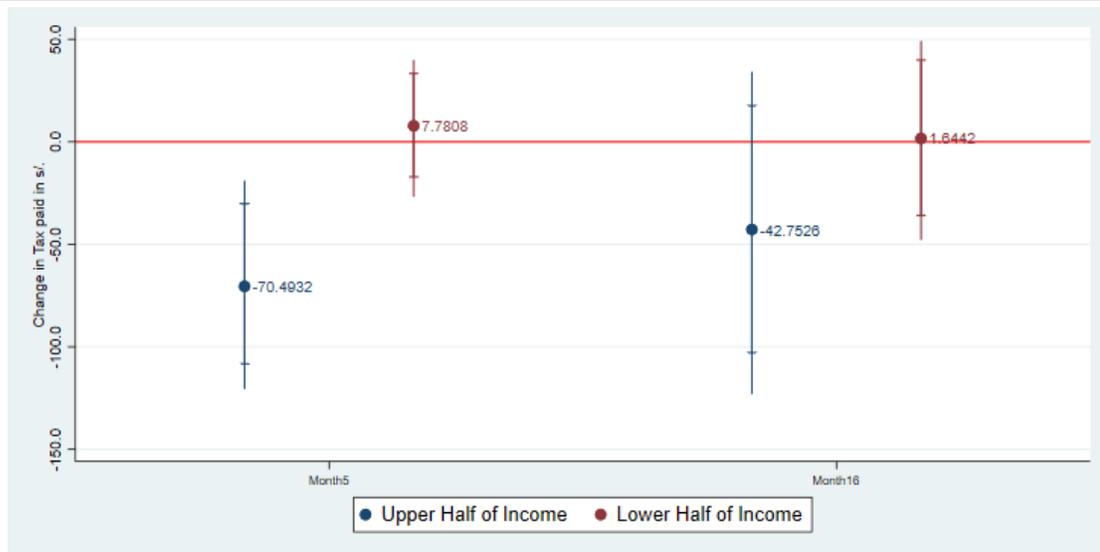
Notes: 90% and 95% confidence intervals. We report the marginal effects implied by a probit model for the results on the likelihood of paying taxes. We transform the amount paid using the Inverse Hyperbolic Sine function. For more information, see Friedline, et al. (2015). All regressions include a set of covariates which is comprised by: 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.7: Direct and indirect effects by income

Panel A: Rental Income (direct effect)

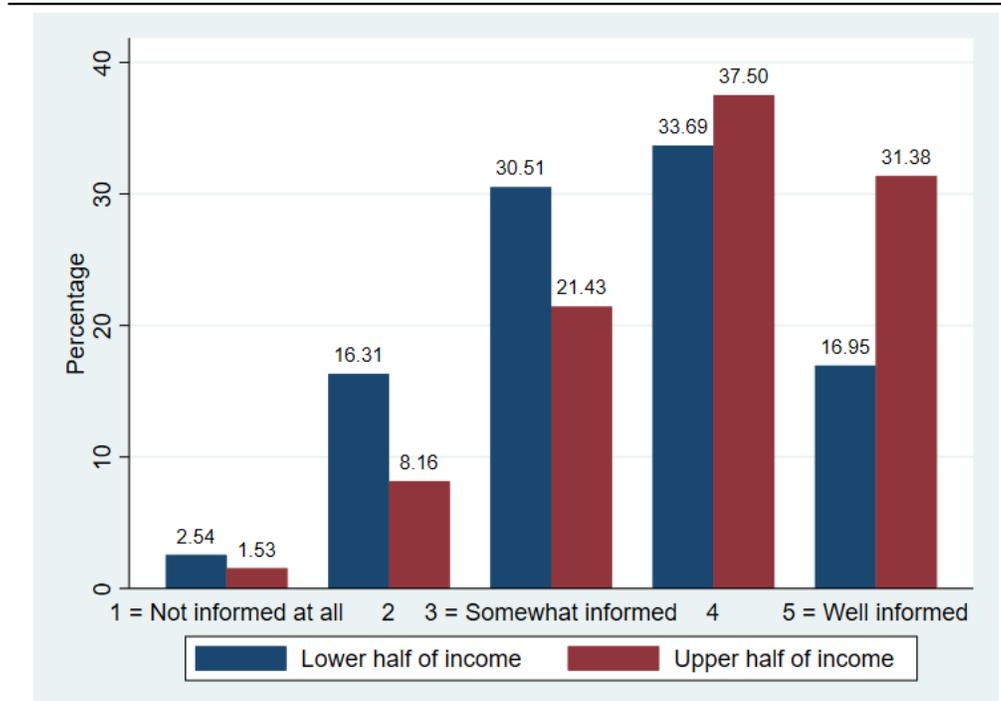


Panel B: Self-Employment + Capital Gains (indirect effect)



