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Nonpecuniary motivations for tax compliance: evidence and network analysis

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Abstract

Tax evasion is a large and growing problem in almost all countries. It reduces available resources for government and limits the capacity for public authorities to implement economic and social policy. Beyond economic motivations, tax evasion has relevant implications on individuals who may adjust their behaviour to cheat on taxes. It may also contribute to generate feelings of unfairness in the population and disrespect for the law. For these and many other reasons, it is essential to understand what motivates individuals to pay taxes. According to the standard model of tax compliance, individuals pay taxes only for economic considerations. However, in the last decades a new strand of literature has recognised that people abstain from tax evasion not only for the expected monetary cost of tax evasion, but also for moral and social considerations.

In this dissertation, we focus on tax morale, social norms, and reputational concerns. The first is commonly defined as a moral obligation to pay taxes. The second can be seen as unwritten rules that prescribe what individuals should and should not do given their social surroundings, while reputational concerns refer to the individuals' willingness to behave pro-socially to protect their social image and/or avoid social stigma.

The contribution of this dissertation to the existing literature is threefold. First, we provide an updated review of the literature on tax compliance, examining separately the reasons that relate to pecuniary and nonpecuniary motivations. Moreover, we review a new strand of literature, which has investigated the role of social networks and communication on tax compliance.

Second, we consider the possibility that being a member of a formal group increases individual's tax morale, focusing on membership in voluntary and/or volunteering organisations. Based on data provided by European Value Survey 2017, we use an ordered probit model to account for the ranking information of the scaled depend variable (tax morale). According to our estimates, group membership is, in general, not correlated with tax morale because of the heterogeneous effects that each group membership exerts on it. However, our findings suggest that memberships of a certain group are significantly correlated with a lower level of individual's willingness to pay taxes.

Finally, we present an agent-based dynamic model of tax compliance in which taxpayers, who live and interact in a network, decide whether to pay or to evade taxes by considering the

expected economic net benefit, the subjective cost (tax morale), and reputation cost (honour and social stigma) of tax evasion. We simulate the model for different values of the parameters and show that the steady-state share of taxpayers is affected by the probability of finding like-minded peers in the reference group, the weight that individuals attribute to reputation, and the share of individuals who update their tax morale (contents published in the *European Journal of Political Economy*)[1]. We also present a variation of the previous agent-based model to focus on the role of the reputational 'costs'. We consider two income-groups whose monetary incentive for tax evasion differ. Our results suggest that in an integrated society, in which individuals interact with all the neighbours, no matter their income, all individuals either evade or pay their taxes. By contrast, a segregated society, in which individuals interact only with neighbours who have the same income, generates obstacles to the diffusion process of information around the network and, as a result, tax evasion and tax compliance might coexist. In both models, we perform simulations to consider the possibility for a fiscal authority to increase tax compliance using the knowledge of the network structure to implement moral or reputational policies. Our numerical simulations show that behavioural strategies could be an effective complement to more traditional policies.

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[1] Di Gioacchino, D. and Fichera, D., 2020. Tax evasion and tax morale: A social network analysis. *European Journal of Political Economy*, 65, p.101922. https://doi.org/10.1016/j.ejpoleco.2020.101922.

Chapter 1 – Literature review on tax compliance

1. Introduction

Tax evasion limits the capacity of governments to raise revenue and conduct economic and social policy. Although precisely quantifying the size of tax evasion and avoidance is difficult, the consensus is that tax evasion is substantial, including in developed countries. According to Murphy (2019), in 2015, the tax gap in the European Union (EU) is estimated to have been € 825 billion per year.[1] Similarly, in 2017, the VAT gap, the only tax gap for which there are comparative estimates for all european countries, is estimated to be approximately €137.5 billion (European Commission, 2019).[2] The existence of evasion is not only connected to large budget deficit, and therefore to lower investments in public goods, but also requires that government allocates physical and economical resources to detect non-compliance, to measure its magnitude and to punish evaders.

In what follows, we examine the main approaches that the theoretical literature has provided to address the puzzle of tax compliance, examining separately the reasons which relate to pecuniary (enforcement) and nonpecuniary (intrinsic motivation and social concerns) motivations and discussing the main evidence from empirical works, field and laboratory experiments.

We also review a new strand of literature which has investigated the role of social networks and communication on tax compliance. This approach has provided new theoretical and empirical tools to address explicitly the role of local interactions among individuals, allowing the investigation of the spillovers from moral suasion, detection, and deterrence policy on tax compliance.

The remainder of this chapter is organized as follows: in section 2, we review the main literature on the pecuniary motivations for tax compliance and their effects on individuals' choice; in section 3, we review the main literature which has focused on the nonpecuniary motivations for compliance, discussing separately the intrinsic motivation, the social motivation and the role of institutions on tax compliance; in section 4, we review the main literature on tax compliance which has introduced the social network analysis; in section 5, we provide some final considerations.

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[1] The percentage of tax gap, expressed as a proportion of expected tax revenue, vary from 7.98% in Luxembourg to 29.51% in Romania. In absolute amounts, the biggest tax gaps are estimated for Italy, France, and Germany (Murphy, 2019).

[2] The VAT gap is the difference between the amount of VAT collected and the estimated amount of VAT theoretically collectable based on VAT rules. The Report estimates that the median gap is 10.1%, varying from the low values of Cyprus (0.6%) and Luxembourg (0.7%) to the largest gaps in Romania (35.5%), Greece (33.6%), and Lithuania (25.3%).

2. Pecuniary motivations

2.1 Theoretical review

The economic analysis of tax decisions can be traced back to the seminal work of Allingham and Sandmo (1972), based on the economics-of-crime approach and on the economics of risk and uncertainty. In their 'classical model' of tax compliance the decision regarding how much income an individual should report is analogous to a portfolio choice where a rational individual maximizes his/her expected return weighting the benefits of successful cheating against the risk of detection and punishment.

In this framework, the individual decision depends exclusively on his/her income, the fine in case of detection, and the audit probability. The model predicts that the chosen level of tax evasion falls when either the penalty rate or the probability of detection is increased, thus individuals pay taxes only because they are afraid of getting caught or penalized if they do not report their income truthfully.

Despite the plausible and productive results of its comparative statics, the model of Allingham and Sandmo (1972) shows two main shortcomings. Firstly, as Yitzhaki (1974) observed, the model predicts that the level of evasion is decreasing in the tax rate. This apparently counterintuitive prediction is a direct consequence of the fine being a multiple of the undeclared taxes.[3]

Secondly, when compared with the probability of detection and the fine rate close to those observed in real economies, the model predicts that all taxpayers should engage in evasion.[4]

In summary, the standard model of tax compliance suggests that enforcement is the only reason for tax compliance and some of its predictions are counterintuitive and often not confirmed by the empirical evidence.

Mainly because of these limitations, there have been several efforts in the literature to extend the standard model of tax evasion in order to provide a more comprehensive theoretical framework adding other factors that motivate individuals to pay taxes, beyond the enforcement variables and risk aversion.

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[3] When the tax rate increases so does the expected cost of evasion suffered by the taxpayers. In the literature this shortcoming is also known as 'Yitzhaki Puzzle'.

[4] Assuming a tax rate equal to 40%, audit probability equal to 2%, and fine equal twice the evade taxes, Alm (2019) shows that, according to the predictions in Allingham and Sandmo (1972), a values of risk aversion near 30 is required to generate an amount of tax compliance comparable with the United States actual experience, although the empirical evidence on the coefficient of relative risk aversion suggests that it ranges between 1 and 2 (Alm, 2019).

Labour Supply

A first theoretical extension to the 'classical model' is provided by Anderson (1977), Pencavel (1979) and Cowell (1981 and 1985), who integrate the standard theory of tax evasion with the conventional theories of labour supply, addressing two main issues. First, to what extent tax evasion and non-declaration of income affect the labour supply decision – i.e. how many hours to work. Second, to what extent tax evasion affects the occupational choice.

The first issue is addressed by Pencavel (1979), who shows that it is difficult to make any prediction on the effect of deterrence factors on tax behaviour in a framework in which individuals have complete freedom in the choice of hours to work and income to report. Pencavel (1979), and Anderson (1977) before him, argues that some assumptions on the values of the relevant parameters are required in order to derive any conclusion when labour supply decision is introduced. However, these restrictions restore almost exactly all the assumptions in the Allingham and Sandmo (1972) model.

On the other hand, Cowell (1981 and 1985) investigates the relationship between tax evasion and occupational choice. In his model, individuals may divide labour time between official market – in which the income must be declared – and unofficial market – in which the income earned is not declared. His comparative statics are coherent with the main predictions of the standard theory. Moreover, his model provides an early explanation for the mechanism by which an increase in the tax rate leads to a growth in the informal economy.

The role of uncertainty

Another issue that has received attention in the tax compliance literature is related to taxpayer uncertainty about tax liabilities. In general, these studies have concluded that an exogenous increase in the level of tax liability's uncertainty results in a higher level of reported income by taxpayers. In this respect, Alm (1988) analyses individuals' reaction to uncertainty about the income tax policies, showing that uncertainty may increase tax collection when the tax base, or the tax rate, is riskier - i.e. when individuals do not know with certainty whether the tax administration will change the nature of the tax base or the level of the tax rate. A similar theoretical insight is provided in Scotchmer and Slemrod (1989), who consider uncertainty in tax law and randomness of enforcement. They suggest that it is not optimal to remove all randomness in tax liability because such source of uncertainty might increase the level of reported income by taxpayers. In a similar theoretical framework Beck and Jung (1989a) also consider individuals' risk-taking attitudes, arguing that in an uncertainty framework the fiscal behaviour of risk-neutral taxpayers is unaffected by tax rate changes.

Tax authority as a new player

One of the main features of the standard models of tax evasion is that they exclusively focus on the taxpayers' behaviour. Omitting the role of the tax administration amounts to considering only one side of tax evasion, given that the individual's behaviour could be significantly affected by the tax administration objective. For this reason, several contributions have included the tax authority as a strategic actor in a game-theoretical approach to tax compliance. These studies are strictly related to the contributions based on the role of uncertainty. The only difference being that the source of uncertainty is the reaction of the fiscal authority to individuals' behaviour.

A first attempt to introduce the tax authority as a strategic actor is due to Reinganum and Wilde (1985 and 1986), who analyse the effect of an audit cut-off policy in which individuals trigger an audit if their reported income is not in line with the tax authority's expectation. They show that the cut-off policy ensures higher amount of tax compliance than the random audit, in both cases of proportional and lump sum tax.[5]

Assuming risk-neutral individuals, Beck and Jung (1989b) analyse an interactive model in which the tax authority does not know the true income of the taxpayers and the taxpayers do not know their true tax liability or the authority's audit cost. Although their approach is slightly different from the previous contributions their conclusions are the same – i.e. an increase in taxpayers' uncertainty leads to higher compliance.

On the other hand, in a game-theoretic model like that built in Beck and Jung (1989b), but in which taxpayers are risk adverse, Cronshaw and Alm (1995) show that government concealment of its audit policies may be counterproductive leading to less compliance.[6]

Extension based on non-expected utility theory

All of the above approaches are based on standard neoclassic assumptions according to which individuals have perfect information and act as rational and selfish agents. Moving from the Allais

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[5] The same assumptions are also proved in Linster (1997), who extends the previous approaches by assuming individuals' heterogeneity in risk aversion.

[6] Another strand of literature has investigated the role of tax practitioners in taxpayers' behaviour. It a standard argument that tax practitioners can play an important role in assisting taxpayers to meet their compliance obligations and, because of the uncertainty in the tax law, they may represent both a means of increasing compliance, and potentially a threat to compliance. Reinganum and Wilde (1991) - through a game-theoretical model - argue that the introduction of third-party assistance might be associated with increasing evasion, which may have negative implications for tax equity and tax efficiency. This conclusion is not in line with the assumption in Beck et al. (1989), according to whom tax practitioners may exert both positive and negative effect on taxpayers' compliance behaviour.

and Ellsberg paradox, the economic literature has shown several violations of the expected utility axioms. The accumulation of such evidence - which (mainly) deals with bounded rationality and cognitive biases - has motivated the construction of alternative theoretical models for preferences that aim to provide a better explanation of the observed choices. There are several examples of these non-expected utility theory including, just to mention a few, the cumulative prospect theory, and the rank-dependent expected utility theory. Taking advantage of those new theories, the literature on tax compliance has extended the standard approach relaxing some of the neoclassic assumptions, especially full rationality, and perfect information.

The main theoretical change is that in this approach individuals maximize a value function instead of a utility function,[7] which is assumed to depend on changes in income from some reference point against to which the individuals compare their wealth position. The value function is also assumed to be steeper for losses than for gains, because an individual attributes more importance to a loss in income than to an equal gain, and it is concave for gains (loss aversion) but convex for losses (risk seeking). Thus, an individual may exhibit risk aversion when confronted with risky but positive prospects, while the same individual may become a risk-lover when faced with prospects that involve possible losses.

In this new framework, by changing the reference point of individual through the introduction of an advance payment, Yaniv (1999) partially solves the inverse relationship between the tax rate and tax evasion, one of the counterintuitive conclusions of the standard model. Moreover, he suggests that increasing the advance payment significantly reduces the cost of detection because it enhances tax compliance, despite high advance payments are unlike to eliminate tax evasion. Bernasconi and Zanardi (2004) identify the range of variation of the reference income reversing the 'Yitzhaki Puzzle' in a more general framework, in which the initial value of the reference income is not explicitly specified. Finally, Arcand and Graziosi (2005) introduce "pessimism" into the individual's decision process showing that this condition is sufficient to ensure a lower amount of underreported income than predicted by Allingham and Sandmo (1972).

All of the above non-expected utility models have introduced more realism in the theoretical decision pattern of individuals, producing, moreover, predictions that better approximate the observed level of

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[7] The term value function refers to those rules in which individuals adjust the probability that an event happens through some weighting functions. By contrast, the term utility function refers to those functions in which individuals do not proceed to such adjustment process.

tax compliance. Notwithstanding, they considerably complicate the analysis of the individual decision.

2.2 Empirical Evidence

The first empirical evidence on taxpayers' compliance dates back to 80s, when Clotfelter (1983) investigated the relationship between the marginal tax rate and tax evasion analysing what the taxpayers reported in their tax form, through a data set consisting of observations of actual tax return of individuals.[8] Contradicting one of the main predictions of the classical model of tax compliance, he finds a positive relationship between tax evasion and tax rate. This result is supported by the findings in Crane and Nourzad (1986) who analysed tax evasion in the United States over the period 1947-81, finding the same relation between the previous variables.

Using data from the Family Expenditure Survey in United Kingdom, Pissarides and Weber (1989) have estimated that underreporting of British self-employed in 1982 to be approximately 35%. The same consumption-based approach has been applied to estimate misreporting in Finland (Johansson, 2000), in United States (Hurst et al., 2014), in North Cyprus (Ekici and Besim, 2016), and in Sweden (Engström and Hagen, 2017). These studies have provided consistent evidence of underreporting by self-employed compared to employed households in a range between $15 - 40\%$. Similarly, Feldman and Slemrod (2007), using a tax deduction-based measure as an indicator of tax evasion, find that the evasion rate for self-employed income ranges between 30% and 40%. A recent contribution (Albarea et al., 2020), has combined the approaches in Pissarides and Weber (1989) and Feldman and Slemrod (2007) in order to estimate the underreported income and tax evasion in Italy, showing that the overall tax evasion rate in this country for the personal income tax is close to 13.5%. Moreover, a study for European member states (Bousquet et al., 2019) has estimated the offshore wealth held by individuals (for the world's main economies) and corresponding estimates of international tax evasion (for the EU and EU Member States). According to these estimates the EU revenue loss to international tax evasion in 2016 was around € 46 billion (0.32% of GDP).

Other contributions have estimated the extent of tax evasion indirectly through the size of the shadow economy.[9] In the world-wide study in Medina and Schneider (2018), the average size of the shadow

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[8] Specifically, his study is based on the Internal Revenue Service's Taxpayer Compliance Measurement Program (TCMP) survey for 1969.

[9] As typically defined, the shadow economy is clearly not synonymous with tax evasion. Even so, researchers often use data on shadow economy to estimate the amount of tax evasion.

economy (as a percentage of GDP) amounts to 31.9%. The largest ones are Zimbabwe with 60.6%, and Bolivia with 62.3%. The lowest ones are Austria with 8.9%, and Switzerland with 7.2%.[10]

The previous micro-macro estimations are not in line with the predictions of the theoretical models of tax evasion. In fact, if economic considerations (related to the enforcement) were the only factor affecting tax-paying behaviour, there should be far less compliance than that observed, given the low audit probabilities and the modest penalties rate existing in many countries.

Another strand of the empirical literature has tested the validity of the compliance determinants mainly through tax experiments, looking at the actual taxpayers' behaviour. The extrinsic reasons for tax compliance have been firstly investigated through a tax experiment in Friedland et al. (1978). Analysing changes in tax-paying behaviour of 15 Israeli psychology students, they find that large fines tend to be more effective deterrents than frequent audits. On the other hand, through a laboratory experiment conducted within the students of University of Colorado, Alm et al. (1993) show that individuals overweight low probability of detection. Thus, when the audit probability is low enough that evasion is the best strategy according to the standard theory of evasion, the level of compliance exceeds the level predicted by expected utility theory.

As discussed in the previous section, several theoretical models have assumed that uncertainty in the fiscal framework could positively affect the behaviour of taxpayers, increasing the level of reported income. These assumptions do not seem to be confirmed by the early empirical works based on laboratory experiments. In this respect, Spicer and Thomas (1982) find that the predicted deterrence effect of the audit probability is empirically valid only when individuals have full information about it. They add that, even when individuals have full information, an increase in the detection probability only affects the decision to evade and not to what extent. Beck et al. (1991) reinforces this evidence, showing that uncertainty weakens the effect of enforcement policies.

On the other hand, Spicer and Hero (1985) study the effectiveness of the enforcement policy over time, showing that those who have been audited in the past perceive a higher probability of audit and therefore tend to evade less. [11]

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[10] They have estimated the shadow economy across 158 over 1991-2015. The estimates in Medina and Schneider (2018) are coherent with previous estimation in Alm and Embaye (2013) – according to whom the average size (unweighted) of the shadow economy is 32.5% of GDP (across 108 countries over the years 1984–2006) – and Schneider et al. (2010) – according to whom the shadow economy varies between 31- 34% of GPD (over the period 1999-2007 across 162 countries).

[11] They tested their hypotheses within a group of 36 psychology students from the University of Colorado.

Although these results are based on artificial settings with small samples of individuals, they have shed new light on the relevance of extrinsic reasons that lead individuals to comply. Furthermore, they have shown that in the presence of uncertainty individuals do not always react as the theory has predicted.

To understand why actual tax compliance is higher than predicted by the classical model, other empirical contributions have performed larger field experiments stressing the role of the individual perception of audit probability. In this respect, Scholz and Pinney (1995), analysing a sample of 445 taxpayers from Long Island, show that individuals who report greater commitment to obey tax law, systematically overweight the expected penalty for noncompliance. A tight relationship between perceptions and behaviour has been also found in Slemrod et al. (2001). In their field experiment in Minnesota, they show that individuals increase their tax payment when are informed - by letter - that their income tax returns could be 'closely examined'. Kleven et al. (2011) evaluate the effectiveness of similar deterrence policy in Denmark, finding that prior audits and threat-of-audit letters have significant effects on self-reported income but no effect on third-party reported income. Using available data for Argentina, Castro and Scartascini (2015) - in a similar field experiment – confirm the previous results about the audit probability perception.[12]

According to the results in Bérgolo et al. (2017) the previous evidence can be extended also to firms. In a large-scale field experiment conducted in Uruguay, they found that a communication policy according to which firms were informed about the probability of being audited and about the penalty rate increased the collected taxes by about 6.3%.

3. Nonpecuniary motivations

3.1 Theoretical review

The empirical studies that have investigated the role of pecuniary motivations for tax compliance have highlighted a sharp contrast between the predictions in Allingham and Sandmo (1972), the observed effects of the audit probability and the tax rate on the compliance behaviour of individuals. Moreover, the classical model and its extensions have not been able to explain the observed level of tax compliance, higher than predicted, despite the low audit probabilities and the modest penalty rate existing in many countries.

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[12] Although the deterrence message in Castro and Scartascini (2015) is much softer than in Slemrod et al. (2001), and Kleven et al. (2011), the letter increases compliance by almost 5% in the treatments and do not have any effects in the control group.

To solve these limitations, the literature has proposed alternative ways to approach tax compliance based on the assumption that individuals - beyond pecuniary reasons - might comply for nonpecuniary motivations like moral sentiments, shame and guilt, or other social concerns.

Nonpecuniary motivations may operate on the individual utility through different mechanisms; that is: (*i*) *tax morale*, which can be viewed as an internal reward (punishment) that increases (decreases) the benefit to the individual who decides to pay taxes (evades);[13] (*ii*) *institutional and cultural factors*, according to which tax compliance depends on the individual's relationship with the state; (*iii*) *peer effects and social influences*, in which the 'moral' reward for paying taxes depends on the fiscal behaviours of other individuals. These motivations are far from being mutually exclusive.

Tax morale and institutional factors

An early attempt to include nonpecuniary motivations in a theoretical framework is made by Cowell and Gordon (1988) and Gordon (1989). The former introduces public goods into the model of Allingham and Sandmo (1972) considering the effect that the purpose for which taxes are raised exerts on evasion. The inclusion of institutional factors allows Cowell and Gordon (1988) to explain the observed relationship between tax evasion and the tax rate, but it does not capture the reasons why compliance is prevalent in real societies. By contrast, allowing for heterogeneity in individuals' tax morale, Gordon (1989) modifies the classical model of tax compliance characterizing the conditions under which evaders and non-evaders may coexist in the same society. In his model, evasion generates psychic costs incurred irrespective of whether the act of evasion is observed.

Bayer (2004) re-examines the Allingham and Sandmo (1972) model assuming risk-neutral individuals and an alternative structure for the evasion cost, with a constant part that captures the cost of acquiring information about evasion opportunities. Under these assumptions, he provides the necessary condition on the cost function to solve the Yitzhaki (1974) puzzle. Although the predictions are in line with the observed relationship among individual's income, tax rate and tax evasion, the risk-neutrality assumption has been strongly criticized. In this respect, Eisenhauer (2008) underlines the importance of including in the same framework morality and risk aversion. He defines tax morale as an unconditional preference parameter that encourages adherence to ethical norms and reveals

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[13] There is no general agreement in the literature about the meaning of *tax morale*. In fact, some authors (Luttmer and Singhal, 2014) define tax morale "*as an umbrella term capturing nonpecuniary motivations for tax compliance as well as factors that fall outside the standard, expected utility framework*". Notwithstanding this, most of the theoretical and empirical literature uses the term tax morale as synonym of intrinsic motivation for compliance. In accordance with the main literature, in this dissertation we use the term tax morale referring to the intrinsic reason that motivates individuals to pay taxes.

itself in feelings of remorse and disutility when it is violated. In his formulation of tax compliance decisions, an individual recognises that tax evasion results in free riding on taxes paid by compliant taxpayers; this generates a sense of guilt for the tax evader. Differently from Gordon (1989), the guilt in Eisenhauer (2008) is represented by discounting the untaxed income by the moral equivalent of a tax rate. Thus, tax evasion reduces the utility that individuals derive from unreported income, regardless of whether it is detected. Despite more realism, the predictions of his model are not in line with the observed data on tax compliance. Indeed, as pointed out by the author himself, to generate the observed compliance the extent of the guilt from under-reporting taxable income by one dollar must be equivalent to the loss of 39 cents.[14]

Social norms and peer effects

Several of the papers that have incorporated nonpecuniary motivations into the standard models of tax compliance have recognised that individuals abstain from tax evasion also for social reasons (besides for the fear of being caught). Differently from tax morale, a social norm depends on the individuals' perception about the prevalence of a given behaviour in the society (in our case tax compliance or evasion). Recognising that taxpayers may be willing to pay their taxes conditionally, depending on the behaviour of other taxpayers, Myles and Naylor (1996) characterise the social equilibrium by including in the standard model of compliance a parameter acting as a social norm for compliance (*peer effect*).

The interdependence of individuals' evasion decisions typically results in a multiplicity of equilibria. Traxler (2010) characterises, analytically, the multiplicity of social equilibria in the share of evaders, showing that an economy can end up either in a state where most pay their due taxes or in a state where evasion is more widespread.[15] Differently from Myles and Naylor (1996), he assumes that the disutility from the violation of the social norm is independent from the amount of evasion. As pointed out by Traxler (2010), this implies that individuals who cheat on taxes choose a different level of evasion than predicted by Allingham and Sandmo (1972).

In a theoretical framework in which individuals interact with others and internalise a reputational cost when deviating from tax compliance (the social norm), Ratto et al. (2013) analyse the potential indirect effects on tax compliance of an increase in the enforcement. They claim that an increase in

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[14] In this respect, Hashimzade et al. (2013) highlight that this is a high value for the guilt parameter since it exceeds the average value of observed tax rates.

[15] He also considers tax compliance in a population comprising subgroups with inter-group spillover, thus emphasising the potential role of norm compliance in reference groups for tax morale in other groups.

the enforcement (for instance in the probability of detection) produces two effects: *i)* a direct (and negative) effect on the individuals' monetary benefit from evasion; *ii)* an indirect (and negative) effect on individuals' reputational costs, which depend on the share of honest taxpayers.[16] They suggest that, when implementing an enforcement policy, the tax authority should account for taxpayers' interdependence – possibly profiling them - in order to maximize the magnitude of the indirect effect of the policy intervention.

Differently from the previous works, Besley et al. (2019) simultaneously consider intrinsic motivation – i.e. tax morale - and social reputation, which is intended as social norm for compliance. The comparative statics and comparative dynamics of their study suggest that temporary shocks in the individual intrinsic motivation may durably change the social norm for compliance and increase the share of honest taxpayers in the population. Along the same lines, Di Gioacchino and Patriarca (2017) investigate the effect of income inequality on tax evasion, considering the case in which social norms are group specific. They show that group specific social norms increase the negative effect of income inequality on tax evasion, having a further regressive effect on disposable incomes. They suggest that policies aimed at increasing tax compliance could exploit the social norm effects and would be more effective if they also reduce segregation among social groups.

