Anti-Tax Evasion, Anti-Corruption and Public Good Provision: An Experimental Analysis of Policy Spillovers

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Abstract

Our framed laboratory experiment analyses the causal relationship between corruption and tax evasion and explores whether deterring one may have desirable spill over effects on the other. We find that the possibility of corruption causally increases tax evasion. The data offers weak evidence that tax evasion leads to more corruption. Introducing a policy to detect and punish public officials who embezzle from tax revenues significantly reduces tax evasion on the part of citizens. However, auditing and punishing tax evading citizens do not deter embezzlement on the part of public officials. Public good provision increases in all deterrence treatments compared to a baseline, with a "Big bang" treatment in which both tax evasion and corruption are detectable and punishable being the most effective. A standalone anti-corruption monitoring and punishment strategy is the next most effective policy followed by tax auditing. Thus, faced with two "evils" regarding public good provision, allocating more resource to fighting corruption may be the better policy response.

Keywords: Corruption, Tax Evasion, Deterrence, Public Good, Lab Experiment.

JEL codes : C92, D73, H26, H41, H83.

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1. Introduction

Developing countries typically have a low tax to GDP ratio, driven primarily by their limited ability to collect direct taxes (Auriol and Warlters, 2005). For instance, according to the Government Revenue Dataset, direct taxation is about 4% of GDP in South Asia and 6% in Sub-Saharan Africa, markedly lower than the corresponding number of 13% in the OECD countries.[1] This is not surprising given the extent of informal economic activity in developing economies and the resulting narrow tax bases. From 2010-2015, the shadow economy, as a share of GDP, was estimated at 36% on average in sub-Saharan Africa, 28% in South Asia, and 15% in the OECD (Medina and Schneider, 2018). In such a context, a better understanding of the potential determinants of voluntary tax compliance can be instrumental for increasing domestic revenue mobilization and reducing tax collection costs for authorities. This paper studies one such determinant suggested by existing theoretical and observational research: corruption, specifically embezzlement.

Fiscal exchange theory suggests that tax compliance is higher when citizens are offered valuable public goods (such as representation, public services, infrastructure etc.) in exchange for their tax payments (see, for example, Buchanan, 1976; Alm, et al., 1993; Moore, 2008; Barone and Mocetti, 2011). Corruption, particularly embezzlement, defined as the use of public funds by government officials for private gain, is detrimental to the provision, quality, and efficacy of public goods (e.g. Del Monte and Papagni, 2001; Gillanders, 2014; Beekman et al., 2014).One might thus expect corruption to undermine tax compliance under the fiscal exchange framework.

The existing literature that seeks to understand the existence and direction of causality between corruption and tax evasion is primarily based on observational data drawn from surveys of firms and individuals. While several studies have documented a link between corruption perceptions and tax morale using both survey and cross-country data (Torgler, 2005; Frey and Torgler, 2007; Konrad and Qari, 2012; Ali et al., 2014), it is hard to identify causality from these data. Both corruption and tax evasion are illegal and secretive activities that are very challenging to observe accurately in the field. In addition to these fundamental measurement issues, corruption can plausibly both facilitate tax evasion and result from a poorly managed tax system. Both corruption and tax evasion can also be driven by unobserved individual or national heterogeneity. In contrast, the experimental approach allows for the direct observation and measurement of the behaviours of interest and for the identification of causal relationships. Moreover, tax evasion and

[1] ICTD/UNU-WIDER (2019).

corruption lab experiments have been shown to have some external validity (Armantier and Boly, 2012; Alm et al., 2015) and reflect the moral cost of unethical behaviour (Banerjee, 2015, 2016).[2]

This paper aims to study three distinct but related research questions. First, we seek to establish a causal relationship between corruption and tax evasion. Our main research question relates to the effect of corruption on tax evasion, for which the fiscal exchange theory provides a strong theoretical basis. We further motivate our core hypotheses by drawing on literatures which have shown how the behaviour of others can influence decision making. For completeness, we also explore the possibility that tax evasion could have a causal effect on corruption. In contrast to corruption, the potential impact of tax evasion on embezzlement has been less explored in the existing research literature. Tax evasion can provide incentives for embezzlement through moral spillover effects where the unethical choices of an individual spill over to influence the behaviour of another. The existing literature points to the existence of such contagion or conformity effects in tax compliance (Fortin et al., 2007; Castro and Scartascini, 2015), lying (Innes and Mitra, 2013) and embezzlement (Boly et al., 2019). Second, we examine the potential for spillovers between anti-corruption and anti-tax evasion policies based on monitoring and punishment. In other words, we investigate if deterring corruption has a positive spillover effect on tax compliance and whether deterring tax evasion has a positive spillover effect on corruption. Third, we estimate the level of public good created under different deterrence policy regimes, with the view to rank their performances in terms of reducing inefficiencies in public good provision.

Our laboratory experiment was conducted in India. The design of the experiment comprises six treatments in total. In the Baseline treatment, subjects are divided into groups of three, where one is randomly assigned the role of a Public Official (PO, henceforth). The remaining two are assigned the role of a citizen. Citizens perform a real effort task and receive a taxable income based on their performance. The citizens can underreport their income and pay taxes only on the declared income. The tax revenue is transferred to the PO responsible for creating a public good to be equally enjoyed by both citizens. However, the PO can embezzle part of the tax revenue before the public good is created. After the corruption decision, the tax revenue is multiplied by a factor and equally divided between the citizens.[3] We refer to this treatment as

[2] See Mascagni (2018) and (Slemrod, 2019) for reviews of the use of field and laboratory experiments in the tax compliance literature. In particular, Mascagni (2018) notes that tax experiments are increasingly moving from the lab to the field taking advantage of the availability of administrative data from tax returns.

[3] Our design can be seen as a modified Trust Game. In a standard Trust game, any amount sent is tripled by the experimenter and given to the Receiver. The Receiver then decides whether to keep all the amount received, or to send some back to the Sender. In our experiment, it is the amount sent back by the Public Official that is multiplied. As a result, embezzlement (keeping some money) introduces inefficiency in the game. For similar but not identical approaches, see Boly and Gillanders (2018), Attanasi et al. (2019), Boly et al. (2019) and Cagala et al. (2019). The multiplication factor reflects consumers' surplus that individuals derive from government provision of a public good (see e.g. Alm, Jackson and McKee, 1993).

the "Evasion-Corruption" treatment, as both citizens and PO can choose to be unethical. Our design embeds a public good game within a tax evasion framework, where tax revenue creates a public good. Also, it introduces corruption as an important motive in addition to free-riding. These features allow us to compare the relative importance of corruption and free-riding in tax evasion.

We conduct five additional treatments. In the first, "Corruption-only", citizens' earnings are taxed automatically (i.e. there is no possibility of tax evasion) and transferred to the PO, who can embezzle part of the revenue before creating the public good. In the second treatment, "Evasion-only", citizens can evade tax, but public officials cannot embezzle.[4] We thus measure the effect of the possibility of corruption on tax evasion by comparing the amount of tax evaded in the "Evasion-only" treatment with the baseline "Evasion-corruption" treatment, which allows both evasion and corruption. Similarly, we identify the effect of tax evasion on corruption by comparing the amount embezzled in the "Corruption-only" treatment with that in the "Evasion-corruption" treatment. In three other treatments, we analyse the effects of deterrence on tax compliance and corruption when the target is i) tax evasion only ("Anti-evasion"), ii) corruption only, ("Anti-corruption") or iii) both tax evasion and corruption, ("Big bang").

We find that the possibility of corruption causally increases tax evasion and tax evasion leads to more corruption although the evidence for the latter effect is relatively weak. In line with previous studies (e.g. Slemrod et al., 2001), we show that deterrence of tax evasion has a significant and negative impact on the share of income evaded and the likelihood of evading taxes. Fighting corruption (or eliminating it) also has a significant and negative effect on the share of income evaded, suggesting spillover effects from anti-corruption to tax evasion behaviour. Likewise, fighting both tax evasion and corruption has a significant and negative impact on the share and likelihood of tax evasion. Monitoring and punishment that targets i) embezzlers or ii) both tax evaders and embezzlers significantly reduces corruption, as expected. However, penalizing tax evasion or eliminating it, a signal that unethical behaviour is not desirable, does not significantly impact corruption at conventional levels. As a result, the spillover effect of deterrence appears unidirectional: from anti-corruption to tax evasion, but not from anti-tax evasion to corruption.[5] Although there are differences in citizens' effort levels, our treatment comparisons of tax evasion outcomes are based

[4] The role of the PO in this treatment is to simply create the public good by clicking a button.

[5] The "Anti-evasion" and the "Evasion-only" treatments are not directly comparable. The former includes an anti-evasion policy and the possibility of corruption, while the latter features no penalty mechanism and precludes corruption. Likewise, the "Anti-corruption" includes an anti-corruption policy and the possibility of evasion, while the "Corruption-only" features no penalty mechanism and precludes tax evasion. As a result, "Evasion-only" and "Corruption-only" are not included in our analysis of the spillover effect of deterrence.

on the share of income evaded, which accounts for differences in income, and thus for differences in effort levels given that income is proportional to effort level.[6]

Finally, we look at the public good provision, which captures the combined effect of tax evasion and corruption, using "Evasion-Corruption" as the baseline. We find that all deterrence treatments increase public good provision compared to the baseline treatment. Our finding complements Cagala et al. (2019), who study the repeated interactions between contributors and rent-extracting administrators in public goods provision and find that the presence of a rent-extracting administrator affects the level and the dynamics of public goods provision. They show that rent-extraction and cooperation shocks trigger short-run adjustments in agents' behaviour, but that shocks do not have permanent effects. We add to this important finding by showing that while a potentially corrupt official may limit public good provision, deterrence policies can improve the situation. Interestingly, there appears to be a clear ranking in increasing public goods contributions. The Big bang approach is the most effective, followed by Anti-corruption, then Anti-evasion. Therefore, when confronted with the twin evils of corruption and tax evasion in the context of public goods provision, allocating more resources to fighting the former may be the better policy choice.

