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Social norms and evolutionary tax compliance

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Abstract

The paper studies tax evasion in an evolutionary setting. In addition to standard variables such as the fine individuals may have to pay if found guilty or the probability of being audited, agents' inclination to engage in tax evasion may also be affected by social interactions. Moreover, expected payoffs may include reputational costs or rewards awarded by society after an individual is audited. The paper shows how (i) social norms may play a very important role in defining the long-run evolution of tax evasion and, consequently, that (ii) policymakers should consider reforms that would increase social awareness and information rather than more (financially and politically) expensive traditional auditing instruments; in addition, (iii) fiscal/auditing policies should be carefully tailored to the particular economic and social setting in place in a country.

KEYWORDS

pro-social behavior, social-norms marketing, tax evasion, tax morale, word of mouth dynamics

JEL CLASSIFICATION

C73; H26; H30

1 | INTRODUCTION

In the attempt to answer the question of why individuals evade taxes, the economic literature has taken inspiration from the economics of crime (Becker, 1968) and traditionally framed tax evasion as a

gamble.[1] The key assumption is that no individual, if allowed, would want to pay taxes. Evading taxes then essentially becomes a gamble that individuals may decide to play, depending on their degree of aversion to risk, the probability of being audited, and the extent of the possible penalty.[2] Specifically, this framework predicts high levels of tax evasion if agents face low audit probability or low penalties. This prediction is, however, in contrast to empirical observation. Tax evasion is, indeed, relatively low in many tax systems, in spite of low audit probability and small penalties.[3] Moreover, even in those environments where evading taxes is possible and often a widespread behavior in society, there are still individuals who act honestly. Leaving aside the role played by third-party reporting, the literature has identified three possible explanations for this puzzle.[4] One possibility is the existence of divergence between auditing rates and detection probabilities.[5] Another possibility is that individuals may tend to overestimate detection probabilities.[6] Finally, individuals may be induced to comply because they experience forms of non-pecuniary motivation.[7]

This paper focuses on this third option. Researchers have attempted to identify and measure the existence and extent of such non-pecuniary incentives, often referred *tax morale*.[8] Luttmer and Singhal (2014) describe various mechanisms according to which tax morale may affect compliance. One mechanism is based on *intrinsic motivation*. In every society, there are individuals who believe that paying taxes is a way to contribute to society's welfare and individuals may obtain private utility from it.[9] There is another important aspect of taxpayers' behavior related to tax morale and that is the role that *social norms* and *reputation* may play.[10] The way society sees the pro-social actions of an individual may have an important reputational effect on the utility that the individual obtains from performing a particular task. Charity, voluntary work, and donations are examples of actions that may improve individuals' reputation (see Bénabou and Tirole, 2006). Indeed, reputation may play an important role when individuals have to consider reporting their income for tax purposes. If audited and found guilty of tax evasion, there may be a significant social cost, a stigma, in addition to a standard fine, that the individual has to face. Similarly, if audited and found not guilty, the individual may be rewarded with a reputation of honestly and citizenship.

[1]See Freire-Serén and Panadés (2013) for a review of the literature.

[2]See for example Allingham and Sandmo (1972), Yitzhaki (1974), Slemrond and Yitzhaki (2002) and Slemrod and Weber (2012).

[3]Deterrence models tend to predict too much tax evasion (see Alm, 1999, Torgler, 2002).

[4]Kleven et al. (2011) show how high compliance in Denmark can be explained significantly by the fact that taxpayers are unable to evade due to third-party reporting. In many contexts it is, nonetheless, important to consider the critical role played also by voluntary compliance, especially when third-party reporting is not possible. For example, Dwenger et al. (2016) show how significant portions of the population may pay taxes in the absence of third-party reporting and auditing.

[5]See Kleven et al. (2011).

[6]See Chetty (2009). Dhami and Al Nowaihi (2007) and De Giovanni et al. (2019) deal with biases induced by prospect theory.

[7]See Andreoni et al. (1998) and Luttmer and Singhal (2014).

[8]Empirical and experimental evidence of the relationship of tax morale and tax compliance is vast. Just to mention a few, see Torgler (2007), Kirchler (2007), Hallsworth et al. (2014) and Cullis et al. (2012). Also, recent psychology literature provides a very useful framework, the so called *Slippery Slope* model, to study the formation of tax morale and the way it influences tax payers' behavior (see Gangl et al., 2015).

[9]See, for example, Lubian and Zarri (2011) and Dwenger et al. (2016).

[10]See the experimental evidence described in Hallsworth et al. (2014), Christian and Alm (2014), Coricelli et al. (2014), Battiston and Gamba (2016).

Luttmer and Singhal () identify *long-run cultural factors* as a significant variable that affects tax morale and compliance.[11] When considering the effects of social norms and reputation on individuals' actions, a static model may be inadequate and the role played by a *continuously evolving* cultural framework should be carefully considered.[12] It should be natural to think, therefore, of the individuals' decisions in a dynamic setting. As Besley and Persson (2014) also point out, the ability of a country to enforce compliance may be affected by sociological and cultural factors and, in turn, it may be a key factor defining the development trajectory of a whole economy.

There are contributions in the literature that have attempted to incorporate tax morale directly into Allingham and Sandmo (1972)'s framework. Most of the theoretical works on tax compliance to date are either "one-shot" in nature (see Luttmer & Singhal, 2014) or dynamic extensions of the traditional framework (see Besley et al., 2015; Gordon, 1989; Kim, 2003; Myles & Naylor, 1996; Traxler, 2010).[13] Essentially tax morale is modeled as an internalized social norm that makes tax evasion more costly, affecting the individuals' decisions under risk. Similar to these works, our paper studies the dynamics of tax evasion; however, this paper studies a very different dynamic adjustment to the one considered in the contributions mentioned above. We consider it an evolutionary game with the *word of mouth dynamics*. Specifically, our paper contributes to the literature in three ways.

First, in line with Besley et al. (2015), we study tax evasion using a dynamic setting explicitly modeling the effects of social norms and tax morale. Besley et al. (2015), however, do not describe how reputational costs and rewards are connected to the social norms according to which individuals interact. In line with related contributions that study pro-social behavior, in Besley et al. (2015) the strength of social norms is expressed by an exogenous parameter. Our aim is to explicitly model the way reputational costs and benefits enter the utility of taxpayers and *endogenously* evolve with time. In our framework, a particularly important feature of the way reputation affects the utility of individuals is that it depends in each period on the particular social practices of the society we are considering. Specifically, while in Besley et al. (2015) individuals' reputation is affected by their decision to pay or evade taxes in the previous period, in our model the extent of the social cost/benefit on a dishonest/honest individual depends on how widespread the phenomenon of tax evasion is in the society.[14]

Second, previous literature studies long-run equilibria employing standard adaptive dynamics. In our model, instead, the dynamic development of tax evasion is described in the form of evolutionary

[11]The literature provides contributions attempting to estimate the existence and effects on tax compliance of cultural differences in an international context. Andrighetto et al. (2016), comparing evidence from a tax experiment in Italy and in Sweden, find country-specific styles of dishonesty, with Italians more prone to "fudging", while Swedes were more likely to be perfectly honest or perfectly dishonest. Another experiment involving Italian and British students by Lewis et al. (2009) shows that Italian students declared less than UK students. A recent experiment by Zhang et al. (2016) seems however to question this difference in compliance culture between UK and Italy. Empirical evidence, based on survey data, of the effects of cultural factors is provided in DeBacker et al. (2015) and Kountouris and Remoundou (2013).