Conversely, Piolatto and Rablen (2017), reconsidering the Yitzhaki puzzle, compare the implication for both expected utility theory and prospect theory of allowing for social stigma and audit probability. They conclude that allowing for enough social stigma always solves the puzzle under the standard theory of compliance – i.e. under the expected utility theory assumptions - but not always under the prospect theory assumptions. [17]

3.2 Empirical evidence

Due to budget constraints, and supported by the theoretical predictions, in the last decades many countries have decided to appeal to the morality of taxpayers through gently persuasive activities - also known as nudging - in order to affect their fiscal behaviour. These activities, that leave the individuals' freedom of choice and economic incentives unchanged, have the advantage to be cheaper

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[16] In their framework the size of the individuals' reputational cost depends - because of individuals' interactions - on the number of other honest taxpayers. An increase in the enforcement will cause the fraction of the population who evades to fall, and this will give an extra reason for people to stop evading.

[17] Differently from the previous works, Cho et al. (1996) consider the stigmatization costs associated to the probability of declaring bankruptcy. Notably, they focus on the peculiar case in which, when detected, individuals cannot pay their due taxes and the penalty for filing a false report because of budget constraint. In this circumstance they show that a policy of renegotiating the tax evasion penalty may increase the fiscal revenue.

than the enforcement and may reach a great deal of taxpayers. On the other hand, they are not as effective as an aggressive enforcement policy. Regardless the economics and political reasons, these activities make available large amount of data on taxpayers' behaviour, which have been used to investigate empirically, through field-experiments, the role of nonpecuniary motivations on the individuals' fiscal decision.

An alternative, and commonly used, method to investigate the effects of nonpecuniary motivations for tax compliance has been through data provided by international surveys[18] - i.e. large-scale and cross-national investigation on socio-cultural characteristics and human values, which provide comparable data into the ideas, beliefs, preferences, attitudes, values, and opinions of citizens within a given geographical area. Generally, surveys do not provide quantitative data on individuals' tax compliance (or tax evasion), thus it is not possible to directly assess the effect of nonpecuniary motivations on it. What it has been commonly done is to analyse the causality between individuals' attitude to tax compliance (as dependent variable, in these studies seen as tax morale) and the other dimensions of nonpecuniary motivations for tax compliance (institutional factors and social norms), controlling for other variables which can affect the individuals' willingness to pay taxes - age, gender, income, education, religiosity, civil status and so on. In so doing, it has been assumed that the institutional factors and social norms might indirectly affect tax compliance through tax morale. When referring to such analysis, unless otherwise specified, it is intended that the individuals' attitude to tax compliance (seen as tax morale) has been analysed based on the respondents' answers to the question:

 "*Please tell me for each of the following statements whether you think it can always be justified, it can never be justified, or it falls somewhere in between: . . . Cheating on tax payments if you get the chance.*"[19]

The way in which the independent variables have been defined and the countries in which the analysis has been performed differentiate the various studies.

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[18] The World Value Survey (WVS) and the European Value Survey (EVS) have been commonly used to investigate moral concerns.

[19] Respondents were asked to assess this issue on a ten-point scale from 1 ("never justifiable") to 10 ("always justifiable"). This question has been used very frequently in the literature to capture tax morale. However, there exists an extensive debate on the unbiasedness of the answers. If this is the case, the country average score of the answer should be a good proxy of the level of tax compliance (if in a given country all the respondents believe that the evasion is never justifiable, then it is reasonable to expect, in case of unbiased answers, a low share of evasion in that country). For more on that issue see Chapter 2 – Section 3.

Main evidence on Tax Morale

The first studies on the role of tax morale have suggested that, in general, moral appeals seem to exert no valuable effect on tax compliance. In this respect, in a large scale-controlled experiment performed in Minnesota, Blumenthal et al. (2001) explore the impact of a moral suasion letter on voluntary compliance, finding little or no evidence that the appeals delivered by the letter affects aggregate tax compliance behaviour. Similar evidence is shown in Fellner et al. (2013), who perform a field experiment based on TV licence in Austria. Their findings suggest that moral strategies do not increase aggregate compliance and indicate that the pure fact of receiving a letter may be more effective than the specific content.[20]

This preliminary evidence moves against the findings in Dwenger et al. (2016), who perform a natural field experiment based on a legally binding local church tax, an environment in which individuals are encouraged to overpay and the actual and perceived enforcement is absent.[21] Individuals could receive one of the following treatments, in addition to a neutral letter: (*i*) a message to inform taxpayers about the absence of any detection; (*ii*) a message which underlines deterrence and communicates positive audit probability and; (*iii*) an appeal to moral values. According to their findings a significant share of the examined sample (about 20%) paid their taxes in the zero-deterrence baseline with no pecuniary incentive to comply. In other words, they paid because moral reasons.

The relevance of the intrinsic motivation has been recently confirmed in an experiment performed in Bott et al. (2020) among taxpayers who earned income in a foreign country. Using data for Norway, they find a large effect of moral suasion that is comparable with the effect of including a threat message in the letter, which increases the perceived probability of detection. Interestingly, their findings suggest that the moral appeal only affects the amount of income reported while an increase in detection probability only increases the number of people declaring foreign income.

Social norms and reputational concerns

Recent contributions have provided empirical evidence through field-experiments on the role of social norms in tax compliance. According to the findings in Hallsworth et al. (2017), the inclusion

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[20] These results are in line with the finding in Ariel (2012), who performs a field experiment on corporations in Israel, showing that a deterrence and moral suasion letter do not produce any valuable results compared with the control group.
[21] In their experiment individuals may be easily divided in evaders and compliers, or donors, because the relevant tax base used by the Church (reported taxable income) is fully observable from tax declarations. This feature allowed the pre-identification of taxpayers who paid only for intrinsic motivations and those who evaded – partially or completely – because of the absence of enforcement.

of social norms and public goods messages in standard tax-payment reminder letters enhances tax compliance. Notably, using data for United Kingdom, they found that a reminder letter with the norm for compliance - which highlights that many citizens pay taxes - increased the amount of collected taxes by about 7.1-7.8%, whereas a public good letter - which highlights the social benefit of paying taxes - increased collected taxes by 5.9-7.6%. By contrast, using data for the City of Philadelphia, Chirico et al. (2017) show the ineffectiveness of a letters including a social norm for compliance. According to their study, the more valuable effect is caused by the threat of an economic sanction for noncompliance. The ineffectiveness of social norms is also supported by John and Blume (2018), who show - through a field-experiment performed in London - that a message sent to individuals that highlights the share of citizens who pay the local taxes does not exert any effect on the overall share of compliance.

Döerrenberg and Peichl (2018) shed light on a potential counterproductive effect of nudging. Their findings suggest that manipulating the social norm through information about the general extent of tax evasion might have a negative effect on tax morale.[22] Surprisingly, this result does not disprove the previous evidence on the effect of social norms on tax compliance. In fact, using data for Germany, they pointed out that many individuals in their experiment underestimated the true extent of tax gap, thus when they were informed on the real numbers of tax evasion they adjusted their behaviour as predicted by the theoretical and empirical literature – i.e. individuals considered more justifiable the evasion because the share of evaders was larger than expected. This evidence on the effects of the misperception of the true level of compliance is also examined through a field experiment in Del Carpio (2014). Based on previous evidence for Peru – according to which in this country the true levels of compliance and enforcement is generally underestimated - she focused on providing the true information on compliance and enforcement by a letter. She found that the strongest effect was generated by the information letter on true levels of compliance, which increased payments by 20% with respect to the no-letter control group.

Differently from the previous contribution, Dwenger and Treber (2018) study the effectiveness of the Slovenian shaming policy according to which tax administration named-and-shamed tax evaders, labelling them as 'delinquent taxpayers'. They found that individuals reduced their tax debt by about 8.5% to avoid public shaming. Using data for Pakistan, Slemrod et al. (2019) found that a disclosure

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[22] They used German Internet Panel (GIP), a longitudinal survey that is operated and administered at the University of Mannheim, in Germany (https://paneldata.org/gip). Even if their contribution it was not based on survey data, they included in the experiment protocol a question measuring tax morale - 'How justifiable do you think it is to evade taxes if an easy opportunity to do so presents itself ?'

policy, that reveals the amount of income tax paid by every taxpayers in that country, increased the reported income by 2-9 log points.[23] Moreover, they found that a public honour policy - according to which the government acknowledges the top 100 taxpayers and grants them certain privileges - increased the individuals' tax liability by (about) 17 log point within the top ranked individuals. Analyzing the effect of a similar policy for Norway, Bø et al. (2015) observed a 3 % average increase in reported income among business owners. In a field experiment performed in United States, Perez-Truglia and Troiano (2015) study the effect of a threat of a shaming penalty among tax evaders, consisting on a higher visibility of recipients' delinquency status toward a subset of their social contacts. They found that the shaming intervention increased the probability of leaving the tax evader status by 2.1%. By contrast, using data for Japan, Hasegawa et al. (2013) study the effect of an income tax disclosure system on tax reports of individuals and businesses, finding no evidence that disclosure increased reported business taxable income.

On the other hand, other survey-based contributions have focused on the causality effects between tax morale and social norm for compliance. An early investigation on this topic is performed in Torgler (2005),[24] who finds a significant correlation between tax morale and the size of the shadow economy, adding that individuals who know, or have heard about, practised tax avoidance have a significantly lower tax morale than others. These preliminary findings are confirmed by Torgler and Schneider (2005), who dynamically assess the conditional cooperation among Austrian citizens, and Frey and Torgler (2007), who assess the same issue differentiating between Western and Eastern Europe. [25]

Reciprocity

The earlier empirical studies on reciprocity have been supported by the equity theory, which suggests that an important determinant of individual satisfaction within an exchange relationship is the perceived parity or equity among the participants involved in the exchange. Considered in terms of taxpayer-government relationship, this theory suggests that tax evasion may be seen (almost partially) as a means by which taxpayers try to restore the perceived inequity in terms of trade with the government. According to this hypothesis, Spicer and Becker (1980) examined the relationship

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[23] The same policy applied to members of the national parliament increased reported income by 40-60 log point.

[24] His estimations are based on data from Latinobarómetro (for the year 1998) and WVS (1995-97).

[25] Differently from Torgler (2005), Torgler and Schneider (2005) and Frey and Torgler (2007) analyse the conditional cooperation assessing the answer to the following question: "*According to you, how many of your compatriots (…) Cheat on taxes if they get the chance?*". Torgler and Schneider (2005) analyse the answer dynamically as resulting from WVS and EVS between 1990 and 1999. By contrast, Frey and Torgler (2007) focus only on data from EVS 1999.

between perceived fiscal inequity and tax evasion, through a laboratory experiment with students from the University of Colorado. To test the equity theory, they communicated three different tax rates to fifty-seven students. Their results showed that tax evasion was the highest among those students who were told that their tax rates were higher than the average, and lowest among those who were told that their tax rates were lower than the average.[26]

On the other hand, many survey-based contributions have indicated that stable and easily knowable institutions help to create public trust, which contribute to increase individuals' tax morale and, as consequence, the overall tax compliance. A first evidence in this direction is provided by Torgler (2003a). Using data for European countries and United States,[27] he suggests that trust in the legal system seems to lead to acceptance of governments' decisions, produces the incentive to obey the rules and has a significant positive effect on tax morale. This preliminary and comprehensive evidence is confirmed in other country-specific studies for Switzerland (Torgler, 2003b),[28] Austria (Torgler and Schneider, 2005) and Spain (Martinez-Vazquez and Torgler, 2009),[29] and in survey-based contributions that have analysed the institutional reform process within transition countries.[30]

Finally, Cummings et al. (2009) use survey data from Afrobarometer (1999-2000) to test the hypothesis that perceptions on the quality of governance might increase compliance.[31] The authors show that a lower quality of governance is associated with lower compliance.

Long-run cultural factors

A last strand of empirical studies has focused on the causality relationship between cultural factors and tax morale. Cultural reasons may be interpreted as a combination of all the previous moral motivations to comply. Following Henrich et al. (2001b), cultural factors may be seen as information stored in people's heads, which can be transmitted among individuals. This information can be thought of as ideas, values, beliefs, behavioural strategies, perceptual models, and organizational structures that are in individuals' brain, and can be learned by other individuals through imitation,

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[26] This evidence is not in line with the findings in the survey-based study of Döerrenberg and Peichl (2013), who show that a progressive tax contributes to less tax evasion and higher perceived fairness and equality. They investigate the causality between tax morale and progressive taxation employing micro-level survey data from World Value Survey (WVS) data and contextual data for tax progressivity from World Tax Indicators (WTI).

[27] His analysis is based on the data from the WVS (1989-1993) and Taxpayer Opinion Survey (1987).

[28] He uses data from WVS (1995-1997) and the International Social Survey Programme.

[29] Differently from Torgler (2003a and 2003b), they assess dynamically the evolution of tax morale using data of several waves from WVS and EVS.

[30] Martinez-Vazquez and McNab (2000), Alm and Martinez-Vazquez (2003), Torgler (2004) Frey and Torgler (2007), Hug and Spörri (2011).

[31] They focus on two countries - Botswana and South Africa - that have similar tax systems but different political histories and institutions.

observation, interaction, discussion and/or teaching. Thus, the cultural factor is a broad concept which accounts for differences – among countries and within a country - in tax administration and citizen attitudes toward governments. In this context, Alm and Torgler (2006) conduct a cross-country comparison of tax morale, showing that individuals in the United States have a statistically significant higher tax morale than those in European countries.[32] Staying within cross-cultural comparison, Henrich et al. (2001a) perform a large cross-cultural study of behaviour using ultimatum, public good, and dictator games. They find a large variation across different cultural groups, arguing that preferences and/or expectations are affected by group-specific conditions such as institutions or cultural fairness norms.

On the other hand, Torgler and Schneider (2004) investigate the impact of culture differences within a country rather than between countries.[33] Focusing on Switzerland, Belgium, and Spain - countries with a certain cultural variety - they find that the cultural background does not seem to have a strong effect on tax morale within a country. However, their finding indicates a strong interaction between culture and institutions, which has a strong impact on tax morale. This evidence is not coherent with the findings in Torgler (2002), who finds a sensible difference (according to the data from WVS 1990-97) between tax morale in East and West Germany, arguing that the difference in cultural background, due to the reform process in the transition countries, seems to have the strongest effect on tax morale.[34]

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The literature which has investigated through field-experiments the role of nonpecuniary motivations on the individuals' fiscal decision has provided conflicting results on the effectiveness of nudging policy to increase tax compliance. On the other hand, survey-based studies have clearly shown that trust in institution and social norms play a key role on individuals' willingness to pay taxes. What is common to survey-based literature is the successful attempt to link a moral concern – i.e. tax morale - with other social capital components (i.e. trust in others, in institutions, and social norms). However, survey-based investigations have completely ignored the effects of the third dimension of social capital – i.e. groups and networks – on tax morale.[35]

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[32] Their evaluations are based on WVS (1990-97).

[33] They based their analysis on data from WVS (1995-1997) and EVS (1999-2000).

[34] This hypothesis is supported by the findings in Torgler (2004), Alm and Torgler (2006) and Frey and Torgler (2007), who show that the residents of Eastern European countries exhibit a lower tax morale than residents of the Western European countries, other things being equal.

[35] According to the socio-economic literature, social capital may be broken down in at least three principal components: *i)* institutions; *ii)* norms and civism; *iii)* groups and networks (Coleman, 1988; Serageldin and Dasgupta, 2001; Van Oorschot et al. 2006).

In chapter 2, based on data from European Value Survey 2017 and following the same approach of the main literature on the field (our investigation follows a methodology very close to Frey and Torgler, 2007; Torgler, 2003b, Torgler and Schneider, 2005), we provide an explorative analysis considering the possibility that being a member of a formal group increases the individual exposition to social stimuli and, as a result, affects (positively or negatively) individual's tax morale. To investigate the potential impact of this effect, we focus on individuals who belong to voluntary or volunteering organisations.

Although the results should be treated with caution, our findings partially confirm the correlation between tax morale and group membership. In fact, on one hand, they suggest that belonging to a voluntary organisation might exert both positive and negative effects on tax morale. On the other hand, they indicate that such relationship exists only within certain groups.

4. The role of social networks and communication

In this section we focus on the role of social networks and communication on tax compliance. This approach has provided new theoretical and empirical tools to address explicitly the role of local interactions among individuals, allowing the investigation of the spillovers from moral suasion, detection, and deterrence policy on tax compliance. Although the contributions we are going to review have most in common with the works which have focused on pecuniary and nonpecuniary motivations for tax compliance (reviewed in the previous sections), we dedicate them a separate section because they explicitly address the role of local comparisons by including a social network analysis in their models.[36] These approaches complement the existing analytical literature on tax evasion, which allows only global social information to enter in individuals' preferences.[37] Analysing the network structure allows to investigate: *i*) how individuals learn from others; *ii*) how individuals' perceptions and beliefs are affected by neighbours; *iii*) how information spreads around the network.

4.1 Theoretical contributions

Allowing for individuals' interaction through a social network structure makes the theoretical framework closer to a complex system in which it is very difficult, if not impossible, to exactly predict theoretically the model implications once individuals are free to interact with others. In this case, it

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[36] A network (or graph) is a mathematical structure used to model pairwise relationship between objects which, depending on requirements, may be individuals, taxpayers, firms and so on.

[37] For instance, some of the previous contributions, which have analysed the role of social norms, assume that individuals may only observe aggregate statistics, as the share of taxpayers in the population who pay taxes (Myles and Naylor, 1996; Traxler, 2010).

is also very difficult to find stable equilibrium conditions and elaborate comparative statics or dynamics. The literature has addressed this problem using the agent-based approach (ABM), that is a theoretical exercise (computer simulation), which compares the final outcomes resulting from different initial conditions.[38]

An early attempt on this field has been made in Korobow et al. (2007).[39] In their ABM they suppose that individuals are disposed in a very simple social network structure also known as *Moore neighbourhood*.[40] Individuals' objective is to maximize their expected utility, which is very similar to that assumed in the standard model of tax compliance. At the end of each period individuals report all taxable income, underreport it, or do not file any tax declarations according to the classical drivers of compliance: penalties, audit probability and tax rate. Differently from the standard model of compliance, at the end of each period individuals observe whether the fiscal authority has audited a neighbour. Based on this information, individuals adjust periodically their beliefs on the audit probability according to a given updating rule. Their numerical simulations suggest that, for a given enforcement activity, a world with limited knowledge of neighbours' payoffs appears to lead to higher levels of aggregate compliance than when individuals are aware of neighbours' payoffs and take into account this information in their individual decisions.

In a very similar framework in which individuals update their subjective beliefs on the audit probability, Hashimzade et al. (2014 and 2015) apply an ABM to study the role of occupation in tax compliance, in a setting in which taxpayers are heterogeneous in risk aversion, beliefs about the probability of audit, and attitude towards tax compliance. They show that compliance behaviour can vary significantly across occupational groups. The more relevant insight from their contribution concerns the enforcement policy. In fact, according to their results an enforcement policy with fixed number of audits in each occupation sector ensures better results, in terms of number of evaders, than

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[38] To implement an agent-based model (ABM) three steps are required. Firstly, the definition of the agents that will interact. In many economical works of this kind focused on tax compliance, agents are defined as individuals characterized by some fixed attributes - such as income, ability, and the like – and variable attributes that will be updated by experience. Moreover, individuals are required to pursue an objective, as maximize their income or their utility. Secondly, the definition of the environment in which the agents interact. An economic environment could be a marketplace with trading rules or an economy with institutions that govern interaction. Given the agents and the environment, the final step is to allow the agents to interact and to observe the dynamic of the process and its steady states. These will be governed by the initial state of the system, by the choices made by the agents, and by any random components during the interaction.

[39] Other contributions (as for instance Bloomquist, 2004; Davis et al. 2003) before Korobow et al. (2007) have applied an ABM to tax compliance. Differently from the works here examined, in those studies individuals may interact randomly with everybody else in the society; in other words, there is not a clear and defined evidence of a network structure.

[40] A two-dimensions lattice structure in which each individual has a fixed number of neighbours (eight) who surround him or her.

a random enforcement policy.[41] In a related contribution, Hashimzade et al. (2016) examine the extent to which predictive analytics on tax evasion - targeting the largest evaders and targeting the most likely evaders - can improve the fiscal revenues compared with random audits. Beside the inclusion of occupational choice, these works differ from Korobow et al. (2007) because of the network structure, that in Hashimzade et al. (2014, 2015 and 2016) is based on Erdős–Rényi algorithm. This allows to generate more realistic social networks in which individuals' sociality (number of neighbours) is governed by a well-define probability distribution and ensures a variety of different social structures. These features allow Hashimzade et al. (2014, 2015 and 2016) to test their model in a great deal of scenarios, making their findings more robust and reliable then Korobow et al. (2007).

Differently from the previous works, Gamannossi degl'Innocenti and Rablen (2020) present a model in which individuals – who live in an Erdős–Rényi (1960) social network - care about relative consumption. They perform numerical simulations, which show that individuals' optimal evasion decision is related to network centrality.[42] Moreover, they point out the importance for a tax authority to know the structure of the social network. This information would allow the tax authority to raise fiscal revenues, because of spillover effects, by targeting individuals whose consumption habits are more visible than others, in their work intended as 'celebrities'.

Following the same approaches in Hashimzade et al. (2014, 2015 and 2016) and Gamannossi degl'Innocenti and Rablen (2020), in chapter 3 we contribute to the existing literature presenting an ABM which add a network structure to the model of Besley et al. (2019). Using the Watts and Strogatz (1998) algorithm to generate random networks, we investigate the mechanism by which local interactions affect tax morale, assuming that it may be influenced by the observed tax morale in the reference group (neighbourhood), which we intend as a social norm for compliance. As in Hashimzade et al. (2014, 2015 and 2016), we focus on non-pecuniary costs associated with individuals' intrinsic motivation and reputation and consider the pressure from neighbours (local peer effect) as the main driver of tax compliance. Different from their work, we stress the role of individuals' influence within the network (network centrality) and the value to a tax authority - in terms of increased compliance - of targeting influential individuals. On the other hand, as in Gamannossi degl'Innocenti and Rablen (2020), we underline the value to a tax authority, in terms of

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[41] The number of fixed audits is assumed to be equal to the expected number of random audits.

[42] Network centrality identify the most "important" individuals within a network. Note that the meaning of "important" is crucial in identifying the central individuals. The simplest measure of centrality relies on the numbers of links of each individual within the network (also known as *degree* centrality). But there are also more sophisticated measures that account for the position of individual within a network (for instance *betweenness*, *eigenvector* and *page rank centrality*). For a comprehensive explanation of those concepts see Jackson (2010).

additional revenues raised, of knowing the structure of the social network. Stressing the role of spillover effects, we suggest that by positively affecting the tax morale of influential individuals the tax authority can maximise the benefits of the diffusion of prosocial behaviour and motivate tax compliance. This policy implication is also in line with the results in Hashimzade et al. (2016) who suggest that a targeting policy might increase the share of compliance in society.

Finally, in chapter 4 we study an extension of the model presented in chapter 3, adding income inequality and assuming a different network structure.

4.2 Empirical evidence.

Some recent works have pointed out the strong relationship between the environment in which the agents 'live' and their fiscal behaviour. In this respect, using data for Norwegian shareholders, Alstadsæter et al. (2019b) analyse to what extent tax avoidance spread within the family network, finding positive relations between family-based interactions and tax avoidance. Analysing claimed commuter tax deductions in Austria, Frimmel et al. (2019) confirm this evidence, showing that tax evasion runs within the very close family (father-son).

Bohne and Nimczik (2018), using data for Ecuador, show that tax avoidance is affected by social environment. They claim that knowledge about tax avoidance opportunities spreads across firms and identify as channel of information transmission the mobility of co-workers and experts.

Another strand of the empirical literature has attempted to measure the spillover effects of a policy intervention – detection or deterrence – on 'non-treated' individuals. Boning et al. (2018) study the direct and network effects in a large scale-field experiment conducted by the United States Internal Revenue Service, in which treated firms could receive a deterrence letter or an in-person visit by the tax authority. They found that the first strategy has no significant network effect but that the second strategy (in-person audit) increased the compliance rate by approximately 2% among those that share a tax preparer with a visited firm. Findings in line with the evidence Pomeranz (2015), who found, using data for Chile, that an increase in audit probability of firms suspected of evasion generates spillovers - in terms of VAT – that lead to an increase of supplier's tax payment (of approximately 12%). Using data for Austria, Paetzold and Winner (2016) found that tax avoidance increases among job changers moving to companies with a higher fraction of evaders; by contrast, movers to companies with a lower fraction of evaders tend not to alter their tax behaviour.

Using data on television licence-fee registration in Austria, Rincke and Traxler (2011) found that, on average, three detections lead one additional evader to comply. Similarly, in a field experiment based

on a geographical network, Drago et al. (2020) found that a deterrence letter sent by the tax authority (in which additional monitoring or an imminent audit are announced) to targeted taxpayers increased the subjective beliefs about the audit probability of the treated and untreated individuals. This indirect effect increased (in their work by nearly 7%) the likelihood that cheaters' neighbours of a treated individual switch from evasion to compliance. The magnitude of the spillover effect was the same as the direct treatment effect (6.6%). This finding indicates that the overall impact of the policy intervention on compliance is twice that one observed by examining only the targeted household. By contrast, in a very similar contribution Meiselman (2018) found no evidence of geographic network effects on individuals' neighbours tax compliance. Notably, his results suggested that sending letters to individuals who have not reported the taxable income does not exert any effects on individuals' geographical network.

5. Conclusions.

In this chapter, we have reviewed some of the main contributions which have focused on the pecuniary and nonpecuniary motivations for tax compliance. The theoretical models based on the former motivations mainly stressed the role of the extrinsic reasons for tax compliance – i.e. audit probability, fine to be paid in case of detection and uncertainty - and are characterised by the fact that the choice problem of the taxpayer is represented as being entirely individualistic. Despite the intuitive results of their comparative statics, their predictions are only partially supported by the empirical studies, especially when the real effects of the audit probability and the tax rate have been examined. Moreover, the empirical works have shown that the amount of tax evasion rarely falls to the level predicted by the theory.