We make several contributions to the literature. First, we identify the causal impact of corruption on tax evasion. Given the endogeneity issues typically associated with cross-country data-driven approaches taken to address this question and the fundamental policy importance of the issue, we believe that this contribution should be of significant interest to policymakers and academics in this space. Second, to the best of our knowledge, our experiment is the first tax evasion game that explicitly embeds corruption, thereby allowing us to identify the corruption-related motive separately from the free-riding motive of tax evasion in a public good environment. Third, the rather extensive literature on deterrence, which rests on the Beckerian framework of crime and punishment (Becker, 1974), focuses entirely on the effect of domain-specific deterrence. Our paper contributes to this literature by extending the scope of deterrence and allowing for cross-domain effects, the policy relevance of which is hard to overstate.

The rest of the paper is organized as follows. Section 2 discusses additional channels through which embezzlement can influence tax behaviour and the possibility for interventions in one domain to influence outcomes in another. We present the experimental design in detail in Section 3 and our research hypotheses. Section 4 presents and discusses the main results, and we examine a potential mechanism in Section 5 before concluding in Section 6.

[6] Our results are robust to the inclusion of effort level in our tax evasion regression analysis. The coefficient of effort level is not significantly different from zero at conventional levels. Results available upon request.

2. Compliance, Deterrence and Spillovers

The deterrence approach to tax evasion argues that holding the benefits of tax-paying constant, tax compliance is a function of the probability of detection and the severity of the penalty (Allingham and Sandmo, 1972; Yitzhaki, 1974).[7] However, empirical and experimental evidence shows that taxpayers do not evade tax as much as a rational model would predict, given the relatively low levels of penalty and probability of detection (Graetz and Wilde, 1985; Alm et al., 1993; Alm et al., 1992; Frey and Torgler, 2007).[8]

The concept of tax morale has been advanced to help bridge this gap. Tax morale can be defined broadly as nonpecuniary factors (such as intrinsic motivation, fiscal exchange or reciprocity) that motivate voluntary tax compliance (Feld and Frey, 2007; Luttmer and Singhal, 2014). Voluntary tax compliance, in turn, consists in obeying the tax laws without being compelled by tax authorities to do so. Related to the tax morale line of thinking, the psychological tax contract strand sees the act of tax paying as a quasi-voluntary one (e.g. Feld and Frey, 2007).[9] This quasi-voluntary compliance is built on the assumption of a contractual relationship between the state and the citizens, wherein the latter is tax compliant if the political process is perceived to be fair and legitimate and public goods are supplied (fiscal exchange). As a result, government policy, tax authorities' behaviour, and state institutions can substantially influence tax compliance.

We also have significant experimental evidence that people are more willing to pay taxes when they have a voice and agency in how the revenues are used (Wahl et al., 2010; Djawadi and Fahr, 2013; Casal et al., 2016; Lamberton et al., 2018; Abbiati et al., 2020). If people pay taxes, in part because they care about the welfare tax revenue can buy, an unwillingness to pay taxes can result from a perception that the tax revenue will not be well used, and the promised services will not be delivered (Besley and Persson, 2014). Consequently, citizens may evade taxes more when there is a possibility that tax revenue will be embezzled and misused and their preferences ignored.

However, corruption may be only a pretext to justify pre-existing tax-avoidance behaviour or preferences, given that taxes are costs that citizens would prefer not to pay in the first place (see, e.g. Slemrod, 2007). For example, in the context of voluntary pro-social behaviour, uncertainty and ambiguity surrounding a potential charitable donation have been shown to serve as an excuse not to contribute (Exley, 2016; Garcia et al., 2020). Fighting corruption could thus facilitate compliance by removing the "excuse" that the funds will only be misused.

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[7] For a review, see Sandmo (2005).

[8] Andreoni et al.(1998) note that although the statutory penalties for tax evasion can in some cases be quite severe, penalties are in fact quite infrequently imposed.

[9] See Musgrave (1939) or Christian (1978) for earlier discussions of the psychological tax contract thesis.

Several studies move further from the standard deterrence model and show that tax compliance depends on the behaviour of others in society (e.g. Myles and Naylor, 1996; Fortin et al., 2007; Castro and Scartascini, 2015). Similarly, while audit risk and strategy influence corporate tax evasion and avoidance behaviours (DeBacker et al., 2015), social capital and norms are also important (Hasan et al., 2017; Kanagaretnam et al., 2018). Corruption is generally regarded as an immoral act that trades off personal gain for social cost and is corrosive of social capital (e.g. Banerjee, 2016). This further suggests that observed or assumed corruption can undermine compliance with tax requirements.

Kirchler et al. (2008) combine the deterrence and psychological tax contract models into the "slippery slope" framework, which differentiates between voluntary and enforced compliances. In this framework, trust in authorities increases voluntary compliance, whereas the power of tax authorities to enforce tax payments determines enforced compliance. The power of authorities refers to taxpayers' perception of tax officers' capacity to detect and punish tax evasion, while trust in authorities relies on citizens' general belief that the tax authorities are benevolent and dedicated to public welfare.

The literature points to the potential for corruption, particularly embezzlement, to foster tax evasion by undermining fiscal exchange and trust in authorities. Indeed, there is evidence that large fractions of government budgets are diverted by public officials for their private use, thereby breaking the psychological tax contract. For example, Reinikka and Svensson (2004) found that schools in Uganda, on average, received only 13 percent of the allocated government grants. Likewise, only 1 percent of non-salary expenditures allocated to primary health clinics in Chad reached the clinics (Gauthier and Wane, 2009).

In terms of corruption, the standard Beckerian approach also suggests that monitoring and punishment can be effective at curbing corruption, and this is validated by experimental studies (Abbink et al., 2002; Serra, 2012; Armantier and Boly, 2011, 2013) as well as empirical ones (Olken, 2007; Di Tella and Schargrodsky, 2003; Fisman and Miguel, 2007).

These large sets of literature investigate the direct effects of deterrence on corruption or tax evasion separately. However, it is plausible that deterring one kind of unethical activity through audit and penalty may have an indirect spill over effect on the other form of unethical behaviour. The studies cited above that pointed to the behaviour of others in different domains and the behaviour of the state and its agents as drivers of compliance point to a possibility of cross-domain effects of efforts to signal that corruption is now more difficult to "get away with", or more generally that a form of unethical behaviour is undesirable. Moreover, a recent theoretical contribution from Anwar et al. (2020) allows for an equilibrium in which severely punishing embezzlement can lead citizens to pay their taxes as they, therefore, expect an efficient level of public goods provision. A distinctive feature of our experiment is that it allows us to empirically

examine the potential for cross-domain effects of deterring corruption on tax evasion and of deterring tax evasion on corruption.[10] This innovation is a key contribution of our study

3. Experimental design

The sections below discuss our experimental design and the research hypotheses that can be tested using our experimental treatments. We also present the details of our subject pool.

3.1. Treatments

An overview of the experimental design is presented in Appendix 1. In the baseline treatment of our framed laboratory experiment, we model both tax evasion and corruption, two factors that can affect public good provision. Subjects in a session are randomly divided into groups of three in each round. One of them is randomly assigned the role of a Public Official (PO), and the two others are assigned the role of citizens. The roles remain the same throughout the experiment. Citizens perform a real effort task and receive an income based on their performance. The task involves counting the number of zeros from a sequence of zeroes and ones (Abeler et al., 2011). Task-based earning is expected to instil a sense of entitlement which may lead subjects to treat the tax as something they are paying out of an earned income, making the decision environment closer to the real world. A citizen earns 100 units of our experimental currency, called Mohars (meaning gold coins in ancient India; M, henceforth) for every correctly solved sequence. POs were paid a flat salary of 2000M.

The earned income is taxed at 40%, but citizens can choose not to declare their entire income (see Alm et al., 1992). Whether the reported income is different from the earned income is private information for a citizen. The total taxes collected from reported incomes give the gross tax revenue. The gross tax revenue is then transferred to the PO, who can decide whether to embezzle part of it. The remainder, the net tax revenue, is multiplied by a factor of 1.6 and shared equally between the two citizens, thereby creating a public good. Note that the PO does not benefit from the public good created.[11]

[10] For a review of literature on the experimental analysis of public good provision see Ledyard (1995) and Chaudhuri (2011).

[11] Situations where a public official does not benefit explicitly from the public goods created are quite common. For example, consider a public official based in a capital city and managing the construction of a school or health centre in a remote village. The public official will not benefit from such a publicly funded good because her children will not attend such a school, or she would never go such a health centre. The same reasoning can be applied to roads or energy projects. Of course, there are also instances where a public official could benefit from publicly funded schools, health centres, roads, if these are in her neighbourhood. Even so, it may be that the public official will send her children to private schools or visit private clinics, instead of publicly funded ones.

The design described above constitutes our baseline "Evasion-Corruption" treatment. In this treatment, unethical behaviour can come from the citizens' tax evasion or the POs' corruption. Tax evasion can thus be motivated by standard free-riding (given that two citizens can pay taxes) and/or by corruption (due to embezzlement by the PO). The existence of these two motives for tax evasion constitutes a distinctive aspect of our experimental design.

Additional treatments were designed to answer the research questions laid out above and discussed in further detail in Section 3.2 below. In the "Evasion-only" treatment, POs cannot embezzle from the tax revenue. Their task only consists in creating the public good by clicking on a button. While the "Evasion-only" treatment removes the corruption motive for tax evasion, it does not prevent free-riding. To assess the impact of free-riding on tax evasion, it is enough to see that the amount evaded in "Evasion-only" is positive and significantly different from zero. Comparing the tax evasion behaviour in "Evasion-only" and "Evasion-corruption" allows us to identify whether citizens underreport their income more when corrupt POs may siphon off part of the tax revenue. This allows us to identify the impact of corruption on tax evasion, holding the free-riding motive constant. In "Corruption-only", citizens cannot evade taxes. Their earnings are automatically taxed at the rate of 40%, and the tax revenue is transferred to the PO, who can then choose to embezzle part of it.