[12]See Turner (1991) for a review of the literature of the evolution of norms proposed in social psychology. Wenzel (2005) also provides evidence that tax morale affects compliance and, more importantly, that compliance in one period can affect tax morale and, consequently, compliance in the next.

[13]See also Nordblom (2017) and, for a review of the contributions on behavioral dynamics of tax evasion, see Pickhardt and Prinz (2014).

[14]This feature of our model is in line with Traxler (2010). However, our framework considers a more complex and realistic set of social norms and reputational effects (see Section 5). In fact, we also consider the possibility that honest/dishonest behaviour can be punished/rewarded by some types of societies.

dynamics.[15] Individuals are boundedly rational[16] and assumed at the beginning to be "programmed" to behave honestly or dishonestly.[17] Through social interaction, agents can over time change their conduct. Whether one or the other (or both) behavior survives in the society is determined by an evolutionary adaptation process, that depends on the expected payoffs of individuals. In standard evolutionary games, it is assumed that individuals are able to compare their expected payoffs to the expected payoffs of the whole population. This is somewhat implausible when considering the decision to evade taxes of an individual. It seems more plausible, instead, to imagine that an individual will be able to compare his/her payoffs with the payoffs of those individuals with whom he/she has been socially interacting. This is in line with those contributions in the literature that stress the importance of network formation and the way the network of relationships may influence individuals' conduct.[18] In our model, we consider a *word of mouth* process where in each period one individual meets another. If both individuals are of the same type (honest/dishonest), then they have no information to wage the advantages of choosing a different behavior. However, if an individual meets a taxpayer of a different type, then they can learn and possibly change their behavior. The probability of facing a tax evader will depend on the level of tax evasion in a certain period.

Finally, in contrast to the theoretical contributions above, we explicitly describe a progressive tax system with two bands and two tax rates. This allows us to study what is the effect on the dynamics of tax evasion of changes in tax rates and the possibility of reform toward a flat rate system. This feature of our model helps us to acquire a better understanding of the effects that have been produced by recent reforms in various countries, with a particularly important example provided by Russia. In 2001 a progressive tax system with rates 12%, 20%, and 30% was replaced in Russia by a flat tax rate of 13%. Interestingly Gorodnichenko et al. (2009) empirically showed that the reform produced a reduction in tax evasion. Our model can help explain this result.

Our dynamic analysis shows that the existence and the attributes (including stability) of the long-run equilibria defining the level of tax evasion in a country significantly depend on the parameters that describe tax morale, social norms, and reputational effects. In addition, the dynamic trajectories of the evolution of tax evasion depend on the initial conditions of the model. This implies that two (both economically and socially) identical countries may experience very different levels of tax evasion in the long run if the initial levels of evasion differ significantly. Supported by these results, the paper shows that the social norms and framework where tax evasion takes place play a very important role in guiding individuals' actions. This result produces two important implications.

First, policymakers should consider reforms that would modify social awareness, social norms, and reputational incentives, including explicitly rewarding honest behavior, rather than (or in addition to)

[15]Antoci et al. (2014) is another work where evolutionary dynamics are employed to study tax evasion. The model, however, takes the form of a public good game, where an individual has to decide whether to contribute to the public good (i.e., comply) or free ride (i.e., evade) and payoffs are represented by parameters. The paper, therefore, does not model the role and evolution of social norms and does not describe any particular fiscal regime (tax rates, income and social/auditing costs are not explicitly included in the model).

[16]Previous behavioural economics contributions considering tax evasion have replaced full rationality by bounded rationality with respect to time discounting (see Chorvat, 2007), prospect theory (see Dhami & al Nowaihi, 2007) and the framing of the tax (see Copeland & Cuccia, 2002).

[17]Frey (1999) shows that in a population there may be taxpayers who do not look for opportunities to evade taxes. On similar lines, Long and Swingen (1991, p. 130) argue that some individuals are not naturally predisposed to evade taxes. This is in line with experimental evidence that shows that some individuals never choose to evade taxes (see Feld & Tyran, 2002), even in the absence of enforcement.

[18]See, for example, Sutcliffe et al. (2012) and van Dolder and Buskens (2014).

more (financially and politically) expensive standard fiscal instruments.[19] Feld et al. (2006) and, more recently, Brockmann et al. (2016) provide experimental evidence on the effects of reward on tax evasion. Feld et al. (2006) also provide anecdotal evidence that forms of rewards for honest taxpayers have been already introduced in some Asian countries. In Japan, if found honest, taxpayers can be offered to have a picture taken with the Emperor. In the Philippines, the names of honest taxpayers can be entered in a lottery and in South Korea, honest taxpayers may be rewarded with certificates and awards.

Second, it is essential to carefully understand the social norms of a country and in particular, the effects that tax reforms may produce depending on the particular social framework. In other words, simply replicating tax reforms that have proved to be successful abroad may produce unexpected and perverse long-run effects in another country.

The paper is organized as follows. Section 2 introduces the model. Section 3 describes some policy implications based on comparative statics analysis. Section 4 describes the dynamic analysis. Section 5 generalizes the analysis and our treatment of tax morale discussing how the results are affected by introducing different classes of social norms representing different societies and cultures. Section 6 concludes.

2 | THE MODEL

Consider a population of taxpayers. Suppose that there are only two possible levels of income, $0 < Y_L < Y_H$, that can be earned. We normalize the size of the population of high-income earners to 1 and we denote by $\gamma \geq 0$ the size of the population of low-income earners.

Suppose that a progressive tax system is in place, with tax rates $0 < t_L < t_H < 1$. Taxpayers need to report their taxable income. Agents who report income Y_L pay taxes $t_L Y_L$, while agents who report income Y_H pay taxes $t_L Y_L + t_H \left(Y_H - Y_L\right)$. Obviously, low-income agents have no incentive to report a level of income other than Y_L. High-income taxpayers, however, may find desirable to evade taxes reporting a level of income equal to Y_L. Let us define by $r \in [0, 1]$ the portion of high-income agents who decide to evade taxes. Suppose that with probability $p \in [0, 1]$ an agent who has reported income Y_L is audited by the tax authority. Let us also assume that, if audited, a dishonest agent is found guilty with certainty. If high-income agents have truthfully reported their income Y_H, then they have clearly acted honestly and, if the tax authority decided to reward honest behavior by publishing the list of honest high-income taxpayers, they could enjoy a positive reputational effect. We assume that this reputation effect increases as the share of dishonest agents in the population increases.[20] Specifically, the reputational benefit for being proved honest is

$$r\zeta$$

[19]Filippin et al. (2013) use microdata on opinions about taxation included in the Survey on Household Income and Wealth in Italy in 2004. The results suggest that tax enforcement affects tax morale. Lago-Peñas and Lago-Peñas (2010) find that a high tax burden makes the taxpayers feel entitled to evade.

