



Social dynamics in tax compliance: The indirect Echo Effect of observing others' tax behavior

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ABSTRACT

This experimental study investigates the Echo Effect (Mittone, 2006) and extends its application to an intergenerational context. The Echo Effect refers to a behavioral pattern in which taxpayers develop persistent tendencies toward compliance or evasion based on their initial audit experiences. While Mittone (2006) focused on the impact of direct audit experiences, we explore whether the Echo Effect can also emerge indirectly: can observing the tax behavior of a previous group influence the compliance decisions of a subsequent one? We examine whether tax behavior formed by one generation under a particular enforcement regime affects the compliance behavior of the next generation, even when enforcement conditions change, and the new generation has no direct exposure to the original audit environment. Our findings provide clear evidence of an *Indirect Echo Effect*. When the first generation was infrequently audited and developed non-compliant behavior, the subsequent generation continued to evade taxes, even under much stricter enforcement. Conversely, when the first generation learned to comply under restrictive conditions, the following generation maintained cooperative behavior, even in the face of fewer audits, although the effect was less pronounced. These findings suggest that audit-induced compliance can reverberate across generations – particularly in the propagation of non-cooperative behaviors – highlighting the enduring and indirect influence of enforcement policies on taxpayer behavior.

1. Introduction

Every government agenda aims to regulate its shadow economy and address the significant issue of tax evasion, which greatly contributes to the underground economy. Traditional neoclassical models – grounded in the Economics of Crime framework (Allingham & Sandmo, 1972; Becker, 1968) – often focus on deterrence measures such as audits and fines. Yet, extensive research shows that this approach alone cannot fully explain tax behavior, which arises from a more complex interplay of behavioral and institutional factors (see e.g., Bott et al., 2020; Casagrande et al., 2015; Cummings et al., 2009; Engel et al., 2020, 2024). Empirical findings from behavioral studies have therefore suggested normative intervention tools for promoting tax compliance (see Kirchler, 2007, for a comprehensive review of the economic psychology of tax behavior).

We build on Mittone (2006)'s *Echo Effect*, whereby initial audit experiences generate within-person tax behavior that persists even when enforcement conditions later reverse (from permissive to restrictive, and vice versa). We ask whether an analogous persistence can arise across cohorts purely through observation. Specifically: does exposure

to an earlier cohort of taxpayers' (non)compliant behavior influence the compliance of a subsequent, different cohort when the enforcement regime is reversed? We term this phenomenon the *Indirect Echo Effect* – a cross-cohort persistence transmitted solely via observing others' declarations, without any information about audits.

Our laboratory design operationalizes this in two phases. In Phase 1, *Generation 2* passively observe the tax declarations of *Generation 1*, without receiving any information about *Generation 1*'s audits or payoffs. In Phase 2, roles are reversed: *Generation 2* makes declaration decisions under the audit intensity opposite to that experienced by *Generation 1*, while the latter observes. This design allows us to test whether behaviors developed under a given enforcement regime in *Generation 1* persist in *Generation 2* when exposed to a reversed regime, despite the absence of feedback about the audits faced by the first generation.

Our study contributes to the literature linking tax compliance decisions to social influences. However, rather than focusing exclusively on the traditional tax morale perspective, which emphasizes imitation and the internalization of social norms, we explore the possibility that

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observed behavior may also transmit cognitive biases across individuals and generations. In our experimental setting, participants in the second generation observe the declarations made by the first generation without receiving information about the enforcement regime that produced those behaviors. One possible interpretation is that the observed behavior of the first generation provides a descriptive signal about how taxpayers typically behave, thereby influencing the expectations and decisions of the second generation. At the same time, we cannot rule out that such observations may also generate injunctive interpretations, whereby the behavior of the first generation is perceived as an implicit indication of how the second generation is expected to behave. In this sense, our experimental design does not allow us to fully disentangle cognitive transmission mechanisms from normative influences. Rather, our contribution is to show that simple exposure to the behavior of previous taxpayers can generate persistent patterns of compliance or evasion consistent with the dynamics observed in [Mittone \(2006\)](#)'s *Echo Effect*.

More broadly, our findings resonate with the logic underlying the broken windows hypothesis ([Kelling & Wilson, 1982](#)), according to which environments characterized by visible norm violations tend to encourage further violations, whereas environments displaying orderly and compliant behavior reinforce adherence to rules. In the context of tax compliance, observing widespread compliance may promote compliant behavior among new taxpayers, while exposure to prevalent evasion may foster further evasion. Our results suggest that such environmental signals may operate not only through explicit social norms but also through the transmission of behavioral biases across successive groups of decision makers.

Taken together, this literature indicates that tax compliance decisions are frequently based not on objective enforcement parameters but on subjective and often biased beliefs about detection risk. Within this perspective, the *Echo Effect* can be interpreted as a behavioral mechanism through which early enforcement experiences shape persistent compliance patterns. When individuals rely on imperfect beliefs about audit probabilities, early encounters with enforcement may anchor their expectations and generate behavioral habits that persist even when the enforcement environment changes.

More precisely, findings indicate evidence of the *Indirect Echo Effect*. When *Generation 1* was frequently audited and became compliant, *Generation 2* maintained high levels of compliance even under a more permissive regime with fewer audits. Conversely, when *Generation 1* learned to evade under permissive conditions, *Generation 2* continued that evasive behavior despite facing a stricter regime. Thus, audit-induced behavior echoes across cohorts through observation alone, without audit information. More broadly, exposure to peers can transmit persistent behavior, consolidating either socially beneficial compliance (even under permissive enforcement with infrequent audits) or socially harmful evasion (despite intensified audits). Notably, the latter effect is more pronounced than the former.

The policy implications follow directly. Preventing the diffusion of detrimental observational-imitation dynamics is essential in social environments where tax evasion is pervasive, as such dynamics may amplify evasion even absent shared information about investigations. Symmetrically, exposing new taxpayers to observed compliant declarations can stabilize prosocial behavior when audits are infrequent. From a practical perspective, a central implication is the necessity of ensuring that newly entering taxpayers are embedded in information environments that promote compliance-oriented behavior.

The paper is structured as follows: Section 2 introduces the relevant literature for this study, Section 2 details the experiment's design, Section 4 discusses the results, and Section 5 concludes.

2. Related literature

2.1. [Mittone \(2006\)](#)'s *Echo Effect*

In his 60-round experiment, [Mittone \(2006\)](#) compared two groups exposed to opposite audit schedules. One group was audited eight times in the first 30 rounds and not at all in the last 30. In contrast, the other group experienced the reverse sequence (no audits in the first 30 rounds and eight in the last 30). The findings revealed that early audit experiences shaped enduring behaviors: those audited early "learned" to comply and kept complying, while those not audited early "learned" to evade and continued to evade even after audits were introduced. Despite the shift in audit frequency, behavior remained anchored to initial experiences — a manifestation of the *Echo Effect* in which early exposure establishes habits that persist regardless of changing circumstances.