There are three additional treatments looking at the impact of monitoring and punishment on i) tax evasion, ii) corruption and iii) both tax evasion and corruption. The "Anti-evasion" treatment introduces an audit mechanism for tax evasion with a 20% chance of detection and a penalty of 150% of the tax evaded."Anti-corruption" presents an identical audit mechanism for corruption with a 20% chance of detection and a penalty of 150% of the amount embezzled. [12] The effect of "Anti-evasion" on the amount of tax evaded by citizens is a simple test of Allingham and Sandmo (1972).

The experiment was programmed in zTree (Fischbacher, 2007). To recruit subjects, announcements were circulated through emails and put on information boards near classroom clusters at a large private university in Bangalore, India. Undergraduate and postgraduate students who reached out were randomized into different sessions that lasted between 1 hour and 1 hour 30 minutes. In addition to the data on tax evasion and corruption, we collected data on risk preference, beliefs about others' cheating behaviours, demographics, socioeconomic status, and attitudes to and experiences of corruption.[13]

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[12] The maximum possible penalty for a citizen would correspond to 60% of the earnings (150%×40% of tax evaded). So, by design, a citizen cannot go into "debt". For a PO to go into "debt", he/she would need to embezzle more than 4000M of collected tax revenue, given the initial endowment of 2000M and noting that the "net" penalty incurred is 50% of the amount embezzled. As the maximum tax revenue collected in the relevant treatments (Anti-corruption and Big bang) was 1960M, no PO faced a situation where he/she could possibly go into "debt".

[13] A citizen is asked about her belief about how much the other citizen evades and the public official embezzles before she goes on to make her own evasion decision. This strategy may frame citizens to think about the percentage

Payoffs are converted into Rupee at the end of the experiment at a rate of 1 Mohor = Rs. 0.10. Each session consisted of 6 rounds of the tax evasion – corruption game and one round of risk elicitation (Holt and Laury, 2002). In each round, new triads are randomly formed by matching one PO and two citizens. Citizens were not informed about the choice made by the PO for the first three rounds, but for the final three rounds, he/she observed how much the PO embezzled at the end of the round. At the end of the experiment, one round was chosen at random from the first six rounds to calculate a subject's earnings for this experiment in addition to her earnings from the risk round. In addition to their earnings, Rs. 50 was paid as a participation fee**.**

3.2. Research hypotheses

Below, we formulate our research hypotheses and indicate how they can be tested using our experimental treatments:

Hypothesis 1: *Tax evasion increases with the presence of corruption. Consequently, the amount of tax evaded in the "Evasion-corruption" treatment should be greater than that in the "Evasion-only" treatment, where corruption is impossible.*

In "Evasion-only", the PO cannot embezzle any funds, while the citizens can evade tax without monitoring and punishment. A comparison of the amount evaded in the Evasion-only treatment and Evasion-corruption treatment allows us to test whether tax evasion by citizens increases with the presence of corruption. This hypothesis is based on the fiscal exchange theory, which suggests that tax compliance is higher when citizens are offered valuable public goods, and on the literature that suggests corruption can act as an "excuse" not to pay tax. As corruption, particularly embezzlement, is detrimental to the provision of public goods, we expect tax evasion to increase when corruption is possible.

Hypothesis 2A: *Tax evasion decreases with monitoring and punishment of tax evasion. The share of income evaded will thus be lower in the "Anti-evasion" treatment than in the "Evasion-Corruption" treatment.*

The effect of "Anti-evasion" on the amount evaded is a straightforward test of the Beckerian framework applied to tax evasion. Deterrence has been found to increase tax compliance (see Alm, Jackson, and McKee, 1992; Alm, McClelland, and Schulze, 1992; Malézieux, 2018; Alm and Malézieux, 2021), and this is our expected result, even in the presence of corruption. However, it is also possible that the asymmetric

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embezzled more than she would naturally do. However, such effect of the order of questions, if any, is unlikely to affect treatment comparisons. The Evasion-Corruption and the audit treatments have the same order of questions. In the Evasion-only treatment too belief about the other citizen's evasion behaviour is elicited, thus generally nudging citizens to think about the strategies of others.

treatment of unethical, or at least socially undesirable, behaviour could lead to negative reciprocity whereby taxpayers evade more (because they are punished and embezzlers are not, or because intrinsic motivation is crowded out by deterrence), rendering detection and punishment ineffective (see, e.g. Fehr and Falk 2002; Falk and Kosfeld 2006).

Hypothesis 2B: *Tax evasion decreases with monitoring and punishment of corruption. The share of income evaded will be lower in the "Anti-corruption" treatment than in the "Evasion-Corruption" treatment.*

This would correspond to a spill-over effect from the "corruption" domain to the "tax evasion" domain. Hypothesis 2B is a corollary of Hypothesis 1. If corruption has a negative impact on tax compliance, deterring corruption should improve public good provision and lead to higher tax compliance. In other words, a citizen is more likely to pay the tax if she thinks the tax money is less likely to be stolen by corrupt POs. In addition, an anti-corruption policy may trigger pro-social norms for citizens. For these reasons, it is plausible that the effect of "Anti-Corruption" on tax evasion may turn out to be negative. The possibility of this policy spillover is an interesting and novel aspect of this paper.

Hypothesis 3: *Corruption decreases in the absence of tax evasion. The share of income embezzled will be lower in the "Corruption-only" treatment than in the "Evasion-corruption" treatment.*

As indicated earlier, the potential impact of tax evasion on corruption has not been explored to the same extent as the effect of corruption on tax compliance to the best of our knowledge. While we lack the formal theoretical framework and suggestive observational evidence that we drew on in the case of coruption, we conjuncture that the presence of tax evasion in the "Evasion-corruption" treatment can provide additional incentives for embezzlement compared to "Corruption-only." Contagion or conformity effects could see public officials react to the possibility of unethical behaviour by tax-evading citizens by acting unethically themselves.[14] As a result, the share of income embezzled would be lower in the "Corruption-only" treatment than in the "Evasion-corruption" treatment.

Hypothesis 4A: *Corruption decreases in the presence of monitoring and punishment. The share of income embezzled will thus be lower in the "Anti-corruption" treatment than in the "Evasion-corruption" treatment.*

The effect of "Anti-corruption" on the amount embezzled is also a straightforward test of the Beckerian framework, in this case as applied to corruption. Deterrence has been found to decrease corruption (see, e.g. Abbink et al., 2002; Armantier and Boly, 2011, 2012; Boly et al., 2019), and we expect a similar result in our comparison of the "Anti-corruption" and the "Evasion-corruption" treatments.

[14] See Fortin et al. (2007) and Castro and Scartascini (2015) for taxation; and Boly et al. (2019) for embezzlement.

Hypothesis 4B: *Corruption decreases with monitoring and punishment of tax evasion. The share of income embezzled will be lower in the "Anti-evasion" treatment than in the "Evasion-corruption" treatment.*

This would correspond to a spillover effect from the "tax evasion" domain to the "corruption" domain. This hypothesis 4B relates to Hypothesis 3. Here as well, we conjuncture that the presence of tax evasion in the "Evasion-corruption" treatment can provide additional incentives for embezzlement due to contagion or conformity effects whereby public officials react to the possibility of unethical behaviour by tax-evading citizens by acting unethically themselves. However, penalizing tax evasion in the "Anti-evasion" treatment could send a signal that tax evasion is not socially desirable behaviour. Such a negative signal can spillover to embezzlement, resulting in the share of income embezzled being lower in the "Anti-evasion" treatment than in the "Evasion-corruption" treatment. We believe this is an interesting empirical investigation of a potential policy spillover, where tightening up the screws around tax evasion leads to a decrease in corruption. It also complements our main investigation of a spillover effect from anti-corruption to tax evasion.

Hypothesis 5: *The "Big Bang" treatment combines the "Anti-evasion" and "Anti-corruption" treatments. As a result, both tax evasion and corruption in the "Big Bang" should be lower than in "Evasion-Corruption".*

The "big bang" approach to transition, often opposed to a gradual approach, seeks to implement rapid and comprehensive reforms simultaneously with the view to establishing a "new normal" (see, e.g. Rothstein, 2011; Rothstein and Teorell, 2015; Roland 2002 for a review). Relative to a "big bang" approach, a possible disadvantage of the gradual approach relates to the loss of complementarity between reforms (Roland, 2002, p. 33). In our "Big bang" treatment, we implement audit and punishment for tax evasion and corruption simultaneously. We expect both tax evasion and corruption in the "Big Bang" to be lower than in "Evasion-Corruption", in line with the Beckerian framework. In addition, we seek to explore whether in the "Big Bang" i) tax evasion will be lower compared to the "Anti-evasion" and ii) and corruption will be lower compared to "Anti-corruption", thereby suggesting complementary between tax evasion and corruption deterring mechanisms. Such an effect would be absent in "Anti-evasion" and "Anti-corruption".

Hypotheses 1, 2A and 2B relate to tax evasion; hypotheses 3, 4A and 4B to corruption; and hypothesis 5 to both tax evasion and corruption. In Appendix 1, we provide a theoretical framework to analyse the relationship between corruption and tax evasion by extending the standard model of tax compliance to include corruption and public goods.

3.3. Subject pool

Table 1 presents summary statistics regarding the basic demographic characteristics (age and gender) of our subject pool and the number of observations by treatment. A total of 418 subjects participated in the six

experimental treatments: 52 subjects in the "Evasion-only" treatment; 72 in "Corruption-only"; 72 in "Evasion-Corruption"; 72 in "Anti-evasion"; 78 in "Anti-corruption"; and 72 in "Big bang".[15] The experimental instructions included multiple examples and quizzes and a trial application to aid comprehension.[16]

The participants' average age ranges from 18.6 in the Evasion-only treatment to 20.92 in the Evasion-Corruption treatment, while the percentage of female participants ranges from 44% in the Anti-evasion treatment to 73% in the Evasion-only treatment. Thus the Evasion-only treatment has, on average, the youngest subjects and the highest share of females. Using the Kruskal-Wallis test, we find significant differences across the treatments in terms of age and gender composition (see Table 1).