[20]The set of social norms and reputational effects described here is clearly a simplification, but it does provide important insights to the problem that will be described in Sections 3 and 4. In Section 5 we shall consider how results may change when different and more realistic classes of social norms and tax morale are introduced, including scenarios in which dishonest/honest behavior is rewarded/frowned upon by society. In addition, notice that our set up explicitly focuses on the impact of social norms based on the behavior (honest/dishonest) of taxpayers. Indeed, it may be the case that the effects of social interaction may be also influenced by income comparisons, where negative or positive effects could be created by learning about income differentials. For tractability and simplicity, we do not address this possibility in this paper, but we leave it as a venue for future research.

with $\zeta \geq 0$. If, instead, a high-income agent, who has reported income Y_L, is audited and charged with tax evasion, (s)he will have to pay a fine equal to M on top of the increment in taxes $t_H\left(Y_H - Y_L\right)$. Being found guilty of tax evasion may have also a negative effect on the utility of the tax evader because of social reputational costs. We assume that this social shaming effect increases as the share of honest agents increases.[21] Specifically, the reputational cost for the dishonest agent is equal to

$$(1-r)\,\theta$$

with $\theta \geq 0$.

Considering reputation and shaming effects, the (certain) utility of an honest high-income taxpayer is

$$U_h = Y_L\left(1-t_L\right) + \left(Y_H - Y_L\right)\left(1-t_H\right) + r\zeta$$

whereas the utility of a dishonest high-income taxpayer is

$$U_d = \begin{cases} U_{dN} = \left(Y_H - Y_L t_L\right) & \text{if not audited} \\ U_{dA} = Y_L\left(1-t_L\right) + \left(Y_H - Y_L\right)\left(1-t_H\right) - M - \theta\,(1-r) & \text{if audited} \end{cases}$$

The (certain) utility of a low-income agent is

$$U_L = Y_L\left(1-t_L\right)$$

Given the utilities described above, we shall study an evolutionary game in which the portion of the population of high-income agents who decide to evade taxes is updated in every period according to the word of mouth dynamics. Specifically, timing unravels as follows. At the beginning of each period, all agents report their income and pay taxes. With probability p, low-income agents are audited by the tax agency.[22] After auditing has taken place, two agents are randomly selected and matched by nature from the population. The two selected agents socially interact and learn whether the agent they have been put in contact with has been audited and whether (s)he has been found guilty of tax evasion. In the next section, we discuss the existence and the nature of interior equilibria. In Section 4, we shall study the dynamics.

3 | COMPARATIVE STATICS ANALYSIS

As we explained above, only high-income individuals can consider dishonest behavior. The expected utility, at time t, of a dishonest high-income agent is

$$\mathbb{E}\left[U_d\right] = pU_{dA} + (1-p)\,U_{dN} \tag{1}$$

whereas the expected utility, at time t, of a honest high-income agent is

$$\mathbb{E}\left[U_h\right] = U_h \tag{2}$$

[21] In line with Frey and Torgler (2007) and Traxler (2010) we assume that tax morale and, in particular, the reputational effects of social norms depend on the degree of compliance in a country.

[22] No agents who have reported income Y_H will be audited, since they are clearly behaving honestly.

For easing the notation, denote the difference in expected utilities by

$$y(r) = \mathbb{E}\left[U_d\right] - \mathbb{E}\left[U_h\right] \tag{3}$$

Function $y(r)$ is often referred to as the "score" function.[23] Expected utilities from the two behaviors are equal for a fraction r^* when $y(r^*) = \mathbb{E}\left[U_d\right] - \mathbb{E}\left[U_h\right] = 0$, which gives the unique possible equilibrium of the system

$$r^* = \frac{p(M+\theta) - (1-p)\, t_H \left(Y_H - Y_L\right)}{\theta p - \zeta} \tag{4}$$

Note that $r^* \in (0,1)$ in the following cases:

CASE 1: $\widehat{t}_H < t_H < \widehat{t}_H$ with $0 < \zeta < \theta$ and $\frac{\zeta}{\theta} < p < 1$; or

CASE 2: $\widehat{t}_H < t_H < \widehat{t}_H$ with $0 < \theta < \zeta$ or with $0 < \zeta \leq \theta$ and $0 < p < \frac{\zeta}{\theta}$, where

$$\widehat{t}_H := \frac{pM + \zeta}{(1-p)\left(Y_H - Y_L\right)} \tag{5}$$

$$\widehat{t}_H := \frac{p(M+\theta)}{(1-p)\left(Y_H - Y_L\right)}$$

Notice that $r^* = 0$ for $t_H = \widehat{t}_H$ and $r^* = 1$ for $t_H = \widehat{t}_H$.

In the next section, we study the dynamic stability of the system and show that only in case 2 above an interior equilibrium $r = r^* \in (0,1)$ may be (locally asymptotically) stable. We, therefore, focus now our attention on the parameter configurations indicated by case 2 and comment on the nature of the interior equilibrium in (4).

It is easy to show that the sign of $\frac{dr^*}{dM}, \frac{dr^*}{d\theta}, \frac{dr^*}{d\zeta}, \frac{dr^*}{dp}, \frac{dr^*}{dY_H}, \frac{dr^*}{dY_L}$ is negative and $\frac{dr^*}{dt_H}$ is positive.

This simple comparative statics analysis produces already interesting indications. First, $\frac{dr^*}{dt_H} > 0$ implies that an increase in the tax rate for the wealthier group of individuals increases tax evasion. In other words, a higher tax rate makes tax evasion more profitable for individuals. This is intuitive. Nonetheless, our result stands in contrast to previous theoretical contributions showing that tax evasion tends to decrease if the tax rate increases (see Yitzhaki, 1974). A consequence of this result is that if the high tax rate is lowered, to the limit, to match t_L, introducing in other words a flat rate system, then ceteris paribus tax evasion would decrease.

$\frac{dr^*}{dM} < 0$ and $\frac{dr^*}{dp} < 0$ show that standard auditing instruments to fight tax evasion may be effective. These instruments, however, usually come at a cost for every government. For this reason, the fact that $\frac{dr^*}{d\theta} < 0$ and $\frac{dr^*}{d\zeta} < 0$ is very important. Policies and public campaigns that increase social awareness towards tax evasion and citizenship may be a cheaper (financially and politically) and, nonetheless, effective alternative to auditing. In this sense, approaches that consider *naming and shaming* tax evaders or, perhaps, more importantly, commending honest individuals may be desirable.

[23]The difference of expected utilities between different agents is meaningful as we assumed that they are ex-ante identical.

4 | WORD OF MOUTH

In this section, we endogenize r, the fraction of high-income agents who decide to evade taxes, which is the state variable of our model. In line with the standard approach of evolutionary dynamics, individuals are assumed to be boundedly rational; a portion of high-income individuals is naturally inclined to evade taxes according to some (state-dependent) probability.[21] Because of their bounded rationality, individuals with identical income and utility may decide to take opposite decisions in terms of tax evasion. The setup implicitly assumes that each period agents are randomly matched in pairs and through this matching they learn about pay-off differentials, if any. This random match, applied to a sufficiently large population, makes it reasonable to assume that at time t the probability of being dishonest is approximated by the fraction r of dishonest agents in the population at that time. Then, this probability is updated according to the expected utilities from the two possible behaviors (honest or dishonest), as specified below. An updated fraction of high-income agents that will evade taxes at time $t+1$ is obtained. We model the dynamics within the *word of mouth* evolutionary framework, see Dawid (1999).