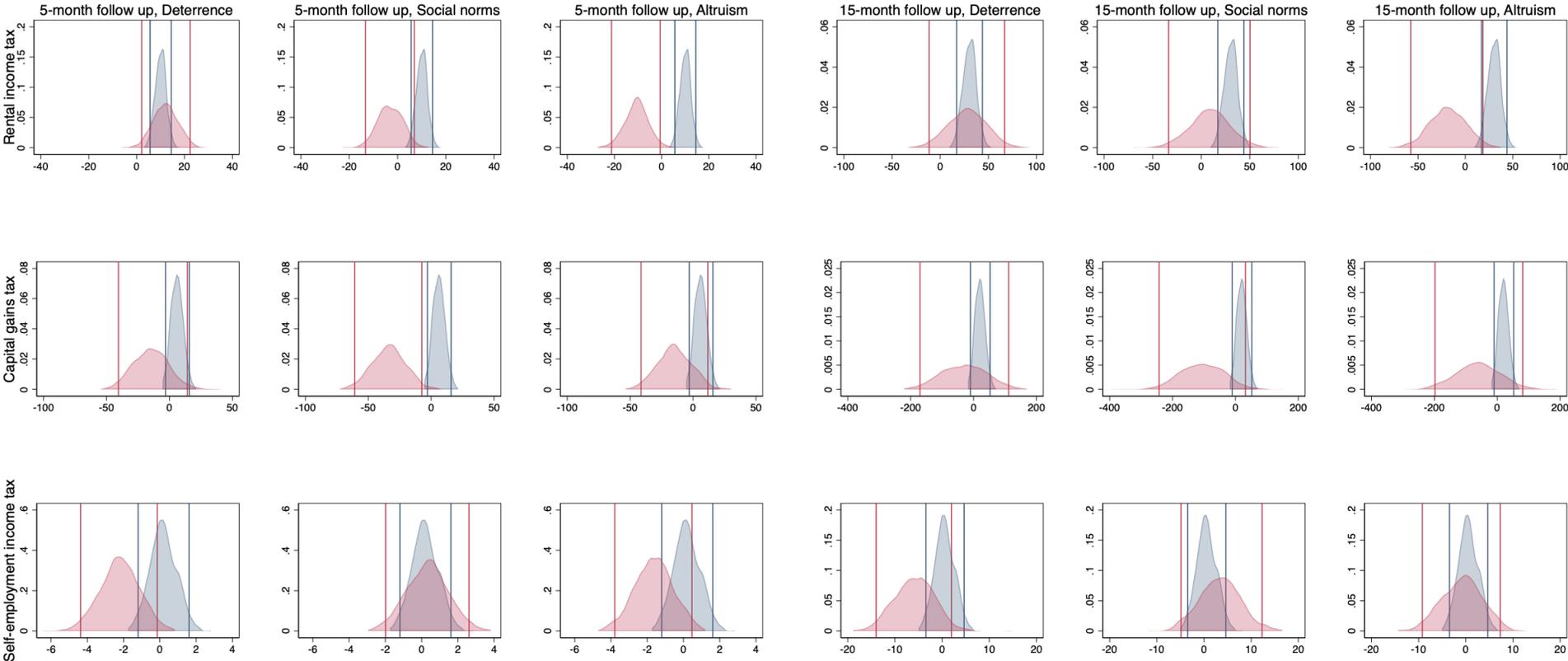
Notes: 90% and 95% confidence. We estimate equation (1) for individuals in the upper half of the distribution of income and in the lower half. We use as outcome an IHS transformation of the amount paid. Then, we apply resulting semi-elasticities to baseline amounts in the control group to transform the semi-elasticity into local currency (USD/PEN=3.5). Standard errors were bootstrapped. All regressions include a set of covariates which is comprised by: 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.8: Knowledge regarding procedures required to pay income taxes



Notes: We asked individuals in our survey to self-report, on a scale of 1 to 5, their knowledge regarding procedures required to pay income taxes. A value of one means ‘Not informed at all’, whereas a value of 5 means ‘Well-informed’.

Figure A.9: Per capita changes in tax revenues caused by the messages (effect of *reminder* in blue, effect of *additional lines* in red)



Notes: We report bootstrapped distributions (n=1000) of per capita changes in tax revenues caused by the messages. Vertical lines indicate 95% confidence intervals. Estimates are expressed in US dollars (USD/PEN=3.5) and correspond to the average potential taxpayer of our sample. *Reminder* refers to the change in tax revenues caused by the text in the letter 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 letter related to the “deterrence”, “social norms” or “altruism” message.