[Table 1 about here]

For age, a pair-wise comparison using Dunn's test suggests a difference between Evasion-only and all other treatments, between Corruption-only on the one hand and Evasion-Corruption and Anti-evasion on the other hand.[17] For females, a pair-wise comparison indicates a significant difference between Evasion-only and all other treatments except Corruption-only. Given these differences across treatments in terms of demographic characteristics, we control for the effect of gender in our regression analysis.

4. Results

In this section, we present the results of our analysis. "Evasion-Corruption" serves as the baseline treatment in most cases, and we compare the other treatments with it to examine treatment effects on citizens' effort levels and tax evasion decisions, POs' corruption choices, and the level of public good provision. We do so using regression analyses in which we control for gender, age, and a dummy variable, capturing the feedback mechanism that was in place for rounds 4-6. We also include round fixed effects and cluster the standard errors at the subject level.

[15] In the "Evasion-only" treatment, there were two sessions with 24 citizens per session (48 in total) and 2 POs per session (4 in total), given their limited role of the latter and in order to maintain comparability with other treatments with regards to the presence of PO while saving costs. The "Big Bang" treatment was also conducted in 2 sessions, while all other treatments were conducted in 3 sessions.

[16] See Appendix 2, which provides experimental instructions related to the "Big bang" treatment.

[17] Results are available upon request.

4.1. Effort and tax evasion by Citizens

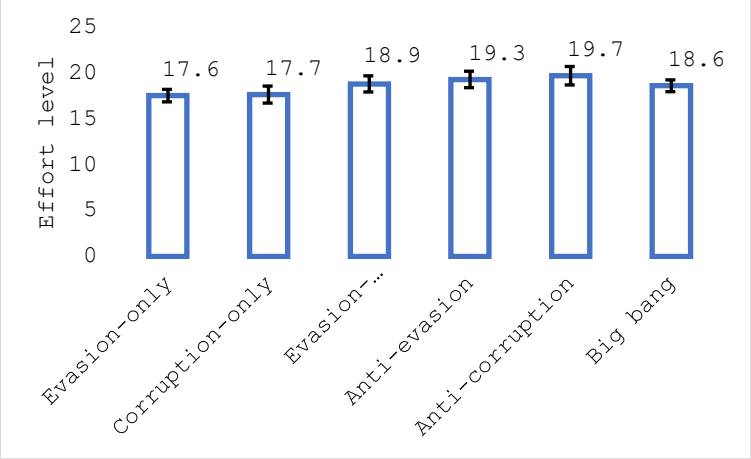
In this section, we analyze two variables: the real effort level of citizens, which determines their earnings (and therefore the taxable base) and the share of income evaded.

4.1.1.Effort level

We begin by considering the possibility that corruption can decrease the effort provided by the citizens, thereby affecting the taxable base itself. Figure 1 plots the number of arrays completed in the real effort task across the treatments. The baseline treatment in this section is "Evasion-only", which depicts an environment free of corruption but with the possibility of tax evasion. "Evasion-only" is compared to the other treatments with both tax evasion and corruption (given that our baseline includes tax evasion).[18]

There can be different channels through which corruption could affect effort in an environment without tax evasion. For instance, a subject may be discouraged from putting in effort in a corrupt environment, or she may increase effort to compensate for the earnings she anticipates losing to corruption. If the standard income effect dominates psychological effects such as discouragement, we would expect subjects to put in more effort. In the presence of tax evasion, however, these effects could disappear given that a citizen would be able to keep her payoff through evasion.

Figure 1: Comparison of scores in the real effort task, by treatment



Note: *Error bars show a 95% Confidence Interval.*

[18] Corruption-only treatment is excluded as there is no tax evasion by design.

Our OLS results are shown in Table 2. In the regression without controls (Column 1), the effort level is significantly lower in the baseline "Evasion-only" treatment, compared to the other four treatments ("Anti-evasion" and "Anti-corruption" at the 1% level; "Evasion-corruption" and the "Big bang" at the 5% level). With controls in Column 2, the effort level is significantly lower in "Evasion-only" compared to "Anti-evasion" at the 5% level and to "Anti-corruption" at the 1% level, but not significantly different from the effort level in "Evasion-corruption" and the "Big bang". The results in Column 2 suggest that subjects increase their effort level relative to a situation with no corruption in the "Evasion-only" baseline treatment, either to cover potential loss due to corruption when tax evasion becomes riskier in "Anti-evasion" or because of expected lower corruption when corruption becomes riskier in "Anti-corruption". Overall, corruption does not reduce the taxable base itself in our experimental framework, although this result is conditional on the presence of tax evasion. More research is needed on whether corruption can affect the taxable base itself, including in an environment without tax evasion.[19]

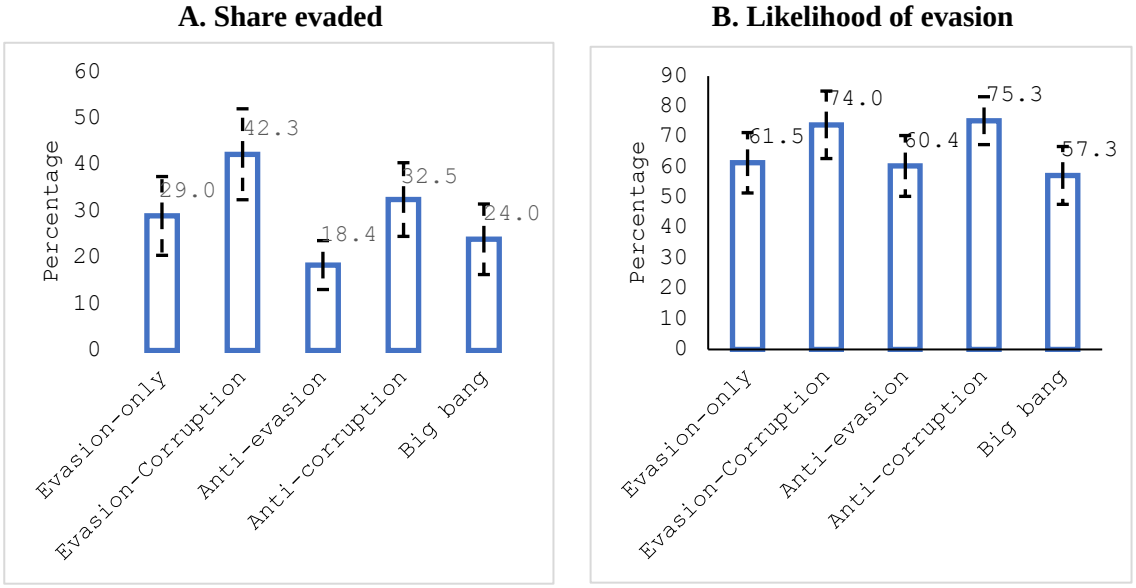
[Table 2 about here]

4.1.2. Tax evasion

In this section, we analyze the extent of tax evasion by citizens. Given that citizens could have different levels of earnings from the real effort task, our dependent variable is the share of earned income evaded. We also examine the likelihood of evasion. The baseline treatment here is "Evasion-Corruption".

[19] Such additional research would add to the literature on the interaction between effort level and factors such as corruption or taxation. For the interaction between effort and taxation, see e.g. Doerrenberg and Duncan, 2014; Kessler and Norton, 2016; Rick, et al., 2018).

Figure 2: Average share of income evaded and the likelihood of evasion by treatment



Note: *We first average by subject, then by treatment. Error bars show a 95% Confidence Interval. Share evaded and the likelihood of evasion are zero in the Corruption-only treatment by design, explaining the absence of this treatment in Figure 2.*

Figure 2.A plots the average share of income evaded by treatment, while Figure 2.B plots the average likelihood of evasion by treatment. The average share evaded is highest in the "Evasion-Corruption" treatment at 42.3% and lowest in the "Anti-evasion" and "Big bang" treatments, at 18.4% and 24%, respectively. Likewise, the likelihood of evasion is highest in the "Evasion-Corruption" treatment at 74% and lowest in the "Anti-evasion" and "Big bang" treatments, at 60.4% and 57.3%, respectively.

Table 3 reports the regression results. When examining the share of income evaded, we estimate fractional response models, which takes into account the fact that the dependent variable is bounded between 0 and 1.[20] "Evasion-Corruption" is used as the baseline, and all other treatments are compared to it using dummies. The standard errors are clustered at the individual level, and period fixed effects are included.

Column (1) reports the results without controls, and Column (2) includes controls such as gender and age of subjects.[21] The share of under-reported income is significantly lower in the "Evasion-only" treatment relative to the baseline, at the 5% level in Column 1 (without controls) and at the 1% level in Column 2 (with controls). Thus, subjects evade less in the absence of corruption, consistent with *Hypothesis 1*. A

[20] For our purpose, we use the *fracreg* command in Stata. For details, see Papke and Wooldridge's (1996, 2008) seminal papers on fractional response model estimation. OLS gives similar results which are available upon request.
[21] Controlling for history of play (e.g. payoff in the previous round or payoff in relation to tax paid in the previous) does not change the results, which are available upon request. The related coefficients are not statistically significant at conventional levels.

back-of-the-envelope calculation suggests that the free-riding motive, which is the only motive present in "Evasion-only", could account for 68.5% of tax evasion in "Evasion-corruption", while the presence of corruption accounts for only 31.5%.[22] In other words, while corruption does explain part of the observed tax evasion behavior as predicted by *Hypothesis 1*, a majority of citizens (68.5%) in the "Evasion-corruption" treatment could be using the public official's embezzlement as an excuse for tax evasion. Similar excuse-driven behaviour has been found in the context of charity giving (Exley, 2016; Garcia et al., 2020).

An anti-evasion policy ("Anti-Evasion" treatment) has a significant and negative impact on the share of income evaded, compared with the Evasion-Corruption treatment, at the 1% level in both Columns 1 and 2. This is consistent with *Hypothesis 2A,* that monitoring and punishment decrease tax evasion.