These patterns are not easily reconciled with standard rational benchmarks. At the outset, participants were told that the audit probability was predetermined and constant throughout the experiment, implying a fixed expected number of audits — even though the sequence, the exact count, and the experiment's duration were unknown. In a finite-horizon setting, the "end-game" effect reinforces incentives to evade (or comply): as the experiment progresses and termination becomes more imminent, a rational agent with stable risk preferences who has experienced many (few) audits should gradually decrease (increase) compliance over time. Yet compliance stabilized at the level set by early experience, evidence of a cognitive *Echo Effect* rather than a purely rational response to unchanging overall audit probability. Even allowing for Bayesian updating does not alter this conclusion unless one assumes participants distrusted the experimental instructions and doubted that the audit probability was consistently fixed throughout the experiment.¹

Contrary to these predictions, however, compliance levels stabilized as the experiment unfolded and, given the two opposite audit sequences announced at the outset, stabilized at levels that should theoretically have been reversed. Extending this logic across cohorts, our contribution isolates an *Indirect Echo Effect* — a cross-cohort persistence transmitted purely through observation — complementing the original within-person mechanism.

The potential relevance of the *Echo Effect* for real-world taxpayer behavior is supported by a substantial body of empirical evidence showing that taxpayers often possess distorted beliefs about the true probability of being audited. Survey evidence consistently indicates that individuals have only a limited understanding of enforcement mechanisms and frequently misperceive the likelihood of detection. Early studies based on U.S. taxpayer surveys already suggested that individuals tend to overestimate audit probabilities, implying that subjective beliefs about enforcement differ significantly from the true audit rates observed in administrative data ([Andreoni et al., 1998](#); [Scholz & Pinney, 1995](#)).

More recent empirical work confirms the existence of this bias. For example, survey evidence combined with administrative data shows that firms in Uruguay perceived the probability of being audited to be around 41 percent, whereas the actual probability was close to 12 percent, indicating a substantial upward distortion in perceived enforcement risk ([Bergolo et al., 2023](#)). Importantly, both field and laboratory experiments suggest that compliance decisions respond primarily to perceived enforcement rather than to objective enforcement parameters. In a well-known field experiment, [Slemrod et al. \(2001\)](#)

¹ The same holds in our framework, where — as will be shown — the complexity is further exacerbated by the fact that experimental subjects assigned to *Generation 2* lack complete information about what occurred in *Generation 1*. Consequently, for these subjects the updating process becomes comparatively more intricate, precisely due to the informational incompleteness.

show that informing taxpayers that their returns would receive closer scrutiny significantly affects compliance behavior, even though the underlying audit probability changes only marginally. Similarly, laboratory experiments find compliance levels that are much higher than those predicted by standard expected-utility models, suggesting that individuals behave as if the probability of audit were substantially higher than its true value (Alm et al., 1992; Alm & Malézieux, 2021). Experimental evidence also shows that audit experiences themselves can distort beliefs about future enforcement. After being audited, some individuals overestimate the likelihood of future audits, while others exhibit the so-called bomb-crater effect, reducing their perceived probability of being audited again (Kastlunger et al., 2009).

2.2. Reinforcement learning theory

Extending the logic above, Reinforcement Learning Theory offers a natural framework to understand this behavior, explaining how behaviors are learned through the consequences of actions (Hull, 1943; Sutton et al., 1998). In this context, tax audits serve as stimuli that reinforce compliance behavior (Kastlunger et al., 2009). When individuals are audited and face penalties for evasion, they learn to associate tax evasion with negative consequences and compliance with positive outcomes (Ferster & Skinner, 1957). Reinforcement learning theory also involves an extinction mechanism, where learned behaviors gradually diminish when the reinforcing stimuli (in our case, tax audits) are removed (Gleitman et al., 1954; Seward & Levy, 1949). For example, suppose a taxpayer initially learns to comply due to frequent audits. In that case, the expectation is that compliance behavior should weaken over time if audits cease, as the immediate reinforcement is no longer present. The extinction mechanism is coherent with the already mentioned rational adaptation of the participant expectations about the probability of being audited. However, the Echo Effect indicates a failure in this extinction mechanism. Instead of diminishing, the compliance behavior learned during the initial audit phase persists even when audits stop. Conversely, those who learned to evade taxes due to a lack of early audits continue to do so even when audits are introduced later. This persistence occurs because the initial experiences create a strong, lasting impression that overrides subsequent changes in audit frequency (Anderson & Schooler, 1991; Bouton, 2004). While Mittone (2006) cannot rule out eventual extinction with a much longer horizon (i.e., a longer series of rounds), within the experimental time frame the learned policy remains remarkably sticky.

This rigidity in decision-making, despite new information, underscores the cognitive bias at play, where initial experiences unduly influence long-term behavior. Cognitive psychology supports this mechanism through the concept of “cognitive inertia” (Nisbett & Ross, 1980), where early experiences form robust memory traces resistant to change. This inertia leads to the maintenance of initial beliefs and behaviors, even in the face of contrary evidence or environmental changes (Gawronski & Bodenhausen, 2006). The failure to adapt to new conditions results in persistent, inefficient decision-making, as individuals continue their early-learned behaviors despite changes in their environment (Ferster & Skinner, 1957).

2.3. The role of peers in tax compliance behavior

Relative to prior work on peer effects in tax compliance (Alm et al., 2017; Frey & Torgler, 2007; Mittone et al., 2017), our contribution is twofold. First, we show that exposure to peers' actions can shape compliance across cohorts even when the enforcement environment is reversed between observers and actors. Second, the cross-cohort persistence we identify is transmitted solely via observation of declarations, without exposure to the reinforcing stimuli (audits/sanctions) that originally shaped those declarations (i.e., an *Indirect Echo Effect*).