Table A.1: Direct and indirect effects of the “deterrence” message on tax compliance

	Oct18	Nov18	Dec18	Jan19	Feb19	Mar19	Apr19	May19	Jun19	Jul19	Aug19	Sep19	Oct19	Nov19	Dec19	Jan20
<i>Panel A: IHS transformation of amount paid between Oct 18 and month X</i>																
Rental income tax	0.038 (0.043)	0.103** (0.053)	0.124** (0.060)	0.138** (0.064)	0.152** (0.068)	0.115 (0.071)	0.135* (0.074)	0.147* (0.075)	0.159** (0.077)	0.145* (0.078)	0.141* (0.080)	0.148* (0.081)	0.130 (0.083)	0.129 (0.084)	0.130 (0.085)	0.114 (0.086)
Control mean	0.387	0.631	0.854	1.011	1.121	1.248	1.331	1.396	1.442	1.495	1.540	1.588	1.637	1.675	1.725	1.761
Capital gains tax	-0.014 (0.030)	0.007 (0.040)	-0.005 (0.046)	-0.041 (0.052)	-0.057 (0.056)	-0.077 (0.060)	-0.080 (0.064)	-0.097 (0.068)	-0.096 (0.070)	-0.067 (0.073)	-0.088 (0.075)	-0.088 (0.077)	-0.080 (0.080)	-0.048 (0.082)	-0.026 (0.084)	-0.035 (0.086)
Control mean	0.109	0.201	0.269	0.326	0.378	0.455	0.540	0.606	0.646	0.701	0.750	0.797	0.844	0.893	0.949	0.997
Self-employment income tax	-0.020 (0.021)	-0.034 (0.023)	-0.039 (0.025)	-0.038 (0.025)	-0.053* (0.027)	-0.046 (0.029)	-0.044 (0.030)	-0.033 (0.029)	-0.031 (0.030)	-0.025 (0.031)	-0.025 (0.032)	-0.032 (0.033)	-0.035 (0.033)	-0.038 (0.034)	-0.048 (0.034)	-0.049 (0.035)
Control mean	0.162	0.218	0.250	0.270	0.287	0.307	0.323	0.337	0.353	0.364	0.379	0.392	0.407	0.413	0.423	0.430
<i>Panel B: Likelihood of paying taxes between Oct 18 and month X</i>																
Rental income tax	0.007 (0.006)	0.016** (0.008)	0.019** (0.008)	0.020** (0.009)	0.022** (0.009)	0.016* (0.010)	0.019* (0.010)	0.021** (0.010)	0.022** (0.010)	0.020** (0.010)	0.019* (0.010)	0.020* (0.010)	0.018* (0.011)	0.018* (0.011)	0.018* (0.011)	0.015 (0.011)
Control mean	0.060	0.094	0.121	0.140	0.153	0.167	0.176	0.183	0.187	0.192	0.196	0.201	0.206	0.210	0.214	0.217
Capital gains tax	-0.003 (0.003)	-0.001 (0.004)	-0.002 (0.005)	-0.006 (0.006)	-0.008 (0.006)	-0.010 (0.007)	-0.010 (0.007)	-0.012* (0.007)	-0.012 (0.008)	-0.009 (0.008)	-0.011 (0.008)	-0.011 (0.008)	-0.010 (0.008)	-0.007 (0.009)	-0.005 (0.009)	-0.005 (0.009)
Control mean	0.013	0.023	0.030	0.037	0.042	0.051	0.060	0.067	0.071	0.077	0.082	0.087	0.092	0.097	0.103	0.108
Self-employment income tax	-0.003 (0.003)	-0.005 (0.003)	-0.006* (0.003)	-0.005 (0.003)	-0.008** (0.004)	-0.006* (0.004)	-0.006 (0.004)	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)	-0.005 (0.004)	-0.005 (0.004)	-0.005 (0.004)	-0.006 (0.004)	-0.006 (0.004)
Control mean	0.024	0.030	0.033	0.035	0.036	0.038	0.040	0.041	0.043	0.044	0.046	0.047	0.048	0.049	0.050	0.050

Notes: Robust standard errors in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

Table A.2: Direct and indirect effects of the “social norms” message on tax compliance