We find that "Anti-corruption" has a significant and negative impact on the share of income evaded at the 5% level only in Column 2, where demographic controls are included. This result suggests cross-domain effects of the penalty from corruption to tax evasion, in line with *Hypothesis 2B*. This result is potentially driven by lower expected corruption due to deterrence, which provides an incentive to evade less tax in order to benefit from the greater provision of the public good. Our paper is, to the best of our knowledge, the first to show evidence of such a cross-domain effect of deterrence between tax evasion and corruption.

[Table 3 about here]

A penalty on both tax evasion and corruption has a significant and negative impact on the share of income evaded, at the 1% level in columns 1 and 2 (see Table 3), consistent with *Hypothesis 5*. The effect of "Anti-evasion" is significantly higher than that of "Anti-corruption" at the 1 percent level (χ^2 test, p-value= 0.0086), but not significantly different compared to "Evasion-only" or "Big bang." This could suggest that anti-evasion deterrence is the main driver of the effect on tax evasion observed in the "Big bang" treatment and that anti-evasion and anti-corruption are not reinforcing each other in a significant way.

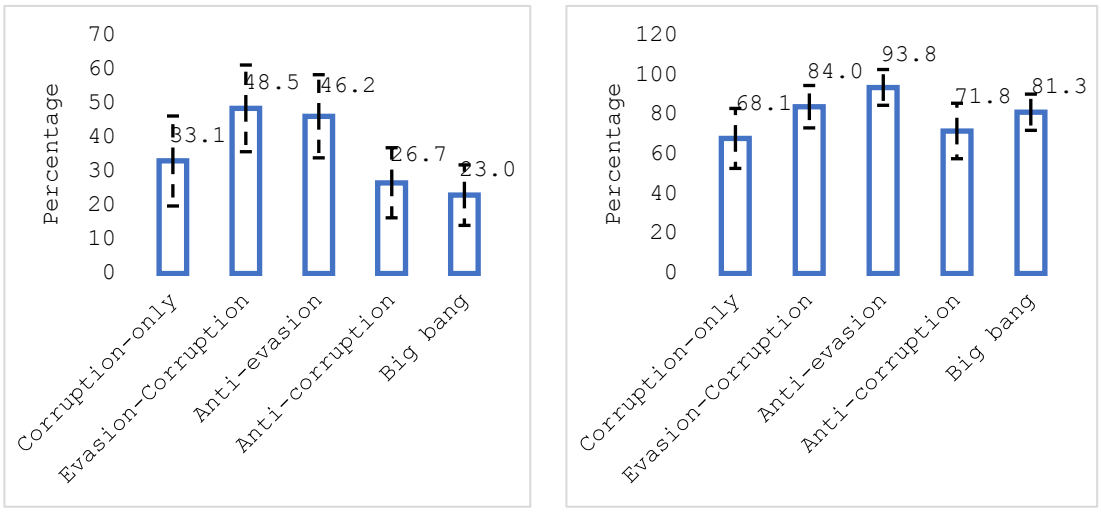
In the remaining columns of Table 3, we estimate probit models where the dependent variable takes a value of one if the citizen elected to evade any tax and zero otherwise. In Column 3, where we omit controls, we find that the "Big bang" decreased the likelihood of tax evasion significantly, at the 5% level. However, Column 4 includes the controls and suggests that both "Evasion-only" and "Big bang" decreased the likelihood of tax evasion significantly, at the 5% level. Fighting tax evasion in "Anti-evasion" or fighting

[22] The percentage of 68.5% is obtained by dividing the share evaded in the Evasion-only (29%) treatment in which free-riding was the only motive by the share evaded in the Evasion-corruption (42.3%) where there both free-riding and corruption are motives.

corruption in "Anti-corruption" has no significant impact on the likelihood of evasion, although Column 2 does find that deterrence of tax evasion or corruption decreases the share of income evaded.

Figure 3: Average share of income embezzled and the likelihood of embezzlement by treatment

A. Share embezzled **B. Likelihood of embezzlement**



Note: *We first average by subject, then by treatment.*

Error bars show a 95% Confidence Interval.

Share embezzled and the likelihood of corruption are zero in the Evasion-only treatment by design.

4.2. Corruption by Public Officials

This section analyzes corruption behaviour by POs – specifically the share of tax revenues embezzled (to account for differences in amounts of tax revenues sent to the POs) and the likelihood of corruption. Although we are primarily interested in the behavior of citizens, analyzing the behavior of Public Officials provides a complete view of the relationship between corruption and tax evasion in our context.

Figure 3.A presents the average percentage of tax revenue embezzled in each treatment, while Figure 3.B shows the average likelihood of embezzlement by treatment. The average share embezzled is highest in the baseline "Evasion-Corruption" treatment at 48.5% and lowest in the "Anti-corruption" and "Big bang" treatments at 26.7% and 23.0%, respectively. The likelihood of embezzlement was highest in the "Anti-evasion" treatment at 93%% and lowest in the "Corruption-only" treatment at 68.1%, compared to 84% in the baseline treatment. Interestingly, the average shares embezzled are significantly different from 100% in all treatments, suggesting that PO would typically refrain from embezzling tax revenues.

We again use a fractional response model to analyze the Share of tax revenue embezzled, which takes values between 0 and 1. "Evasion-Corruption" is also the baseline and all other treatments are compared to

it using dummies. The standard errors are clustered at the individual level, and period fixed effects are included.

Column 1 of Table 4 reports the results without controls while Column 2 controls for as gender and age of subjects. As shown in columns 1 and 2 of Table 4, eliminating tax evasion in the "Corruption-only" treatment has a negative but insignificant effect on corruption compared to the "Evasion-corruption" treatment in contrast to *Hypothesis 3*, which posited that corruption decreases in the absence of tax evasion.

[Table 4 about here]

As shown in columns 1 and 2 of Table 4, fighting corruption only in "Anti-corruption" has a significant and negative impact, at the 1% level, in line with *Hypothesis 4A* that corruption decreases in the presence of monitoring and punishment. Anti-evasion has no significant impact on the share of tax embezzled, suggesting the absence of crossover effects of penalty from anti-evasion domain to corruption, and in contrast to *Hypothesis 4B* that there could be a spillover effect from the "tax evasion" domain to the "corruption" domain. Fighting both tax evasion and corruption has a significant and negative impact on the share of income embezzled, at the 1% level, in line with *Hypothesis 5* that corruption in the "Big Bang" is expected to be lower than in "Evasion-Corruption".

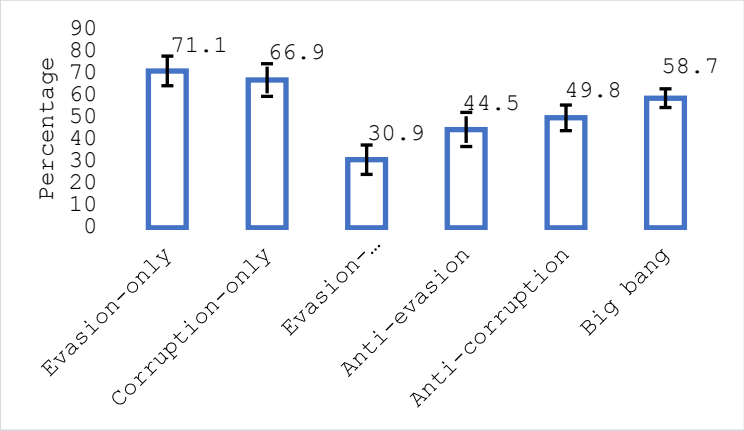
Relative to the baseline, none of the treatments has a significant effect on the likelihood of corruption (see column 3 and 4 of Table 4, without and with demographic controls, respectively), suggesting that deterrence policies only operate on the extent of corruption and not on the decision to act corruptly or honestly.

4.3. Public Good provision

This section looks at public good (PG) provision, which captures the combined effect of tax evasion and corruption. Figure 4 shows PG provision across treatments. For each period, the realized PG ratio is computed as the ratio of the PG created over the potential PG that could have been created if there was no tax evasion or corruption. It is worth noticing that tax evasion or corruption introduces inefficiencies in PG provision, as the realized ratio is significantly lower than 100% in all treatments and is at its lowest in the "Evasion-Corruption" treatment at 30.9%.

The baseline treatment here is "Evasion-Corruption", which depicts an environment in which both tax evasion and corruption are possible, and there is no mechanism to monitor and punish either type of behaviour. Using averages over the period, we find that all five treatments (totally removing tax evasion or corruption, or using deterrence) increase PG provision compared to the baseline treatment. "Evasion-only" and "Corruption-only" have the largest levels of realized PG at 71.1% and 66.9%, respectively. They are followed by the "Big bang" (58.7%), "Anti-corruption" (49.6%) and "Anti-evasion" (44.5%).

Figure 4: Realized public good ratios, by treatments



Note: *We first average by subject, then by treatment.*

Error bars show a 95% Confidence Interval.

The regression results in Table 5 show that all treatments significantly increase PG provision (see Column 1 without demographic controls and Column 2 with controls). When comparing coefficients, the regression results also provide an interesting ranking between deterrence treatments. Eliminating tax evasion or corruption can be considered first best - but this is clearly an unrealistic policy goal.

More interestingly, using results from Column 1 of Table 5 (without demographic controls), we find that the effect of the "Big bang" treatment is significantly higher compared to "Anti-evasion" at the 1% level (χ^2 test, p-value=0.000) and compared to "Anti-corruption" at the 1% level (χ^2 test, p-value= 0.006). Yet, the effect of "Anti-corruption" is not significantly higher than that of "Anti-evasion" (χ^2 test, p-value= 0.1190).

Column 2 of Table 5 includes demographic controls. We find that the effect of the "Big bang" treatment is significantly higher compared to "Anti-evasion" at the 1% level (χ^2 test, p-value=0.000) and compared to "Anti-corruption" at the 5% level (χ^2 test, p-value= 0.0388). In turn, the effect of "Anti-corruption" is significantly higher than that of "Anti-evasion" at the 5% level (χ^2 test, p-value= 0.0136). As a result, in terms of designing policy interventions to maximize PG provision, the Big bang approach appears the most effective, followed by Anti-corruption, then Anti-evasion. Therefore, in the hypothetical case where one has to fight one of two evils (corruption or tax evasion) to maximise PG provision, allocating more resources to fight corruption may be the better policy choice.