Alm et al. (2017) ran a 20-round experiment in which participants were assigned to fixed groups of five (“neighbors”). After each

round, they were shown their neighbors' tax decisions and could adjust their own choices in the next round. This structure created mutual influence and feedback, allowing individuals to learn group patterns over time. Participants tended to coordinate on an emerging social norm: compliance rose when they believed others were complying and fell when they believed others were cheating. Ultimately, shared expectations – reinforced by group responses to conformity and deviation – shaped tax behavior dynamically. By contrast, our design decouples observation and action and isolates observational imitation. *Generation 2* are completely passive while watching *Generation 1*, and once *Generation 2* becomes active, *Generation 1* becomes passive.² There is no communication, no public good, anonymity, no payoff interdependencies, and no visibility of audits or sanctions. These features preclude injunctive-norm transmission (beliefs about what one ought to do) and identify descriptive learning from others' declarations as the operative mechanism. Accordingly, when *Generation 2* carries forward the level of (non)compliance it observed in *Generation 1* despite facing a different audit regime, we interpret this as imitation-driven persistence rather than conformity to an injunctive norm – that is, the *Indirect Echo Effect*.

Our experimental setup therefore isolates a non-interactive, one-way observational channel. Participants cannot rely on norm-driven conformation because they face an opposite enforcement landscape to their predecessors and, more importantly, operate in a separate social environment without any direct interaction with their forerunners.

3. The experiment

3.1. Experimental setting

Our design follows Mittone (2006)'s two-phase structure: an initial phase with frequent (infrequent) audits and a subsequent phase with infrequent (frequent) audits. The difference lies in the number of rounds played by each participant: in Mittone (2006), each participant played all rounds, whereas in our setting, participants are divided into two generations (*Generation 1* and *Generation 2*).

As in the original study, our setup consists of 60 rounds, during which participants must pay taxes based on their individual endowments. Unlike Mittone (2006), however, participants do not have an active role through all the rounds. Instead, in rounds 1–30, *Generation 1* makes tax reporting decisions while *Generation 2* remains inactive (they do not make any decisions regarding their own tax compliance) and merely observes *Generation 1*'s declarations. Importantly, observers do not see audits or any reinforcing outcomes, such as sanctions or payoffs. In rounds 31–60, the roles switch: *Generation 2* becomes active under the opposite audit intensity to that faced by *Generation 1*, while *Generation 1* becomes passive.

This one-way exposure allows us to test for the *Indirect Echo Effect* – whether *Generation 2* imitates *Generation 1*'s reinforced behavior despite (i) never observing the reinforcing stimuli and (ii) facing a reversed enforcement regime. Crucially, the rational-benchmark considerations discussed for Mittone (2006) – including the expected compliance dynamics under full rationality and risk neutrality, as well as Bayesian updating conditional on the stated process – apply unchanged to our design.

Consistent with Mittone (2006), decision making is strictly individual: no public good is embedded in the tax game. This design deliberately excludes social identification factors to isolate any potential *Indirect Echo Effect*. Observers only watch others' actions, but those observed decisions do not affect their own payoffs.

When in an active role, each participant is assigned an income of 100 Experimental Currency Units (ECU) per round and is required to declare income for taxation. Participants are made aware that 20% of

² For clarity, we define an active (passive) player as a participant who is (is not) currently making the tax-declaration decision.

the declared amount is withheld as income tax and that collected tax revenues are not redistributed. They are also informed that 15% of all declarations made during the experimental session will be audited throughout the entire experiment.

If an audit reveals underreporting (i.e., a declaration below the true income of 100 ECU), a penalty equal to twice the evaded tax is deducted from that round's earnings. Let $c_i \in \{0, 1, 2, \dots, 50\}$ denote the declaration of participant i , and $\mathbb{1}_i$ be an indicator function that equals 1 if an audit occurs in that round and 0 otherwise.

The round payoff³ for participant i is:

$$\pi_i = 100 - 0.2 \cdot c_i - \mathbb{1}_i[2 \cdot (20 - 0.2 \cdot c_i)].$$

It is important to emphasize two points. First, participants were intentionally kept in the dark about two key aspects: (i) the total number of rounds (60), and (ii) the specific round in which they would switch between active and passive roles.⁴ They were only told that a switch would occur at some point and that 15% of all declarations would undergo scrutiny throughout the entire experiment. Second, participants in the role of observers received round-by-round information on both the average declaration and the individual declarations of all active players, but no information about whether audits occurred.⁵ Thus, when participants from *Generation 2* began playing in round 31 (i.e., began their active role), they had seen *Generation 1*'s declarations but remained unaware of the number or timing of audits conducted in the initial phase (i.e., in rounds 1–30). This one-directional exposure – visible declarations, hidden audits, followed by a role switch into the *opposite* regime – is the key identifying ingredient for the *Indirect Echo Effect* in our setting.

Following the framework of [Mittone \(2006\)](#), we implemented two treatments:

- **AUDIT_LOW_HIGH:** Fiscal audits are concentrated in rounds 31–60, with 8 of the 9 audits occurring during *Generation 2*'s active phase. Consequently, *Generation 1* plays under a “permissive” fiscal system, while *Generation 2* plays under a “restrictive” system.
- **AUDIT_HIGH_LOW:** Fiscal audits are concentrated in rounds 1–30, with 8 of the 9 audits occurring during *Generation 1*'s active phase. Thus, *Generation 1* plays under a “restrictive” system, while *Generation 2* plays under a “permissive” system.

In both treatments, exactly 9 of the 60 rounds are audited (15%), which is precisely what participants were told: that 15% of total rounds

would be audited. Clearly, the patterns selected in the two treatments⁶ represent only two out of all possible permutations. However, it is important to emphasize that pre-determining the set of audits does not violate the no cheating condition commonly adopted in Experimental Economics methodology. In fact, the audit sequences employed were drawn from the set of all possible random sequences that satisfy the condition that exactly 9 of the 60 rounds are audited ($\approx 5.36 \times 10^{15}$). Every sequence within this set is probabilistically possible and equivalent.

We cannot fully rule out the possibility that some participants misinterpreted the information, that is, interpreted “15%” as a per-round audit probability rather than as the overall share of audited rounds. Under that interpretation, each experimental session would have exhibited a different pattern and, potentially, a different total number of audits (i.e., other than nine). Nevertheless, we consider it reasonable to assume that this did not occur in our sessions, given the experimental protocol⁷ adopted during the study. In any case, because the same protocol was used across both treatments, any distortion resulting from such a misinterpretation would plausibly be evenly distributed across the two treatments (and across the two specific phases of each treatment), rather than disproportionately concentrated in one condition.⁸

3.2. Behavioral predictions

Given the low level of enforcement threats in our setting, a neoclassical and risk-neutral taxpayer would maximize their expected payoff by evading. Risk aversion alone is unlikely to account for the emergence of compliance. Instead, such compliance may arise from social preferences along the lines of [Fehr and Schmidt \(1999\)](#), intrinsic motivations ([Dwenger et al., 2016](#)), “duty-to-comply” attitude,⁹ or more

⁶ The audits were conducted in rounds 3, 5, 6, 11, 13, 20, 24, 29, and 49 in AUDIT_HIGH_LOW, and in rounds 19, 33, 35, 36, 41, 43, 50, 54, and 59 in AUDIT_LOW_HIGH.