	Oct18	Nov18	Dec18	Jan19	Feb19	Mar19	Apr19	May19	Jun19	Jul19	Aug19	Sep19	Oct19	Nov19	Dec19	Jan20
<i>Panel A: IHS transformation of amount paid between Oct 18 and month X</i>																
Rental income tax	-0.065 (0.040)	-0.033 (0.051)	-0.036 (0.059)	-0.035 (0.063)	-0.042 (0.067)	-0.031 (0.069)	-0.007 (0.071)	0.016 (0.074)	0.010 (0.075)	0.014 (0.077)	0.014 (0.078)	0.005 (0.080)	-0.003 (0.081)	0.016 (0.082)	0.027 (0.084)	0.033 (0.085)
Control mean	0.387	0.631	0.854	1.011	1.121	1.248	1.331	1.396	1.442	1.495	1.540	1.588	1.637	1.675	1.725	1.761
Capital gains tax	-0.042 (0.027)	-0.054 (0.036)	-0.068 (0.044)	-0.129*** (0.049)	-0.134** (0.053)	-0.139** (0.059)	-0.123* (0.063)	-0.133** (0.067)	-0.144** (0.069)	-0.132* (0.071)	-0.143* (0.074)	-0.138* (0.076)	-0.160** (0.078)	-0.131 (0.080)	-0.148* (0.082)	-0.129 (0.084)
Control mean	0.109	0.201	0.269	0.326	0.378	0.455	0.540	0.606	0.646	0.701	0.750	0.797	0.844	0.893	0.949	0.997
Self-employment income tax	-0.011 (0.022)	0.001 (0.025)	0.021 (0.027)	0.023 (0.027)	0.008 (0.028)	0.012 (0.029)	0.010 (0.030)	0.017 (0.031)	0.018 (0.031)	0.020 (0.032)	0.019 (0.033)	0.019 (0.034)	0.033 (0.036)	0.035 (0.036)	0.033 (0.037)	0.029 (0.038)
Control mean	0.162	0.218	0.250	0.270	0.287	0.307	0.323	0.337	0.353	0.364	0.379	0.392	0.407	0.413	0.423	0.430
<i>Panel B: Likelihood of paying taxes between Oct 18 and month X</i>																
Rental income tax	-0.008 (0.006)	-0.003 (0.007)	-0.004 (0.008)	-0.006 (0.009)	-0.006 (0.009)	-0.006 (0.009)	-0.002 (0.010)	0.003 (0.010)	0.001 (0.010)	0.002 (0.010)	0.002 (0.010)	0.001 (0.010)	-0.001 (0.010)	0.003 (0.010)	0.004 (0.010)	0.003 (0.011)
Control mean	0.060	0.094	0.121	0.140	0.153	0.167	0.176	0.183	0.187	0.192	0.196	0.201	0.206	0.210	0.214	0.217
Capital gains tax	-0.005 (0.003)	-0.006 (0.004)	-0.008* (0.005)	-0.014*** (0.005)	-0.015*** (0.006)	-0.016** (0.006)	-0.015** (0.007)	-0.015** (0.007)	-0.017** (0.007)	-0.015** (0.008)	-0.016** (0.008)	-0.016* (0.008)	-0.018** (0.008)	-0.016* (0.008)	-0.017** (0.009)	-0.015* (0.009)
Control mean	0.013	0.023	0.030	0.037	0.042	0.051	0.060	0.067	0.071	0.077	0.082	0.087	0.092	0.097	0.103	0.108
Self-employment income tax	-0.001 (0.003)	0.000 (0.004)	0.003 (0.004)	0.003 (0.004)	0.000 (0.004)	0.001 (0.004)	0.000 (0.004)	0.002 (0.004)	0.001 (0.004)	0.001 (0.004)	0.002 (0.004)	0.002 (0.004)	0.004 (0.004)	0.004 (0.004)	0.004 (0.005)	0.004 (0.005)
Control mean	0.024	0.030	0.033	0.035	0.036	0.038	0.040	0.041	0.043	0.044	0.046	0.047	0.048	0.049	0.050	0.050

Notes: Robust standard errors in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

Table A.3: Direct and indirect effects of the “altruism” message on tax compliance