[Table 5 about here]

5. Discussion on the potential transmission mechanism

Our experimental treatments focus mainly on varying deterrence levels. The effects on the choice of a Citizen "i" of a variation in corruption by the PO or in tax evasion by a citizen "$-i$" are thus indirect and obtained through the effects of deterrence. In Table 6, we present results suggesting that a key transmission mechanism is through a change in subjects' beliefs about others' behaviours. The importance of beliefs in shaping human behaviour has been long recognized, particularly in situations of incomplete information where a player's payoff depends on his own action and the actions of others (see, e.g. Benabou and Tirole, 2016, for a discussion).

Compared to the "Evasion-Corruption" treatment, we find that a citizen evades less in "Anti-Corruption" when she thinks that the PO will embezzle less due to anti-corruption deterrence (see Table 6, Column 1 and 2), thereby decreasing the benefits from evasion. The belief by a citizen that the other citizen will evade less in the absence of corruption can also be seen in the negative and significant coefficient of the "Evasion-only" treatment in Column 4 of Table 6.

[Table 6 about here]

In the "Anti-evasion" treatment, citizens do not believe that corruption will be significantly lower compared to "Evasion-Corruption" (see Table 6, columns 1 and 2). However, they still have an incentive to evade less due to evasion deterrence and the belief that the other citizen will also evade less (see Table 6, columns 1 and 2). The citizens evade less in "Big-Bang" due to the tax evasion deterrence and to the belief that anti-corruption will lead the PO to embezzle less.

In the treatments "Anti-evasion", "Anti-corruption", and "Big-Bang", the PO believes that the citizens will evade less on average, compared to the "Evasion-Corruption" treatment (see Table 6, columns 5 and 6). A straightforward reason is the presence of evasion deterrence in "Anti-evasion" and "Big-Bang". For the "Anti-corruption" treatment, it can be a second-order belief as the PO thinks that the citizens think that he/she will embezzle less, so they evade less. But as suggested by Table 4, the PO does not really factor in beliefs by citizens in his decision making as only treatments with corruption deterrence (Anti-corruption and Big-Bang) results in lower corruption. This could explain the lack of spill over effects from tax evasion deterrence to corruption deterrence.

6. Conclusion

This paper aims to unpack the causal relationship observed between corruption and tax evasion by analysing the effect of anti-corruption policy on tax compliance and corruption, using a framed laboratory experiment conducted in India. Specifically, we analyse the effects of monitoring and punishment when the target is i) tax evasion only, ii) corruption only, or iii) both tax evasion and corruption. Our design differs from previous experiments on taxation due to the presence of corruption, in addition to free-riding, as a motive for tax evasion.

Consistent with the existing literature, we find that deterrence has a significant and negative impact on the share of income evaded and the likelihood of evading taxes. Interestingly, fighting corruption or eliminating it has also a significant and negative impact on the share of income evaded, suggesting a crossover effect of a penalty from the anti-corruption domain to tax evasion outcomes. In contrast, penalizing tax evasion or even eliminating altogether does not have a significant impact on embezzlement at conventional levels. As a result, the crossover effect of the penalty appears to be unidirectional, from anti-corruption to tax evasion, but not from anti-evasion to embezzlement. The existence of such a spill-over effect points out to a positive seesaw effect, whereby directing limited resources towards fighting corruption (a first evil) can have a positive effect on tax evasion (a second evil).

In all treatments, we find that public good (PG) provision is significantly higher compared to the baseline where there is both corruption and tax evasion without deterrence. In treatments with deterrence, we also find that the Big bang approach in which both corruption and tax evasion are targeted is the most effective at increasing PG provision, followed by Anti-corruption and Anti-evasion. Such a result suggests that to maximize PG provision, a Big-bang approach is the optimal policy choice. If one has to choose to fight either corruption or tax evasion, fighting corruption may yield a higher level of PG provision. This supports the conclusion of Ivanyna et al. (2015) that it can be optimal to fight corruption before cracking down on tax evasion. More generally, our results reinforce the necessity of building legitimate and accountable states by allocating more resources to fighting corruption to improve domestic resource mobilization in developing countries (see, e.g. Bird, Martinez-Vazquez and Torgler, 2008).

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Table 1: Summary statistics of Subject Pool

Variables	Evasion-only	Corruption-only	Evasion-Corruption	Anti-evasion	Anti-corruption	Big bang	Kruskal-Wallis (p-value)
			Mean (SD)				
Age	18.60 (0.79)	19.68 (1.89)	20.92 (2.3)	20.58 (1.66)	19.68 (0.73)	20.64 (2.91)	0.0001
Gender (1 if female)	0.73 (0.45)	0.56 (0.5)	0.46 (0.5)	0.44 (0.5)	0.47 (0.5)	0.46 (0.5)	0.0238
Observations	**48**	**72**	**72**	**72**	**78**	**72**	

Source: Authors' calculations based on data from the experiment. PO in Evasion-only excluded.

Table 2: Regression analysis - Differences in effort levels

	OLS	
	Baseline: Evasion-only	
Evasion-Corruption	1.281**	0.695
	[0.551]	[0.535]
Anti-evasion	1.767***	1.203**
	[0.558]	[0.569]
Anti-corruption	2.174***	1.776***
	[0.603]	[0.602]
Big bang	1.076**	0.508
	[0.464]	[0.494]
Female (1 if female; 0 otherwise)		-0.763**
		[0.380]
Age		0.172*
		[0.088]
Feedback (1 if Period>3)		4.971***
		[0.201]
Constant	14.742***	12.099***
	[0.343]	[1.745]
Period FE	Yes	Yes
Observations	**1464**	**1464**
Subjects	**244**	**244**

Clustered standard errors in brackets
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 3: Regression analysis - Share of income evaded and likelihood of tax evasion

	FRACTIONAL RESPONSE REGRESSION		PROBIT (1 if Evasion)	
	Baseline treatment: Evasion-Corruption			
	(1)	(2)	(3)	(4)
Evasion-only	-0.586**	-0.798***	-0.351*	-0.443**
	[0.285]	[0.287]	[0.212]	[0.224]
Anti-evasion	-1.181***	-1.204***	-0.378*	-0.388*
	[0.263]	[0.263]	[0.212]	[0.212]
Anti-corruption	-0.420	-0.549**	0.043	-0.007
	[0.268]	[0.265]	[0.209]	[0.213]
Big bang	-0.846***	-0.891***	-0.458**	-0.467**
	[0.286]	[0.292]	[0.207]	[0.207]
Female (1 if female)		-0.214		-0.021
		[0.180]		[0.122]
Age		-0.124***		-0.043
		[0.048]		[0.031]
Feedback (1 if Period>3)		0.168		0.070
		[0.107]		[0.096]
Constant	-0.302	2.362**	0.657***	1.562**
	[0.206]	[1.014]	[0.179]	[0.698]
Observations	**1464**	**1464**	**1464**	**1464**
Subjects	**244**	**244**	**244**	**244**
Period FE	**Yes**	**Yes**	**Yes**	**Yes**

Clustered standard errors in brackets
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 4: Regression analysis - Share embezzled and likelihood of corruption

	FRACTIONAL RESPONSE REGRESSION		**PROBIT (1 if Corruption)**	
	Baseline treatment: Evasion-Corruption			
	(1)	**(2)**	**(3)**	**(4)**
Corruption-only	-0.652*	-0.713*	-0.536*	-0.402
	[0.377]	[0.390]	[0.292]	[0.277]
Anti-evasion	-0.094	-0.104	0.539	0.642
	[0.340]	[0.347]	[0.410]	[0.411]
Anti-corruption	-0.962***	-1.026***	-0.424	-0.302
	[0.352]	[0.372]	[0.291]	[0.291]
Big bang	-1.158***	-1.186***	-0.108	-0.038
	[0.343]	[0.344]	[0.267]	[0.268]
Female (1 if female; 0 otherwise)		0.315		0.352*
		[0.245]		[0.193]
Age		-0.030		0.085*
		[0.070]		[0.045]
Feedback (1 if Period>3)		0.441***		-0.007
		[0.128]		[0.148]
Constant	0.458***	0.312	1.161***	-0.775
	[0.062]	[1.565]	[0.226]	[0.934]
Observations	**732**	**732**		**732**
Subjects	**122**	**122**		**122**
Period FE	**Yes**	**Yes**		**Yes**

Clustered standard errors in brackets. Evasion-only not included given the limited role for PO.
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 5: Regression - Realized public good (ratio between 0 and 1)

	FRACTIONAL RESPONSE REGRESSION	
	Baseline treatment: Evasion-Corruption	
	(1)	**(2)**
Evasion-only	1.719***	1.897***
	[0.149]	[0.150]
Corruption-only	1.524***	1.637***
	[0.173]	[0.170]
Anti-evasion	0.592***	0.562***
	[0.151]	[0.146]
Anti-corruption	0.806***	0.901***
	[0.143]	[0.141]
Big bang	1.169***	1.191***
	[0.147]	[0.147]
Citizens' total earnings (Log)		0.263
		[0.321]
Female citizen group (1 if 100% female)		0.270***
		[0.096]
Citizen age (mean)		0.098***
		[0.021]
Feedback (1 if Period>3)		-0.478***
		[0.172]
Constant	-0.712***	-4.970*
	[0.141]	[2.597]
Observations	**876**	**876**
Subjects	**170**	**170**
Period FE	**Yes**	**Yes**

Standard errors in brackets
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 6: Effects of treatments on beliefs