The effective income earned and the income reported by individuals in a population are not directly observable by other agents. The income and honesty of an individual are made public only after an audit or after the tax authority has published the list of high-income taxpayers. Otherwise, only social interaction can allow individuals to learn about the utility of other agents. Suppose that at each (discrete) time period two (high-income) agents meet and compare their positions. If both agents have the same behavior (either both honest or both dishonest), they have the same utility and no need for switching behavior arises. However, if one honest taxpayer meets a dishonest taxpayer, they could reconsider their behavior according to the utility obtained by the other agent. Thus, an honest agent may change her mind if she meets a dishonest and their utility is different. Clearly, the higher the difference is between the dishonest and the honest's utility, the more likely the honest will become dishonest. Define by Φ the probability of switching behavior from honest to dishonest given that $U_d \geq U_h$, and denote it by $\Phi\left(U_d - U_h\right)$:

$$\Phi\left(U_d - U_h\right) = \mathbb{P}\left(h \to d | U_d \geq U_h\right)$$

Φ, being a probability distribution function, is non-decreasing in its argument $y = U_d - U_h$ with[22]

$$\lim_{y \to -\infty} \Phi(y) = 0$$

$$\lim_{y \to +\infty} \Phi(y) = 1$$

The probability $p_{h \to d}$ that an honest individual becomes dishonest is given by the probability that an honest individual meets a dishonest agent, which is r, times the probability Φ to change behavior, namely

$$p_{h \to d} = r\Phi(y)$$

[21]Here we explain the evolutionary dynamics along the lines of the classical biological interpretation of replicator dynamics. A similar modeling structure has been employed in evolutionary oligopolies to investigate competition where players have different information sets or different objective functions, see Droste et al. (2002), Bischi et al. (2015), Cerboni Baiardi et al. (2015), Kopel et al. (2014).

[22]Note that the difference in utility in the model is always bounded. For completeness, the asymptotic properties of $\Phi(y)$ described here provide a general presentation of the word of mouth mechanism.

from which it follows that the probability to remain honest is $p_{h\to h} = 1 - p_{h\to d}$. Analogously, a dishonest agent can become honest with a probability given by the probability that (s)he meets an honest individual, which is $(1 - r)$, times the probability Ψ that a dishonest individual becomes honest, given the difference in utilities $U_h - U_d$. Clearly, $\Psi(-y) = 1 - \Phi(y)$, so that the overall probability that a dishonest individual becomes honest is

$$p_{d\to h} = (1 - r)\left[1 - \Phi(y)\right]$$

with an obvious meaning of the notation. Finally, it is $p_{d\to d} = 1 - p_{d\to h}$.

Suppose that the matching between agents of the population is uniform and that a large number of sampling from the population is taken. The average utility difference of the two behaviors is well approximated by the expected difference (3).

From now on, we denote by r_t the fraction of dishonest taxpayers, where t emphasizes its time dependence. Because of the reputational effects of auditing, the expected payoffs are functions of the fraction r_t, that is, $\mathbb{E}\left[U_d\right] = \mathbb{E}\left[U_d\left(r_t\right)\right]$, $\mathbb{E}\left[U_h\right] = \mathbb{E}\left[U_h\left(r_t\right)\right]$ and $y = y\left(r_t\right)$.

The dynamics of the probability r_t is then:

$$r_{t+1} = r_t + \underbrace{\left(1 - r_t\right) p_{hd}}_{\text{share of honest agents becoming dishonest}} - \underbrace{r_t p_{dh} r_t p_{dh}}_{\text{share of dishonest agents becoming honest}} \tag{6}$$

$$= r_t + r_t\left(1 - r_t\right)\Phi\left(y\left(r_t\right)\right) - r_t\left(1 - r_t\right)\left[1 - \Phi\left(y\left(r_t\right)\right)\right].$$

which can be rewritten as the unidimensional map

$$r_{t+1} = r_t\left[1 + \left(1 - r_t\right) G\left(y\left(r_t\right)\right)\right] \tag{7}$$

where $G(x) = 2\Phi(x) - 1$. Equation (6) can be described as a balance equation: the fraction of dishonest agents at time $t + 1$, r_{t+1}, is increased by the expected fraction of agents that decide to become dishonest, $\left(1 - r_t\right) p_{h\to d}$, and decreased by the expected fraction of agents that decide to become honest, $r_t p_{d\to h}$. G inherits from Φ the following properties:

$$\lim_{y\to -\infty} G(y) = -1$$

$$\lim_{y\to +\infty} G(y) = 1$$

Moreover, being Φ a probability distribution function, by assuming unimodality and symmetry of the corresponding density function, the following assumptions on G hold:

1. $G(0) = 0$;
2. G is odd (symmetric with respect to 0);
3. G is increasing;

4. G is convex in $(-\infty, 0)$ and concave in $(0, +\infty)$;
5. G is differentiable at least in $y = 0$.[23]

For a given $r_t \in (0, 1)$ it is $r_{t+1} > r_t [<]$ if and only if $G\left(y\left(r_t\right)\right) > 0 [< 0]$. By monotonicity of $G(.)$, the sign of $G(.)$ coincides with the sign of $y(r)$, so that an increment (decrement) in the share r occurs if and only if $y(r) > 0$ [< 0]. Hence, the dynamical system (7) is a particular example of *monotone selection dynamics*, see Cressman (2003) and Weibull (1995) for details.

4.1 | Dynamics

This section is devoted to the analysis of the system (7), which models the dynamics of the fraction of high-income dishonest agents. Map (7) admits two kinds of fixed points:

- boundary equilibria, $r^0 = 0$ and $r^1 = 1$;
- inner equilibria, which are any $r^* \in (0, 1)$ such that $y(r^*) = 0$, that is, such that expected utilities of behaving honestly or dishonestly are equal, $\mathbb{E}\left(U_h\right) = \mathbb{E}\left(U_d\right)$, see (4).

On one hand, boundary equilibria exist for all parameter values and correspond to monomorphic population configurations where all high-income agents are honest ($r_0 = 0$) or dishonest ($r_1 = 1$). On the other hand, the inner equilibrium r^* in (4) only exists when the tax rate t_H belongs to given intervals, as we remarked before, see (5); r^* corresponds to a polymorphic configuration of the population of high-income taxpayers where both honest and dishonest agents are present. Proposition 1 reports on the stability of the inner equilibrium (the proof is based on the linearization of the map and available upon request).

Proposition 1 Consider the adjustment dynamics modelled by map (7) and the thresholds levels $\widehat{t}_H$ *and* $\widehat{t}_H$ in (5).