	Oct18	Nov18	Dec18	Jan19	Feb19	Mar19	Apr19	May19	Jun19	Jul19	Aug19	Sep19	Oct19	Nov19	Dec19	Jan20
<i>Panel A: IHS transformation of amount paid between Oct 18 and month X</i>																
Rental income tax	-0.066 (0.040)	-0.101** (0.049)	-0.121** (0.057)	-0.124** (0.061)	-0.139** (0.065)	-0.132* (0.068)	-0.124* (0.070)	-0.107 (0.072)	-0.107 (0.074)	-0.110 (0.076)	-0.117 (0.077)	-0.092 (0.078)	-0.095 (0.080)	-0.090 (0.081)	-0.085 (0.083)	-0.083 (0.084)
Control mean	0.387	0.631	0.854	1.011	1.121	1.248	1.331	1.396	1.442	1.495	1.540	1.588	1.637	1.675	1.725	1.761
Capital gains tax	0.010 (0.030)	0.031 (0.040)	0.010 (0.046)	-0.029 (0.052)	-0.058 (0.055)	-0.067 (0.060)	-0.033 (0.065)	-0.062 (0.068)	-0.081 (0.070)	-0.054 (0.073)	-0.056 (0.075)	-0.081 (0.077)	-0.099 (0.079)	-0.090 (0.080)	-0.058 (0.083)	-0.073 (0.085)
Control mean	0.109	0.201	0.269	0.326	0.378	0.455	0.540	0.606	0.646	0.701	0.750	0.797	0.844	0.893	0.949	0.997
Self-employment income tax	-0.036* (0.021)	-0.028 (0.023)	-0.036 (0.024)	-0.025 (0.024)	-0.039 (0.026)	-0.035 (0.027)	-0.037 (0.029)	-0.025 (0.029)	-0.013 (0.030)	-0.017 (0.031)	-0.022 (0.032)	-0.018 (0.033)	-0.009 (0.035)	-0.008 (0.035)	-0.006 (0.036)	-0.006 (0.037)
Control mean	0.162	0.218	0.250	0.270	0.287	0.307	0.323	0.337	0.353	0.364	0.379	0.392	0.407	0.413	0.423	0.430
<i>Panel B: Likelihood of paying taxes between Oct 18 and month X</i>																
Rental income tax	-0.009 (0.006)	-0.014* (0.007)	-0.016** (0.008)	-0.018** (0.008)	-0.020** (0.009)	-0.020** (0.009)	-0.018* (0.009)	-0.014 (0.010)	-0.014 (0.010)	-0.014 (0.010)	-0.015 (0.010)	-0.012 (0.010)	-0.012 (0.010)	-0.011 (0.010)	-0.010 (0.010)	-0.010 (0.010)
Control mean	0.060	0.094	0.121	0.140	0.153	0.167	0.176	0.183	0.187	0.192	0.196	0.201	0.206	0.210	0.214	0.217
Capital gains tax	0.001 (0.003)	0.003 (0.004)	0.000 (0.005)	-0.004 (0.006)	-0.007 (0.006)	-0.008 (0.007)	-0.005 (0.007)	-0.008 (0.007)	-0.010 (0.008)	-0.007 (0.008)	-0.006 (0.008)	-0.008 (0.008)	-0.010 (0.008)	-0.010 (0.009)	-0.007 (0.009)	-0.008 (0.009)
Control mean	0.013	0.023	0.030	0.037	0.042	0.051	0.060	0.067	0.071	0.077	0.082	0.087	0.092	0.097	0.103	0.108
Self-employment income tax	-0.004 (0.003)	-0.003 (0.003)	-0.004 (0.003)	-0.003 (0.003)	-0.005 (0.003)	-0.004 (0.004)	-0.005 (0.004)	-0.003 (0.004)	-0.002 (0.004)	-0.002 (0.004)	-0.003 (0.004)	-0.002 (0.004)	-0.001 (0.004)	-0.001 (0.004)	-0.001 (0.004)	-0.001 (0.004)
Control mean	0.024	0.030	0.033	0.035	0.036	0.038	0.040	0.041	0.043	0.044	0.046	0.047	0.048	0.049	0.050	0.050

Notes: Robust standard errors in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. We report the marginal effects implied by 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 which is comprised by: 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 initial value of the dependent variable between Jan 18 and Sept 18, that is, before the intervention.

B Survey Appendix

We carried out our experiment on a sample of property owners which 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 are our results. Throughout the paper 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 conducted a survey to a random sub-sample of 867 taxpayers that were included in the control group and each of the treatment arms of the study. We successfully surveyed 211, 197, 218 and 241 individuals of the control group, the “deterrence” 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 services supplied by different governmental instances and several other characteristics. Even though we would be interested in testing if treatment letters caused an impact 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 presence in more than 60 countries investigating 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 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.1.³³ 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 seem to be alike, however taxpayers in our sample tend to be more give more trust toward 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 may be consistent with the fact the individuals in our sample live in the richest districts which in 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 is referred 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 seem to be leaning 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 extrapolate our results to other contexts, it would be helpful to first take into account 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 on this.

³³Since in this section we want to characterize our sample in absence of any treatment, we focus on the control group to prevent any contamination from the treatment letters as they could in principle have had an impact on some of the variables collected in the survey. Nonetheless, results are very similar if we focus on the overall sample.

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%)