FRACTIONAL RESPONSE REGRESSION	**Citizen's belief about PO's corruption**		**Citizen's belief about the other Citizen's evasion**		**PO's belief about Citizens' average evasion**	
	Baseline treatment: Evasion-Corruption					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Corruption-only	-0.292*	-0.413**				
	[0.175]	[0.167]				
Evasion-only			-0.385*	-0.584***		
			[0.219]	[0.215]		
Anti-evasion	-0.091	-0.103	-1.014***	-1.032***	-0.562**	-0.665***
	[0.180]	[0.163]	[0.211]	[0.206]	[0.219]	[0.210]
Anti-corruption	-0.724***	-0.833***	-0.723***	-0.830***	-0.475***	-0.670***
	[0.177]	[0.166]	[0.189]	[0.184]	[0.165]	[0.164]
Big bang	-0.888***	-0.922***	-0.855***	-0.886***	-0.619***	-0.716***
	[0.188]	[0.184]	[0.202]	[0.204]	[0.180]	[0.160]
Female (1 if female; 0 otherwise)		-0.008		-0.077		-0.135
		[0.105]		[0.133]		[0.135]
Age		-0.104***		-0.101***		-0.130***
		[0.027]		[0.036]		[0.034]
Feedback (1 if Period>3)		0.695***		0.275***		-0.111
		[0.103]		[0.106]		[0.140]
Constant	-0.731***	1.434**	-0.430***	1.694**	-0.151	2.660***
	[0.146]	[0.584]	[0.151]	[0.767]	[0.150]	[0.751]
Period FE	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Observations	**1464**	**1464**	**1464**	**1464**	**588**	**588**
Subjects	**244**	**244**	**244**	**244**	**98**	**98**

Clustered standard errors in brackets
** p < 0.10, ** p < 0.05, *** p < 0.01*

Appendix 1

A1.1 Overview of the experimental design

Evasion-only	Corruption-only	Corruption-Evasion	Anti-evasion	Anti-corruption	Big Bang
Citizens: real effort task, actual earning determined	Citizens: real effort task, actual earning determined	Citizens: real effort task, actual earning determined	Citizens: real effort task, actual earning determined	Citizens: real effort task, actual earning determined	Citizens: real effort task, actual earning determined
⬇	⬇	⬇	⬇	⬇	⬇
Citizens Report Earnings (Amt. Underreported)	Citizens: Tax Evasion disallowed	Citizens Report Earnings (Amt. Underreported)	Citizens Report Earnings (Amt. Underreported)	Citizens Report Earnings (Amt. Underreported)	Citizens Report Earnings (Amt. Underreported)
⬇	⬇	⬇	⬇	⬇	⬇
Taxes transferred to Public Officials	Taxes transferred to Public Officials	Taxes transferred to Public Officials	Taxes transferred to Public Officials	Taxes transferred to Public Officials	Taxes transferred to Public Officials
⬇	⬇	⬇	⬇	⬇	⬇
Public Officials: Embezzlement disallowed	Public Officials: Embezzlement	Public Officials: Embezzlement	Public Officials: Embezzlement	Public Officials: Embezzlement	Public Officials: Embezzlement
			⬇	⬇	⬇
			20% chance of audit, 150% penalty: Tax Evasion	20% chance of audit, 150% penalty: Embezzlement	20% chance of audit, 150% penalty: Tax Evasion and Embezzlement

A1.2. Theoretical considerations

A. Citizen's Behaviour

Suppose that Citizen i receives a fixed amount of income I_i and must choose how much to evade. The amount evaded is E_i. Declared income ($I_i - E_i$) is taxed at the rate t. Evaded income is not taxed, but the citizen may be audited with probability p_C ($0 < p_C < 1$) and fined at a rate f for each unit of evaded taxes. In our experimental design, outlined in detail in Section 3, total tax revenues are collected and transferred

to a Public Official (PO), who can decide whether or not to embezzle part of it. The remainder is multiplied by a factor M (to reflect the consumers' surplus from a public good) and shared equally between N Citizens, thereby creating a public good.

If evasion is undetected, the citizen's gain y^u is:

$$y^u = E_i + (1-t)(I_i - E_i) + \frac{1}{N} M[t\{(I_i - E_i) + (I_{-i} - E_{-i})\} - D] - \gamma t(\widetilde{K}_i - E_i) \qquad (1)$$

Where $-i$ denotes the other N-1 Citizens and I_{-i} and E_{-i} their total and evaded incomes, respectively; D is the amount embezzled by the PO. The Citizen is also assumed to suffer a psychological cost, $\gamma t(\widetilde{K}_i - E_i)$, incurred by deviating from a descriptive social norm of cheating, represented by $\widetilde{K}_i$; with $\widetilde{K}_i \geq E_i$.[23] The positive coefficient γ measures how much the individual is willing to pay to avoid a unit of this psychological cost (for a similar approach to introducing a psychological costs in the utility function, see Alm and Torgler, 2011).[24]

A possible social norm in our setting is a conformity norm, as several studies showed that tax compliance depends on the behaviour of others in society (e.g. Gordon, 1989; Myles and Naylor, 1996; Fortin et al., 2007; Castro and Scartascini, 2015).[25] A psychological cost is thus incurred by not adhering to the pattern of (mis)behaviour, proxied by $\widetilde{K}_i$, in a reference group; the same way there is a conformity payoff from adhering to the standard pattern of social tax behaviour (see e.g. Myles and Naylor, 1996). The term $\gamma t(\widetilde{K}_i - E_i)$ is highest when $E_i = 0$, corresponding to a case where a Citizen "i" refrains from tax evasion despite tax evasion by other citizens and corruption by the PO.

If evasion is detected, the citizen's gain y^d is:

$$y^d = E_i + (1-t)(I_i - E_i) + \frac{1}{N} M[t\{(I_i - E_i) + (I_{-i} - E_{-i})\} - D] - \gamma t(\widetilde{K}_i - E_i) - ftE_i \qquad (2)$$

---

[23] Cialdini et al. (1990) distinguish between two types of norms that can exist simultaneously and can have either congruent or contradictory implications for behaviour: descriptive norms (what most others do) and injunctive norms (what most others morally approve or disapprove). We assume that the presence of both tax evasion by another citizen and embezzlement by the PO makes descriptive norms more salient in our experiment.
For the sake of simplicity, we consider that $\widetilde{K}_i \geq E_i$ and that $\widetilde{K}_i$ is constant but individual specific. However, $\widetilde{K}_i$ can be modelled as a function of evasion by the other N-1 Citizens (E_{-i}) and of embezzlement by the PO (D); with $\frac{\partial \widetilde{K}_i}{\partial E_{-i}} > 0$ and $\frac{\partial \widetilde{K}_i}{\partial D} > 0$.

[24] A negative coefficient γ would correspond to a social anti-conformity effect.

[25] Another social norm that can be considered is a reciprocity norm, which rewards kind action and punishes unkind ones (see e.g. Fehr and Gächter, 2000). Here, a subject incurs a psychological cost by deviating from a reciprocity norm (not evading as much as $\widetilde{K}_i$), noting that tax evasion by other Citizens and embezzlement by the PO both hurt the subject's benefits (ceteris paribus). This could suggest a psychological distaste for tax evasion by the other citizen and for embezzlement.

The moral cost persists even in the case of detection. Alternatively, and without changing the analysis, we could have posited that these psychic costs arise only if one is evading tax and is not caught (as in Cummings et al. 2009). The Citizen i chooses E_i to maximize expected utility:

$$\max_{0 \le E_i \le I} \Phi(E_i) = (1 - p_C)U(y^u) + p_C U(y^d) \tag{3}$$

Where p_C is the probability of detecting tax evasion. With a prime denoting a partial derivative, the necessary condition for an interior maximum is:

$$\Phi_E = (1 - p_C)\left(1 - \frac{1}{N}M + \gamma\right) tU'(y^u) + p_C\left(1 - \frac{1}{N}M + \gamma - f\right) tU'(y^d) = 0 \tag{4}$$

Equation (4) can also be sufficient in case $U'' < 0$ (risk-averse individual). In such a case, the second derivative Φ_{EE} will be negative.[26]

We then apply the Implicit Function Theorem to analyse the signs of the comparative statics of the optimal amount of evaded income with respect to changes in the following variables that we consider exogenous: D, E_{-i}, p_O and p_C.

The presence of free-riding and corruption complicates the analysis of tax evasion decision-making in our setting, making it impossible in several instances to determine a priori their impact and that of deterrence instruments on compliance. With free-riding and corruption, an individual must take into account the responses of the others in her/his own decision-making process.

Essentially, the signs of comparative statistics depend on the expressions $(1 - \frac{1}{N}M + \gamma)$ and $(1 - \frac{1}{N}M + \gamma - f)$. In these expressions, 1 represents the benefits of evading 1 unit of income, $\frac{1}{N}M$ is the marginal loss caused by tax evasion due to reduced public good, γ is the marginal physic benefit for following a descriptive social norm $\widetilde{K_i}$, and f is the fine if caught.

Applying the Implicit Function Theorem, we obtain the following comparative statics relative to D, E_{-i}, p_O and p_C:

$$\frac{\partial E^*}{\partial D} = \left(\frac{1}{N}M\right) \frac{(1 - p_C)\left(1 - \frac{1}{N}M + \gamma\right) tU''(y^u) + p_C\left(1 - \frac{1}{N}M + \gamma - f\right) tU''(y^d)}{\Phi_{EE}} \tag{5}$$

$$\frac{\partial E^*}{\partial p_O} = \left(-\frac{\partial D}{\partial p_O}\right) \frac{\Phi_{ED}}{\Phi_{EE}} \tag{6}$$

[26] $\Phi_{EE} = (1 - p_C)\left(1 - \frac{1}{2}M + \gamma\right)^2 t^2 U''(y^u) + p_C\left(1 - \frac{1}{2}M + \gamma - f\right)^2 t^2 U''(y^d)$.

$$\frac{\partial E^*}{\partial E_{-i}} = \left(\frac{1}{N}Mt\right)\frac{(1-p_C)\left(1-\frac{1}{N}M+\gamma\right)tU''(y^u)+p_C\left(1-\frac{1}{N}M+\gamma-f\right)tU''(y^d)}{\Phi_{EE}} \quad (7)$$

$$\frac{\partial E^*}{\partial p_C} = \frac{\left(1-\frac{1}{N}M+\gamma\right)tU'(y^u)-\left(1-\frac{1}{N}M+\gamma-f\right)tU'(y^d)}{\Phi_{EE}} \quad (8)$$

The effect of a change of D on E motivates Hypothesis 1, that corruption leads to an increase in tax evasion. The effect of changes of p_C and p_O on E motivates Hypothesis 2A and 2B, respectively. These hypotheses posit that tax evasion decreases with monitoring and punishment of tax evasion (2A) and corruption (2B).