Other contributions have focused on nonpecuniary motivations for compliance, based on the assumptions that individuals, beyond pecuniary reasons, pay taxes also because moral, social, and reputational concerns. The introduction of nonpecuniary motivations has allowed to reverse (theoretically) some of the counterintuitive predictions of the classic model of compliance. However, the relevance of such motivations within the framework of tax compliance has been clearly proved only through empirical studies based on survey data. In fact, others empirical works – based on field experiments – have shown contradictory results, especially when the individuals' response to public policy that appeal to the morality (or social concerns) of the taxpayers through gently persuasive activities (nudging) has been examined.

Although, both those strands of studies have a lot to say about what motivates tax compliance, they do not account for the potential spillover effects stemming from social (and local) interactions. In the

last few years, the availability of huge amounts of data and the new digital tools have allowed researchers to keep track of the influence that social interactions exert on individuals' fiscal behaviour. Those last approaches have jointly analysed both motivations, contributing to generate a new strand of literature which might support a tax authority in devising more effective strategic audit selection methods and to account for the spillover effects of the enforcement and nonpecuniary sanctions on non-audited individuals.

In order to provide a further contribution to the existing literature, in the following chapters of this dissertation we try to cover some unexplored issues, focusing on nonpecuniary motivations for compliance. Firstly, we examine (chapter 2) if group membership affects individual tax morale, using survey data provided by EVS 2017. Secondly, we present (chapter 3) an agent-based model in order to study the mechanism by which local interactions affect tax morale. Finally, we focus (chapter 4) on the reputational costs associated with tax evasion, presenting a variation of the agent-based model in chapter 3.

Chapter 2 - Can group membership affect individual tax morale?

1. Introduction

The literature that has investigated empirically the reasons for tax compliance agrees that, beyond the traditional costs, tax evasion is influenced by several nonpecuniary costs, related to personal characteristics such as values, social norms, and trust. While the relationship between tax morale and those determinants (i.e. socio-demographic factors, perceived evasion, trust in other and institutions) has been extensively investigated, the influence of social relations within a specific context has to date been mainly ignored.

In this exploratory contribution, we extend the existing literature on tax compliance considering the possibility that being a member of a group – i.e. associations/organisations with two or more people - might increase the individual exposition to social stimuli and, as a result, affect (positively or negatively) individuals' tax morale. To investigate the potential impact of this effect, based on data from the European Value Survey 2017 (EVS 2017), we focus on individuals who belong to voluntary or volunteering organisations, analysing such relationship through a cross-national investigation.

Our findings partially confirm the correlation between tax morale and group membership. In fact, on one hand, they suggest that belonging to a voluntary organisation might exert both positive and negative effects on tax morale. On the other hand, they indicate that such relationship exists only within certain groups.

The remainder of this chapter is organized as follows. In Section 2, we briefly review the contributions related to our work which have focused on the relation between social capital and groups' membership.[1] In Section 3, we describe the data and the model. In Section 4, we discuss the results. In Section 5, we provide some concluding remarks.

2. Related literature

In the last two decades, several studies in the tax compliance literature have investigated the role of tax morale, societal institutions, and social norms to better understand the reasons why individuals pay taxes. In this respect, as discussed in chapter 1, survey-based studies have shown that trust into the legal system, parliament and government positively affect tax morale (Torgler, 2003b; Martinez-

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[1]For more on the literature on tax morale see Chapter 1 – Section 3.

Vazquez and Torgler, 2009; Martinez-Vazquez and McNab, 2000; Alm and Martinez-Vazquez, 2003; Torgler, 2004; Hug and Spörri, 2011) and, as for the role of social norms, that taxpayers are strongly influenced by their perception of other taxpayers' behaviour (Frey and Torgler, 2007; Torgler and Schneider, 2005; Torgler, 2005).

What is common to all these researches is the successful attempt to link a moral concern – i.e. tax morale - with other social capital components (i.e. trust in others, in institutions, and social norms). According to the socio-economic literature, social capital may be broken down in at least three principal components: *i*) institutions; *ii*) norms and civism; *iii*) groups and networks.[2]

Differently from the first two dimensions, the effects of groups and networks on tax morale has been almost completely unexplored. On the empirical side, some studies have found a strong relationship between the social network in which the individuals live and their fiscal behaviour, considering the role of information transmission within the family (Frimmel et al., 2019; Alstadsaeter et al., 2019b), among co-workers and firms (Paetzold and Winner, 2016; Bohne and Nimczik, 2018).

Although these studies make it clear that social relationships affect the individuals' fiscal behaviour, they do not provide any evidence on the mechanism through which the information operates. In fact, it might affect the individuals' perception of social norm for compliance, as shown in Frey and Torgler (2007), or alternatively the intrinsic motivation to comply, as in Di Gioacchino and Fichera (2020).

Our survey-based explorative study contributes to extend the existing literature on the field considering the possibility that being a member of a formal group – i.e. associations/organisations with two or more people - increases the individual exposition to social stimuli and, as a result, affects (positively or negatively) individual's tax morale. To investigate the potential impact of this effect, we focus on individuals who belong to voluntary or volunteering organisations.

Related contributions have focused on the link between voluntary organisations and social capital. In his seminal study on the development of Italian regional politics, Putnam et al. (2001) find a positive relationship between individuals' participation in voluntary organisations and practices and attitudes towards established political institutions. Along the line of Putnam et al. (2001), several studies have investigated the role of voluntary organisations in social capital. Through a survey-based study performed in Norway, Seippel (2006) shows that being a member of a voluntary sport organisation contributes to generalised trust, but less than for members of other voluntary organisations. The

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[2] Coleman (1988); Serageldin and Dasgupta (2001); Van Oorschot et al. (2006).

relationship between membership in sport organisations and social capital is an open debate. Notably, some studies (Wang et al., 2012; Nicholson et al., 2013) confirm the findings in Seippel (2006), although other researchers (Dyreson, 2001; Jarvie, 2003; Coalter, 2007) suggest that sport communities might have positive as well as negative effects on individuals' social capital.

Folgheraiter and Pasini (2009) investigate the relation between the membership in mutual aid organisations and social capital using data for Italy. According to their findings, individuals with long-standing membership in self-help organisations achieve better social capital score – assessed in terms of participation in the local community, proactivity in the social context, and family, friends and neighbourhood connections - than do younger participants, and a significant sample of the Italian population as well.

In the same line but in a different background, Furrow et al. (2004) perform a survey-based study in Los Angles and argue that belonging to faith-based organisation might facilitate social interactions and promote a set of shared beliefs and values. The positive effect of religious affiliation on social capital is confirmed in a more comprehensive survey-based work in Bekkers (2005). Using data for Netherlands, he shows that active participation in political parties, labour unions, and cultural, professional, religious, environmental, and humanitarian organisations supports human and social capital as well as civic engagement. There is no full agreement on the effect of labour unions on social capital. Johnson and Jarley (2005) perform an experimental study within two large trade unions in the United States and suggest that being a unionist has a positive effect on workplace social network and civic engagement. On the other hand, Saundry et al. (2012), in a field experiment in the United Kingdom, show that unionists are more likely to generate social capital outside trade unions. They add that an individual might be member of trade unions not for a sense of belonging, or social solidarity, but to defend his/her self-interest and increase his/her bargaining power.

The previous studies are in line with the preliminary findings in Stolle and Rochon (1998), one of the first comprehensive empirical investigation on this filed. Based on three national survey studies (United States, Germany, and Sweden), they argue that membership in voluntary organisations and social capital are positively related. Moreover, they show that the intensity of this relationship depends on the type of organisation. For instance, members of cultural associations appear to show a higher level of generalized trust and prosocial values, while membership in political association is less likely to be positively associated with generalized trust, tolerance, optimism, and free ridership.

Although the previous evidence suggests that being a member of a group results in higher civic engagement and prosocial behaviour, none of them has specifically explored the relationship between

membership in voluntary and volunteering organisations and tax morale. Moreover, the link between voluntary organisations and social capital is not as self-evident as often assumed. In this respect, Delhey and Newton (2003),[3] argue that voluntary organisations do not seem to do much for generalized trust and social values in most of the countries they analysed.

Based on the above evidence, in this empirical explorative contribution we analyse the relationship between tax morale and the 'third' component of social capital, that is group membership. There are at least three main reasons, beyond those above mentioned, because group membership might have a substantial influence on values concerning the fiscal behaviour. Firstly, as shown in Charness et al. (2007), Sutter (2009) and Chen and Li (2009) through laboratory experiments, group members behave differently from people who perceive themselves as isolated individuals. Secondly, individual's intrinsic motivation for tax compliance may depend on the tax morale of the individual's reference group (see Di Gioacchino and Fichera, 2020). Finally, social psychology experiments have shown that people use their group membership to help define who they are along relevant categories, which include factors such as religion, sexual orientation, occupation, values, opinion and believes. According to McDermott (2009), once a person sees himself/herself as part of a group, s/he will be able to derive self-esteem from that group's membership.

3. Data analysis

To investigate whether group membership affects individuals' tax morale, we use survey data provided by EVS 2017, which is a large-scale cross-national survey on socio-cultural characteristics and human values.[4] It provides comparable data on ideas, beliefs, preferences, attitudes, values, and opinions of citizens in Europe and few other countries (34 countries).[5] Our dependent variable is *tax*

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[3] Their study is based on Euromodule survey conducted within seven European countries: Germany, Hungary, Slovenia, South Korea, Spain, and Switzerland between 1999 and 2001.

[4] Each national survey in EVS 2017 conforms to guidelines designed to ensure quality and consistency. The national effective sample size is at least 1200, for countries with a population over 2 million and at least 1000 for countries with a population below 2 million. Random samples give full coverage of the target population (persons 18 years and older resident in private households, regardless of nationality or language). Respondents are interviewed face-to-face for approximately one hour by trained interviewers. The questionnaire contains pre-classified variables for education, income, political parties, religion, and region, and open questions for occupation, nationality, and language, which are coded according to pre-classified country-comparable classifications. Quality control checks are carried out and documented on a sample of respondents, refusals, and non-contacts. For more on sample selection and EVS 2017 methodology see https://europeanvaluesstudy.eu/methodology-data-documentation/survey-2017/methodology/ .

[5]The EVS 2017 covers 34 countries : Albania (AL); Armenia (AM); Austria (AT); Azerbaijan (AZ); Belarus (BY); Bosnia and Herzegovina (BA); Bulgaria (BG); Croatia (HR); Czech Republic (CZ); Denmark (DK); Estonia (EE); Finland (FI); France (FR); Georgia (GE); Germany (DE); Great-Britain (GB); Hungary (HU); Iceland (IS); Italy (IT); Lithuania (LT); Montenegro (ME); Netherlands (NL); North Macedonia (MK); Norway (NO); Poland (PL); Portugal (PT); Romania (RO); Russian Federation (RU); Serbia (RS); Slovakia (CS); Slovenia (SI); Sweden (SE); Spain (ES); Switzerland (CH). In total, about 56,491 respondents.

morale, defined as the intrinsic motivation to pay taxes, which has been assessed based on the respondents' answers to the following question:

"*Please tell me for each of the following statements whether you think it can always be justified, it can never be justified, or it falls somewhere in between: . . . Cheating on tax payments if you get the chance*."

Respondents were asked to assess this issue on a ten-point scale from 1 ("never justifiable") to 10 ("always justifiable"). This question has often been used in the literature to capture tax morale. However, there exists an extensive debate on the unbiasedness of the answers. In this respect, Döerrenberg and Peichl (2013) summarised the conclusions of the existing literature suggesting that according to some authors such a bias exists (Elffers et al., 1987) but, it is lower than asking about tax morale instead of tax compliance (Frey and Torgler, 2007). Moreover, other studies have shown that for developed countries tax morale (as resulting from surveys) and actual tax compliance are highly correlated (Richardson, 2006; Torgler et al., 2008).

In order to provide an updated contribution to this debate, in what follows we briefly overview the answers to the previous question presenting some descriptive statistics, subsequently we describe the model and the variables used and, finally, we discuss the main results of the analysis.

3.1 Descriptive analysis on tax morale

Before discussing the model and presenting the results, we provide a descriptive analysis of tax morale as resulting from EVS 2017. For the sake of exposition, in this paragraph we reverse the original scale used in EVS 2017. As a result, higher score relates to higher tax morale.

According to Figure 1 around 60% of individuals state that tax evasion is never justifiable and around 2% state that it is always justifiable. Those who express a preference in the interval 1-6 represent less than 10% of the sample.

Figure 1 – Overview on tax morale
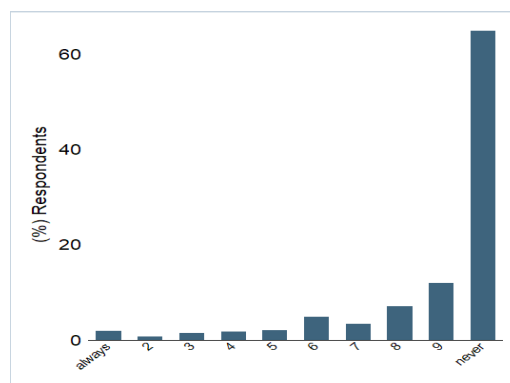
The average value of tax morale for each country, shown in Table 1, suggests that residents in the former Soviet Union - such as Russia, Georgia, and Belarus - exhibit on average a lower tax morale than residents in Western European countries. Poland shows the highest tax morale, followed by Hungary and Denmark. Residents in the Central and Western Europe exhibit on average the same level of tax morale.

Table 1 – Average value of tax morale in EVS countries.

Country	Tax Morale		Country	Tax Morale	
	Mean	St. Dev		Mean	St. Dev
Poland	9.50	1.37	Serbia	9.03	1.97
Hungary	9.50	1.30	Switzerland	9.02	1.81
Denmark	9.47	1.28	Estonia	9.02	1.86
Albania	9.42	1.67	France	9.02	1.81
Germany	9.40	1.45	Czech. Rep.	9.00	1.90
Sweden	9.35	1.37	Croatia	8.99	2.19
Norway	9.33	1.50	Italy	8.97	1.89
North Ma	9.32	1.72	Netherlands	8.91	1.76
Bulgaria	9.31	1.69	Georgia	8.77	2.18
Great Br	9.30	1.55	Slovakia	8.43	2.11
Finland	9.27	1.48	Romania	8.36	2.77
Slovenia	9.25	1.58	Lithuania	8.32	2.18
Bosnia	9.25	2.00	Spain	8.16	2.74
Austria	9.19	1.64	Azerbaijan	8.02	2.72
Iceland	9.17	1.53	Belarus	7.79	2.40
Montenegro	9.13	1.72	Armenia	7.26	3.01
Portugal	9.05	1.67	Russia	7.22	2.79

This first evidence is in line with the findings in Torgler (2004) and Frey and Torgler (2007), who show that citizens in transition countries exhibit a lower tax morale than residents in Western European countries, other things being equal. They also argue that the difference in tax morale is (mainly) due to the quality of institutions, as previously highlighted by Martinez-Vazquez and McNab (2000).

The share of individuals who consider "*never justifiable*" cheating on taxes (Figure 2) varies between 60% and 75% of the interviewed in most countries (21 out of 34), except for Albania, Bosnia, Hungary and Poland in which this share rises to 80-85% and the former Soviet countries, in which this share falls dramatically to 30-45%.

Figure 2- Share of individuals who consider "never justifiable" cheating on taxes.
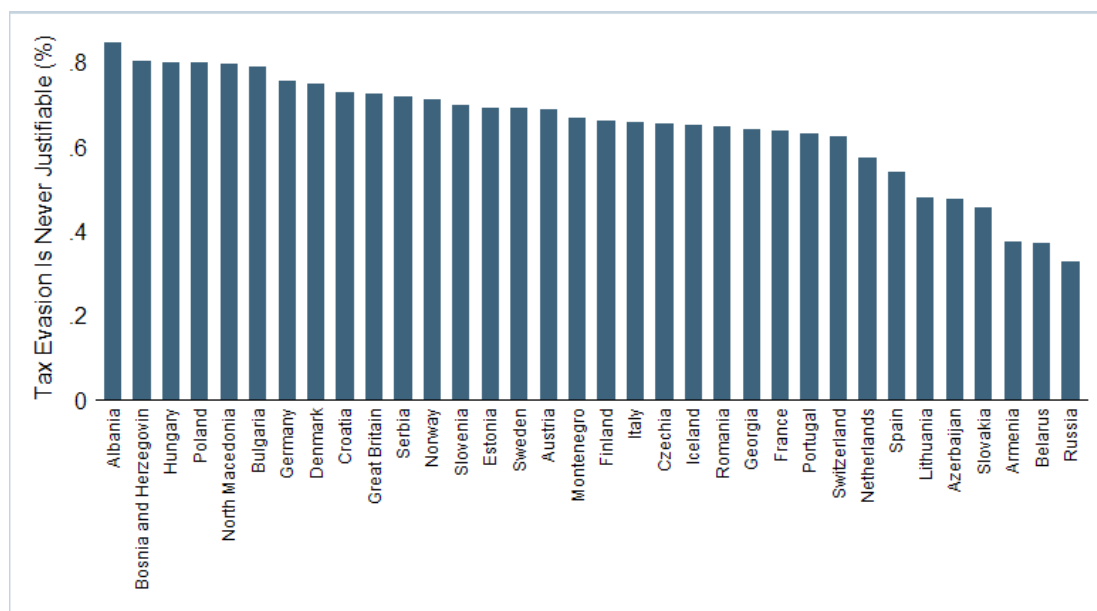
It is a relevant issue to investigate whether such difference in tax morale is reflected in any difference in real behaviour across these countries. Indeed, it is reasonable to expect tax morale to have real effects on the tax gap, which is the difference between the total amount of taxes collected and the total tax revenues that would be collected under full tax compliance. To check such a tendency within the European countries, in Figure 3 we compare the data on Vat Gap, for 2017, and on Tax Gap, for 2015 - provided respectively by the European Commission (2019) and Murphy (2019) - with the average tax morale as resulting from EVS 2017.

The fitted line in Figure 3a suggests a negative correlation between tax morale and the Vat Gap.[6] This correlation holds also relating tax morale to the more comprehensive data on Tax Gap[7] (see Figure 3b). However, only relying on the fitted line could be misleading. At a closer look, the negative sign of the previous relationship seems to be caused by the tax morale and tax gap values reported by some Eastern European countries (i.e. Romania, Slovakia, and Lithuania). Without them, the scatter plot seems to indicate a relationship between tax morale and Vat or Tax Gap closer to the independence.

Figure 3a and 3b raise two other issues. On one hand, not all the countries that show a higher level of tax morale have a lower tax gap. For instance, Polish and Hungarian, who are the most motivated

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[6] Own calculation based on the vat gap estimated for the 2017 by the European Commission (2019) and data on GDP available on https://ec.europa.eu/eurostat/home (EuroStat).

[7] Own calculation based on the tax gap estimated for the 2015 by the Murphy (2019) and data on GDP available https://ec.europa.eu/eurostat/home (EuroStat).

citizens in Europe according the survey (see Table 1), evade on average a higher share of their due taxes than other European citizens (for instance Netherlands), although the magnitude of this evidence is not substantial. Indeed, differences among countries in terms of Tax or Vat Gap amount to few decimal points. On the other hand, both figures suggest that Spain is an outlier because, despite its low level of Vat and Tax Gap, shows on average a rather low tax morale.

Figure 3 – Vat and Tax Gap in European Countries

(a)   (b)
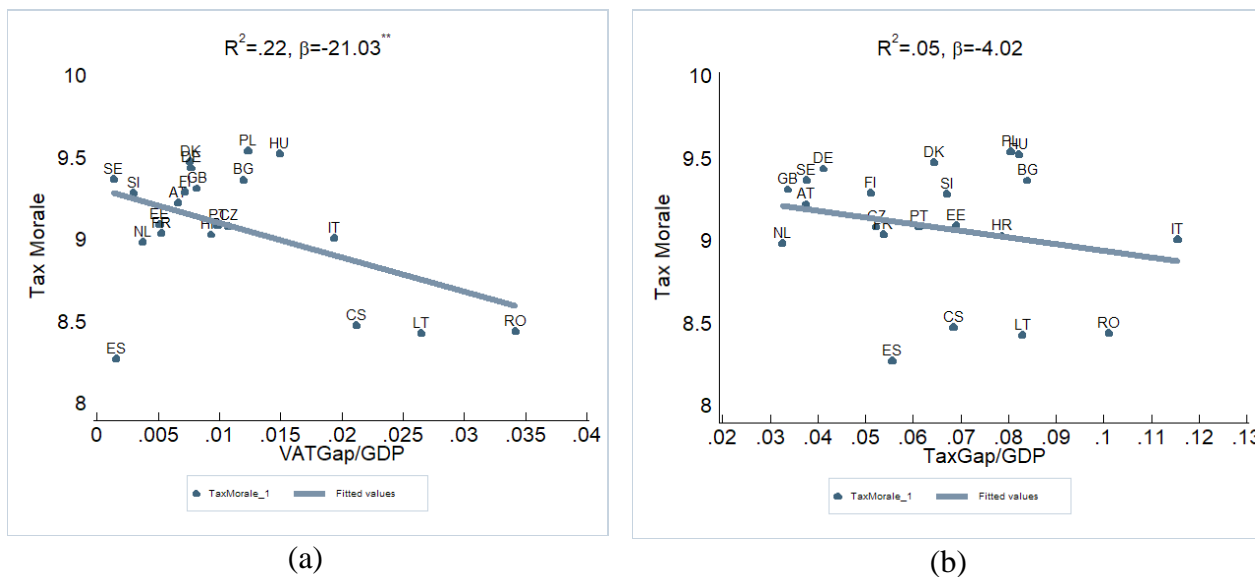
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%.

To examine the effect of tax morale on the fiscal behaviour of non-European countries in our sample, we use as proxy of the Tax Gap data on the shadow economy from Medina and Schneider (2018). Although these two measures do not match exactly, tax evasion is always connected with the activities that contribute to shape the shadow economy that is, following an usual distinction: (*i*) pure tax evasion; (*ii*) the black economy, where legal activities are illegally performed; (*iii*) criminal activities. Moreover, the literature that has investigated tax morale and the size of the shadow economy has found a strong negative correlation between the two measures in Europe and United States (Alm and Torgler, 2006), in transition countries (Alm et al., 2006) and in Latin America (Torgler, 2005).

Based on the data provided by Medina and Schneider (2018), for 2015, figure 4 shows the relationship between tax morale and the shadow economy (in term of GDP) within the countries in EVS 2017.[8]

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[8] Medina and Schneider (2018) do not provide any estimation on the shadow economy for Montenegro and Serbia. For this reason, figure 4 does not show any information on them.

Figure 4 - Relation between tax morale and shadow economy (in term of GDP) within the country in EVS 2017
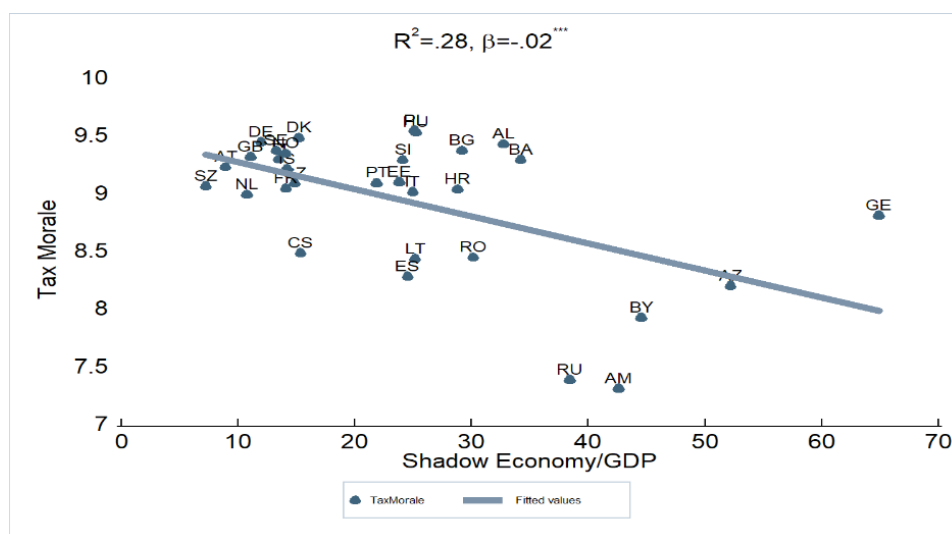
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%.

The evidence in Figure 4 is coherent with the previous evaluations. Tax morale is negatively related to the shadow economy and, in general, the size of the shadow economy is bigger in transition countries than in Central and Western European Countries. Moreover, the slope of the fitted line seems to be strongly affected by the values reported for Eastern countries. Here too, without them the scatter plot seems to suggest a relationship close to independence.

In summary, the above figures show that tax morale estimates, as resulting in the EVS 2017, are in general consistent with the actual taxpayer behaviour in European and non-European countries, although the relationship is not as strong as one might have expected. [9] Consequently, although we consider that this question allows us to obtain a reasonable measure of tax morale, the results should be treated with caution.

3.2 Model and main variables

Our dependent variable is *tax morale* assessed according to the answer to the above-mentioned question. The ordinal nature of the answers makes it appropriate to use an ordered probit model,[10]

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[9] A last remark about Spain. It seems that other factors beyond the tax gap and the shadow economy could negatively affect the tax morale. In this respect, Pérez et al. (2006) showed that in Spain tax morale is significantly affected by political and ideological factors, arguing that it is especially low among the supporters of nationalist parties in Catalonia and the Basque Country, who may feel excluded from the central government in Madrid. In the last decades, this factor could have had an important role on the level of Spanish tax morale because of the Catalan independence movement which seeks the independence of Catalonia from Spain. This last hypothesis is consistent with the tendency showed in Martinez-Vazquez and Torgler (2009). Indeed, analysing the evolution of tax morale in Spain over a 20-year span (1981 - 2000), they have shown that tax morale increased steadily from 1981 to 1995 and then declined slightly, but nevertheless significantly, through 1999/2000.