The inner equilibrium r^* *in (4) is asymptotically stable with a basin of attraction* $\mathscr{B}(r^*) = (0, 1)$ iff $\widehat{t}_H < t_H < \widehat{t}_H$ *and either* $\zeta > \theta > 0$ *or* $0 < \zeta \leq \theta$ *with* $0 < p < \frac{\zeta}{\theta}$ *and the following "non-overshooting" condition holds:*

$$G'(0) \in \left(0, \frac{2}{(1 - r^*)\, r^* \,(\zeta - p\theta)}\right) \tag{8}$$

At $G'(0) = \frac{2}{(1-r^*)r^*(\zeta - p\theta)}$, *equilibrium* r^* *looses stability through a period-doubling bifurcation, with the appearance of cyclic or chaotic motion as parameter* $G'(0)$ *is further increased.*

An interior equilibrium, where only a portion $r^* \in (0, 1)$ of the population decides to evade taxes can be meaningful and stable only for intermediate values of t_H and $\zeta > p\theta$. An intermediate t_H ensures that a portion of the population in equilibrium may find it profitable to evade and at the same time the

[23] A possible specification for for $G(x)$ is $G(x) = \frac{2}{\pi}\arctan\left(\frac{\lambda}{2}\pi x\right)$, see Bischi et al. (2009), where $\lambda = G'(0) > 0$ is a parameter that model the intensity of choice, i.e., in our context the *willingness to change behavior* from honest to dishonest for chasing utility differential $y(r)$ over time. This functional form satisfies all the required assumptions to be employed in (7). We shall adopt this specification in the numerical analysis provided in Section 5.

remaining portion may find it optimal to pay taxes honestly. In addition, it is necessary that $\zeta > p\theta$ for $r^* \in (0, 1)$ to be a stable equilibrium. In other words, only a system that has in place social norms that prioritize commending and nurturing honest behavior rather than naming and shaming tax evasion can reach a stable interior equilibrium. If instead $\zeta < p\theta$, in the long run, the system will converge to full honestly or full tax evasion, depending on the particular original value of r.

An implication of Proposition 1 is that, regardless of the benefits/costs created by social norms and pro-social behavior, the system may reach corner solutions for extreme values of the tax rate t_H. This is intuitive. If t_H is sufficiently low, then the expected pay-off of those individuals who honestly pay taxes is higher compared to the pay-off of those who evade taxes. In the long run, the system will converge to a stable equilibrium in which all individuals would pay taxes. The other extreme is produced when t_H is sufficiently high, with all individuals evading taxes. These two extremes show how changes in tax rates may have short-run positive effects on tax revenue collection, but they may also bring catastrophic long-run effects.

A final comment before moving to a discussion of the effects of tax morale and more realistic types of social norms. We argued that, regardless of the benefits/costs created by social norms and pro-social behavior, a level of t_H sufficiently low would ensure low or no tax evasion in the long run. As long as $t_L < max\left[\widehat{t}_H, \widehat{t}_H\right]$, then a reduction in t_H would produce an evolutionary path towards a reduction of tax evasion. Indeed, for $t_L < max\left[\widehat{t}_H, \widehat{t}_H\right]$, allowing $t_H \to t_L$ (in other words introducing a flat rate $t = t_H = t_L$) would ensure that a strictly positive portion of the population will pay taxes honestly. In addition, this honest portion of the population will be higher the lower will be the flat rate. This result provides a dynamic and behavioral explanation of the experimental evidence provided by Heinemann and Kocher (2013).

5 | SOCIAL NORMS AND TAX MORALE

The social rewards/costs that we have considered so far implicitly assumed a very specific configuration of social norms. In this section, we provide a more general and realistic description of society and we explicitly model social norms in the rewards and costs experienced by individuals.

Honest taxpayers now internalize in their utility function the following social rewards/costs

$$R_h = \zeta \{r + K[(\beta - r) r - r]\}$$

where $\zeta > 0$, $K \in [0, 1]$ and $\beta \geq 0$. In Section 4, we effectively considered the case $K = 0$. In what follows, we assume $K = 1$ and disregard intermediate values of K for which the results are analogous to the case $K = 1$. ζ describes again the scale of the social effect of being identified as an honest agent. However, the extent of the social effect now depends also on social norms as described by parameter β. Specifically, β describes the extent of the level of society's appreciation for honest behavior. Indeed, notice that if $\beta \geq 2$, then R_h is monotonically increasing in r. This scenario describes a society in which honest behavior is more rewarded the higher is the level of tax evasion in the population. In other words, this social effect increases as the share of dishonest agents in the population increases. Qualitatively this scenario replicates the same society that we have studied in Section 4. If $\beta < 2$, however, R_h is maximized for some value of r between 0 and 1. The model now describes a society where honest taxpayers obtain a positive social reward that increases in r only if a small portion of the population engages in tax evasion. However, if r is sufficiently large ($r > \beta/2$), then honest behavior (seen as an action against conformity to social practices) tends to be less

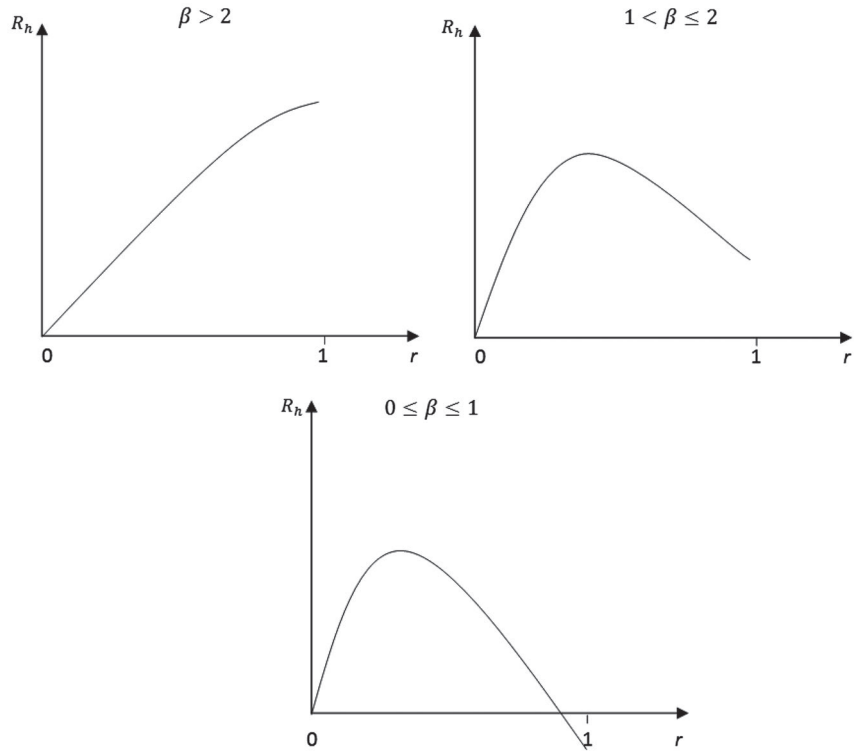

FIGURE 1 Benefit of an honest reputation as a function of social practices (r) in relation to social norms (β)

appreciated by society.[27] Eventually, for β sufficiently small ($\beta < 1$) and r relatively large ($r > \beta$), honest behavior will be disliked by society, which may now assign a social cost to honest taxpayers. In this scenario, honest individuals are effectively discriminated for going against the majority of the population.