⁷ The experimenter read the instructions aloud together with the participants connected in the dedicated Zoom meeting. The protocol stipulated that any questions or doubts raised by participants would first be addressed privately writing directly to the experimenter via the Zoom chat; if the answer concerned the general rules of the experiment, it would then be communicated to all participants. The potential misinterpretation of the 15% fell into this category: in such cases, it was publicly clarified that 15% of the total rounds would be audited, and not that each individual round had a 15% probability of being inspected. In a couple of experimental sessions, this misunderstanding did occur, but the experimenter reiterated the clarification even in sessions where participants had not raised any questions.

⁸ Additionally and importantly, our mechanism does not require participants to know or compute an exact audit probability. In tax-compliance settings, what matters behaviorally is the taxpayer's perceived enforcement environment rather than the objective audit frequency alone. Prior research shows that compliance depends on taxpayers' awareness and interpretation of enforcement information ([Alm et al., 2009](#)), that audit communications can affect both perceptions and behavior in ways that are not fully consistent with standard expected-utility models ([Bergolo et al., 2023](#)), and that prior audits can influence subsequent compliance through dynamic behavioral responses ([Gemmell & Ratto, 2012](#); [Kastlunger et al., 2009](#)). Moreover, [Mittone et al. \(2017\)](#) explicitly document heterogeneous beliefs about audit risk and show that even “Bayesian” subjects do not behave as if exact audit probabilities fully determine compliance choices. We therefore interpret our treatment as shifting the salience of enforcement and the perceived risk environment, rather than as assuming precise probabilistic sophistication.

⁹ Several studies underscore the positive effect of non-neutral framing on tax compliance, operating through individuals' perceived obligation to comply ([Choo et al., 2016](#); [Durham et al., 2014](#)); more recently [Casal et al. \(2022\)](#) explores the concept of Unconditional Tax Propensity (UTP), which is an individual's willingness to cooperate (i.e., to pay taxes) regardless of economic considerations like deterrence or the benefits received from public services; a phenomenon purely triggered by the experimental framing. Nonetheless,

³ The final and total payoff comprised the sum of the round payoffs in which the participant played an active role.

⁴ The decision not to disclose the total number of rounds was motivated by several factors. The first was to replicate the design adopted in [Mittone \(2006\)](#), in which participants were not informed about the number of rounds. The second, similarly to the rationale behind [Mittone \(2006\)](#)'s setting, was aimed at making it more difficult for participants to update their probability of being audited. For instance, knowing the total number of rounds and keeping track of audits already conducted, a participant who has already observed a number of audits equal to 15% of the total rounds could be certain that no further audits would take place, thereby nullifying any potential deterrent effect of audits and fines and, rationally, reducing compliance to zero. A similar reasoning, but with opposite effects, applies when a participant has observed no audits and knows that the number of rounds to be audited roughly corresponds to the remaining rounds to be played: in this case, rationally, compliance is expected to be maximal. In line with this principle, we also chose not to disclose the timing of the role switch, in order to minimize a possible anchoring effect (for example, “the switch occurs after 30 rounds, so I will now play for 30 rounds”), which could influence participants' decisions.

⁵ The number of individual declarations displayed depended on the number of participants in the session, ranging from a minimum of 7 (in the session with the fewest participants, which included 14 players evenly divided across generations) to a maximum of 20 (in sessions with 40 participants).

generally, adherence to social norms (Alm et al., 1999). Accordingly, we expect a substantial level of compliance in both treatments.

While we maintain the standard assumption of rational, risk-neutral decision makers, we expect different compliance levels across the two first-generation cohorts. It is important to emphasize that, in both treatments and within their respective active periods, only *Generation 1* is able to keep an accurate count of the audits, as it begins its active phase in round 1 and can therefore state with certainty that no audit has yet been conducted from that point onwards. By contrast, second-generation participants, although able to observe *Generation 1*'s declarations, receive no information regarding the number of audits that may have already been conducted during the initial phase of the experiment.

Thus, if first-generation participants are fully rational (and risk-neutral), and are aware that: (i) 15% of the total 60 rounds – including those played by their own generation and the following one – will be audited, and (ii) many audits have occurred at the beginning of their active period, then tax evasion is expected to increase as the number of conducted audits rises. The reasoning is straightforward: with the total number of audits fixed at 15% of all rounds, each audit that occurs early reduces the likelihood of further audits later in their active period. Accordingly, under rational behavior, we expect *Generation 1*'s declarations to decrease over rounds in AUDIT_HIGH_LOW (many early audits) and increase in AUDIT_LOW_HIGH (few early audits).

From a behavioral perspective, however, as Kirchler (2007) emphasizes, subjective perceptions of audit risk may have a greater impact on tax compliance than the actual probability of being audited – a conclusion also supported by the results of Mittone (2006). Consistent with this view – and with the broad regularity that higher audit probabilities generally increase compliance in laboratory settings (Malézieux, 2018) – early sequences with frequent audits make enforcement especially salient and can anchor a “strict-enforcement” belief, thereby maintaining relatively higher compliance in the AUDIT_HIGH_LOW treatment.

Behavioral Hypothesis 1. Among *Generation 1* participants, exposure to numerous audits leads to an overestimation of future investigation and, therefore, higher compliance. Thus, *Generation 1*'s compliance is higher in the AUDIT_HIGH_LOW group than in the AUDIT_LOW_HIGH group.

Formulating hypotheses for the *Generation 2* is more challenging, even under full rationality. Unlike *Generation 1*, *Generation 2* begins the experiment with limited information. They do not know how many tax audits have already occurred in the first part of the experiment (rounds 1–30), nor the remaining horizon (i.e., the exact number of remaining rounds they will play). This lack of information makes Bayesian updating hard to formalize. While updating is theoretically possible in principle, the missing data about past audits and future duration prevents accurate rational predictions.

Behaviorally, however, insights from Mittone (2006) suggest that *Generation 1*'s declarations can serve as a descriptive reference for *Generation 2* (Kirchler, 2007). If observational imitation is at work, the behavior acquired by observing *Generation 1* should persist even when the audit schedule is reversed, giving rise to a cross-cohort *Indirect Echo Effect*.

such a loaded frame is necessary for addressing our research question, namely whether the observation of tax behavior by one generation influences the behavior of a subsequent generation. Furthermore, the adoption of this frame allows us to extend (Mittone, 2006), which employed the same setting. It would also be difficult to conceive of a neutral frame suitable for studying the phenomenon of the *Indirect Echo Effect*, as this would require abandoning the notion of tax audits altogether or replacing them with a generic punishment mechanism, which would be difficult to justify in a de-framed context.