[10] In our analysis we take account of the sampling weight provided by EVS.

which ranks information of the scaled dependent variable. As it is common in the literature,[11] and because of the distribution of the answers (see figure 1), the ten-point scale has been recoded into a four-point scale (from 0 to 3), with value 3 standing for "*never justifiable*". The responses 4-10 have been combined into the value 0 due to the lack of variance and because together they account for less than 10% of the sample. However, to check the robustness of our results from the chosen categorization, in Section 4.1 we also use the original ten-point scale, considering the dependent variable as ordinal and discrete.[12]

3.2.1 Explanatory variables

Our main aim is to examine if group membership affects tax morale. Our analysis is assisted by the answer to the following question:

"*Please look carefully at the following list of voluntary organisations and say which, if any, do you belong to?*"

Respondents were asked to mention whether s/he is a member of trade unions, political parties or religious, sport, cultural, environmental, professional, humanitarian, consumer and self-help organisation or other association if s/he belongs to some other groups not mentioned before. To analyse the effects of group membership on tax morale, we create a dummy variable for each group listed in the EVS 2017.

As discussed in section 2, the literature which has investigated the impact of group membership on social capital has suggested that being a member of some of the previous associations may have an effect on the social capital dimensions of respondents. Based on this empirical evidence, we expect that members of self-help, religious, cultural, humanitarian, and environmental groups, and professional organisation exhibit on average a higher probability of responding "never justifiable" cheating on tax than others. It is not possible to make any prediction concerning the sign of the relationship between membership in sport associations, trade unions, political parties, and tax morale because of the contradictory evidence from the literature on social capital.

To best of our knowledge there are no contributions, which have specifically investigated the relationship between consumers' associations and social capital. Therefore, to understand how

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[11] See for instance Torgler (2004), Torgler and Schneider (2004), Alm and Torgler (2006), Torgler (2006), Frey and Torgler (2007), Rodriguez-Justicia and Theilen (2018).

[12] The results in Table 6 show that, in general, the estimates do not change qualitatively, neither considering the dependent variable as ordinal nor as discrete.

membership in consumers' organisation may affect tax morale, we rely on the purpose of such association.

Consumer organisations have two main peculiarities. First, they (mainly) serve the interest of their members providing legal assistance or professional advice for problems concerning mortgages, debt, bills, discrimination, civil rights and so on. Second, they aim to assist the consumption decisions of their members providing them information that highlights the value for money of products and the non-financial aspect of consumption (i.e. the social and environmental impact). The first aspect makes it clear that one of the main reasons why individual join consumers' organisations is to obtain some professional service in exchange. In this respect, the mutual component that characterises most of the previous associations here is missing. For what concerns the second aspect, the main topic of the information provided by consumers' organisations to their member concerns violation of law, fraud and so on.

In summary, it is likely that members of such organisations have not had good experience with others or society. Thus, it is reasonable to expect that they have not developed, or maintained, pro-social feelings and behaviour. For these reasons, we expect a negative relationship with tax morale.

3.2.2 Control Variables

The studies that have analysed empirically the components of tax morale, especially those based on surveys, have identified personal and demographic factors that appear to be important determinants of the intrinsic motivation to pay taxes. So, following the literature we include *Age, Gender, Marital status, Religions, Patriotism, Children,* occupation status (*Employment*), *Income* and *Education* as control.[13]

Regarding the impact of these variables on tax morale it has been found that elder (Torgler, 2005; Martinez-Vazquez and Torgler, 2009), women (Alm and Torgler, 2006; Torgler and Valev, 2010), retired (Torgler, 2006; Konrad and Qari, 2012), married (Alm and Torgler, 2006; Frey and Torgler, 2007), religious (Torgler, 2006), highly educated (Rodriguez-Justicia and Theilen, 2018), patriotic (Konrad and Qari, 2012) and with children (Rodriguez-Justicia and Theilen, 2018) individuals exhibit higher levels of tax morale; while self-employed (Alm and Torgler, 2006) have lower levels of tax morale. Finally, with respect to the effect of income on tax morale, the results are less clear. For example, Torgler (2006), and Döerrenberg and Peichl (2013) find a negative relationship between

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[13] See Table A.1 in the appendix for details on the definitions and measurement of the variables.

income and tax morale, while Konrad and Qari (2012) and Torgler et al. (2008) find that income has not a significant impact on tax morale.[14]

To measure their quantitative effect on tax morale, we calculate the marginal effects that indicate the percentage change in the probability of taxpayers having a specific level of tax morale when the independent variable increases by one unit. For simplicity, the marginal effects in all estimates are presented for the highest value of tax morale only. In line with the above evidence, we expect that elders, women, married, religious, patriotic, parents and highly educated individuals exhibit, on average, a higher probability of responding that it is never justifiable cheating on taxes.

Finally, to account for unobserved country effects, we include country dummies.

4. Results

We use two estimation techniques to identify the effects of the control variables and group membership on tax morale. We use robust standard errors and standard errors adjusted for clustering on 33 countries.[15] The latter allows for intra-group correlation, relaxing the usual requirement that the observations are independent. That is, the observations are independent across clusters (countries) but not necessarily within clusters. Therefore, it accounts for unobservable country-specific characteristics.

The estimation results in Table 2, column 1 indicate that membership in 5 groups out of 11 has a significant effect on the tax morale.[16] The sign of the coefficients indicates that belonging to a trade union and humanitarian organisation has a positive impact on tax morale, which amount to a higher probability of responding never justifiable respectively by 2.2% and 1.6%. On the other hand, membership in sport associations, consumers and self-help organisations has a negative effect on tax

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[14] By contrast, a positive relation between income and tax morale has been recently proved trough a laboratory experiment in Grundmann and Lambsdorff (2017). Their results suggest that higher income reduces tax morale. They argue that the relationship is explained by a psychological force that tempts rich people to cheat more often, a force that is not responsive to distributional justice or to absolute levels of taxation. They argue that income exerts a positive effect on the individuals' feelings of power, and, because of it, individuals are only focused on the potential rewards of any action. Therefore, they tend to follow their self-interest and are less sensitive to social disapproval. As a result, the higher the subject earning, the more entitled they might have felt to cheat.

[15] Portugal has not been included because of missing data on income.

[16] In other estimations do not show here, we analyse group membership through a unique dummy variable, which takes value 1 if respondent belongs at least to one of the listed groups and 0 otherwise. The results suggest that there is not a significant impact of being a member of a groups and having a higher tax morale. In fact, the heterogeneous effect that each group exert on tax morale, expressed by the sign of the coefficients in Table 2, is the main reason for this result. This evidence is coherent with the main literature on social capital, according to which belonging to certain groups rather than others has a different effect on morality, civic engagement, and values.

morale. Individuals belonging to such groups show a lower probability to believe that evasion is never justifiable respectively by 2.2%, 4.9% and 2.9%.

Interestingly, according to our estimates there exists a negative effect of membership in sport associations on tax morale. This evidence supports the findings in Jarvie (2003) and Coalter (2007) according to which sport communities may exert positive as well as negative influence on individuals. They argue that the sign of this effect should be evaluated according to the social contest in which an individual lives, adding that the degree of interaction with the world beyond one's own immediate neighbourhood is a key feature. Notably, there might exist a potential danger that the individuals' sport social network can lead to segregation and exclusionary behaviour with a negative impact on civic engagement. So, it is possible that while such groups can strengthen the network component of individuals' social capital, promoting social connection between similar individuals, it may lead to communities that share negative attitudes rejecting prosocial behaviour.

Differently from membership in sport associations, our estimates suggest that being a unionist or a member of humanitarian organisations exerts a positive effect on tax morale. In the former case, there is no full agreement in the literature on the effect of trade unions on social capital, although our findings are in line with the predominant view (Raiser et al, 2002; Johnson and Jarley, 2005; Bekkers, 2005) according to which belonging to a trade union promotes social capital, here measured in its morality and prosocial dimensions. In the latter case, the result is in line with our expectations, although the relationship between membership in humanitarian organisation and tax morale is on the border of significance.

Contrary to expectations, self-help groups exert a negative effect on tax morale. These organisations are characterized by individuals who share a common problem or condition (such as addiction) and who get together for mutual support and to find new ways of coping. Folgheraiter and Pasini (2009) highlight that only people with long-term experience of self-help groups achieve a better social capital scores than younger participants. We have not enough data to operate such a division among individuals, so we cannot support or discard their findings. A possible explanation for this results might be that, although self-help group membership may exert a positive effect on some components of social capital, such as social relationships, this might not be enough to affect the values and the morality of individuals, whose self-esteem and prosocial behaviour could be damaged by addiction or other problems. In other terms, it makes no sense to pay your taxes if you think that society has not been fair to you.

Finally, our estimates show that being a member of a consumers' organisation is associated with a lower probability of responding never justifiable cheating on tax. This result confirms our prediction according to which members of consumer organisations, by their very nature, are more likely to have, develop, or maintain beliefs and values which do not support prosocial behaviour.

For what concerns the remaining estimates, as expected, belonging to religious, cultural and environmental organisation exerts a positive effect on tax morale, whereas being a member of a political, or other, organisations has a negative effect on it. Moreover, the estimates suggest that belonging to professional organisation has no effect on tax morale. On the other hand, our findings suggest that all these relationships are not significant.

Interestingly, we do not find a significant relationship between being a member of a religious organisation and tax morale. This result is not coherent with the findings in Torgler (2006) according to which being a member of a religious organisation positively affects tax morale. One of the main reasons to explain this discrepancy may be sought in the different dataset he used. Differently from our study, his findings are based on the World Value Survey (1995-1997) and on a different set of countries. He has analysed religiosity as a potential factor that affects tax morale, using different measurements such as church attendance, religious education, being an active member of a church or a religious organisation, perceived religiosity, religious guidance and trust in the church. He has also included Latin American and Asiatic Countries.

These results do not allow to conclude that being a member of an organisation exerts effects on tax morale, but only that some organisations seem to influence the values and beliefs of individuals. In this respect, our findings partially support the evidence in Stolle and Rochon (1998) and Delhey and Newton (2003). Of the former, in so far as the intensity and the sign of the relationship between membership in voluntary organisation and social capital (here measured in its morality and prosocial dimensions) depends on the organisations in which individuals are member. Of the latter, in so far as the link between voluntary organisations and tax morale is not as self-evident as one would expect.

Regarding the control variables, estimation results are substantially in line with the main evidence from the literature on tax morale. Elders, women, religious, patriotic, and retired people exhibit higher tax morale than other individuals. The marginal values indicate that the magnitude of these effects is substantial. Notably, individuals falling within the previous categories have a higher probability of responding *never justifiable* by respectively 8%, 5.5%, 3.3%, 6.7% and 3.8 %. Education is also

significantly and positively related to tax morale, although the effects on tax morale is negligible.[17] On the other hand, divorced (or never married), self-employed, unemployed and student have on average a lower tax morale than other individuals. The marginal effect of these variables is around 3%. This last result is consistent with the standard argument that self-employed taxpayers have a lower tax morale as they have higher opportunity costs of being honest.

Estimations suggest that income exerts a negative influence on tax morale, although based on the available data there are not enough evidence to argue that income is a significant component of tax morale. This result is not surprising and is in line with the literature.

Column 1 of Table 4 shows the estimation results obtained with the standard errors adjusted for clustering on countries. This only affects the test statistics keeping the coefficients and the marginal effects unchanged. The previous results still hold. Moreover, the results indicate the relevance of including a broad set of control variables.

4.1 Robustness check

To check for robustness, we use other variables related to *trust* and *civism*. In fact, as pointed out in Van Oorschot et al. (2006) membership in a group is just the objective dimension of the much more structured concept of social capital. According to the literature on the field, there exists also a subjective dimension consisting of a set of values and attitudes of individuals relating to trust, reciprocity, and willingness to cooperate. In this respect, Van Oorschot et al. (2006) identify two different components of such subjective dimension, that is *trust* - whose main components are generalized trust in others and trust in institutions - and *civism* - whose main components are trustworthiness and political engagement. [18] As discussed in chapter 1, the literature on tax morale agrees that both these dimensions exert a positive effect on individuals' intrinsic motivation to pay taxes.

To check whether these two dimensions affect our estimates and to isolate, as well as possible, the effect of group membership on tax morale, we perform two alternative estimations taking into account other control variables relating to trust in others, in State institutions (trust dimension), and individuals' political engagement (civic dimension).

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[17] Increasing the education by one unit (a further level of education) increases the probability of individual to have the highest level of tax morale on average by 0.03 %.

[18] Van Oorschot et al. (2006) measure the trustworthiness as the civic commitment and morality. In our work this correspond to the dependent variable so we cannot control for it.

To assess generalized trust, we use the answers to the following questions:

"*Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?*"

"*Could you tell me for each whether you trust people from this group completely, somewhat, not very much or not at all?... (a)Your family... (b)People you know personally*".

The dichotomic answer to the first question measures the trust in others in general, while the answer to the second question measures the trust in the family network and within the known people.[19]

To assess trust in institutions we use the answers to the following questions:

"*(…) how much confidence you have in them, is it a great deal, quite a lot, not very much or none at all? …(a) Parliament…(b)The Justice system…(c) Government*"

These three dimensions of institutional trust allow us to analyse the individuals' trust at the constitutional level (justice and parliament) and political level (government).[20]

Finally, to test the effect of the civic component on tax morale we use the answer to the following question:

"*How interested would you say you are in politics?*"[21]

The estimations in column 3 and 4 of Table 2 show that the impact of *trust in family* and *trust in known people* is substantial. They have a strong, and positive, effect on tax morale quantifiable in a higher probability of responding never justifiable by 7.5% and 6.2%. The results are also significant when the regression with standard error adjusted for clustering is performed (as shown in column 3 and 4 of Table 4). *Trust in others* is less strongly (but positive) related to tax morale. The size of the effect amounts to a higher probability for individual to have a higher tax morale by 1.4% (as shown

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[19] In the answer to the first question 1 stands for "*most people can be trusted*" whereas 2 for "*can't be too careful*". We have recoded the answer through a dummy variable, which assumes 1 if the interviewed answered 1 and 0 otherwise. In the second question, the interviewed expressed a preference through a four-point scale, where 1 stands for "*Trust completely*" and 4 for "*do not trust at all*". We have recoded the latter answer through a dummy variable, which assumes value 1 if the interviewed answered 1 or 2 and 0 otherwise.

[20] The interviewed expressed a preference through a four-point scale, where 1 stand for "*a great deal*" confidence and 4 for "*none at all*". We have recoded the answer through a dummy variable, which assumes value 1 if the interviewed answered 1 or 2 and 0 otherwise.

[21] The interviewed expressed a preference through a four-point scale where, 1 stand for "*very interested*" and 4 for "*not at all interested*". We have recoded the answer through a dummy variable, which takes 1 if the interviewed answered 1 or 2 and 0 otherwise.

in column 2 of Table 2). However, the significance of this effect disappears when we perform the regression clustering standard errors (as shown in column 2 of Table 4), suggesting that unobservable country-specific characteristics have affected this estimation.

The above evidence indicates that trust in known people and family – and partially in others - are relevant components of tax morale and suggests that, in general, societies characterized by horizontal trust - i.e. among taxpayers - tend to produce stronger social norms, in this case with respect to tax compliance.

In columns 1, 2 and 3 of Table 3, we measure the impact of trust in State institutions. The results indicate that *trust in Parliament*, *trust in Justice* and *trust in Government* have a positive (and significant) impact on tax morale. The size of these effects amount to a higher probability for the individual to have a higher tax morale respectively by 2.4%, 3.6% and 4.5 %. The results are also significant even if we perform the regression with clustering standard errors on countries (as shown in column 1, 2 and 3 of Table 5).

To observe the impact of the civic dimension on tax morale, in column 4 of Table 3 (and in column 4 of Table 5) we repeat the previous analysis including the control variable *interest in politics*. The resulting coefficient is significant. The marginal effect indicates that interest in politics is generally associated with a higher probability of responding *never justifiable* by 2.8%.

Our findings concerning trust (in people and in institution) and civism (interest in politics) are in line with the main evidence in the literature.[22]

It must be noted that including these controls does not affect the significance level of membership in trade unions, sport, self-hep and consumer organisations. By contrast, this check weakens the relationship between membership in humanitarian organisation and tax morale. Notably, our estimates suggest that *trust in others* and *interest in politics* explain part of this relationship. When they are introduced, membership in humanitarian organisation and tax morale are not significantly related anymore, notwithstanding the weak correlation between these controls and the explanatory variable (see Table A.2).[23] Moreover, compared with the basic setting, the introduction of the variables *trust in known people, in Parliament, in Government, and interest in politics* makes the relation between membership in political groups and tax morale significant, although these effects

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[22] Just to name a few, Torgler (2003b), Torgler and Schneider, (2005), Martinez-Vazquez and Torgler (2009).

[23] However, note that in all our estimations the relation between membership in humanitarian organisation and tax morale is on the border of significance.

disappear - except for *interest in politics* - when we use standard errors adjusted for the clustering on countries. This suggests that these last results could be caused by unobservable country-specific characteristics. However, the different impact (evaluated in terms of the sign of the coefficients) that they have on tax morale – positive for trust variables and *interest in politics* and negative for membership in political group – suggests that these effects operate through different channels. [24]

Finally, to test whether the results are sensitive to the categorization of our dependent variable, we perform the previous analysis with the original ten-point scale from the survey. The results in Table 6 show that, in general, the estimates do not change qualitatively, neither considering the dependent variable as ordinal nor as discrete.

As anticipated, our estimates do not allow to state that being a member of a group influences tax morale. What we can conclude is that some groups contribute more than others to affect social values and individual beliefs.

4.2 Endogeneity

In the previous section, we have presented an exploratory analysis which aims to estimate the potential role of group membership on tax morale, attempting to provide a causality interpretation between these variables. Although our results suggest that some group memberships are significantly related with tax morale, we recognise that our analysis might be weakened by endogeneity problems. A first source of endogeneity comes from omitted variables. This might be, for instance, the case of trade union membership. The marginal effect that we have estimated, might be affected by the fact that such individuals have not the opportunity to evade (at least the taxes related to labour income). In fact, most of the individuals who belong to such organisations are employees characterized by tax withholding[25] - i.e. a system in which the taxes are paid to the government by the payer of the income (employers) rather than by recipient of the income. Omitted variables might also weaken the estimated relationship between membership in sport associations and tax morale. In this case, the state of health might affect the individuals' preference for public expenditure and through this channel their motivation to pay taxes. Moreover, as discussed in the previous section, the preference for public expenditure might affect also the relationship between tax morale and self-help group membership.

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[24] Note that, as shown in Table A.2 in the appendix all these variables are weakly correlated.

[25] About 74% of the individuals who belong to a trade union are employees, 13% are retired people, 3% are self-employed. The remaining 10% is almost equally distributed among unemployed, disabled, students and others.

In the absence of data on the individuals' preference for public expenditure and on individuals' actual opportunity to evade, we have attempted to address the above issues through instrumental variables but, unfortunately, we have not found in the EVS 2017 any individual characteristic correlated with group membership but not with tax morale.

We are conscious that our analysis is not immune from other kind of endogeneity problems. In fact, belonging to a group is a personal choice, which could depend on some other variables that we are not able to recognize. Moreover, it is also possible that group membership could be affected by the participation in other groups. In order to address these questions, we perform other analysis. Firstly, we add the explanatory variables (group membership) one by one to investigate whether some variables act as confounder, although the correlation matrix (see Table A.2 in the Appendix) does not provide any argument supporting this assumption. Indeed, we do not find relevant problems of confounding. The only noteworthy fact concerns trade union membership, which exerts a slightly lower effect on tax morale when evaluated alone, although it remains significant. Based on several trials, we find that belonging to a consumers' organisation slightly improve the effect of trade union on tax morale, but the opposite is not true. The literature on group membership does not provide any evidence that could help explain this occurrence. However, considering the low correlation between the two variables and the negligible magnitude of this effect in terms of significance, we have entered both variables in the previous analysis.

Finally, to account for other sources of endogeneity we analyse group membership using a dummy variable (which takes value 1 if the respondent belongs to at least one of the listed groups and 0 otherwise) and a discrete variable (that counts the number of groups to which an individual belong to). However, in both cases we have not found a significant correlation with tax morale. The heterogeneous effect that each group exert on tax morale – above discussed - is the main reason for this result.

5. Conclusions

In this contribution, we provide a preliminary and explorative empirical investigation on the role of group membership on tax morale, encouraged by the promising evidence from the social capital literature. According to our findings, there is not enough evidence to state that group membership is correlated with tax morale because of the heterogeneous effects that each group membership exerts on tax morale. However, few group memberships are significantly correlated with a lower level of tax morale (such as consumer, sport organisation and self-help).

The prevalence of negative coefficients among those organisations which significantly affect tax morale could suggest that group membership does not contribute to generate the social capital components but rather to destroy some dimensions of it. An alternative explanation, more in line with the literature, could be that the negative relationship between the two dimensions of social capital is mainly due to individuals' social network. This assumption is supported by two facts. First, adding the control variables concerning trust (in institution and other) and civism (interest in politics) does not affect the influence of group membership on tax morale - therefore, the effect of group membership on tax morale is not related to other components of social capital.

Second, as discussed in section 2, the literature agrees that being a member of a group has a positive effect on the number of individual's social relationships. However, as shown in Jarvie (2003) and Coalter (2007), this only implies that, other things being equal, members of a group are, on average, more exposed to social influence than others. Put it differently, it is not straightforward that having more social relationships results in a higher (overall) score of social capital, it depends on the social context in which these social relationships have been built. So, the prevalence of the negative effect on tax morale could depend on the stimuli that individuals received in a specific contest.

As a follow up it would be interesting to design laboratory-controlled experiments to compare the intrinsic motivation to pay taxes of individuals belonging to various associations/organisations. This methodology, putting restrictions in place so that certain variables do not impact the outcome of the experiment, would make possible to address some of the endogeneity issues highlighted in the previous section.

Table 2 – Weighted ordered probit with robust standard errors - column 2,3,4 control for trust in others.

DEP VARIABLE: TAXMORALE	(1)			(2)			(3)			(4)		
INDEPENDENT VARIABLES	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*
(a) Membership in a group												
Religious Org.	0.015	0.764	0.005	0.013	0.693	0.005	0.014	0.73	0.005	0.013	0.682	0.005
Cultural Org.	0.019	0.892	0.007	0.017	0.761	0.006	0.019	0.894	0.007	0.017	0.773	0.006
Trade Unions	0.060***	2.758	0.022	0.059***	2.748	0.022	0.059***	2.741	0.022	0.056***	2.607	0.021
Political Org.	-0.051	-1.615	-0.019	-0.052	-1.645	-0.02	-0.052	-1.626	-0.019	-0.053*	-1.675	-0.02
Environ. Org.	0.033	1.196	0.012	0.032	1.145	0.012	0.034	1.218	0.012	0.034	1.228	0.012
Professional Org.	0	-0.004	0	-0.002	-0.059	-0.001	0.001	0.036	0	0	0.009	0
Sport Ass.	-0.060***	-3.308	-0.022	-0.061***	-3.354	-0.023	-0.062***	-3.382	-0.023	-0.061***	-3.366	-0.023
Humanitarian Org.	0.042*	1.749	0.016	0.04	1.637	0.015	0.042*	1.735	0.015	0.041*	1.702	0.015
Consumer Ass.	-0.130***	-3.377	-0.049	-0.131***	-3.418	-0.05	-0.130***	-3.378	-0.049	-0.128***	-3.332	-0.048
Self-help Org.	-0.078**	-2.081	-0.029	-0.077**	-2.044	-0.029	-0.078**	-2.061	-0.029	-0.078**	-2.067	-0.029
Other Org.	-0.027	-1.053	-0.01	-0.028	-1.079	-0.01	-0.026	-1.026	-0.01	-0.028	-1.102	-0.011
(b) Demographic Factors												
AGE 30-39	0.036	1.348	0.014	0.036	1.357	0.014	0.037	1.395	0.014	0.036	1.367	0.014
AGE 40-49	0.060**	2.169	0.023	0.060**	2.162	0.023	0.062**	2.247	0.024	0.060**	2.162	0.023
AGE 50-59	0.145***	5.094	0.054	0.144***	5.069	0.054	0.149***	5.225	0.055	0.144***	5.058	0.053
AGE 60-69	0.143***	4.23	0.053	0.141***	4.184	0.053	0.146***	4.332	0.055	0.141***	4.165	0.052
AGE 70+	0.219***	5.494	0.08	0.217***	5.445	0.08	0.222***	5.567	0.082	0.216***	5.405	0.079
Female	0.149***	10.241	0.055	0.149***	10.245	0.055	0.148***	10.197	0.055	0.149***	10.21	0.055
Religious	0.090***	5.45	0.033	0.091***	5.495	0.034	0.089***	5.365	0.033	0.088***	5.348	0.033
Patriotic	0.177***	9.334	0.067	0.176***	9.285	0.066	0.174***	9.157	0.066	0.170***	8.976	0.064
(c) Marital Status												
Widowed	-0.025	-0.901	-0.009	-0.025	-0.897	-0.009	-0.023	-0.848	-0.009	-0.023	-0.837	-0.008
Divorced	-0.105***	-4.176	-0.039	-0.104***	-4.163	-0.039	-0.098***	-3.929	-0.037	-0.103***	-4.096	-0.038
Separated	0.036	0.642	0.013	0.037	0.665	0.014	0.041	0.722	0.015	0.037	0.661	0.013
Never Mar.	-0.066***	-2.964	-0.024	-0.066***	-2.983	-0.025	-0.063***	-2.831	-0.023	-0.067***	-3.014	-0.025
Children	0.008	1.242	0.003	0.008	1.239	0.003	0.007	1.117	0.003	0.008	1.255	0.003
Education	0.009***	2.975	0.003	0.009***	2.843	0.003	0.009***	2.92	0.003	0.009***	2.867	0.003
Income	-0.002	-0.541	-0.001	-0.002	-0.704	-0.001	-0.002	-0.676	-0.001	-0.003	-0.981	-0.001

(d) Employment Status												
Part- Time Empl.	-0.006	-0.212	-0.002	-0.007	-0.227	-0.002	-0.007	-0.226	-0.002	-0.007	-0.25	-0.003
Self Empl.	-0.098***	-3.408	-0.037	-0.099***	-3.447	-0.037	-0.098***	-3.401	-0.037	-0.097***	-3.363	-0.036
Military	-0.346	-1.235	-0.134	-0.348	-1.241	-0.135	-0.349	-1.246	-0.136	-0.352	-1.25	-0.136
Pensioned	0.106***	3.637	0.038	0.107***	3.668	0.039	0.108***	3.691	0.039	0.107***	3.656	0.039
At home	-0.03	-0.867	-0.011	-0.029	-0.854	-0.011	-0.029	-0.852	-0.011	-0.026	-0.752	-0.01
Student	-0.103***	-2.773	-0.039	-0.104***	-2.815	-0.039	-0.105***	-2.82	-0.039	-0.107***	-2.892	-0.04
Unemployed	-0.088***	-2.985	-0.033	-0.088***	-2.988	-0.033	-0.087***	-2.94	-0.033	-0.086***	-2.923	-0.032
Disabled	0.008	0.16	0.003	0.012	0.226	0.004	0.018	0.348	0.007	0.015	0.292	0.006
Other	0.005	0.059	0.002	0.005	0.065	0.002	0.011	0.129	0.004	0.012	0.138	0.004
(e) Individual Trust												
Trust in Other				0.037**	2.401	0.014						
Trust in Family							0.204***	3.87	0.075			
Trust in known people										0.167***	7.17	0.062
_cons1	-0.604***	-11.421		-0.599***	-11.331		-0.408***	-5.54		-0.502***	-9.163	
_cons2	-0.321***	-6.087		-0.316***	-5.997		-0.125*	-1.694		-0.219***	-4.001	
_cons3	0.066	-1.262		0.071	1.349		0.263***	3.58		0.169***	3.098	
Number of observations	45.323			45.323			45.323			45.323		
Countries FE	YES			YES			YES			YES		
Prob > chi2	0			0			0			0		
Pseudo R2	0.0547			0.0547			0.0549			0.055		

Notes: Dependent variable on a four-point scale. Reference group: Age<30, Male, Not Religious, Not Patriotic, Married, Full employed and with no membership in any groups.
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%. Marginal effect: highest tax morale score.