Social norms can also affect the social cost of dishonest agents. Suppose that the social cost of being found guilty of tax evasion is now equal to

$$R_d = -\theta \{(1 - r) + K [(\beta - r) - (1 - r)]\}$$

with $\theta > 0$ describing again the scale of the social effect of being identified as a dishonest agent. Similar to the case of honest agents, we shall focus on the case where $K = 1$. Social norms towards tax evasion are again described by parameter β. A β sufficiently large ($\beta \geq 1$) describes a society that clearly dislikes dishonest behavior and, therefore, R_d represents the disutility experienced by dishonest individuals for any value of r. In addition, notice that the social cost of tax evasion is highest when the dishonest agent operates in an environment in which most individuals honestly pay taxes. Interestingly, a smaller $\beta(\beta < 1)$ would describe, instead, a society more lenient toward tax evasion. If only a small portion of the population evades taxes ($r < \beta$), dishonest individuals still obtain a negative social effect. However, if tax evasion is a more widespread phenomenon in society ($r > \beta$), then dishonest individuals may even obtain a positive social reward. In other words, they have recognized a "smart" and the conformity of their actions to the practices of the majority of society is rewarded (see Figures 1 and 2).

[27]The fact that social costs/rewards may be influenced by the way an individual's behavior conforms to the practices of a society is known as *normative social influence* in social psychology literature. See, for example, Terry and Hogg (2001).

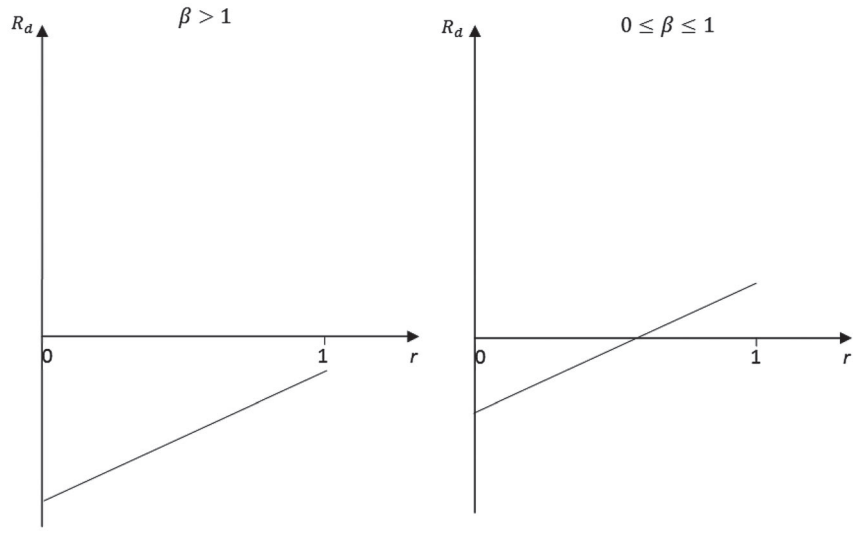

FIGURE 2 Effects of an dishonest reputation as a function of social practices (r) in relation to social norms (β)

Now we consider the effects that tax morale may have on the dynamics of compliance and show that indeed tax morale may play a critical role in determining the long-run equilibrium. Let us assume that honest taxpayers[24] experience an extra utility arising from tax morale of the form.

$$\alpha t_H \left(Y_H - Y_L\right)$$

where $\alpha \in [0, 1]$. A value of $\alpha > 0$ denotes a positive tax morale, that is, the taxpayer obtains an extra benefit from paying high taxes, for example, because of its contribution to society.[29] We can now rewrite the utilities of a high-income taxpayer as follows:

$$\tilde{U}_h = Y_L \left(1 - t_L\right) + \left(Y_H - Y_L\right) \left(1 - t_H + \alpha t_H\right) + \zeta r \left(\beta - r\right)$$

whereas the utility of a dishonest high-income taxpayer is

$$U_d = \begin{cases} \%\tilde{U}_{dN} = U_{dN} = \left(Y_H - Y_L t_L\right) \text{ if not audited} \\ \tilde{U}_{dA} = Y_L \left(1 - t_L\right) + \left(Y_H - Y_L\right) \left(1 - t_H\right) - M - \theta \left(\beta - r\right) \text{ if audited} \end{cases}$$

Similarly to our analysis in Section 4, the expected utility of an dishonest agent is given by

$$\mathbb{E}\left[\%\tilde{U}_d\right] = p\tilde{U}_{dA} + (1 - p)\,\tilde{U}_{dN} \tag{9}$$

whereas the expected utility of a honest agent reads

$$\mathbb{E}\left[\%\tilde{U}_h\right] = \tilde{U}_h \tag{10}$$

[24]It seems reasonable to assume that only honest taxpayer can experience some form of tax morale, while dishonest individuals would not be concerned with the way they perceive paying taxes.

[29]In principle, we could have cases in which $\alpha < 0$, denoting a negative tax morale, i.e., paying high taxes is perceived as a waste of money. We disregard these cases in this paper.

Also in this case word of mouth dynamics of the form (7) always admit the boundary states $r^0 = 0$ and $r^1 = 1$ as equilibria of the model. However, with tax morale and social costs, there are two possible inner equilibrium shares of dishonest agents satisfying an isoutility condition where the score function

$$y(r) = \mathbb{E}\left[\%\tilde{U}_d\right] - \mathbb{E}\left[\%\tilde{U}_h\right] \tag{11}$$

is zero. By solving equation $y(r) = 0$ with respect to r, we obtain the two equilibrium shares

$$r^*_{1,2} = \frac{\beta\zeta - \theta p \pm \sqrt{4\zeta M p + (\beta\zeta + \theta p)^2 + 4(\alpha - 1)\zeta(1-p)t_H\left(Y_H - Y_L\right)}}{2\zeta} \tag{12}$$

In what follows we provide a qualitative description of the dynamics of map (7) with score function defined in (11). The results of numerical analysis are based on the simple functional form for $G(y(r))$ previously employed by Bischi et al. (2003a, 2003b) and Bischi et al. (2009), see footnote [6] for details. Notice, however, that the qualitative properties of the dynamics considered here do not depend on the exact specification of $G(y)$, but on the form of the utility differential $y(r)$. Thus, a functional form such as the one in footnote [6] is just a useful way to obtain in the explicit form a dynamical system that models switching from honest to dishonest behavior and vice-versa.