Table 1

Descriptive statistics.

Variable	AUDIT_LOW_HIGH	AUDIT_HIGH_LOW
# obs.	88	94
% Females	55.68	61.70
All observations (variable: declared income)		
Mean (SD)	32.61 (42.22)	42.62 (45.28)
Median	0	20
Min	0	0
Max	100	100
Generation 1 (variable: declared income)		
Mean (SD)	34.14 (42.00)	48.10 (45.70)
Median	0	50
Min	0	0
Max	100	100
Generation 2 (variable: declared income)		
Mean (SD)	31.06 (42.41)	37.15 (44.20)
Median	0	0
Min	0	0
Max	100	100

Behavioral Hypothesis 2. Compliance levels persist from *Generation 1* to *Generation 2* within each treatment despite the change in enforcement, yielding broadly similar (non)compliance across generations.

3.3. Experimental procedures

The experiment was conducted at the Cognitive and Experimental Economics Laboratory (CEEL) at the University of Trento (Italy) using o-Tree (Chen et al., 2016). We recruited 182 participants across six online sessions (three sessions for each treatment, run in May 2023 and July 2023) through the CEEL mailing list and enrollment system. All sessions were conducted online, with participants and experimenters connected via Zoom: subjects were identified in the Zoom session with a unique alphanumeric label. Instructions¹⁰ were read aloud by the experimenter in each session.

The individual's final payoff consisted of two components:

1. **Active-phase earnings:** the total earnings accumulated during rounds in which participants played an active role by making declaration decisions;
2. **Observer-phase earnings:** the earnings obtained during the rounds with a non-active role. In these rounds, participants were asked to make a prediction regarding the average amount of income declared by active participants. If the prediction fell within the range observed average $\pm 10\%$, the participant would receive 25 ECU.¹¹

The average payment for participants was €14.81 (using an exchange rate of 250 ECU = €1), including a €3 show-up fee, for an average session duration of 1 h:35 min.

4. Results

4.1. Behavior as an active player

Assuming full rationality among participants, overall tax compliance (and thus declared income) should not differ between treatments, since both involve a 15% audit probability and identical individual incentives.

The data, however, indicate behavioral differences across treatments: Table 1 summarize descriptive statistics for treatments AUDIT_LOW_HIGH and AUDIT_HIGH_LOW.

¹⁰ Reported in Appendix A (translated from Italian).

¹¹ By incentivizing belief elicitation, we encourage observers to pay attention to the tax behaviors of the active players.

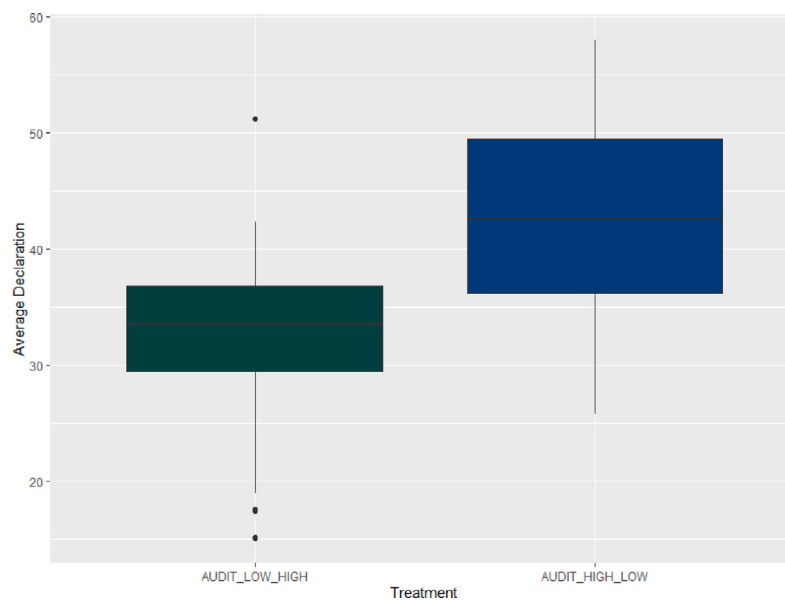


Fig. 1. Distribution of average income declarations per round, by treatment.

Fig. 1 reports the distribution of average income declarations recorded in each round for both treatments: the boxplots show that the distribution of mean declarations in AUDIT_HIGH_LOW is shifted upward compared to AUDIT_LOW_HIGH, indicating a higher level of tax compliance. This difference is statistically significant, as confirmed by the Mann–Whitney test (p -value = $5.589\text{e-}09$).

Result 1. Overall, declarations are significantly lower in AUDIT_LOW_HIGH than AUDIT_HIGH_LOW.

The key difference between the two treatments is the sequence of tax audits, which affects how many audits *Generations 1* and *2* face, while keeping the total number of audits constant throughout the experiment. Fig. 2 reports the average income declared each round for AUDIT_LOW_HIGH (panel a.) and AUDIT_HIGH_LOW (panel b.): the dark dots refer to *Generation 1* (who paid taxes without observing what a previous group did), while the light dots refer to *Generation 2* (who paid taxes after observing *Generation 1*). The dashed red lines indicate the rounds in which tax audits were conducted. As can be seen, when the treatment manipulation applied only one audit throughout a participant's active rounds, the participant experienced a single inspection (in the 19th round of activity). By contrast, when the treatment manipulation involved multiple audits in the same timeframe, the participant underwent 8 inspections (in the 3rd, 5th, 6th, 11th, 13th, 20th, 24th, and 29th rounds of activity).

Two patterns emerge: (i) *Generation 1* declares more, on average, in AUDIT_HIGH_LOW than in AUDIT_LOW_HIGH, and (ii) participants exposed to frequent audits in AUDIT_LOW_HIGH (*Generation 2*) declare less on average than those facing the identical audit sequence in AUDIT_HIGH_LOW (*Generation 1*). Thus, for *Generation 1*, undergoing multiple audits during their active rounds is associated with higher compliance. However, the deterrent effect of repeated audits appears to be less pronounced for *Generation 2*, who had previously observed *Generation 1* under the opposite regime.

To unpack these mechanisms, the next sections provide a more detailed analysis by examining and comparing the behavior of (i) individuals assigned to *Generation 1*, (ii) individuals within the same treatment, and (iii) individuals under the same audit regime.