Table 3 - Weighted ordered probit with robust standard errors - column 1, 2,3 control for trust in institutions and column 4 control for interest in politics.

DEP VARIABLE: TAXMORALE	(1)			(2)			(3)			(4)		
INDEPENDENT VARIABLES	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*
(a) Membership in a group												
Religious Org.	0.014	0.739	0.005	0.012	0.595	0.004	0.011	0.587	0.004	0.014	0.743	0.005
Cultural Org.	0.018	0.811	0.006	0.017	0.786	0.006	0.017	0.794	0.006	0.014	0.665	0.005
Trade Unions	0.060***	2.765	0.022	0.058***	2.672	0.021	0.061***	2.826	0.022	0.059***	2.718	0.022
Political Org.	-0.056*	-1.758	-0.021	-0.052	-1.637	-0.019	-0.061*	-1.905	-0.023	-0.073**	-2.275	-0.027
Environ. Org.	0.034	1.229	0.012	0.036	1.3	0.013	0.034	1.248	0.013	0.03	1.103	0.011
Professional Org.	-0.003	-0.104	-0.001	-0.003	-0.11	-0.001	-0.002	-0.089	-0.001	-0.004	-0.16	-0.001
Sport Ass.	-0.062***	-3.416	-0.023	-0.063***	-3.435	-0.023	-0.066***	-3.595	-0.024	-0.061***	-3.319	-0.023
Humanitarian Org.	0.040*	1.669	0.015	0.041*	1.681	0.015	0.042*	1.735	0.015	0.038	1.559	0.014
Consumer Ass.	-0.131***	-3.412	-0.049	-0.131***	-3.416	-0.05	-0.129***	-3.364	-0.049	-0.128***	-3.336	-0.048
Self-help Org	-0.077**	-2.055	-0.029	-0.077**	-2.045	-0.029	-0.075**	-2.002	-0.028	-0.077**	-2.052	-0.029
Other Org	-0.027	-1.04	-0.01	-0.029	-1.114	-0.011	-0.027	-1.069	-0.01	-0.031	-1.191	-0.011
(f) Trust in Institutions												
Trust in Parliament	0.064***	4.323	0.024									
Trust in Justice				0.097***	6.492	0.036						
Trust in Government							0.122***	8.157	0.045			
(g) Civism												
Interest in Politics										0.076***	5.171	0.028
_cons1	-0.599***	-11.338		-0.580***	-10.953		-0.598***	-11.315		-0.596***	-11.293	
_cons2	-0.316***	-6		-0.297***	-5.623		-0.314***	-5.966		-0.313***	-5.947	
_cons3	0.071	1.355		0.090*	1.717		0.073	1.397		0.075	1.42	
Number of observations	45.323			45.323			45.323			45.323		
Countries FE	YES			YES			YES			YES		
Prob > chi2	0			0			0			0		
Pseudo R2	0.0549			0.0553			0.0556			0.055		

Notes: Dependent variable on a four-point scale. Reference group: Age<30, Male, Not Religious, Not Patriotic, Married, Full employed and with no membership in any groups.
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%. Marginal effect: highest tax morale score.

Table 4 - Weighted ordered probit with standard errors adjusted for cluster on countries - column 2,3,4 control for trust in others.

DEP VARIABLE: TAXMORALE	(1)			(2)			(3)			(4)		
INDEPENDENT VARIABLES	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*
(a) Membership in a group												
Religious Org.	0.015	0.426	0.005	0.013	0.391	0.005	0.014	0.41	0.005	0.013	0.383	0.005
Cultural Org.	0.019	0.831	0.007	0.017	0.727	0.006	0.019	0.832	0.007	0.017	0.727	0.006
Trade Unions	0.060**	2.374	0.022	0.059**	2.375	0.022	0.059**	2.357	0.022	0.056**	2.229	0.021
Political Org.	-0.051	-1.23	-0.019	-0.052	-1.25	-0.02	-0.052	-1.233	-0.019	-0.053	-1.284	-0.02
Environ. Org.	0.033	1.143	0.012	0.032	1.113	0.012	0.034	1.168	0.012	0.034	1.163	0.012
Professional Org.	0	-0.004	0	-0.002	-0.063	-0.001	0.001	0.038	0	0	0.01	0
Sport Ass.	-0.060**	-2.327	-0.022	-0.061**	-2.383	-0.023	-0.062**	-2.384	-0.023	-0.061**	-2.352	-0.023
Humanitarian Org.	0.042*	1.77	0.016	0.04	1.644	0.015	0.042*	1.767	0.015	0.041*	1.729	0.015
Consumer Ass.	-0.130***	-3.576	-0.049	-0.131***	-3.656	-0.05	-0.130***	-3.579	-0.049	-0.128***	-3.559	-0.048
Self-help Org.	-0.078**	-2.119	-0.029	-0.077**	-2.093	-0.029	-0.078**	-2.097	-0.029	-0.078**	-2.129	-0.029
Other Org.	-0.027	-1.012	-0.01	-0.028	-1.039	-0.01	-0.026	-0.989	-0.01	-0.028	-1.06	-0.011
(b) Demographic Factors												
AGE 30-39	0.036	1.013	0.014	0.036	1.019	0.014	0.037	1.043	0.014	0.036	1.02	0.014
AGE 40-49	0.060*	1.692	0.023	0.060*	1.691	0.023	0.062*	1.761	0.024	0.060*	1.671	0.023
AGE 50-59	0.145***	4.241	0.054	0.144***	4.225	0.054	0.149***	4.346	0.055	0.144***	4.158	0.053
AGE 60-69	0.143***	3.435	0.053	0.141***	3.391	0.053	0.146***	3.511	0.055	0.141***	3.289	0.052
AGE 70+	0.219***	4.653	0.08	0.217***	4.59	0.08	0.222***	4.695	0.082	0.216***	4.517	0.079
Female	0.149***	5.821	0.055	0.149***	5.836	0.055	0.148***	5.821	0.055	0.149***	5.82	0.055
Religious	0.090***	3.449	0.033	0.091***	3.501	0.034	0.089***	3.387	0.033	0.088***	3.454	0.033
Patriotic	0.177***	6.576	0.067	0.176***	6.501	0.066	0.174***	6.498	0.066	0.170***	6.496	0.064
(c) Marital Status												
Widowed	-0.025	-0.917	-0.009	-0.025	-0.911	-0.009	-0.023	-0.864	-0.009	-0.023	-0.846	-0.008
Divorced	-0.105***	-4.168	-0.039	-0.104***	-4.168	-0.039	-0.098***	-3.921	-0.037	-0.103***	-4.134	-0.038
Separated	0.036	0.816	0.013	0.037	0.844	0.014	0.041	0.913	0.015	0.037	0.834	0.013
Never Mar.	-0.066***	-2.621	-0.024	-0.066***	-2.649	-0.025	-0.063**	-2.499	-0.023	-0.067***	-2.691	-0.025
Children	0.008	1.198	0.003	0.008	1.197	0.003	0.007	1.075	0.003	0.008	1.226	0.003
Education	0.009***	2.962	0.003	0.009***	2.844	0.003	0.009***	2.975	0.003	0.009***	2.972	0.003
Income	-0.002	-0.331	-0.001	-0.002	-0.435	-0.001	-0.002	-0.413	-0.001	-0.003	-0.593	-0.001

(d) Employment Status												
Part-Time Empl.	-0.006	-0.21	-0.002	-0.007	-0.223	-0.002	-0.007	-0.225	-0.002	-0.007	-0.249	-0.003
Self-Empl.	-0.098**	-2.323	-0.037	-0.099**	-2.347	-0.037	-0.098**	-2.323	-0.037	-0.097**	-2.267	-0.036
Military	-0.346	-1.423	-0.134	-0.348	-1.432	-0.135	-0.349	-1.434	-0.136	-0.352	-1.426	-0.136
Pensioned	0.106***	3.1	0.038	0.107***	3.102	0.039	0.108***	3.12	0.039	0.107***	3.113	0.039
At home	-0.03	-0.818	-0.011	-0.029	-0.805	-0.011	-0.029	-0.805	-0.011	-0.026	-0.717	-0.01
Student	-0.103*	-1.955	-0.039	-0.104**	-1.996	-0.039	-0.105**	-1.994	-0.039	-0.107**	-2.047	-0.04
Unemployed	-0.088***	-2.741	-0.033	-0.088***	-2.741	-0.033	-0.087***	-2.693	-0.033	-0.086***	-2.666	-0.032
Disabled	0.008	0.19	0.003	0.012	0.267	0.004	0.018	0.42	0.007	0.015	0.352	0.006
Other	0.005	0.057	0.002	0.005	0.064	0.002	0.011	0.124	0.004	0.012	0.131	0.004
(e) Individual Trust												
Trust in Other				0.037	1.349	0.014						
Trust in Family							0.204***	3.478	0.075			
Trust in Known People										0.167***	8.984	0.062
_cons1	-0.604***	-11.641		-0.599***	-11.65		-0.408***	-5.121		-0.502***	-9.786	
_cons2	-0.321***	-6.896		-0.316***	-6.853		-0.125*	-1.666		-0.219***	-4.57	
_cons3	0.066	1.468		0.071	1.571		0.263***	3.498		0.169***	3.462	
Number of observations	45323			45323			45.323			45.323		
Countries FE	YES			YES			YES			YES		
Prob > chi2	0			0			0			0		
Pseudo R2	0.0547			0.0547			0.0549			0.055		

Notes: Dependent variable on a four-point scale. Reference group: Age<30, Male, Not Religious, Not Patriotic, Married, Full employed and with no membership in any groups.
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%. Marginal effect: highest tax morale score.

Table 5 - Weighted ordered probit with standard errors adjusted for cluster on countries - column 1, 2,3 control for trust in institutions and column 4 control for interest in politics.

DEP VARIABLE: TAXMORALE	(1)			(2)			(3)			(4)		
INDEPENDENT VARIABLES	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*
(a) Membership in a group												
Religious Org.	0.014	0.41	0.005	0.012	0.333	0.004	0.011	0.324	0.004	0.014	0.418	0.005
Cultural Org.	0.018	0.757	0.006	0.017	0.742	0.006	0.017	0.741	0.006	0.014	0.613	0.005
Trade Unions	0.060**	2.392	0.022	0.058**	2.293	0.021	0.061**	2.436	0.022	0.059**	2.339	0.022
Political Org.	-0.056	-1.33	-0.021	-0.052	-1.243	-0.019	-0.061	-1.465	-0.023	-0.073*	-1.743	-0.027
Environ. Org.	0.034	1.16	0.012	0.036	1.234	0.013	0.034	1.157	0.013	0.03	1.07	0.011
Professional Org.	-0.003	-0.112	-0.001	-0.003	-0.117	-0.001	-0.002	-0.094	-0.001	-0.004	-0.171	-0.001
Sport Ass.	-0.062**	-2.444	-0.023	-0.063**	-2.464	-0.023	-0.066***	-2.577	-0.024	-0.061**	-2.347	-0.023
Humanitarian Org.	0.040*	1.687	0.015	0.041*	1.686	0.015	0.042*	1.762	0.015	0.038	1.565	0.014
Consumer Ass.	-0.131***	-3.62	-0.049	-0.131***	-3.577	-0.05	-0.129***	-3.521	-0.049	-0.128***	-3.603	-0.048
Self-help Org.	-0.077**	-2.094	-0.029	-0.077**	-2.105	-0.029	-0.075**	-2.011	-0.028	-0.077**	-2.103	-0.029
Other Org.	-0.027	-0.997	-0.01	-0.029	-1.071	-0.011	-0.027	-1.023	-0.01	-0.031	-1.149	-0.011
(f) Trust in Institutions												
Trust in Parliament	0.064***	2.608	0.024									
Trust in Justice				0.097***	3.568	0.036						
Trust in Government							0.122***	4.841	0.045			
(g) Civism												
Interest in Politics										0.076***	3.194	0.028
_cons1	-0.599***	-11.584		-0.580***	-11.444		-0.598***	-11.635		-0.596***	-11.848	
_cons2	-0.316***	-6.808		-0.297***	-6.432		-0.314***	-6.834		-0.313***	-6.949	
_cons3	0.071	1.573		0.090**	1.966		0.073	1.641		0.075*	1.686	
Number of observations	45.323			45.323			45.323			45.323		
Countries FE	YES			YES			YES			YES		
Prob > chi2	0			0			0			0		
Pseudo R2	0.0549			0.0553			0.0556			0.0556		

Notes: Dependent variable on a four-point scale. Reference group: Age<30, Male, Not Religious, Not Patriotic, Married, Full employed and with no membership in any groups.
* Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%. Marginal effect: highest tax morale score.

Table 6 - Weighted ordered probit with tax morale assessed through a ten-point scale. In Column1 robust standard errors, in column 2 standard errors adjusted for clustering on 33 countries

DEP VARIABLE: TAXMORALE	WEIGHTED PROBIT Robust Standard Errors (1)			WEIGHTED PROBIT Standard errors adjusted for clustering on countries (2)			OLS Robust Standard Errors (3)		OLS Standard errors adjusted for clustering on countries (4)	
INDEPENDENT VARIABLES	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Marginal Effect*	*Coef.*	*z*	*Coef.*	*z*
(a) Membership in a group										
Religious Org.	0.018	0.956	0.007	0.018	0.564	0.007	0.01	0.624	0.01	0.334
Cultural Org.	0.015	0.714	0.006	0.015	0.692	0.006	0.025	1.355	0.025	1.224
Trade Unions	0.061***	2.911	0.022	0.061**	2.37	0.022	0.052***	2.828	0.052**	2.618
Political Org.	-0.061*	-1.882	-0.023	-0.061	-1.379	-0.023	-0.036	-1.286	-0.036	-0.941
Environ. Org.	0.027	0.979	0.01	0.027	0.857	0.01	0.033	1.429	0.033	1.498
Professional Org.	-0.004	-0.17	-0.002	-0.004	-0.174	-0.002	0.008	0.373	0.008	0.377
Sport Ass.	-0.058***	-3.244	-0.022	-0.058**	-2.274	-0.022	-0.052***	-3.29	-0.052**	-2.383
Humanitarian Org.	0.037	1.554	0.014	0.037	1.569	0.014	0.037*	1.886	0.037*	1.944
Consumer Ass.	-0.134***	-3.529	-0.05	-0.134***	-3.611	-0.05	-0.105***	-3.073	-0.105***	-2.899
Self-help Org.	-0.084**	-2.3	-0.032	-0.084**	-2.038	-0.032	-0.083***	-2.616	-0.083**	-2.649
Other Org.	-0.022	-0.878	-0.008	-0.022	-0.802	-0.008	-0.024	-1.101	-0.024	-1.007
(b) Demographic Factors										
AGE 30-39	0.046*	1.784	0.018	0.046	1.429	0.018	0.033	1.342	0.033	1.034
AGE 40-49	0.077***	2.856	0.029	0.077**	2.37	0.029	0.061**	2.354	0.061*	1.868
AGE 50-59	0.163***	5.897	0.061	0.163***	4.982	0.061	0.139***	5.347	0.139***	4.327
AGE 60-69	0.161***	4.885	0.06	0.161***	3.876	0.06	0.141***	4.7	0.141***	3.814
AGE 70+	0.232***	5.951	0.085	0.232***	5.028	0.085	0.191***	5.628	0.191***	4.881
Female	0.142***	9.988	0.053	0.142***	5.626	0.053	0.122***	9.569	0.122***	6.293
Religious	0.081***	5.08	0.03	0.081***	3.476	0.03	0.077***	5.322	0.077***	3.234
Patriotic	0.184***	9.794	0.069	0.184***	7.069	0.069	0.156***	8.884	0.156***	6.196
(c) Marital Status										
Widowed	-0.014	-0.527	-0.005	-0.014	-0.54	-0.005	-0.019	-0.842	-0.019	-0.853
Divorced	-0.086***	-3.594	-0.032	-0.086***	-3.964	-0.032	-0.096***	-4.305	-0.096***	-4.056
Separated	0.013	0.226	0.005	0.013	0.265	0.005	0.027	0.551	0.027	0.715
Never Mar.	-0.062***	-2.839	-0.023	-0.062**	-2.426	-0.023	-0.057***	-2.841	-0.057**	-2.573
Children	0.006	0.829	0.002	0.006	0.805	0.002	0.007	1.215	0.007	1.233
Education	0.010***	3.019	0.004	0.010***	2.769	0.004	0.007***	4.192	0.007**	2.627
Income	-0.002	-0.531	-0.001	-0.002	-0.298	-0.001	-0.001	-0.271	-0.001	-0.163

(e) Employment Status										
Part-Time Empl.	-0.014	-0.503	-0.005	-0.014	-0.49	-0.005	-0.004	-0.157	-0.004	-0.155
Self-Empl.	-0.106***	-3.751	-0.04	-0.106***	-2.702	-0.04	-0.092***	-3.394	-0.092**	-2.255
Military	-0.304	-1.401	-0.118	-0.304	-1.315	-0.118	-0.389	-1.31	-0.389	-1.54
Pensioned	0.096***	3.325	0.035	0.096***	2.876	0.035	0.075***	3.102	0.075***	2.861
At home	-0.035	-1.016	-0.013	-0.035	-0.895	-0.013	-0.023	-0.76	-0.023	-0.732
Student	-0.076**	-2.124	-0.028	-0.076*	-1.721	-0.028	-0.086**	-2.407	-0.086	-1.686
Unemployed	-0.071**	-2.512	-0.027	-0.071**	-2.376	-0.027	-0.082***	-3.037	-0.082**	-2.647
Disabled	-0.023	-0.438	-0.009	-0.023	-0.524	-0.009	0.002	0.037	0.002	0.045
Other	-0.009	-0.113	-0.003	-0.009	-0.121	-0.003	0.022	0.312	0.022	0.304
_cons1	-1.783***	-32.983		-1.783***	-23.795		1.875***	38.897	1.875***	46.414
_cons2	-1.635***	-30.816		-1.635***	-24.564					
_cons3	-1.427***	-27.345		-1.427***	-23.687					
_cons4	-1.238***	-23.854		-1.238***	-23.081					
_cons5	-1.068***	-20.589		-1.068***	-20.484					
_cons6	-0.775***	-15.008		-0.775***	-14.898					
_cons7	-0.608***	-11.78		-0.608***	-12.06					
_cons8	-0.325***	-6.317		-0.325***	-6.992					
_cons9	0.061	1.197		0.061	1.325					
Number of observations	45.323			45.323			45.323		45.323	
Countries FE	YES			YES			YES		YES	
Prob > chi2	0			0						
Pseudo R2	0.0424			0.0424			0.1123		0.1123	

Notes: Column (1) and (2) Dependent variable on a four-point scale. Reference group: Age<30, Male, Not Religious, Not Patriotic, Married, Full employed and with no membership in any groups. Marginal effect: highest tax morale score. Column (1) - (4) * Statistical significance at the 10% level, ** Idem, 5%, *** Idem, 1%.

APPENDIX
TABLE A.1

Variable	Definition	Measurement
Tax Morale	Respondents' tax morale	Rescaled into a four-point scale. Responses 4 through 10 were combined into a value 0 (low tax morale), while the remaining responses were combined in groups of three (3 into 1; 2 into 2; 1 into 3).
Age	Respondents' age	Respondents' age calculated using the year of birth
Gender	Respondents' gender	Dichotomous variable taking value 1 for female and 0 for male.
Religious	Respondents' religious beliefs	Variable taking value 1 if the respondent declares to be a religious person and 0 otherwise
Patriotic	Respondents' patriotic feeling	Variable taking value 1 if the respondent declares to be very or quite proud of being a citizen of the country and 0 otherwise.
Marital Status	Respondents' marital status	Categorical variable which takes value 1 if the respondent is Married, 2 if Widowed, 3 if Divorced, 4 if Separated, 5 if Never Married o other cases.
Children	Respondents' number of children	Discrete variable accounting for the number of children of the individuals
Income	Respondents' income level	Ten-scale variable accounting for the income level of the respondent.
Employment Status	Respondents' employment status	Categorical variable which takes value 1 if the Full-time employed, 2 if Part-time employed, 3 if Self-Employed, 4 if Military, 5 if Retired/pensioned, 6 if At Home, 7 if Student, 8 if Unemployed, 9 if Disabled, 10 other cases
Religious Org.	Membership in a group	Dichotomous variable taking value 1 if the respondent belongs to a religious organisation and 0 otherwise.
Cultural Org.		Dichotomous variable taking value 1 if the respondent belongs to a cultural organisation and 0 otherwise.
Trade Unions		Dichotomous variable taking value 1 if the respondent belongs to a trade union and 0 otherwise.
Political Org.		Dichotomous variable taking value 1 if the respondent belongs to a political organisation and 0 otherwise.
Environ. Org.		Dichotomous variable taking value 1 if the respondent belongs to a ecology organisation and 0 otherwise.
Professional Org.		Dichotomous variable taking value 1 if the respondent belongs to a professional organisation and 0 otherwise.
Sport Ass.		Dichotomous variable taking value 1 if the respondent belongs to a sport association and 0 otherwise.
Humanitarian Org.		Dichotomous variable taking value 1 if the respondent belongs to a humanitarian organisation and 0 otherwise.
Consumer Ass.		Dichotomous variable taking value 1 if the respondent belongs to a consumer association and 0 otherwise.
Aid Org.		Dichotomous variable taking value 1 if the respondent belongs to an aid organisation and 0 otherwise.
Other Org.		Variable taking value 1 if the respondent belongs to another organisation not mentioned before and 0 otherwise.
Trust in Other	Trust	Dichotomous variable taking value 1 if the respondent believe that other people can be trusted and 0 otherwise.
Trust in Family		Variable which takes value 1 if the respondent "trust completely" or "somewhat" to his/her family, and 0 otherwise.
Trust in Known People		Variable which takes value 1 if the respondent "trust completely" or "somewhat" to "known people", and 0 otherwise.
Trust in Parliament		Variable which takes value 1 if the respondent has a "great deal" or "quite a lot" confidence in Parliament, and 0 otherwise.
Trust in Justice		Variable which takes value 1 if the respondent has a "great deal" or "quite a lot" confidence in Justice, and 0 otherwise.
Trust in Government		Variable which takes value 1 if the respondent has a "great deal" or "quite a lot" confidence in Government, and 0 otherwise.
Interest in Politics	Interest in politics	Variable which takes value 1 if the respondent is "very interested" or "somewhat interested" confidence in politics, and 0 otherwise.

TABLE A.2 – CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Religious	1																		
2 Religious Org.	0.1447*	1																	
3 Cultural Org.	-0.0283*	0.1796*	1																
4 Trade Unions	-0.0927*	0.2045*	0.1152*	1															
5 Political Org.	0.0055*	0.1101*	0.1232*	0.1294*	1														
6 Environ Org.	-0.0562*	0.1197*	0.2281*	0.1202*	0.1194*	1													
7 Professional Org.	-0.0575*	0.1388*	0.2084*	0.1857*	0.1139*	0.1764*	1												
8 Sport Ass.	-0.1204*	0.1870*	0.2469*	0.1711*	0.0854*	0.1753*	0.1812*	1											
9 Hum. Org.	-0.0179*	0.1932*	0.2434*	0.1541*	0.1347*	0.3086*	0.1754*	0.2004*	1										
10 Consumer Org.	-0.0325*	0.1169*	0.1351*	0.1361*	0.0970*	0.1887*	0.1367*	0.1415*	0.1773*	1									
11 Self-help Org.	0.0112*	0.1006*	0.1503*	0.0685*	0.0882*	0.1645*	0.1125*	0.1141*	0.2066*	0.1507*	1								
12 Other Org.	-0.0379*	0.0953*	0.1048*	0.0762*	0.0940*	0.1057*	0.1065*	0.1063*	0.1051*	0.1015*	0.1030*	1							
13 Tr. in Other	-0.1282*	0.1857*	0.1548*	0.1915*	0.0656*	0.1284*	0.1341*	0.1840*	0.1614*	0.0987*	0.0426*	0.1007*	1						
14 Tr. in Family	0.0223*	0.0249*	0.0137*	0.0241*	0.0082*	-0.0013	0.0106*	0.0284*	0.0129*	0.0027	-0.0034*	-0.0017	0.0527*	1					
15 Tr. in K. People	-0.0783*	0.0870*	0.0700*	0.0952*	0.0307*	0.0530*	0.0611*	0.1053*	0.0656*	0.0381*	0.0186*	0.0477*	0.1983*	0.1352*	1				
16 Tr. in Parliament	-0.0125*	0.0931*	0.0638*	0.0848*	0.0652*	0.0446*	0.0661*	0.0849*	0.0675*	0.0535*	0.0105*	0.0486*	0.2051*	0.0384*	0.0898*	1			
17 Tr. in Justice	-0.0679*	0.1357*	0.0766*	0.1276*	0.0341*	0.0521*	0.0775*	0.1217*	0.0757*	0.0533*	0.0153*	0.0618*	0.2514*	0.0480*	0.1197*	0.4158*	1		
18 Tr. in Gov.	0.0231*	0.0680*	0.0420*	0.0351*	0.0584*	0.0249*	0.0404*	0.0586*	0.0249*	0.0318*	-0.0027	0.0314*	0.1666*	0.0316*	0.0737*	0.5635*	0.3855*	1	
19 Interest in Politics	-0.0500*	0.1090*	0.1150*	0.1033*	0.1636*	0.0953*	0.1147*	0.1163*	0.1133*	0.0633*	0.0457*	0.0889*	0.1637*	0.0197*	0.0990*	0.1557*	0.1228*	0.1329*	1

* Statistical significance at the 5%.