Let us start the analysis by a diagrammatic exercise that summarizes typical transition scenarios of the model as parameters are varied. Figure 3 provides four cobweb plots on the plane (r_t, r_{t+1}) of word of mouth dynamics (7), where the parameter values are $Y_L = 35$; $Y_H = 115$; $M = 5$; $t_L = 15\%$; $t_H = 45\%$; $\gamma = 1$; $p = 0.8$; $\theta = 0.1$; $\zeta = 1.2$; $\beta = 0.6$ and $\lambda = 25$. We consider in the four plots the same three initial conditions: 5% (red); 25% (grey) and 50% (blue) of dishonest agents and the effect of increasing tax morale through parameter α.

a. The top left plot has $\alpha = 0.4$. The plot shows that in the long run, regardless of the initial conditions, the system converges to the boundary equilibrium in which all agents are dishonest. Inner equilibria $r^*_{1,2}$ in (12) are not feasible (they are not real numbers) for these parameter values.
b. The top right plot depicts a cobweb diagram with the same parameters of plot (a) except for $\alpha = 0.426$. The increase in α causes a fold bifurcation where the equilibria $r^*_{1,2}$ in (12) are created. In this case, trajectories with initial conditions below the threshold given by the inner steady state just created converge to it, whereas trajectories with initial conditions above the threshold converge to $r^1 = 1$ (where all individuals are dishonest in the long run).
c. The bottom left plot describes a further increase in α, which is now $\alpha = 0.428$. Here $r^*_1 \approx 15.51\% < r^*_2 \approx 37.82\%$, see (12). For these parameter values the lower equilibrium r^*_1 is stable (here overshooting around equilibrium does not occur, since parameter λ is sufficiently low) and the basin of attraction of r^*_1, that is, all initial conditions of the share of dishonest agents, whose trajectories eventually converge to r^*_1, is $\mathscr{B}\left(r^*_1\right) = \left(0, r^*_2\right)$. Notice that trajectories starting with 5% and 25% of dishonest agents converge to r^*_1, while trajectories with initial conditions above r^*_2 converge to $r^1 = 1$ (e.g., the depicted trajectory with 50% of dishonest as an initial condition).
d. The bottom right plot describes the effects of a further increase in tax morale α. Specifically, parameters are the same as in case (c), except for $\alpha = 0.55$. An increase in α produces two transcritical bifurcations (i.e., r^*_1 and r^*_2 are real numbers, but they do not belong to the set $(0, 1)$). This further increase in tax morale induces the system to converge to the boundary equilibrium in which no individual evades taxes.

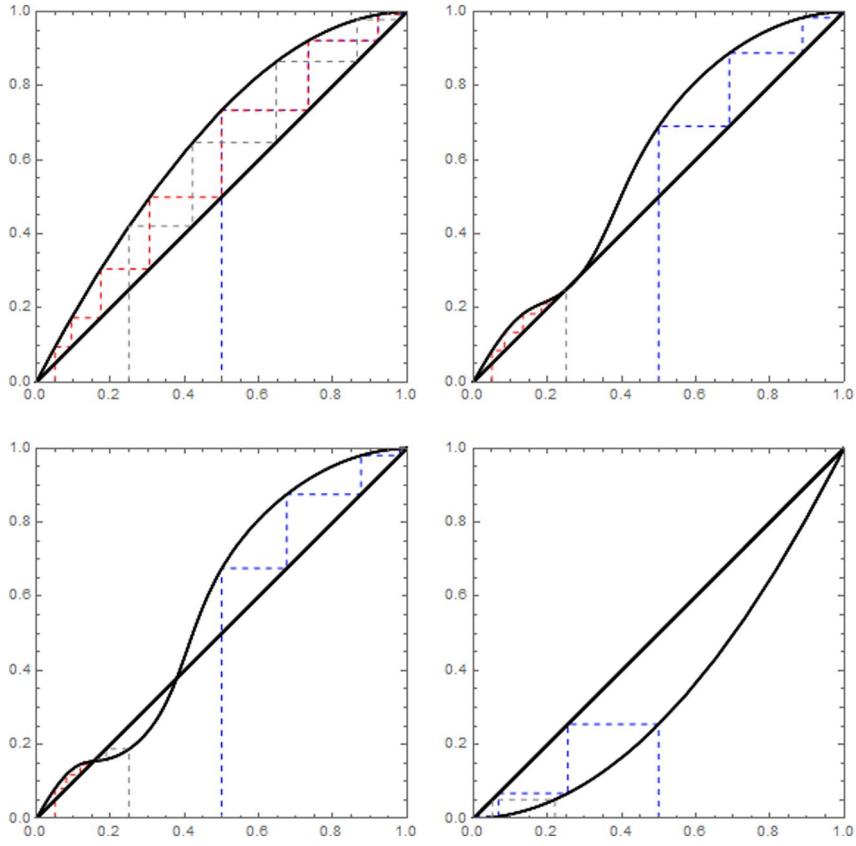

FIGURE 3 Cobweb plots of map $r_{t+1} = r_t\left[1 + \left(1 - r_t\right) G\left(y\left(r_t\right)\right)\right]$ with $G\left(y\left(r\right)\right) = \frac{2}{\pi}\arctan\left(\frac{\pi}{2}\lambda y\left(r\right)\right)$. Parameter values: $Y_L = 35$; $Y_H = 115$; $M = 5$; $t_L = 15\,\%$; $t_H = 45\,\%$; $\gamma = 1$; $p = 0.8$; $\theta = 0.1$; $\zeta = 1.2$; $\beta = 0.6$ and $\lambda = 25$. (a) Top left $\alpha = 0.4$. (b) Top right $\alpha = 0.426$. (c) Bottom left $\alpha = 0.428$. (d) Bottom right $\alpha = 0.55$ [Colour figure can be viewed at wileyonlinelibrary.com]

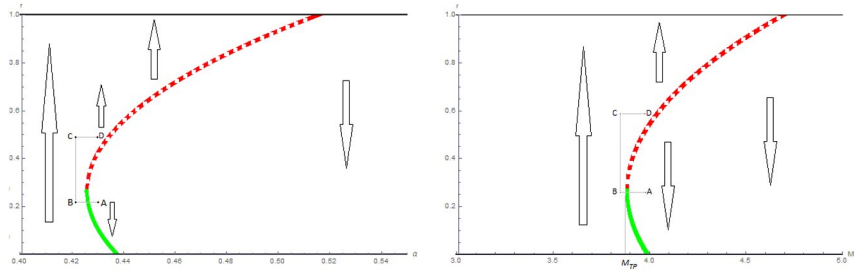

FIGURE 4 Bifucation diagram of map (7) with parameters $Y_L = 35$; $Y_H = 115$; $t_L = 15\backslash\%$; $t_H = 45\backslash\%$; $\gamma = 1$; $p = 0.8$; $\theta = 0.1$; $\zeta = 1.2$; $\beta = 0.6$ and $\lambda = 25$. (a) left: $M = 5\alpha \in [0.4, 0.55]$; (b) right: $\alpha = 0.55$ and $M \in [3, 5]$ [Colour figure can be viewed at wileyonlinelibrary.com]

The various dynamics here described can also be appraised by observing the bifurcation diagrams in Figure 4, where stable equilibria are depicted as solid curves and unstable equilibria as dashed ones. Figure 4a (left plot) is obtained with the same set of parameters of Figure 3a–c and with α varying in the interval $[0.4, 0.55]$, whereas Figure 4b (right plot) presents a bifurcation diagram with the same

parameters as Figure 4a, but with $\alpha = 0.55$ and with M, the fine imposed to dishonest agents after auditing, ranging in the interval $[3, 5]$.

The plots in Figure 4 show how the variation of a parameter in a given interval (here an increment in α or in M) can produce transitions from cases where tax evasion tends to rise over time to cases where the opposite occurs, as the intuition would suggest; for intermediate values of the varying parameter (α and M, respectively), one or two equilibria of the type $r^*_{1,2}$ in (12) may exists.