To unpack these mechanisms, the next sections provide a detailed analysis structured around three complementary dimensions:¹²

- i. **Direct Deterrence:** a cross-treatment comparison of *Generation 1* behavior to isolate the immediate impact of audit frequency in a “baseline” environment;
- ii. **Intra-treatment Dynamics:** comparison between *Generation 1* and *Generation 2* within the same treatment to observe how behavior evolves following a regime shift;
- iii. **Inter-generational Spillovers:** a comparison of individuals operating under the same audit regime (e.g., *Generation 1* in AUDIT_LOW_HIGH vs. *Generation 2* in AUDIT_HIGH_LOW) to isolate the “legacy effect” of observed past behavior.

4.1.1. Direct deterrence

As noted in Section 3.2, the fixed ex ante 15% audit implies opposite rational predictions across treatments: *Generation 1* compliance should rise in AUDIT_LOW_HIGH and fall in AUDIT_HIGH_LOW.

From a behavioral perspective, however, subjective perceptions of audit risk may matter more than the objective probability (Kirchler, 2007; Mittone, 2006). When audits are concentrated early, enforcement becomes more salient, leading participants to believe that audit probability is higher and to comply more, even after actual audit frequency decreases (Malézieux, 2018). Accordingly, *Generation 1* compliance may be higher in AUDIT_HIGH_LOW, where early audits were more frequent (8 compared to 1), making enforcement more salient.

To assess which of these competing predictions finds greater support in the data, Table 2 restricts the analysis to *Generation 1* cohorts and examines the determinants of tax compliance. The treatment effect is captured by the AUDIT_HIGH_LOW dummy; in each model the coefficient identifies the difference in compliance rate relative to the omitted condition (treatment AUDIT_LOW_HIGH). Model 2 adds a control for gender, while Model 3 further introduces the variables Round, which

¹² While one could also compare *Generation 2* across treatments (AUDIT_LOW_HIGH vs. AUDIT_HIGH_LOW), such a comparison simultaneously varies both the current fiscal regime and the observed history. This introduces a significant identification challenge. While we report this comparison in Appendix A.2.1 for completeness to evaluate the total institutional path effect, we prioritize the three comparisons above as they allow for a cleaner isolation of the underlying behavioral mechanisms.

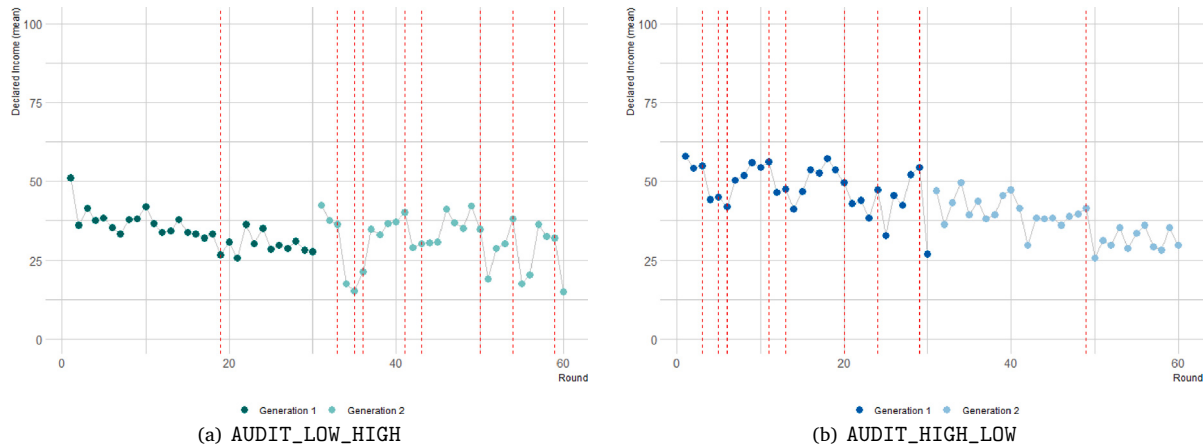


Fig. 2. Mean declarations across rounds.

Table 2
Generation 1 across treatments.

	Dependent variable:		
	Declaration (1)	(2)	(3)
AUDIT_HIGH_LOW	13.956** (6.964)	13.899** (7.002)	16.288** (7.427)
Round			−0.368*** (0.097)
Gender		2.199 (6.848)	1.252 (6.930)
justchecked			−8.941*** (1.635)
AUDIT_HIGH_LOW × Round			0.002 (0.135)
Constant	34.145*** (5.005)	32.845*** (6.456)	39.019*** (6.714)
Observations	2730	2730	2639

Note:
Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
AUDIT_HIGH_LOW is a treatment dummy, Female is a gender dummy, Round register the round of the experiment (1 to 30), Just_checked captures whether the subject has been audited in the previous round.

registers the round of the experiment in which the participant was active (from 1 to 30), and Just_checked, which captures whether the participant has been audited in the previous round.¹³ Random effects at the individual level account for within-person dependence arising from repeated choices.

Compared with AUDIT_LOW_HIGH – where *Generation 1* faces only one audit across 30 rounds – a stricter audit schedule (eight audits in 30 rounds) significantly increases tax compliance. Model 3 highlights that, on average, tax compliance in AUDIT_LOW_HIGH declines over rounds: declarations fall by 0.37 for each additional round. This time trend does not differ significantly by treatment: while the treatment

itself affects declarations, its effect remains consistent as the experiment proceeds, resulting in a similar downward trend in declarations for both groups.

These results demonstrate that *Generation 1* does not behave fully rationally. Indeed, if participants were fully rational, we would expect higher compliance in AUDIT_LOW_HIGH than in AUDIT_HIGH_LOW. Instead, consistent with [Behavioral Hypothesis 1](#), *Generation 1* reports higher declarations in AUDIT_HIGH_LOW.

Result 2. When tax behavior cannot be influenced by observing the tax behavior of a previous cohort of taxpayers, a more restrictive tax system increases tax compliance.

4.1.2. Intra-treatment dynamics

[Tables 3](#) and [4](#) focus the analysis on the AUDIT_LOW_HIGH and AUDIT_HIGH_LOW treatments, restricting the sample to the corresponding observations: GEN2 is a dummy equal to 1 for decisions made by second-generation participants. The omitted variable is the one which refers to first-generation participants.

[Table 3](#) shows that, in AUDIT_LOW_HIGH, changing the tax regime did not affect *Generation 2*'s declaration levels. Consistent with [Behavioral Hypothesis 2](#), *Generation 2*'s declarations are not significantly different from those of *Generation 1* despite facing 8 out of 9 audits. Even under a stricter system – where higher compliance would be expected, especially since [Result 1](#) links frequent inspections to greater compliance – *Generation 2* did not increase their declarations. Similar to the findings reported by [Mittone \(2006\)](#), where moving to a stricter regime failed to increase within-person declarations, we observe an analogous pattern across cohorts: tax behavior persists via an *Indirect Echo Effect*. Purely through observation, *Generation 2* inherits *Generation 1*'s declaration pattern, even though it operates under a different regime and has not directly experienced the audits encountered by *Generation 1*.