Proposition 1.

Assuming that $U''(y) < 0 < U'(y), \forall y \in R_0^+;\ 0 < t < 1;\ 0 < p_C < 1$, the signs of the comparative statistics for tax evasion are as follows:

- **Case 1**: $1-\frac{1}{N}M+\gamma < 0\ (\Rightarrow 1-\frac{1}{N}M+\gamma-f < 0)$:

  $\frac{\partial E^*}{\partial D} < 0$: higher expected embezzlement leads to lower evasion.

  $\frac{\partial E^*}{\partial E_{-i}} < 0$: higher evasion by the other Citizen leads to lower evasion.

  $\frac{\partial E^*}{\partial p_C} \gtreqless 0$: the effect of higher monitoring is uncertain.

  $\frac{\partial E^*}{\partial p_O} > 0$: higher penalty on the PO increases tax evasion.

- **Case 2**: $1-\frac{1}{N}M+\gamma-f > 0\ (\Rightarrow 1-\frac{1}{N}M+\gamma > 0)$:

  $\frac{\partial E^*}{\partial D} > 0$: higher expected embezzlement leads to higher evasion.

  $\frac{\partial E^*}{\partial E_{-i}} > 0$: higher evasion by the other Citizen leads to higher evasion.

  $\frac{\partial E^*}{\partial p_C} \gtreqless 0$: the effect of higher monitoring is uncertain.

  $\frac{\partial E^*}{\partial p_O} < 0$: higher penalty on the PO decreases tax evasion.

- **Case 3**: $1-\frac{1}{N}M+\gamma-f < 0 < 1-\frac{1}{N}M+\gamma$:

  $\frac{\partial E^*}{\partial D} \gtreqless 0$: the effect of embezzlement is uncertain.

  $\frac{\partial E^*}{\partial E_{-i}} \gtreqless 0$: the effect of evasion by the other Citizen is uncertain.

  $\frac{\partial E^*}{\partial p_C} < 0$: higher monitoring of tax evasion has a negative effect.

  $\frac{\partial E^*}{\partial p_O} \gtreqless 0$: the effect of higher monitoring of the PO is uncertain.

Essentially, the signs of comparative statistics depend on the expressions $(1 - \frac{1}{N}M + \gamma)$ and $(1 - \frac{1}{N}M + \gamma - f)$; where as $\frac{1}{N}M$, γ, $\widetilde{K}_i$ and f can be seen as "institutional quality" parameters. In these expressions, 1 represents the benefits of evading 1 unit of income, $\frac{1}{N}M$ is the marginal loss caused by tax evasion due to reduced public good, γ is the marginal physic benefit for following a descriptive social norm $\widetilde{K}_i$, and f is the fine if caught:

- When return to public good is relatively high enough (e.g. $M > N$ and $1 - \frac{1}{N}M + \gamma < 0$), an individual will decrease evasion and pay more tax in order to benefit from the public good, which more than compensate the loss due to embezzlement or free-riding.
- When the efficiency in producing public goods is low (e.g. $M \ll N$), the effects of embezzlement and free-riding will depend mainly on the strength of costs factors:
    - If deterrence factors are relatively weak ($f < 1 - \frac{1}{N}M + \gamma$ is the marginal physic costs), embezzlement by a PO or free-riding by another citizen encourages tax evasion; as the marginal benefits from paying tax (which produces benefits through public good provision) does not compensate the loss from embezzlement or free-riding.
    - If both the fine and the psychic cost are strong enough such that $(1 - \frac{1}{N}M + \gamma - f < 0 < 1 - \frac{1}{N}M + \gamma)$, the effect of embezzlement or free-riding becomes uncertain on tax evasion due to the tension between γ that incites to tax evasion and f that deters tax evasion.

It is worth noting that the indeterminacy of results is not uncommon in the tax literature (see e.g. Alm et al. 1992; Fortin et al. 2007)

B. Public Official's Behaviour

A PO receives a fixed salary S. In addition, (s)he can decide to embezzle an amount D from tax revenues paid by the citizens. The PO can be audited with probability p_O ($0 < p_O < 1$) and fined at a rate f for each unit of tax embezzled. If corruption goes undetected, the PO's gain z^u is:

$$z^u = S + D \tag{9}$$

Where D is embezzlement, and t the tax rate.

If embezzlement is detected, the PO's gain z^d is:

$$z^d = S + (1 - f)D \tag{10}$$

For simplicity, we assume no psychic costs for the PO. The PO chooses D to maximize expected utility:

$$\max_{0 \le D \le tR} \Phi(D) = (1 - p_O)U(z^u) + p_O U\left(z^d\right) \tag{11}$$

The necessary condition for an interior maximum is:

$$\Phi_D = (1 - p_O)U'(z^u) + p_O(1 - f)U'\left(z^d\right) = 0 \tag{12}$$

Equation (12) can also be sufficient in case $U'' < 0$ (risk-averse individual). In such a case, the second derivative Φ_{DD} will be negative.[27]

Applying the implicit function theorem, we obtain:

$$\frac{\partial D^*}{\partial p_O} = -\frac{\Phi_{Dp_O}}{\Phi_{DD}} = -\frac{-U'(z^u) + (1 - f)U'\left(z^d\right)}{\Phi_{DD}}$$

Assuming $f > 1$, we obtain that $\frac{\partial D}{\partial p_O} < 0$: higher penalty rate leads to lower share of embezzlement.

Note that we can rewrite $D = etR$ with $R = (I_i - E_i) + (I_{-i} - E_{-i})$ being total tax revenues and e the shared embezzled. As a result, we obtained:

$$\frac{\partial e^*}{\partial p_O} = -\frac{\Phi_{ep_O}}{\Phi_{ee}} = -\frac{-tRU'(z^u) + tR(1 - f)U'\left(z^d\right)}{\Phi_{ee}} \tag{13}$$

$$\frac{\partial e^*}{\partial R} = -\frac{\Phi_{eR}}{\Phi_{ee}} = -\frac{(1 - p_O)et^2RU''(z^u) + p_O e(1 - f)^2 t^2 RU''\left(z^d\right)}{\Phi_{ee}} \tag{14}$$

$$\frac{\partial e^*}{\partial p_c} = -\frac{\Phi_{eR}}{\Phi_{ee}}\frac{dR}{dp_c} = \frac{\Phi_{eR}}{\Phi_{ee}}\left[\frac{dE_i}{dp_c}\right] \tag{15}$$

[27] $\Phi_{DD} = (1 - p_O)U''(z^u) + p_O(1 - f)^2 U''(z^d) < 0$

The effect of a change of R on e provides an "indirect" prediction about Hypothesis 3, which suggests that that corruption decreases in the absence of tax evasion. Indeed, total tax revenue collected R is higher, the lower tax evasion is. The effect of changes of p_O and p_C on e provide predictions about Hypothesis 4A and 4B, respectively. These hypotheses posit that corruption decreases with monitoring and punishment of corruption (4A) and of tax evasion (4B).

Proposition 2.

The signs of the comparative statistics for embezzlement are as follows:

- Assuming $f > 1$, $\frac{\partial e^*}{\partial p_O} < 0$: A higher penalty rate leads to lower share of embezzlement. If $f < 1$, we obtain that $\frac{\partial e^*}{\partial p_O} \gtreqless 0$.
- $\frac{\partial e^*}{\partial R} < 0$: higher tax revenue leads to lower share of embezzlement. In other words, lower evasion can lead to lower share of embezzlement.
- $sign\frac{\partial e^*}{\partial p_c} = sign\frac{dE^*{}_i}{dp_c}$ higher likelihood of auditing tax evasion decreases embezzlement. Auditing tax evasion can have a spillover effect on corruption, but the effect is difficult to predict as the sign of $\frac{dE^*{}_i}{dp_c}$ depends on $\frac{1}{N}M$, γ and f.

C. Discussion

A sufficient condition for tax evasion to take place is obtained by evaluating Equation 4 at $E = 0$. Assuming a rational standard evasion model, that is $\gamma = 0$, we find that:

$$\Phi_{E=0} = (1 - p_C)\left(1 - \frac{1}{N}M\right)tU'(y) + p_C\left(1 - \frac{1}{N}M - f\right)tU'(y)$$
$$= \left(1 - \frac{1}{N}M - p_C f\right)\, tU'(y)$$

For some tax evasion to be optimal, it must be the case that this derivative is positive, which is the case if and only: $1 - \frac{1}{2}M - p_C f > 0$.

Plugging our experimental parameters into this expression, we find: $1 - \frac{1}{N}M - p_C f = -0.4 < 0$ with $p_c = p_o = 0.4, f = 1.5,\ M = 1.6$ and $N = 2$. As a result, tax evasion is not optimal in our experimental design.[28] Yet, a look at Figure 2.A shows that a majority of participants still evade tax, contrary to the

[28] Note the choice of a corner solution provides an easy way to test if equilibrium behaviour is prevalent.

predictions of the standard model of evasion. The presence of a social norm provides a potential explanation for this result, as tax evasion becomes optimal if and only: $1 - \frac{1}{2}M + \gamma - p_C f > 0$.

Our experimental parameters are also such that $1 - \frac{1}{N}M - f = -1.3 < 0$. We thus fall into Case 1 or Case 3 of our theoretical predictions. Taking into account our findings that i) higher monitoring of tax evasion decreases tax evasion, ii) higher monitoring of corruption decreases tax evasion, we are mostly likely in Case 3 given our experimental findings (as Case 1 e.g. predicts that higher monitoring of corruption increases tax evasion).

Being in Case 3 in turn suggests that the psychic cost γ (incurred by deviating from a social norm reference point) could be strong enough such that $0 < 1 - \frac{1}{N}M + \gamma$ (or $\gamma > 0.4$ using our experimental parameters).

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