The plots reported in Figures 3 and 4 provide important policy insights.

First, tax morale (represented in our model by parameter α) plays a critical role in defining the long-run level of tax evasion in a society.[25] Traditional fiscal/auditing policies in a society that experiences relatively low tax morale will be ineffective and the society will see the level of tax evasion rise with time. If tax morale increases, then the level of tax evasion may converge to equilibria in which only a portion of the population engages in dishonest practices. This implies that forms of social-norms marketing (e.g., information campaigns, moral exhortation, fear-inducing messages, nudging)[26] could prove to be more effective (and less expensive) than standard approaches.

Another important insight provided by the plots in Figures 3 and 4 is that the initial levels of tax evasion are critical to understand the evolution of tax evasion. Consider two economically and socially identical countries. Suppose that these two countries have the same parameter values and for both the evolutionary patterns of tax evasion can be described by plot 3(c) or by Figure 4. If the initial levels of tax evasion differ (e.g., above or below the dashed red curves of Figure 4a or b, such as the points labeled A and D in those plots), however, the two countries will experience very different levels of tax evasion in the long run. This remark produces a very important caveat for those policymakers who may decide to adopt fiscal/auditing policies that have proved to be successful in other countries.

Note, in addition, that the numerical analysis described in Figure 3 shows that the level of tax morale may significantly modify the evolutionary process of the level of tax evasion in a country. The countries described in plots 3(d) and 3(c) are identical, except for the level of tax morale. Starting with plot 3(d), where tax morale is relatively high, we see that in the long run the system sees the whole population acting honestly. If tax morale decreases (perhaps because the government is seen by the population as corrupt and inefficient due to a scandal), the evolutionary process of tax evasion changes dramatically and is now described by plot 3(c). This observation highlights the importance of carefully understanding tax morale and including its effects in the definition of fiscal/auditing policies. Our analysis provides another important caveat. Psychology literature acknowledges that social-norm marketing, unfortunately, does not come without potential drawbacks.[27] In particular, a known problem of social-norm marketing is the possibility of *boomerang effects*, that is, the possibility that the attempt to induce society to modify its social norms may produce perverse effects. For example, a social campaign targeting moral exhortation, if accompanied by fear-inducing messages (for example the threat of forms of *naming and shaming* for dishonest individuals) may change the perception of individuals (who now may see the government as greedy and oppressive) and generate the perverse effect of reducing tax morale (i.e., lowering α).

The bifurcation diagrams in Figure 4 show that the system may exhibit irreversibility, which is a form of *hysteresis* (see Arnold (1992) for details). Let us suppose that the initial state of the system is as in point A of Figure 4a, where a reduction of dishonest behavior tends to occur. Now a reduction in

[25]Here we focus the discussion on tax morale, modeled through parameter α. However, reductions of α lead qualitatively to results that are similar to those obtained by reducing β. which are therefore omitted.

[26]See Schultz (1999), Schultz et al. (2008) and Thaler and Sunstein (2008).

[27]See Schultz et al. (2007).

α takes the system to point B, where dishonest behavior spreads in the society; here, if the policymaker wanted to restore the system to the previous situation, setting α to its initial level could be insufficient to invert the evolutionary tendency towards generalized tax evasion. In fact, in point B the share of dishonest agents tends to increase and it could end up in a point such as C. From this point, the effort to restore α to the initial level brings the system to point D, where the tendency is still to converge to equilibrium $r^1 = 1$ where all agents are dishonest. This irreversibility of the system resembles empirical observations as the poll tax in England discussed in the introduction of this paper.

The diagrams provide also insights regarding the effects of policies related to traditional auditing instruments. Suppose, for example, that α is high enough so that in the long run $r^0 = 0$ is likely to occur. Because of this tendency toward honest behavior, the government may decide to reduce the fine M and take the system to the situation depicted in Figure 4b, where $\alpha = 0.55$ and where changes in the fine M are depicted. For comparison purposes with Figure 4a, start with $M = 4$ and consider a gradual reduction of the fine. The share of dishonest agents rises continuously with the reduction of the fine M (solid curve), but this only occurs up to the *tipping point* at $M_{TP} \approx 3.87$ below which all agents find it more profitable to evade taxes. Thus, small reductions of fines seem to induce small increments of the share of dishonest agents. However, this could hold only *locally*, that is, only for given reductions of the fee and not for all reduction of it. Here, we also find the same kind of irreversibility of the action of the policymaker that we detected in the example of Figure 4a, see the points A, B, C, D, where the discussion regarding hysteresis is similar to the case previously discussed.

6 | CONCLUSIONS

In this paper, we have stressed the importance of taking a long-run perspective and considering dynamic adjustments when studying the effects of policies targeted at reducing tax evasion in a country. We have shown, in particular, that the social norms and the cultural framework where tax evasion takes place may play a very important role in guiding individuals' actions and, ultimately, the long-run extent of tax evasion. In line with OEC recommendations,[28] policymakers should consider adopting forms of social-norms marketing to increase awareness and social incentives and modify taxpayers' conduct. Indeed, standard instruments in the hands of fiscal policymakers may be less effective than forms of social-norms marketing attempting to influence social norms and reputational benefits/costs. We stressed, in particular, the importance for policymakers to start considering and implementing ways to commend and reward honest behavior.

In addition, compared to traditional fiscal instruments, social instruments tend to be less costly both financially (auditing and investigations are in general expensive) and politically (a government that declared to increase auditing effort and tax evasion fines may appear in some circumstances too oppressive and that may have a negative effect on tax morale). The paper also provided an important caveat. Given the importance of social norms, it would be foolish to expect that tax reforms that have been successful in a country will also necessarily produce positive results in another, if the societies in those countries are significantly different. Finally, the model discussed in the paper provides insights regarding the way tax rates may affect compliance. In particular, in contrast to results reported in previous literature, tax evasion tends to decrease when the highest tax rate in a progressive system is lowered. The possibility that lowering the high tax rate may help reducing tax evasion, in the long run, may explain why reforming the system to adopt a flat rate may have a positive effect in increasing the honesty of taxpayers.

[28]See Daude et al. (2012).

The proposed model is deliberately stylized in order to evaluate the effects of social norms and tax morals in a simple analytical context. However, taking a cue from the modeling proposed here, various possibilities for extensions can be considered for future research. First of all, an interesting extension would be to introduce a continuous distribution of income. This would allow us to endogenize agents' decisions in terms of the level of compliance. Specifically, one could consider utility functions for risk-averse agents with the existence of interior solutions in which all agents (including low-income ones) may engage with some form of evasion. Another possibility of extending the model, which can be implemented within the agent-based framework, concerns the presence of interaction between agents with heterogeneous expectations on the level of evasion of the population and/or with dynamics of tax evasion that is dependent on the structure of the agents' social connections in the population. Looking at tax evasion through the lenses of agent-based modeling would not allow us to produce analytical solutions and insights based on comparative statics analysis; however, it would make it possible to directly include in the model more sophisticated forms of social interaction and bounded rationality, such as utility functions with features described by prospect theory. We leave these ideas for future developments of the work.

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