Chapter 3 - Tax evasion and tax morale: a social network analysis[*]

1. Introduction

Tax evasion is a serious concern, also in advanced societies.[1] It reduces available resources for economic and social policy, thus affecting society at large; moreover, if tax evasion is not equally distributed across income groups and/or income types it has redistributive effects, potentially reducing progressivity.

From a theoretical point of view, the literature has identified three main motivations for individual tax-paying decisions: the monetary trade-off, tax morale and social reputation. The monetary trade-off depends on the institutional features of the tax system, including the tax-burden, the audit system and the fine to be paid in case tax evasion is discovered. Tax morale refers to individuals' intrinsic motivation and value system. Social reputation relates to the penalty for deviating from - and the reward for compliance to - the accepted social norms. Adherence to the social norm, motivated by social reputation concerns, tends to produce behavioural conformity.

In this chapter we stress the role of tax morale and reputation in affecting taxpaying behaviour. We present an 'agent-based' dynamic model in which taxpayers 'live' in a network and care about their social reputation.[2] Individuals decide whether to pay or to evade taxes by considering the expected economic net benefit (balancing monetary costs and benefits from tax evasion), the subjective cost, and the reputation cost. The higher the subjective cost from tax evasion, the higher is the individual's intrinsic motivation to comply, namely, his/her tax morale. In our model, this is updated by following an adaptive rule that considers the intrinsic motivation of the individual's 'neighbours' (the reference

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[1] According to Murphy (2019), in 2015 the EU tax gap - expressed as a proportion of expected tax revenue - varies from 8% in Luxembourg to 29.5% in Romania. Similarly, for the year 2017, the European Commission (2019) has estimated the VAT gap to be approximately €137.5 billion. The Report estimates that the median gap is 10.1%, varying from the low values of Cyprus (0.6%) and Luxembourg (0.7%) to the largest gaps in Romania (35.5%), Greece (33.6%), and Lithuania (25.3%).

[2] A social network is a set of interconnected individuals who interact with each other. It can be seen as a generalization of the notion of group considered in the previous chapter – i.e. associations/organisations with two or more people. In fact, a group is characterised by the fact that a set of individuals spontaneously and deliberately interact because they have some interests in common or share the same ideals. Differently from groups – as intended in the previous chapter - in other social networks individuals might be required to interact because, for instance, working relationships, parenthood or because they are obliged to attend the same school.

group). Individuals also care about their reputation as taxpayers, which depends on the strength of the social norm in their reference group.

First, we simulate the model for different values of the parameters. We focus on the effect of three parameters on tax compliance, namely, the probability to find like-minded peers in the reference group (network integration), the weight individuals attribute to reputation, and the share of updating individuals. The results suggest that the more individuals are integrated and the more they care about reputation, the higher the tax compliance. We also show that, if all individuals in the network update their intrinsic motivation by considering their neighbours' tax morale, they converge to a common tax morale (a social norm in the network). In this situation, all individuals either evade or pay their taxes. By contrast, if only some individuals update their intrinsic motivation, tax evasion and compliance may coexist in a steady state, suggesting a sub-network social norm. In this last case, we show that the relation between the share of updating individuals and tax compliance has an inverted U-shape, which depends on two conflicting effects. On the one hand, as more individuals update their intrinsic motivation the conformism is reflected in a softened effect of reputation. On the other hand, as the share of updating individuals increases, because tax compliance is a socially rewarded behaviour, the updating process induces an increase in the tax morale of evaders. The first effect encourages tax evasion; the second effect works in the opposite direction. For a low share of updating individuals, the second effect dominates, and this is reflected in an increase in the compliance share; the opposite is observed for high share of updating individuals.

The second contribution of this chapter is to consider the possibility for a fiscal authority exploiting the knowledge of the network structure and targeting 'central' individuals. By positively affecting the tax morale of individuals whose influence within the network is high, a fiscal authority can hope to increase overall tax morale and thus tax compliance. We have in mind a communication campaign in which the tax authority conveys some content to the taxpayers. For example, a personal letter targeted at central individuals, as discussed in the recent debate on 'nudging' taxpayers (see OECD, 2019 and, for a critical appraisal, Antinyan and Asatryan, 2019). Another possibility is to engage 'influencers' for a communication campaign to raise taxpayers' awareness about the importance of paying taxes as a moral obligation and as a means to finance public spending. Our simulations show that by positively affecting the tax morale of influential individuals, a fiscal authority can increase tax compliance. We compare this targeting strategy, which exploits the diffusion process in the network and acts upon tax morale, with a more conventional policy that increases the monetary cost of tax evasion and conclude that affecting the tax morale of influential individuals could complement other

efforts to improve compliance, providing an extra reason for individuals in the network to stop evading.

Summarising, our contribution to the exiting literature is two-fold: [3] *i)* we investigate the mechanism by which local interactions affect tax morale and the channels by which tax morale and reputation influence tax compliance; *ii*) we conduct a policy exercise and consider the effects of a policy intervention designed to enhance the tax morale of influential individuals and, by exploiting the diffusion dynamics in the network, increase overall tax compliance. We compare this strategy with a policy that increases the audit frequency.

The remainder of the chapter is organised as follows: in section 2, we introduce basic concepts and definitions of networks; in section 3, we present a simple model of taxpayer behaviour; in section 4, we summarise the results of simulations; in section 5, we illustrate our 'policy exercise'; and in section 6, we provide some final remarks and policy implications.

2. Network structure and individual's influence

In this section, we present the basic definitions from network theory that we use in this chapter.[4] A network is a pair (*N, A*) where *N* is the number of individuals (nodes) and *A* is an nxn adjacent matrix on the set of individuals. The elements of the matrix $a_{ij} \in \{0,1\}$ indicate the relationship between individuals *i* and *j*. A relationship exists if $a_{ij} = 1$, namely, individuals *i* and *j* are connected, and it does not if $a_{ij} = 0$.[5] Individual *i*'s neighbourhood, N_i, is the set of individuals to whom s/he is connected: $N_i = \{j \in N \text{ s.t. } a_{ij} = 1\}$. The degree (d_i) is the cardinality of the set N_i, whereas the average degree $(\bar{d})$ is the average number of connections per individuals in the network. A *walk* in a network (*N, A*) refers to a sequence of nodes $i_1, i_2, \ldots, i_{h-1}, i_H$, such that $a_{i_h i_{h+1}} = 1$ for each *h* from 1 to *H*. A *path* is a walk such that all nodes are distinct. A network is *connected* if there exists a path between every pair of nodes *i* and *j*. The distance (or *geodesic*) between two nodes in a connected network is the length of the shortest path between them. The largest distance between any two nodes is expressed by the network's *diameter*.

In a random network, the number of individuals is pre-specified, and the individuals' degree distribution is based on a well-defined rule. Here, we use Watts-Strogatz (1998) algorithm to generate

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[3] For more on the related literature see Chapter 1 - Section 4.

[4] For more on networks see Jackson (2010).

[5] Without loss of generality, we set $a_{ii} = 0$.

connected networks in which the relationship between any pair of individuals is reciprocal (undirected network). The algorithm, starting from a regular ring lattice (Figure 1[a]) in which individual is connected to $\hat{d}$ neighbours ($\hat{d}/2$ each side),[6] rewires the connections among the individuals, with a given probability $\beta \in [0,1]$ (if $\beta = 0$ there is no rewiring). The higher the value of β, the greater the difference between the original network (regular ring lattice) and the final network.[7] Notably, for $\beta=1$, the network structure in Watts and Strogatz (1998) approximatively coincides with the random network in Erdős and Rényi (1960), in which individuals' degree follows a Poisson distribution. They both ensure that, *a priori*, all individuals have the same degree distribution, but Watts and Strogatz (1998) also account for the so-called small-world property[8] and prevent disproportionate influence by some individuals. Figure 1 shows three networks with $N=100$ and $\hat{d}=4$ resulting from different values of β. In blue are the connections that have been rewired; in red are those that have not.[9] Figure 1 also shows that, after the rewiring, d_i (the degree of individual i) and $\hat{d}$ (the individuals' degree before the rewiring – i.e. in the regular ring lattice) might not be equal. On the other hand, $\hat{d}$ is always equal to the average degree in the network ($\bar{d}$).

Figure1: Watts-Strogatz Random Network

(a) $N = 100$, $\hat{d} = 4$, $\beta = 0$

(b) $N = 100$, $\hat{d} = 4$, $\beta = 0.5$

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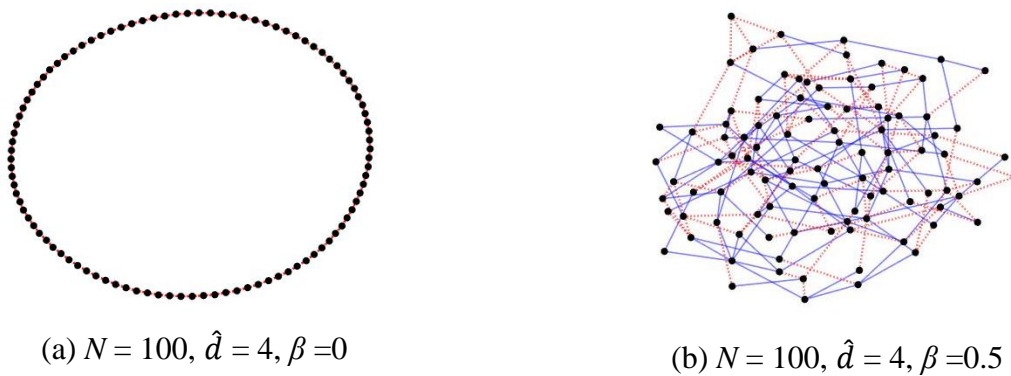
[6] Thus, if we assume that N individuals are labelled by a natural number $i \in [1, N]$ and listed in ascending order, the regular ring lattice is a network in which the individual i is connected with $\hat{d}$ individuals, $i+1$, $i+2$, …, $i+(\hat{d}/2)$ on the right and $i-1$, $i-2$, …, $i-(\hat{d}/2)$ on the left. Moreover, to ensure the ring structure the right neighbours of individuals from $(N-\hat{d}/2)$ to N are chosen, following the previous rule, between the individuals from 1 to $\hat{d}/2$; whereas the left neighbours of individuals from 1 to $\hat{d}/2$ are chosen between the individuals from $(N-\hat{d}/2)$ to N. Finally, if $\hat{d}$ is an odd number the last neighbour is randomly chosen between $i+(\hat{d}/2)$ and $i-(\hat{d}/2)$.

[7] Note the higher the value of β the lower the network's diameter.

[8] This feature, observed in real networks, ensures that each node can be reached from every other node with a short path.

[9] With $\beta =1$, we expect all connections to be rewired. The red lines, in this case, are the connections that after rewiring, have been 'reconnected'.
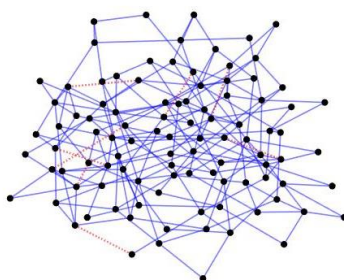
(c) $N = 100$, $\hat{d} = 4$, $\beta = 1$

In network analysis, the importance of an individual is related to his/her influence (centrality) within the network.[10] In what follows, we focus on *degree* centrality, according to which an individual's influence is measured by the number of his/her neighbours.[11] Using the degree centrality score d_i, the individuals' relative degree in the network is $s_i = \frac{d_i}{\sum_{i=1}^{N} d_i}$.

3. The model

Our theoretical framework adds a network structure to the model of Besley et al. (2019) to describe individuals' reference groups.[12] In our model, N individuals are connected in a network relationship. We assume that the relationship is reciprocal, namely, if i is connected to j, j is connected to i. For individual i, neighbourhood N_i is defined as the set of individuals to whom s/he is connected.

To focus on tax morale and social norms, we assume that individuals have the same exogenous constant income (y) and tax burden (x) but differ in the intrinsic motivation for tax compliance. We indicate by $v_{i,t}$ individual i's intrinsic motivation at time t, which is a measure of the subjective cost to evade taxes because of the individual's tax morale. An individual's intrinsic motivation at time $t=0$ is a random variable distributed according to a given (symmetric) distribution function. Initially,

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[10] Several definitions of centrality have been proposed in the literature to measure individuals' influence (degree, closeness, betweenness, eigenvector, and page rank). Roughly, the first two measures are proportional to individuals' degree, so the higher the individual's degree, the higher is his/her centrality (influence). The other three assign a centrality score depending on the individual's neighbours and position on the network. Therefore, betweenness centrality considers the frequency at which a node acts as a bridge along the shortest path between two other nodes, and page rank and eigenvector centrality assign a higher value to individuals with influential neighbours. Notably, these measures may produce different rankings. For example, a possibility is that the individual with the lowest degree in the network is also the most central according to betweenness and eigenvector centrality (see Jackson, 2010). Banerjee et al. (2013 and 2019) introduce a centrality measure—diffusion centrality—which returns degree and eigenvector centrality as special cases. Diffusion centrality has been used to characterise the importance of nodes in a network in which each node transmits information to his/her neighbours with a given probability and those who have received the information transmit it to their neighbours with the same probability, and this is repeated for T periods. A node's influence is related to the number of nodes reached if the diffusion process starts from that node.

[11] All the results in the following sections hold when we assume eigenvector centrality as a measure of individuals' influence, instead of degree centrality.

[12] Table A1, in the appendix, summarises the symbols used for the model's variables and parameters.

individuals are ranked according to their motivation, in ascending order: $v_{1,0} < v_{2,0} < \ldots < v_{N,0}$. In each subsequent period, a fraction α of the individuals, randomly drawn at $t=0$, update their intrinsic motivation by observing the neighbours' average motivation, which they know only with a period lag. We assume the following updating rule:

$$v_{i,t} = (1 - \lambda)v_{i,t-1} + \lambda v_{t-1}^{N_i} \qquad (1)$$

where $v_{i,t-1}$ is the individual's intrinsic motivation in the previous period; $v_{t-1}^{N_i}$ is the social norm in the individual's reference group, computed as the average motivation among i's neighbours at time t-1; and $\lambda \in [0,1]$ is the weight given to the social norm in the updating rule.

In each period, individuals decide whether to pay or to evade taxes: $e_t \in \{0,1\}$ - where $e_t = 0$ denotes tax compliance at time t. Individuals trade off the benefits of tax evasion (lower tax payments) against the costs, given by the (expected) monetary cost of being caught and punished (m),[13] plus the non-pecuniary costs related to the individual's intrinsic motivation, $v_{i,t}$, plus the reputation loss, namely, the social stigma attached to tax evasion.

An individual's reputation for tax compliance is given by the difference between the 'honour' associated with tax compliance and the 'stigma' associated with tax evasion in the reference group. The first is computed as the average intrinsic motivation of the individual's neighbours who have paid their taxes in the last period, $v_{t-1}^{C_i}$ - where $C_i = \{j \in N_i \text{ s.t. } e_{j,t-1} = 0\}$ - minus the unconditional mean $(v_{t-1}^{N_i})$. Similarly, the stigma associated with tax evasion is computed as the difference between the average intrinsic motivation of the individual's neighbours who evaded their taxes in the last period, $v_{t-1}^{E_i}$ - where $E_i = \{j \in N_i \text{ s.t. } e_{j,t-1} = 1\}$ - and the unconditional mean $(v_{t-1}^{N_i})$. Thus, the reputation associated with tax compliance is $\Delta_{i,t} = [v_{t-1}^{C_i} - v_{t-1}^{E_i}]$.[14]

In summary, at time t, individuals decide whether to pay or to evade taxes by comparing the payoff they receive by paying their taxes $(e_t = 0)$ with the payoff they receive by tax evasion $(e_t = 1)$, respectively,

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[13] This is obtained by multiplying the probability of being caught (p) by the fine to be paid if discovered, where the fine is equal to f>1 times the tax evaded (x). Namely, $m=pfx$.

[14] This follows because $\Delta_{i,t} = [v_{t-1}^{C_i} - v_{t-1}^{N_i}] - [v_{t-1}^{E_i} - v_{t-1}^{N_i}]$. In Section 4 we assume that $v_{i,0}$ takes positive values, so it is reasonable to expect that $\Delta_{i,t} \geq 0$ - i.e. the intrinsic motivation of taxpayers - is always higher than that of tax evaders among i's neighbours. However, since each $\Delta_{i,t}$ is computed locally (among i's neighbours), it may be that for some individual $\Delta_{i,t} < 0$, namely evasion is rewarded in i's reference group. In Besley et al. (2019), $\Delta_{i,t}$ is always defined because there is always at least one individual of each type. In our framework, where $\Delta_{i,t}$ is computed among an individual's neighbours, we impose a boundary condition such that if in period t an individual's neighbours are all tax evaders or all taxpayers, there is complete group conformity and $\Delta_{i,t} = 0$.

$$y - x + \mu v^{C_i}_{t-1} \quad and \quad y - m - v_{i,t} + \mu v^{E_i}_{t-1} \qquad (2)$$

The parameter $\mu \in [0,1]$ is the weight placed on reputation; it is a scale factor assumed to be equal for all individuals in the network. The higher its value, the more society rewards tax compliance.

The threshold value determining the individual's taxpaying behaviour at time t is given by

$$v^*_{i,t} = x - m - \mu \Delta_{i,t} \qquad (3)$$

If $v_{i,t} > v^*_{i,t}$, individual i pays taxes at time t. The compliance share at time t is $C_t = \frac{\sum_i^N I_{i,t}}{N}$, where

$$I_{i,t} = \begin{cases} 0 & \text{if } v_{i,t} < v^*_{i,t} \\ 1 & \text{if } v_{i,t} > v^*_{i,t} \end{cases}$$

Equations (1) and (3) jointly determine the dynamics of the model and the diffusion of taxpaying behaviour within the network.

For an individual, the strength of the social norm ($\mu \Delta_{i,t}$) comprises two elements: society's view of tax evasion and the individual's reputation in the reference group. By affecting the threshold $v^*_{i,t}$, the strength of the social norm exerts pressure on the individual's taxpaying behaviour. If $\mu \Delta_{i,t}$ is high, the social stigma associated with tax evasion is high, and tax compliance is highly rewarded; in this case, social pressure pushes the individual towards tax compliance. By contrast, if $\mu \Delta_{i,t}$ is small, tax evasion is not perceived as serious misconduct, and tax compliance is not highly considered; thus, society's pressure for tax compliance is low. Our discussion identifies the factors involved in individuals' taxpaying decision: the (expected) monetary trade-off, his/her intrinsic motivation, and the strength of the social norm within the reference group.

We assume that individuals' intrinsic motivation at time zero is randomly drawn from a uniform distribution and that the mean is equal to the (expected) net monetary benefit from tax evasion (x-m). Thus, in the absence of social reputation, namely, if $\mu = 0$, an individual with initial intrinsic motivation equal to the average is indifferent between evasion and compliance.[15] We also assume that, at time 0, the individual, who has no information on the neighbours' behaviour, cannot compute the reputation loss; thus, we set the initial condition $\Delta_{i,0} = 0, \ \forall i$. This implies that $v^*_{i,0} = v^*_0 = x - m$ and that the (expected) share of tax evaders at time zero is equal to the share of taxpayers: $E_0 = C_0 = \frac{1}{2}$. We finally assume that, knowing the network structure, individuals recognise that some are more influential than others and assign them a higher weight in the updating process. Using the degree

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[15] We assume that if indifferent, the individual pays taxes.

centrality score d_j, the weight that individual i assigns to neighbour j in the updating process is $b_{ij} = \frac{d_j}{\sum_{k \in N_i} d_k}$; thus, in the updating rule (1), the average intrinsic motivation of individual i's neighbours is:[16]

$$v_t^{N_i} = \sum_{j \in N_i} b_{ij} \, v_{j,t} \tag{4}$$

4. Simulation

In this section, we characterise the steady state compliance share C as a function of the model's parameters and of the network structure.[17] To conduct the simulations, we generate ten datasets that differ for the value of β.[18] Each dataset contains 5.000 distinct Watts-Strogatz (1998) random networks with $N=100$ individuals and $\bar{d}=6$. For each run, we set the exogenous parameters and then simulate the model - equations (1) to (4) - for a time horizon of 100 periods. For each dataset, the steady state compliance share is computed as the average over the 5.000 random networks.

In summary, the simulation's protocol is the following:

1. The economic characteristics are chosen; unless otherwise specified, we take $y=1$ and $x-m=0.32$ and $m=0.026$.[19]

2. At time zero, individuals' intrinsic motivation is randomly drawn from a uniform distribution, $v_{i,0} \sim U(0, 2v_0^*)$, where $v_0^* = x - m$; individuals are then listed in ascending order according to their intrinsic motivation.

3. The share of updating individuals α, the weight in the updating rule λ, and the reputation parameter μ are set exogenously.

4. Individuals communicate with their neighbours and update their intrinsic motivation, according to the rule in equations (1), (3) and (4).

5. The threshold values, $v_{i,t}^*$, are updated according to equation (3).

6. Individuals decide whether to comply, observing their payoff according to equation (2).

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[16] Accordingly in (2), $v_t^{C_i} = \sum_{j \in C_i} b_{ij}^{C_i} v_{j,t}$, where $b_{ij}^{C_i} = \frac{d_j}{\sum_{k \in C_i} d_k}$ and $C_i = \{j \in N_i \text{ s.t. } e_{j,t-1} = 0\}$. Similarly, $v_t^{E_i} = \sum_{j \in E_i} b_{ij}^{E_i} v_{j,t}$, where $b_{ij}^{E_i} = \frac{d_j}{\sum_{k \in E_i} d_k}$ and $E_i = \{j \in N_i \text{ s.t. } e_{j,t-1} = 1\}$.

[17] Table A2 in the appendix summarises the results of the simulations for various combinations of the parameters.

[18] The support of β used to generate the networks is $\beta = \{0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1\}$. For $\beta = 0$, only one network can be obtained; thus, there is no need to take the average.

[19] The chosen value for the tax burden ($x=0.35$) is close to the average tax burden among OECD countries in 2018, which is 34.3%. The value for m is obtained by taking a probability of being caught $p=5\%$ and a fine $f=150\%$ of the due taxes. It follows that $m=0.02625$ and $x-m=0.32375$. With a lower and maybe more realistic audit probability at 2%, the same value of $x-m$ would be obtained for x slightly higher than 33%. For Italy, Busato and Chiarini (2004) estimate $p=3\%$, $f=130\%$, and $x= 33.5\%$.

In this section, we first investigate the effects of the network structure and of social reputation on compliance, by imposing $\alpha=0$ (no updating of the intrinsic motivation). Next, we relax this last condition and analyse the role of the updating process on individuals' intrinsic motivation and on the compliance rate.

4.1 No updating ($\alpha=0$).

In our model, the network structure depends on three parameters: number of individuals (N), average degree ($\bar{d}$), and rewiring probability (β). Here, we focus on the last feature. Parameter β is the probability that an individual is connected to individuals whose intrinsic motivation is different from his/her own. If $\beta = 0$, when interacting with the neighbours, an individual, almost surely, meets only individuals who have an intrinsic motivation similar to his/her own; therefore, with high probability, in the previous period, they have made the same taxpaying decision. By contrast, if $0 < \beta < 1$, there is a positive probability that a tax evader has a taxpayer as a neighbour and vice versa.

Figure 2 shows the relationship between β and the steady state compliance share for different values of μ. The 3D graph suggests that tax compliance increases with β.[20] Intuitively, the higher β is, the more tax evaders and taxpayers 'meet' with each other. This contributes to the diffusion of a common tax morale. By contrast, when individuals interact mainly with like-minded peers, polarisation of behaviours is likely to persist (figure 3).

Figure 2: Compliance share, rewiring probability, and reputation (α = 0)
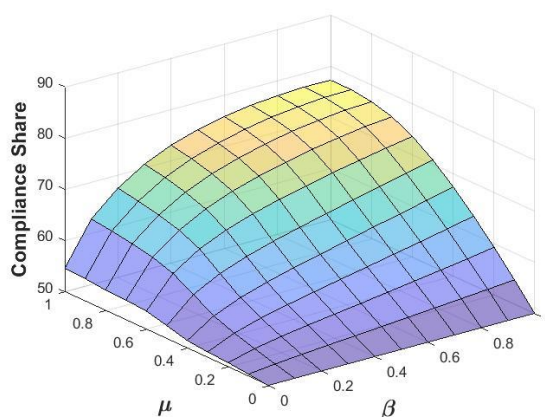
Figure 2 also shows that the weight society gives to reputation (μ) amplifies the diffusion of tax compliance, for any given β. The reason for this is that if the reward for prosocial behaviour is high, the individual cost of tax evasion is also high. By contrast, when $\mu = 0$, there is no role for reputation:

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[20] A similar effect is observed for the average degree $\bar{d}$. Intuitively, the greater an individual's degree, the higher the probability that s/he gets in touch with an individual who has taken a different action from his/her own in the previous period. Thus, the higher the average degree $\bar{d}$, the more the network supports behaviour conformity.

the threshold value ($v_{i,0}^*$) does not change and individuals do not change their taxpaying behaviour; thus, the steady state compliance share is equal to $C_0 = 50\%$.