Result 3. In AUDIT_LOW_HIGH, the *Indirect Echo Effect* neutralizes the impact of a tightening of the enforcement of the tax system.

Consistent with [Behavioral Hypothesis 2](#), the same pattern emerges in AUDIT_HIGH_LOW treatment ([Table 4](#)): no significant differences are observed in declaration levels between participants from *Generations 1* and *2*. Thus, tax behavior again persists across cohorts, with *Generation 2* mirroring the patterns established by its respective *Generation 1* counterparts, even when facing a drastic shift in the tax regime.

Result 4. In the AUDIT_HIGH_LOW, the *Indirect Echo Effect* counteracts the impact of a relaxation in tax enforcement.

¹³ In Model 3 the observations relative to the first round have been dropped since it is not possible (by construction) to have undergone a tax inspection in the previous round. For completeness, we report that, as expected, the statements in the first round made by *Generations 1* do not statistically differ across treatments (Mann-Whitney test, p -value = 0.3437) with mean values of 51.21 and 58.04 in AUDIT_LOW_HIGH and AUDIT_HIGH_LOW, respectively.

Table 3
Compliance in AUDIT_LOW_HIGH.

	Dependent variable:		
	Declaration (1)	(2)	(3)
GEN2	−3.077 (6.584)	−2.872 (6.630)	−4.007 (7.067)
Round_played			−0.592*** (0.216)
Gender		3.014 (6.674)	2.736 (6.741)
Just_checked			−9.414*** (1.678)
GEN2 × Round_played			0.224 (0.137)
Constant	37.222*** (10.410)	35.235*** (11.346)	42.150*** (11.982)
Observations	2640	2640	2552

Note:

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

GEN2 is a generation dummy, Female is a gender dummy, Round_played register the round played by the individual (it always assumes a value from 1 to 30, regardless of belonging to one generation or another), Just_checked captures whether the subject has been audited in the previous round.

Table 4
Compliance in AUDIT_HIGH_LOW.

	Dependent variable:		
	Declaration (1)	(2)	(3)
GEN2	−10.955 (7.215)	−10.955 (7.235)	−11.757 (7.616)
Round_played			−0.270 (0.206)
Gender		5.013 (7.127)	4.274 (7.197)
Just_checked			−10.026*** (1.599)
GEN2 × Round_played			−0.101 (0.130)
Constant	59.055*** (11.408)	55.962*** (12.255)	65.575*** (12.852)
Observations	2820	2820	2726

Note:

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

GEN2 is a generation dummy, Female is a gender dummy, Round_played register the round played by the individual (it always assumes a value from 1 to 30, regardless of belonging to one generation or another), Just_checked captures whether the subject has been audited in the previous round.

Referring back to [Result 1](#), the lower overall compliance observed in AUDIT_LOW_HIGH can be attributed to two main factors: (i) the significantly lower declarations by *Generation 1* compared to *Generation 1* in AUDIT_HIGH_LOW; and (ii) the relative stability in the fiscal behavior of *Generation 2*, in both treatments, which does not significantly deviate from the patterns exhibited by their respective *Generation 1* cohorts. Taken together, these two dynamics account for the difference in overall compliance observed across treatments.

Table 5
Compliance under a restrictive tax system.

	Dependent variable:		
	Declaration (1)	(2)	(3)
GEN2	−17.033** (6.837)	−17.559** (6.877)	−21.266*** (7.276)
Round_played			−0.597*** (0.218)
Gender		−5.571 (6.653)	−6.254 (6.702)
Just_checked			−10.420*** (1.304)
GEN2 × Round_played			0.225 (0.139)
Constant	65.134*** (10.703)	69.097*** (11.719)	81.717*** (12.316)
Observations	2730	2730	2639

Note:

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

GEN2 is a generation dummy, Female is a gender dummy, Round_played register the round played by the individual (it always assumes a value from 1 to 30, regardless of belonging to one generation or another), Just_checked captures whether the subject has been audited in the previous round.

4.1.3. Inter-generational spillovers

Two additional comparisons allow for a more complete understanding of the mechanisms related to treatments and generations, offering a clear explanation of the *Indirect Echo Effect*.

Assuming full rationality of the subjects, if participants of *Generation 2* assumed that no audits occurred in the first 30 rounds, their level of tax compliance should be similar to that observed in *Generation 1* under the same audit sequence. This leads to the following expectations: *Generation 2* in AUDIT_LOW_HIGH should exhibit fiscal behavior analogous to that of *Generation 1* in AUDIT_HIGH_LOW, and, conversely, *Generation 2* in AUDIT_HIGH_LOW should behave similarly to *Generation 1* in AUDIT_LOW_HIGH.

Conversely, if *Generation 2* assumed that some audits had already taken place during those first 30 rounds, the compliance rate of *Generation 2* would be expected to be smaller than that of *Generation 1* under the same tax regime.

[Fig. 3](#) supports these comparisons. The left panel compares the generations exposed to a restrictive regime (i.e., exposed to a high number of tax audits): *Generation 1* in AUDIT_HIGH_LOW (dark blue) vs. *Generation 2* in AUDIT_LOW_HIGH (light green). The right panel, by contrast, compares the generations facing a permissive regime (a single audit): *Generation 1* in AUDIT_LOW_HIGH (dark green) vs. *Generation 2* in AUDIT_HIGH_LOW (light blue).

In the restrictive regime, the left panel suggests that *Generation 1* in AUDIT_HIGH_LOW declares more than *Generation 2* in AUDIT_LOW_HIGH despite the identical audit sequence. Regression estimates in [Table 5](#) confirm that *Generation 2*'s declarations are significantly lower. This within-regime difference aligns with [Result 3](#): second-generation participants in AUDIT_LOW_HIGH demonstrated reduced compliance, likely due to inheriting, via the *Indirect Echo Effect*, the fiscal behaviors of their respective *Generation 1*.

With regard to the comparison between generations under a permissive tax regime, no analogous dynamic is observed: in fact, there is no significant difference between the behavior of *Generation 1* in AUDIT_LOW_HIGH and that of *Generation 2* in AUDIT_HIGH_LOW (see [Table 6](#)).