Figure 3: Compliance share and rewiring probability (green triangles indicate tax-evaders, and blue circles indicate taxpayers)

(a) $\alpha = 0$, $\beta = 0.2$, $\mu = 0.4$ (b) $\alpha = 0$, $\beta = 0.8$, $\mu = 0.4$
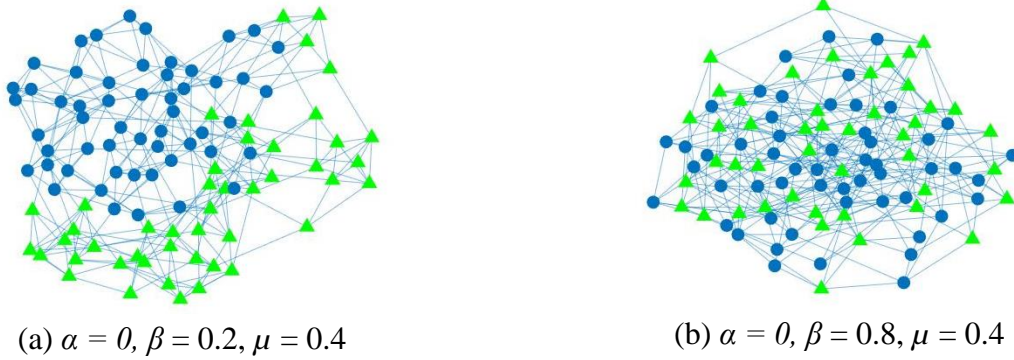
In summary, with $\alpha = 0$ (no updating of intrinsic motivation), the steady state compliance share is always higher than the initial share. This finding indicates that the higher β and μ are, the more the network encourages the diffusion of the socially rewarded behaviour.

In what follows, unless otherwise specified, we set $\beta = 0.5$. This value ensures that all individuals are likely to have as neighbours high and low intrinsically motivated individuals. Moreover, we conventionally focus on two values of μ, namely, 0.4 and 0.7.[21] This allows us to compare two 'societies' that differ in the value they attribute to reputation for tax compliance.

4.2 Updating ($0 < \alpha \leq 1$).

We now examine the case in which individuals update their intrinsic motivation according to (1), (3) and (4).

Updating and intrinsic motivation.

In the benchmark case in which $\alpha = 1$ and $\lambda = 1$, namely, if all individuals update their intrinsic motivation based solely on their neighbours' intrinsic motivation, we can apply the result in Golub and Jackson (2010). They show that, in an undirected network, the absence of individuals with disproportionate popularity guarantees the convergence of beliefs to a common value.[22] In our framework, this amounts to the convergence of individuals' intrinsic motivation to a common tax morale v^N, which can be computed as $v^N = s v_0$, where s is the vector of individuals' relative

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[21] The results in this and the next section hold also assuming $\mu \in (0,1]$.

[22] There is no predominant individual if the highest degree in the network is low relative to the sum of all individuals' degrees. The Watts-Strogatz (1998) algorithm, which imposes on average the same number of neighbours for each individual, prevents the presence of predominant individuals in the network.

degree, s_i, and v_0 is the vector of individuals' initial motivation ($v_{i,0}$). Depending on the degree distribution, v^N can be higher or lower than the initial threshold v_0^*. If the rewiring process assigns, on average, a higher degree to individuals with higher intrinsic motivation, $v^N > v_0^*$; otherwise, $v^N < v_0^*$. In our model, individuals' degree and intrinsic motivation are independent; thus, $P(v^N > v_0^*) = P(v^N < v_0^*)$.

Convergence to a common tax morale is also observed for any positive λ (De Marzo et al., 2003). By contrast, for $\lambda = 0$ the results are the same as those in the case of no updating. Figure 4 plots the updating dynamics of ten representative individuals and shows that their intrinsic motivation converges to a common value, faster for higher values of λ.[23]

Figure 4: Convergence of intrinsic motivation to a common tax morale

(a) $\alpha=1$, $\beta = 0.5$, $\mu=0.4$, $\underline{\lambda=0.2}$ (b) $\alpha=1$, $\beta = 0.5$, $\mu=0.4$, $\underline{\lambda=0.8}$
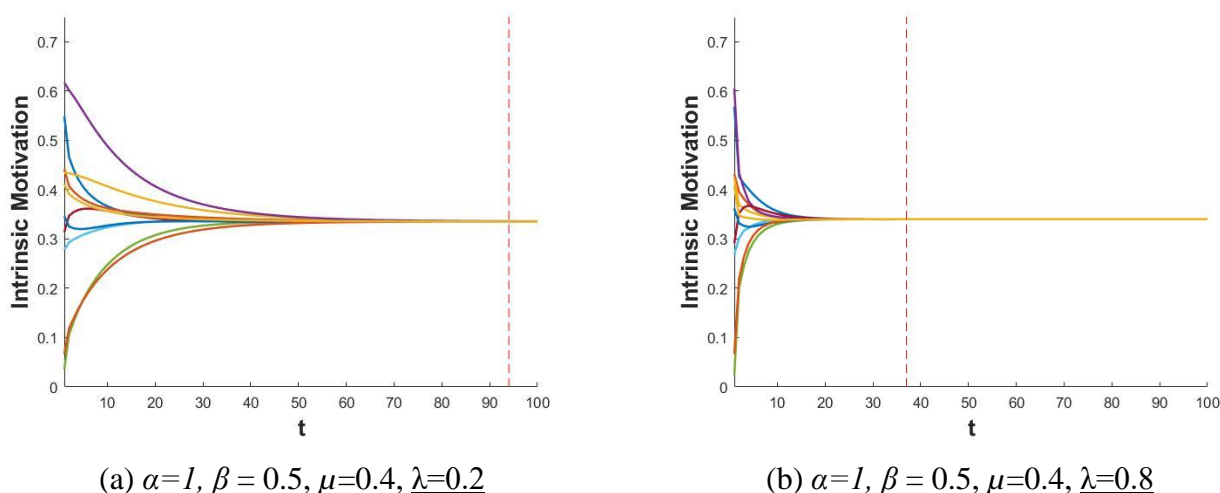
In summary, when $\alpha = 1$, namely, if all individuals update their intrinsic motivation, there is full convergence for any $\lambda > 0$, and in the steady state, all individuals share the same tax morale.[24] For $\alpha < 1$, there is no convergence of individuals' intrinsic motivation to a common value (figure 5); thus, tax compliance and tax evasion coexist (see below). Once again, λ only affects the speed of convergence. In this case, the rewiring probability (β) affects the steady state distribution of the intrinsic motivation: the lower the rewiring probability, the more individuals are 'segregated', and the more tax morale is polarised.[25]

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[23] The ten individuals are randomly chosen - one in each decile of the initial ranking. In figure 4, the dashed vertical lines around $t=93$, in panel (a), and $t=38$, in panel (b), denote the time period in which convergence is reached.

[24] Note that, as for λ, when individuals' intrinsic motivation converges to a common value, the parameter β only affects the speed of convergence. In fact, the higher β, the more interconnected is the network (see figure 1).

[25] This finding is similar to those of Mengel (2008) and Traxler and Spichtig, (2011). In a social learning context, they have demonstrated that the strength of the norm is affected by the level of individuals' integration and/or by the heterogeneity in the social environment.

In what follows, we do not indicate the value of λ because, as we have observed, it only affects the speed of convergence.

Figure 5: Non-convergence of intrinsic motivation

(a) α=0.5, $\underline{\beta = 0.2}$, μ=0.4, λ=0.5   (b) α=0.5, $\underline{\beta = 0.8}$, μ=0.4, λ=0.5
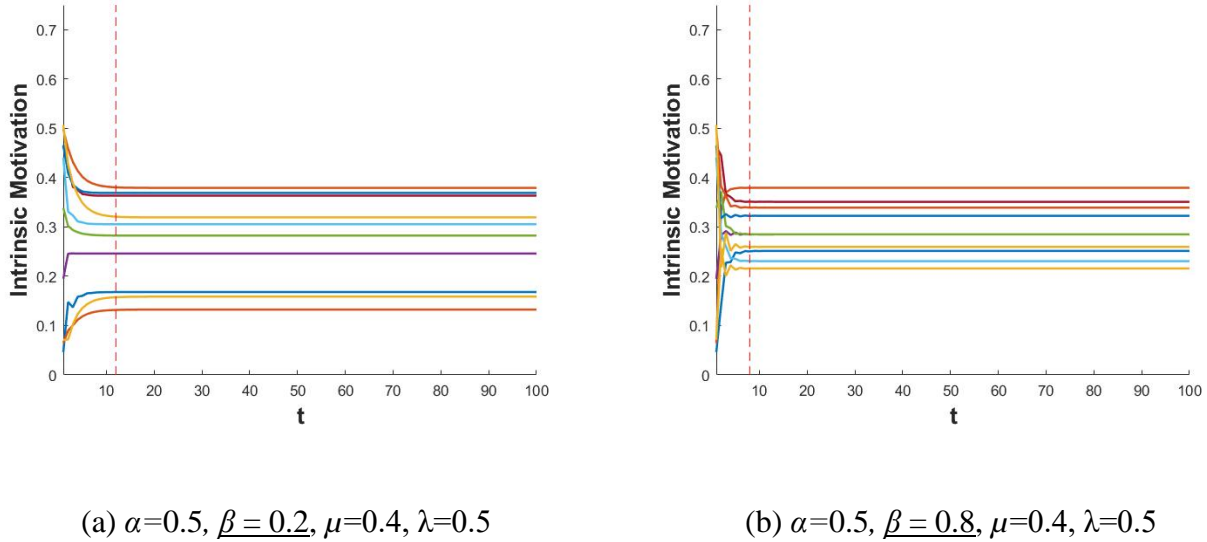
Updating and compliance

Next, we analyse the effect of α on the steady state compliance share, keeping in mind that the decision on whether to pay or to evade depends on the value of $v_{i,t}$ relative to $v_{i,t}^*$. Non-updating individuals, whose intrinsic motivation is unaffected by social interaction, might switch their taxpaying behaviour if the change in $v_{i,t}^*$ is sufficiently large. For example, an individual with a low value of the intrinsic motivation might pay because in the reference group the social stigma associated with tax evasion is high. Similarly, an individual with strong tax morale might evade if in the reference group, the reputation effect ($\mu\Delta_{i,t}$) is insufficiently powerful.

Figure 6 shows the relationship between the steady state compliance share and the share of updating individuals (α). The inverted-U shape is the result of two conflicting effects. On the one hand, as α increases, more individuals update their intrinsic motivation, and this pushes towards conformism in tax morale, which is reflected in a softened effect of reputation: namely, lower values of Δ_{it} and thus higher values of the threshold value $v_{i,t}^*$.[26] On the other hand, as α increases, a growing number of tax evaders update their intrinsic motivation; because tax compliance is a socially rewarded behaviour, the updating process induces an increase in their tax morale.[27] The first effect encourages

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[26] Recall that $v_{i,t}^* = x - m - \mu\Delta_{i,t}$.

[27] Network conformism pushes taxpayers' intrinsic motivation down; nevertheless, it remains higher than the threshold level; thus, their taxpaying behaviour does not change (figure 5).

tax evasion; the second effect works in the opposite direction. For low values of α, the second effect dominates, and this is reflected in an increase in the compliance share; the opposite is observed for high values of α.

When all individuals update their intrinsic motivation ($\alpha = 1$), as we have observed, individuals' intrinsic motivation converges to a common value v^N. If all individuals share the same intrinsic motivation, there is complete group conformity ($\Delta_{i,t} = 0$) and $v_{i,t}^* = v_0^*$. Therefore, all individuals make the same tax decision: evasion if $v^N < v_0^*$ and compliance otherwise. Because $P(v^N < v_0^*) = P(v^N > v_0^*) = \frac{1}{2}$, on average, the steady state compliance share is 50%.

Figure 6: Compliance and share of updating individuals

(a) $\beta = 0.5$, $\mu = 0.4$ (b) $\beta = 0.5$, $\mu = 0.7$
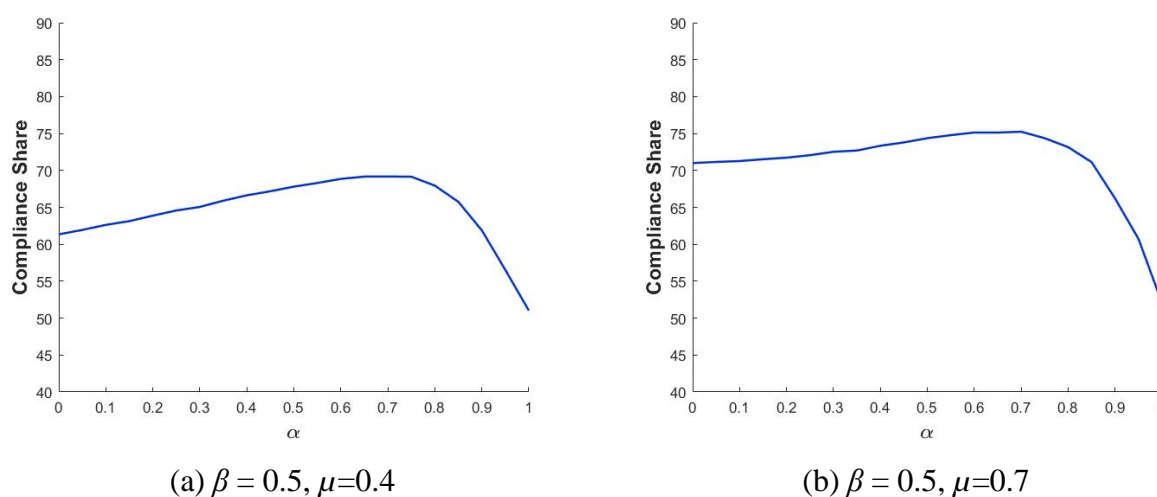
5. Targeting central individuals: a policy exercise.

We now consider the possibility for a tax authority using the knowledge of the network structure to promote tax compliance. We suppose that the tax authority can design a policy intervention to increase individuals' tax morale. It could be a personal communication or an information campaign to make the recipients understand the social harm caused by tax evasion, stressing the stigma associated with it. We compare two possible strategies for selecting the recipients: random pick and centrality targeting. In both cases, the tax authority chooses 5% of the population (i.e. five individuals out of one hundred) and, by means of a personal communication, which affects intrinsic motivation, persuades them to comply. In the first case, the five recipients are randomly drawn; in the second case, the authority targets the most influential individuals. The idea is that by convincing influential individuals, the tax authority expects tax compliance to spread throughout the network.

Figure 7 compares the steady state compliance share under the two aforementioned policies with the 'no-policy' results from figure 6. Clearly, a policy measure targeted at influential individuals is more

effective at increasing tax compliance than the same policy addressed randomly. The reason for this finding is that once the seed has been planted 'in the right place', the network - because of its structure - contributes to spreading it around, and the more so, the higher is μ.

Figure 7: Random targeting (dotted red line) and centrality targeting (dashed green line)

(a) $\beta = 0.5$, $\mu=0.4$ (b) $\beta = 0.5$, $\mu=0.7$
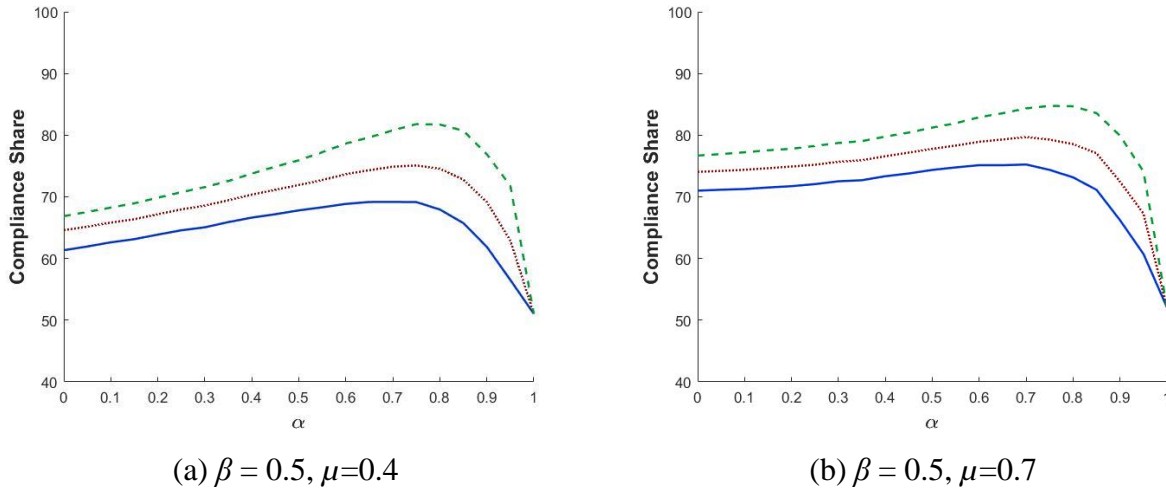
The benefit - in terms of additional compliance - of centrality targeting over random pick increases as the share of updating individuals (α) increases. In figure 8, to measure policy effectiveness, we take the increase in compliance with respect to the 'no policy'. Depending on the value of α, targeting the five most central individuals in a population of one hundred induces between six and fifteen additional individuals to comply (this is computed as the difference between the dashed green line and the blue line in figure 7). By contrast, random pick induces between two and six additional individuals to comply (this is computed as the difference between the dotted red line and the blue line in figure 7).[28] The reason for this finding is that the policy we are considering is a one-shot treatment, unlike a change in the audit probability which is permanent. Therefore, its effectiveness relies on the diffusion of high tax morale, rather than on the direct effect on the intrinsic motivation of selected recipients. Accordingly, if the treated individuals are those who are more influential, a relevant (indirect) effect on the diffusion of tax compliance is obtained. By contrast, if the recipients are randomly chosen, the effect of the policy quickly vanishes.

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[28] In figure 8, we have excluded $\alpha = 1$ because, as discusses in section 4.2 and shown in figure 6, in this case the steady state compliance share is always 50%. In addition, note that in figure 8, the number of additional individuals who, in the steady state, comply can be less than 5 – the number of treated individuals. The reason is that if an individual, randomly picked for treatment, 'lives' in a neighbourhood of tax evaders, might comply when treated but in the subsequent periods, s/he will conform to his/her peers' tax morale.

Figure 8: Effectiveness of random targeting (dotted red line) vs centrality targeting (dashed green line)

(a) $\beta = 0.5$, μ=0.4   (b) $\beta = 0.5$, μ=0.7
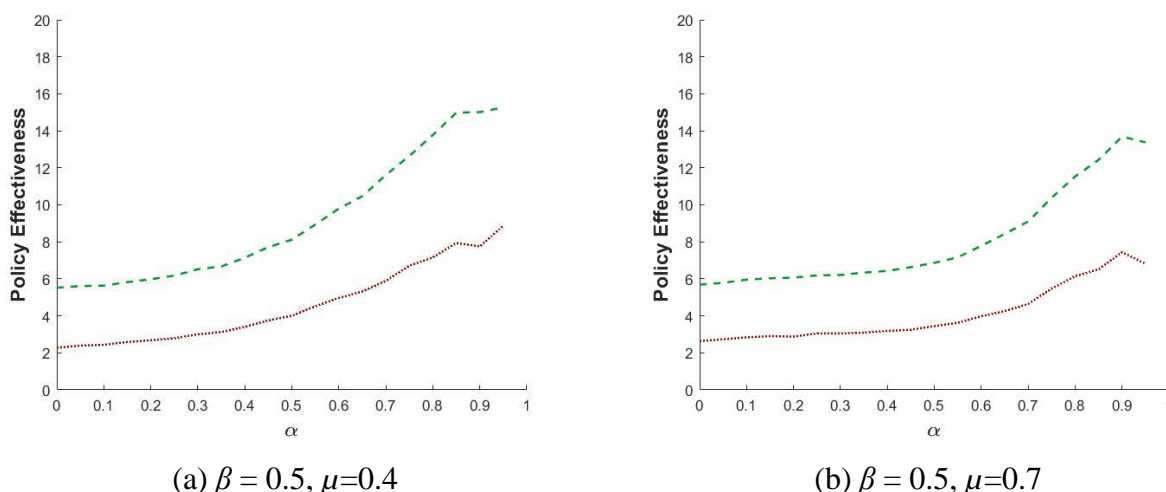
As a final exercise, we compare centrality targeting and random targeting with the 'no-policy' outcome by focusing on the role of the rewiring probability β.[29] Figure 9 shows that depending on the value of β, targeting five central individuals induces compliance from between six and ten individuals, compared with random pick, which induces compliance from between two and six individuals.

Figure 9: Random targeting (dotted red line) and centrality targeting (dashed green line)

(a) $\alpha = 0.5$, μ=0.4   (b) $\alpha = 0.5$, μ=0.7
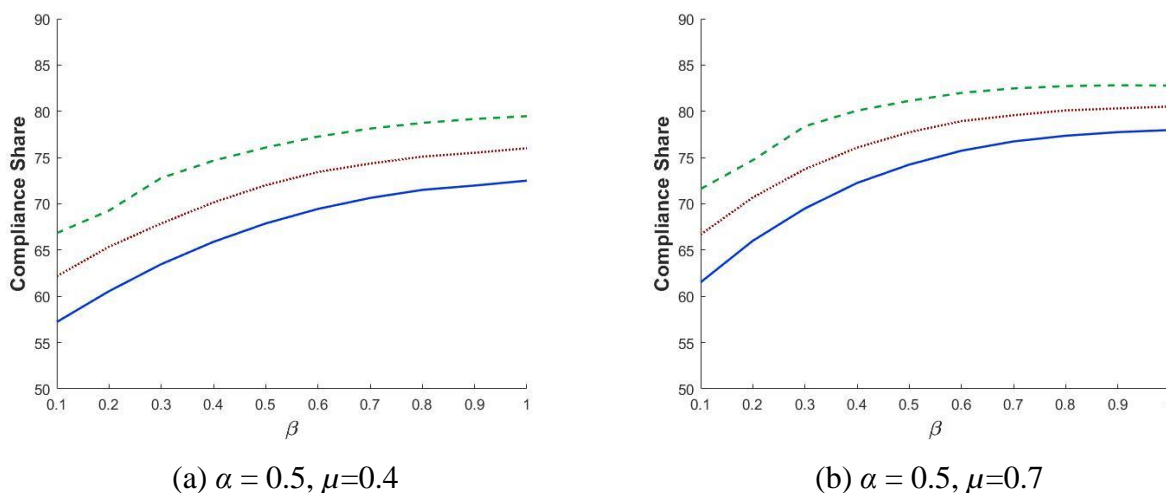
In figure 10, the benefit - in terms of additional compliance - of a targeting strategy decreases as network integration β increases. The reason this occurs is that for low values of β, a tax evader's neighbourhood is likely to contain mainly tax evaders; thus, if targeted, s/he has many potential individuals to 'infect' and induce to comply. By contrast, for high values of β, a tax evader is likely to have as neighbours like-minded peers and taxpayers; in this case, the potential impact of the policy

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[29] We have excluded $\beta = 0$ because without rewiring all individuals to have the same degree, centrality targeting and random targeting produce the same results.

is more limited. The results of our policy exercise are summarised in the appendix (tables A2 to A4), where we compare the no-policy outcome with random targeting and centrality targeting for different combinations of the parameters. Notably, centrality targeting seems to be less effective for higher values of μ because moving closer to the upper limit in compliance, which occurs as μ increases, leaves less room for additional improvements.

Figure 10: Effectiveness of random targeting (dotted red line) vs centrality targeting (dashed green line)

(a) $\alpha = 0.5, \mu=0.4$ (b) $\alpha = 0.5, \mu=0.7$
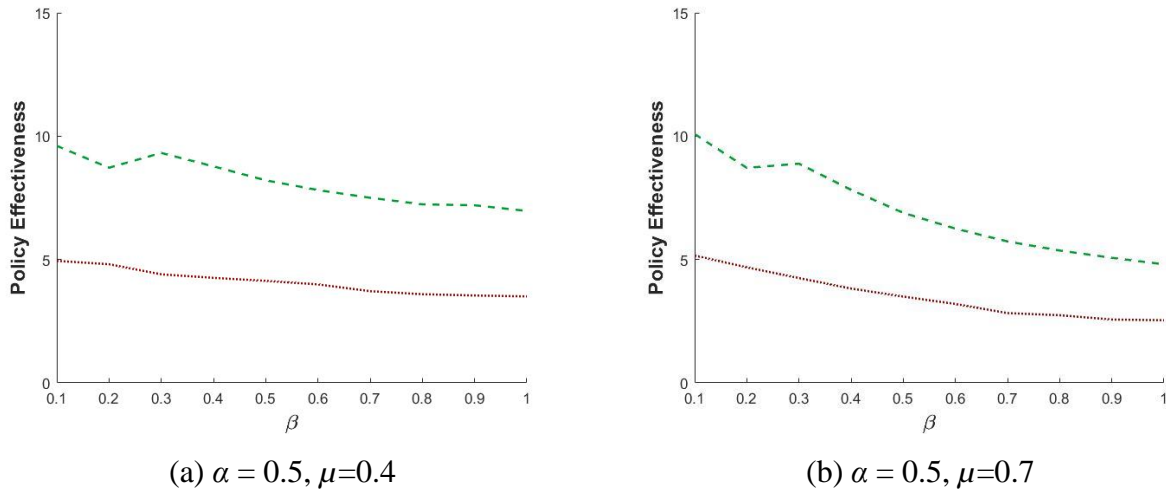
The effects highlighted by our policy exercise are in line with findings in Banerjee et al. (2013 and 2019) and Drago et al. (2020), that is, the effects of a policy intervention by the tax authority are amplified whenever the policy addresses central individuals. They also suggest that, depending on the individuals' learning process and the hypothesis on the channel of information transmission, some centrality measures explain the empirical evidence better than others.[30]

As a robustness check, we repeat our policy exercise by using as a targeting strategy, alternatively, eigenvector, diffusion, and betweenness instead of degree centrality. In our framework, these centrality measures lead approximatively to the same results, although degree centrality returns a slightly higher compliance share. The reason this occurs is that Watts-Strogatz algorithm, by preventing disproportionate influence by some individuals, makes unlikely the existence of individuals having relatively more influential neighbours than others (accounted for by eigenvector or diffusion centrality) or acting as a bridge along the shortest path between two other nodes (accounted for by betweenness centrality).