These findings provide a clearer understanding of the mechanism underlying the *Indirect Echo Effect*: when *Generation 2* is exposed to

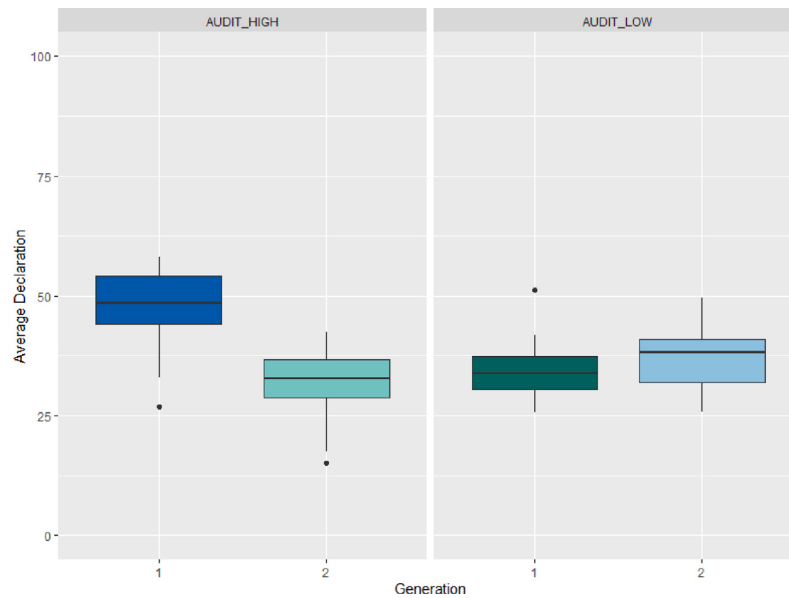


Fig. 3. Distribution of average income declarations per round, by treatment and generations.

Table 6

Compliance under a permissive tax system.

	Dependent variable:		
	Declaration (1)	(2)	(3)
GEN2	3.001 (7.032)	2.616 (6.905)	4.560 (7.278)
Round_played			−0.270 (0.203)
Gender		14.750** (7.057)	14.407** (7.141)
Just_checked			−5.589* (2.924)
GEN2 × Round_played			−0.105 (0.127)
Constant	31.143*** (11.228)	22.813* (11.720)	26.676** (12.297)
Observations	2730	2730	2639

Note:

Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

GEN2 is a generation dummy, Female is a gender dummy, Round_played register the round played by the individual (it always assumes a value from 1 to 30, regardless of belonging to one generation or another), Just_checked captures whether the subject has been audited in the previous round.

only a single audit, the intensity of the effect is noticeably reduced. In this case, tax compliance tends to converge toward a “natural” level, corresponding to that observed when audits are virtually absent (Casal et al., 2022).

In sum, the *Indirect Echo Effect* proves capable of neutralizing, at least partially, the deterrent impact of audits and penalties, thereby fostering the persistence of tax evasion even after stricter regulations are introduced. Conversely, in the opposite direction – when shifting from a restrictive to a permissive system – this effect does not appear able to sustain compliance, which instead stabilizes at an intrinsic and unconditional level, independent of previous generational behavior.

Result 5. The *Indirect Echo Effect* is more effective in perpetuating antisocial behavior (i.e., tax evasion) than at reinforcing cooperative behavior (i.e., tax compliance).

5. Conclusions

In an era where sustainability and long-horizon planning shape policy debates, explaining tax compliance dynamics calls for moving beyond purely economic models to frameworks that consider cognitive and intergenerational factors. Canonical models – most notably (Allingham & Sandmo, 1972) – emphasize the role of detection and penalties, while subsequent behavioral research has underscored non-pecuniary drivers (e.g., social norms, perceived fairness, and institutional legitimacy). Reinforcement learning theory further suggests that learned behaviors may diminish, or “extinguish” when reinforcing stimuli (in our case, tax audits) are removed. Consequently, a reduction in audit frequency can be expected to lead to a decline in previously established compliance.

Yet the Mittone (2006)’s *Echo Effect* challenges this prediction. Early experiences leave durable, within-person imprints that persist even when enforcement reverses. We extend this mechanism across cohorts as an *Indirect Echo Effect*: passive exposure to a previous generation’s behavior – whether compliant or evasive – can become “locked in” and transmitted to the next generation, even when enforcement regimes change. In our setting, when the first generation faced few audits and learned to evade, the subsequent generation continued to evade taxes, even under a much stricter enforcement. Conversely, when the first generation learned to comply under restrictive conditions, the next generation maintained relatively high compliance despite facing fewer audits – though this persistence was less pronounced.

A key insight of our research is that passive observation alone can shape long-term tax behavior. In this respect, our findings resonate with the broader logic underlying the broken windows hypothesis (Kelling & Wilson, 1982), according to which environments characterized by visible norm violations tend to encourage further violations, whereas environments displaying orderly and rule-abiding behavior reinforce compliance. In our experimental setting, observing widespread tax compliance encourages compliant behavior among subsequent taxpayers, while observing persistent evasion fosters further evasion. This suggests that the informational environment surrounding taxpayers

– what they see others doing – can play a crucial role in shaping compliance dynamics over time.

Recognizing that compliance or evasion can be socially inherited opens new avenues for policy design. Policymakers can leverage these dynamics by highlighting pro-social behaviors through transparent governance, educational campaigns, and community-driven incentives. Early exposure to effective enforcement – or conversely, to unchecked evasion – can shape long-term attitudes, emphasizing the lasting impact of formative experiences on tax compliance.

Our results suggest that enforcement policies must account for both their immediate and long-term effects, as tax behavior is influenced not only by personal experience but also by the behaviors and attitudes of prior generations, particularly in spreading non-cooperative behaviors. If new taxpayers adopt compliance habits based on what they observe rather than what they experience directly, fostering a culture of compliance will require sustained engagement beyond periodic enforcement crackdowns.

Future research could explore in greater detail the mechanisms through which compliance behaviors are socially inherited. Two possible explanations merit particular attention. The first posits a straightforward activation of social norms based on pure conformity: individuals simply mimic the behavior of others (“I do what others do”). The second suggests a more complex mechanism, where social norms are shaped not by conformity alone but through the intergenerational transmission of shared cognitive biases.

Exploring these alternatives would enhance our understanding of how tax attitudes are transmitted across generations, providing valuable insights for both scholars and policymakers. To investigate these alternative mechanisms, one could modify the experimental setting by recording the choices related to second-generation tax compliance and their beliefs about tax audit scrutiny experienced by the first generation. Another potential design variation could introduce a treatment in which second-generation subjects observe both the filing behavior and audit outcomes of their predecessors. We leave these avenues open for future studies.

CRedit authorship contribution statement

Azzurra Morreale: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Luigi Mit-tone:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Sandro Casal:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.socec.2026.102596>.

Data availability

Data will be made available on request.

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