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[30] More specifically, they show that diffusion centrality explains their empirical evidence better than eigenvector and degree centrality, the two measures most studied in the theoretical literature (DeGroot, 1974; DeMarzo et al., 2003; Golub and Jackson, 2010).

Last, we compare our targeting strategy with a more conventional policy that increases the audit probability (or equivalently, the fine to be paid in case of detection) permanently. With our parameters' specification, to replicate the results obtained with central targeting, the tax authority would have to persistently increase the audit probability from 5% (in basic set-up) up to 12%.[31] This is not an indication that moral-based interventions should be a substitute for audits; it rather suggests that behavioural strategies should be considered a complement to more traditional policies, recognising that tax morale and its diffusion interact in a complex inter-relationship with other factors affecting compliance.

6. Concluding remarks

We have developed an 'agent-based' model in which individuals are connected in a network. Their decision on whether to evade taxes or to comply depends on the costs and benefits of the choice, and these include economic, moral, and social aspects. Our simulation results suggest that in the steady state, the compliance share depends on individual characteristics and institutional features which are, at least partially, under public control and can thus be affected by public policy.

In addition to the standard policies found in the literature, such as increasing the audit probability and the level of the fine to be paid in case tax evasion is discovered, our results point to other policy implications. We suggest that the tax authority can implement policies targeted at improving the population's civic sense and at encouraging voluntary compliance, for example, by means of media campaigns aimed at changing public attitudes towards tax evasion and at stressing the benefits of tax compliance for society (Luttmer and Singhal, 2014). In terms of our model, this would increase the social stigma attached to tax evasion (μ). Our results also indicate that by targeting central individuals, the tax authority can maximise the benefits of the diffusion of prosocial behaviour and foster tax compliance. To identify the most influential individuals, the tax authority should acquire information on the network structure, which in the current digital era, can be accomplished by exploiting large databases and using data analytics, which several tax authorities have been doing (OECD, 2016). Our proposal is to use data analytics not only to conduct better audits and select the most likely under-reporting taxpayers, but also to promote voluntary compliance.

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[31] This value is obtained setting $\beta = 0.5$. The corresponding value for $\beta = 0$ is approximately 15%, and it is approximately 10% for $\beta = 1$. Notably, the necessary increase in the audit probability to match central targeting does not change significantly with α or μ.

Appendix

Table A1: Summary of parameters and variables

Parameter/variable	Meaning
α	Share of updating individuals
β	Rewiring probability
μ	Society's weight on reputation
λ	Weight given by individuals to the local norm when updating
$v_{i,t}$	Individual i's intrinsic motivation at time t
$v_{i,t}^*$	Threshold value for individual i at time t
$\Delta_{i,t}$	Reputation in individual i's neighbourhood
x	Tax burden (the same for all individuals)
$m = pfx$	Expected monetary cost of tax evasion

The tables below summarise our main results (table A2) and show the effects of centrality targeting for different combinations of the parameters. For α and β, we have considered three values: low, high, and medium.[32] For μ, we maintain the values used in the chapter.

Table A2:

No Policy

(a) $\mu = 0.4$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	55	61	67
$\alpha = 0.5$	57	68	72
$\alpha = 1$	51	51	51

(a) $\mu = 0.7$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	60	71	76
$\alpha = 0.5$	61	74	78
$\alpha = 1$	50	52	52

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[32] We have excluded $\beta = 0$ because without rewiring, all individuals have the same degree; thus, regardless of the values of α, we would have the same compliance share with random targeting and with degree centrality targeting.

Table A3:

Random Targeting

(a) $\mu = 0.4$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	60	65	70
$\alpha = 0.5$	62	72	76
$\alpha = 1$	51	51	52

(a) $\mu = 0.7$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	66	74	77
$\alpha = 0.5$	67	78	81
$\alpha = 1$	50	52	52

Table A4:

Centrality Targeting

(a) $\mu = 0.4$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	63	67	71
$\alpha = 0.5$	67	76	79
$\alpha = 1$	51	51	51

(a) $\mu = 0.7$

	$\beta = 0.1$	$\beta = 0.5$	$\beta = 1$
$\alpha = 0$	71	77	77
$\alpha = 0.5$	72	81	89
$\alpha = 1$	51	52	52

Chapter 4 – Tax evasion and social reputation: a network analysis [*]

1.Introduction

In this chapter we present an agent-based model in which interconnected individuals care about social reputation when deciding to pay or evade taxes.

The theoretical framework we are going to investigate is based on the model presented in the previous chapter, to which we add income inequality. Here we focus on the dynamics of the weight given by individuals to social reputation (μ), and do not consider the intrinsic motivation to comply. Moreover, to perform our simulations we use an algorithm that generates random networks in which some individuals are more influential than others.

Our purpose is to emphasise the role of social networks in tax compliance and investigate the effect of a reputational policy, according to which the tax authority exploits the influence of 'celebrities' to improve the social value that the 'followers' assign to the tax compliance.

In our model, individuals decide whether to pay or to evade taxes taking into account the expected economic net benefit (balancing monetary costs and benefits from tax evasion) and the reputation cost from tax evasion, which depends, differently from the model in chapter 3, only on the share of individuals in the reference group who pay taxes.[1] If tax evasion is widely spread then the social sanction for not complying with the social norm is low; on the contrary, in a group in which everybody conforms to the social norm and pay their due taxes, the reputation loss from tax evasion is high. We consider two income-groups whose monetary incentive for tax evasion differ. We assume that, *ceteris paribus*, high-income individuals gain relatively more from tax evasion than low-income individuals do. This assumption moves from the empirical evidence in the tax compliance literature, which have shown that richest individuals evade more that middle-low income people (Alstadsæter et al., 2019a; Bloomquist, K., 2003).

However, we assume that individuals also differ in the weight given to social reputation relative to monetary considerations. We interpret this parameter as measuring the strength of the social norm for

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[*] The contents of this chapter have been presented at the International Online Conference on "Tax Compliance: New Methodological And Empirical Approaches" October 29-30, 2020 University of Perugia, Assisi, Italy.

[1] In the previous chapter, we assume that the reputation cost from evasion is computed as the difference between the average intrinsic motivation of the individual's neighbours who have paid their taxes in the last period and the average intrinsic motivation of the individual's neighbours who evaded their taxes in the last period.

the individual. This is our main parameter of interest and we assume that it is updated looking at the beliefs about the importance of social reputation in the individual's reference group. We consider two settings: in the first, individuals communicate with others irrespective of their income; in the second, individuals only communicate with peers in the same income group. The former characterises a more integrated society, the latter a relatively segregated society. In the updating process, 'celebrities' - i.e. individuals with many followers - play a fundamental role in affecting the social norm for tax compliance.

We simulate the model and characterise the steady state under the two alternative settings. The results indicate that, in an integrated society, network conformity is reached and all individuals either evade or pay their taxes. On the other hand, a segregated society might generate obstacles to the spread of information around the network and, as a result, tax evasion and tax compliance might coexist in the same network, suggesting a sub-network social norm.

Secondly, we consider the effects of a media campaign starring 'celebrities', financed by a fiscal authority to increase overall tax compliance by exploiting the diffusion dynamics in the network. We show that by positively affecting the reputation weight of influential individuals, a fiscal authority can increase tax compliance. Moreover, our simulations suggest that the media campaign has a stronger impact on tax compliance when the information may freely spread around the network – i.e. in an integrated society. We compare this strategy, with a policy that increases the audit frequency and conclude that our suggested policy can be as effective and less expensive.

In this chapter, we follow Di Gioacchino and Patriarca (2017) and consider two income groups whose monetary incentives for tax evasion are different. As in Di Gioacchino and Fichera (2020), and similarly to Hashimzade et al. (2014, 2015 and 2016), we focus on non-pecuniary costs and consider the pressure from neighbours (local peer effect) as the main driver of tax compliance. Specifically, we focus on the dynamics of social reputation and allow individuals' connections to be unidirectional and/or reciprocal. We stress the role of celebrities (or influencers) – defined as individuals with many followers - and the value to a tax authority of using their influence to increase social concern for prosocial behaviour. Gamannossi degl'Innocenti and Rablen (2020) have recently proposed the same idea.[2] They investigate the value to a tax authority - in terms of additional revenues raised - of knowing the structure of the social network and of targeting 'celebrity' taxpayers. Together with the findings in the previous chapter, this contribution adds new arguments to the existing literature on the

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[2] In their model, individuals care about relative consumption and, for this reason, taxpayers that are more central – influencers - have higher incentive for tax evasion.

role of nonpecuniary motivations for tax-paying decisions, and on diffusion processes in social and economic networks.[3]

The remainder of the chapter is organised as follows: in section 2, we introduce the network structure; in section 3, we present the model of taxpayer behaviour; in section 4, we summarise the results of simulations; in section 5, we illustrate our 'policy exercise'; and in section 6, we provide some final remarks.

2. Networks structure.

In this section, we present the basic definitions from network theory used in this chapter, focusing on directed network. A directed network is a pair (N, A) where N is the number of individuals (*nodes*) and A is a $n \, x \, n$ adjacent matrix on the set of individuals. The elements of the matrix $a_{ij} \in \{0,1\}$ indicate the relationship between individuals i and j. A directed relationship exists if $a_{ij} = 1$, namely if individuals i and j are connected, and it does not if $a_{ij} = 0$. Individual i's *out-neighbourhood*, N_i^{out}, is the set of individuals to whom s/he is connected - $N_i^{out} = \{j \in N$ s.t. $a_{ij} = 1\}$. Individual i's *in-neighbourhood*, N_i^{in}, is the set of individuals connected with him/her - $N_i^{in} = \{j \in N$ s.t. $a_{ji} = 1\}$. The *degrees* d_i^{out} and d_i^{in} are, respectively, the cardinality of the set N_i^{out} and N_i^{in}. A (directed) *walk* in a network refers to a sequence of nodes $i_1, i_2, \ldots, i_{h-1}, i_H$, such that $a_{i_h, i_{h+1}} = 1$ for each h from 1 to H. A (directed) *path* is a walk such that all nodes are distinct. A (directed) *cycle* in a network is a path in which the first and the last nodes of the sequence are the same. A network is *strongly connected* if there exists a path between every pair of nodes i and j.[4] The distance between two nodes in a *strongly connected* network is the length of the shortest path between them. The largest distance between any two nodes is expressed by the network's *diameter*. Moreover, if the network is not strongly connected, we refer to the diameter as the largest distance between any two nodes in the biggest network component.[5]

To perform our simulations, we have generated a dataset of distinct random networks using the three steps procedure in Azzimonti and Fernandes (2018).

In the first step, a Barabasi and Albert's (1999) random graph is generated, which is a directed network with few popular individuals (Figure 1a). Starting from a small random network (*seed*) of γ individuals, the algorithm iteratively adds new nodes which are connected to a fixed number γ_0

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[3] For more on the related literature see Chapter 1 - Section 4.

[4] Note that in a directed network the existence of a path between two individuals, i and j, does not imply that also individual j can reach individual i.

[5] A network component is a strongly connected sub-network.

existing node - where $\gamma_0 \leq \gamma$;[6] thus, in each iterations the procedure expands the N_i^{in} of the existing nodes. To enhance the randomness of our network, we have randomly (and conventionally) drawn γ in the range $[2, 5]$.[7] The connection probability between a new and existing node is endogenously determined. It is proportional to the number of connections that the existing nodes already have. Formally, the probability that an existing node i is chosen (among the other j existing nodes) as neighbour from a new node is: $pr_i = \frac{d_i^{in}}{\sum_j d_j^{in}}$. This process ensures that, the 'older' individuals are more likely to have many followers than the 'youngers' (this property is known as *preferential attachment*). As consequence, the individuals in the *seed* are more likely to be the celebrities of the network.

In the second step an Erdős and Rényi's (1960) random network is generated, according to which individuals have the same probability, ϕ, to be linked with another individual in the network (Figure 1b). The value of ϕ is directly related with the reciprocity of connections. A value of $\phi = 1$ implies that all connections are reciprocal, while a value $0 < \phi < 1$ implies that only a fraction of them might be reciprocal. To generate the set of networks used in the simulations, we have randomly drawn (for every network) $\phi \in [0, 0.18]$. This condition, combined with the assumption on the *seed*, ensures a reciprocity rate around 6%, close to the one estimated in Azzimonti and Fernandes (2018).[8] Finally, in the third step the two previous networks are combined (Figure 1c).

Figure 1–The three steps in Azzimonti and Fernandes's algorithm (N=15, ϕ =0.11, γ =3, γ_0=2)

(a)   1° step- Barabasi and Albert's network (γ =3, γ_0=2).

(b)   2°step - Erdős and Rényi's network (ϕ =0.11).

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[6] For each network we randomly drawn γ_0 in the range $[2, \gamma]$.

[7] In Barabasi and Albert's (1999) algorithm the *seed* network can be any random networks with no isolated nodes (a node i is isolated if N_i^{out} and N_i^{in} are empty sets). To generate the *seed,* we use the algorithm in Erdős and Rényi (1960). This algorithm ensures, almost surely, the absence of isolated nodes when the probability of connection is greater than the threshold value log(*N*)/*N*. However, this is a limit condition, more likely satisfied for networks populated by a large number of individuals. For this reason, we have randomly drawn the connection probability between log(γ)/γ and 1, and checked for isolated nodes in the *seed*. If this last condition was not satisfied, we discarded the *seed* and repeated the procedure. Note that we operate in that way only for the *seed* network.

[8] For their network near 4%.
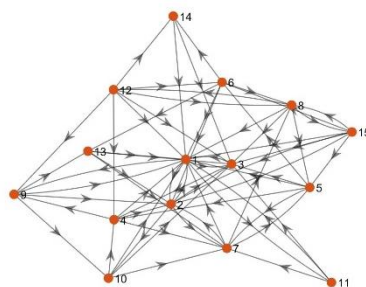
(c)   3° step - Azzimonti and Fernandes's random network

3.The model

Our theoretical framework is based on Besley et al. (2019) model of social norms and tax compliance, to which we add a network structure to describe individuals' reference group. In our model, N individuals are connected in a network relationship. A network is a list of links between individuals that here represents information exchange. An individual's neighbourhood is the set of individuals to whom s/he is connected. We assume that *(i)* information exchange can be unidirectional (directed) or bidirectional (reciprocal) and *(ii)* some individuals are more influential than other because their actions are observed by more people (differential influence).[9] The first assumption allows individuals to 'provide information to' and/or 'receive information from' neighbours. According to this assumption N_i^{in} identifies the set of individuals who receive information from i – hereinafter we refer to these individuals as *followers* of i. The second assumption reflects one crucial characteristic of real and social networks (Instagram, Facebook and so on) where the message sent by a 'celebrity' affects the behaviour (consumption habits, attitudes, beliefs) of thousands of followers. In our setting, the number of followers is a measure of an individual's influence, celebrities are individuals whose behaviour is widely observed in the network, and the *reference group* is the set of neighbours the individual follows and from whom s/he receives information – i.e. N_i^{out}.

Each period, individuals in the network must decide whether to pay or to evade taxes: $e_t \in \{0,1\}$ - where $e_t = 1$ denotes tax evasion at time t. Individuals must trade off the benefits of tax evasion (lower tax payments) with the costs. These are given by the (expected) monetary cost of being caught and punished plus the social reputation loss. We assume a proportional income tax (τ) and a network population equally divided between two-income types: y^H and y^L . The expected monetary cost of tax evasion is computed by multiplying the probability of being caught (p) by the fine to be paid if

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[9] Both the assumptions can be implemented by the algorithm in Azzimonti and Fernandes (2018).

discovered, which is equal to f times ($f>1$) the evaded tax (τy^R, R = H, L). So, the expected monetary cost of tax evasion is equal to $\tau f p y^R$.

Individuals also differ in the importance they assign to social reputation. An individual obtains a reputation benefit (honour) from tax-compliance and pays a reputation cost (stigma) if s/he evades. We assume that reputation cost, $c(\alpha_{i,t})$, and benefit, $b(\alpha_{i,t})$, depend on $\alpha_{i,t}$, the share of individuals in the reference group who, in the current period, pay their due taxes.

Summarizing, at time t individual i decides whether to pay or to evade by comparing the payoff from paying the due taxes ($e_t = 0$) with the payoff from tax evasion ($e_t = 1$), respectively,

$$(1 - \tau)y_i^R + \mu_{i,t}b(\alpha_{i,t}) \quad \text{and} \quad (1 - \tau f p)y_i^R - \mu_{i,t}c(\alpha_{i,t}) \tag{1}$$

The parameter $\mu_{i,t}$ is the weight given by the individual to social reputation relative to monetary gains and losses. At time t=0, the reputation weight is randomly drawn from a uniform distribution defined over the interval [0, 1]. We assume that the individual updates $\mu_{i,t}$ looking at the reference group (the set of neighbours s/he follows), according to the following rule:

$$\mu_{i,t} = (1 - \lambda)\mu_{i,t-1} + \lambda\mu_{i,t-1}^g \tag{2}$$

where $\mu_{i,t-1}^g$ is the average weight given to social reputation in individual i's reference group and $\lambda\epsilon[0,1]$ measures relative importance of the group for the individual (*peer effect*).[10]

Individuals with many followers – celebrities - are more likely to enter in $\mu_{i,t}^g$ and thus to influence the weight given to social reputation. In the simulations, we consider two different reference groups: *both-income* and *same-income*. In the first, the reference group contains individuals from both income groups; in the second, an individual only looks at peers in the same income group.[11] The first describes a more integrated society, the second a rather segregated society.

From (1), the threshold value that determines individual i's taxpaying behaviour at time t is:

$$\mu_{i,t}^* = \frac{\tau(1 - fp)y_i^R}{h(\alpha_{i,t})}$$

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[10] In our setting, μ_i measures the importance for an individual to be considered as "*an honest citizen*" by the neighbours. Being a variable that measures a value that develops in, and exists only referred to, a social group, we assume that μ_i is context-related – i.e. it depends on the social context in which s\he lives. For this reason, when interacting with neighbours, an individual compares the weight that s/he assigns to the reputation with the weight that the reference group assigns to it, and if it is the case, adjusts μ_i. In other terms, we aim to emphasize the fact that an individual is motivated to care about reputation if it is highly regarded in the reference group.

[11] Obviously, the two updating procedures produce the same result if all individuals have the same income.

where $\tau(1 - fp)y_i^R$ is the expected monetary net benefit from tax evasion[12] and $h(\alpha_{i,t}) = b(\alpha_{i,t}) + c(\alpha_{i,t})$ is the reputation gain from tax compliance (the earned honour plus the avoided stigma). If $\mu_{i,t} > \mu_{i,t}^*$ then individual i pays at time t.[13]

Given the institutional setting, summarised by $k = \tau(1 - fp)$, an individual is more likely to evade the higher is the share of tax-evaders in his/her reference group, if his/her income is high and if s/he believes that social reputation is not so important.

The condition for tax compliance can be written as $\mu_{i,t}h(\alpha_{i,t}) > ky_i^R$. Namely, individual i complies if the overall reputation gain from tax compliance - $\mu_{i,t}h(\alpha_{i,t})$ - is higher than the expected monetary net benefit from tax evasion - ky_i^R. Note that there are two parts to social reputation. The first, $h(.)$, is a social norm for tax compliance; namely, everyone agrees that reputation cost and benefit from tax behaviour depend on the behaviour of the own reference group -"*if taxpayers observe tax evasion to be common, then tax morale decreases. Alternatively, if they observe others to be honest, tax morale increases*". The second, $\mu_{i,t}$, is a subjective component that measures how much the individual cares about social reputation; this is the key element of our dynamics: the weight given to social reputation changes with social interactions – "*I know that tax evasion is an anti-social behaviour, but if my peers do not care about social reputation neither do I*".

4.Simulations

To conduct the simulations, we have generated a dataset containing 5.000 distinct networks with *N*=100. Each network is obtained by randomly drawing the algorithm parameters, within specified intervals. In choosing these intervals, our aim was to generate networks with enough reciprocal

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[12] In the model we assume that tfy^R, where *f>1*, is the overall amount that an individual would pay in the case of evasion (the evaded taxes plus the sanction). An alternative, and equivalent, way to express the cost of evasion is to consider the evaded taxes and the sanction separately. In this case the cost of evasion is $ty_i^R + tsy^R$, where $s \in (0,1]$ is the sanction, and the $\widehat{\mu_{i,t}^*} = \frac{\tau[1-(1+s)p]y_i^R}{h(\alpha_{i,t})}$ is the threshold. However, replacing $(1 + s)$ with f, $\widehat{\mu_{i,t}^*} = \mu_{i,t}^*$.

[13] As discussed in the Introduction, this setting differs from the model presented in chapter 3 for two main reasons: *i)* we introduce income inequality; *ii)* we focus on the dynamic of the weight given by individuals to social reputation (μ_i), instead of the intrinsic motivation to comply. Despite income inequality, the monetary incentive interpretation of tax evasion in $\mu_{i,t}^*$ is equivalent to that analysed in $v_{i,t}^*$- see expression (3) in chapter 3. On the other hand, $v_{i,t}^*$ and $\mu_{i,t}^*$ deeply differ in the meaning of the social norm term, respectively $\Delta_{i,t}$ and $h(\alpha_{i,t})$. Specifically, in chapter 3 the social norm term is computed as the difference between the average intrinsic motivation of the individual's neighbours who have paid and evaded their taxes, whereas in the present model it is intended as a function that depends on the share of individuals in the reference group who pay their due taxes.

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connections and such that some individuals are more influential than others.[14] For each run, we set the exogenous parameters (τ, f and p) and then simulate the model for a time horizon of 100 periods. We compute the steady state compliance share in each of the 5.000 random networks and characterise its frequency distribution.

In the simulations, we set $h(\alpha_{i,t}) = \frac{1}{1-\alpha_{i,t}}$,[15] which implies,

$$\mu_{i,t}^* = k(1 - \alpha_{i,t})y_i^R \tag{3}$$

Summarizing, the simulation's protocol is the following:

1. The economic characteristics are chosen. Unless otherwise specified, in what follows we set $\tau = 0.35$, $f = 1.5$ and $p = 0.05$, which implies $k = 0.3237$.[16]

2. At time zero, individual weights on social reputation $(\mu_{i,0})$ are randomly drawn from a uniform distribution with support [0, 1] and $\alpha_{i,0} = 0.5$.[17]

3. Individuals receive information from their reference group and update $\mu_{i,t}$ as in equation (2).

4. The threshold values $(\mu_{i,t}^*)$ are computed as in equation (3).

5. Individuals decide whether to comply or not, looking at their payoff as in expression (1).

In what follows, we first discuss the dynamics of the reputation weight μ and then characterise the frequency distribution of the steady state compliance share.

4.1 The dynamics of the reputation weight (μ).

As discussed above, at time 0 individuals differ in the weight they assign to reputation $(\mu_{i,0})$. This is updated over time looking at the own reference group. We consider two alternative reference groups: *both-income* and *same-income*. In the first, the individual's reference group contains individuals from both income groups. In this case, if the network is *(i)* strongly connected and *(ii)* aperiodic, then

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[14] As discussed in the previous section the average reciprocity rate is about 6% whereas the expected number of influential individuals is $\bar{\gamma}$.

[15] This is a simple (monotone) increasing and convex function, which implies a linear $\mu_{i,t}^*$. Moreover, given $\alpha_{i,t} \in [0,1]$, it follows that $\mu_{i,t}^* \in [0, ky_i^R]$. The function $h(\alpha_{i,t}) = \frac{1}{1-\alpha_{i,t}}$ can be thought of as the sum of $b(\alpha_{i,t}) = \frac{z\alpha_{i,t}}{1-\alpha_{i,t}}$ and $c(\alpha_{i,t}) = \frac{1-z\alpha_{i,t}}{1-\alpha_{i,t}}$, both increasing with the number of taxpayers.

[16] The chosen value for the tax burden ($\tau = 0.35$) is close to the average tax burden among OECD countries in 2018, which is 34.3% (https://data.oecd.org/tax/tax-revenue.htm). We have tried other parameters values and results are qualitatively the same.

[17] At time 0, individuals have no information about the fiscal behaviour in their reference group and assume the same share of evaders and taxpayers.

individuals' reputation weights converge to a common value μ^N.[18] The first condition ensures that information freely spreads around the network and, therefore, everyone receives, through the neighbours, all the information available in the network. The second condition ensures that $\mu_{i,t}$ does not cycle indefinitely. The limit value μ^N is a weighted average of the initial values $\mu_{i,0}$ with weights correlated to individuals influence (see Golub and Jackson, 2010). Thus, if all individuals in the network have the same influence, the expected value of μ^N is equal to the expected value of $\mu_{i,0}$, that is $\frac{1}{2}$. By contrast, if there are some 'celebrities' the expected value of μ^N will be biased towards their initial evaluation of social reputation.[19] However, since we have assumed $\mu_{i,0}$ to be uniformly distributed in [0,1], the expected value of a celebrity's initial evaluation of social reputation is $\frac{1}{2}$ and the limit distribution of μ^N is symmetric around its mean $(\frac{1}{2})$. Figure 2 shows the limit distribution of μ^N in our simulations, where convergence is obtained in 99% of the 5.000 networks.

When the reference group only contains individuals with the *same-income*, the original structure of the network splits into (two or more) sub-networks. In this case, if each sub-network is strongly connected and aperiodic, the above result applies to each sub-network and $\mu_{i,t}$ converges to a unique value in each sub-network.

Figure 2 - Distribution of μ^N
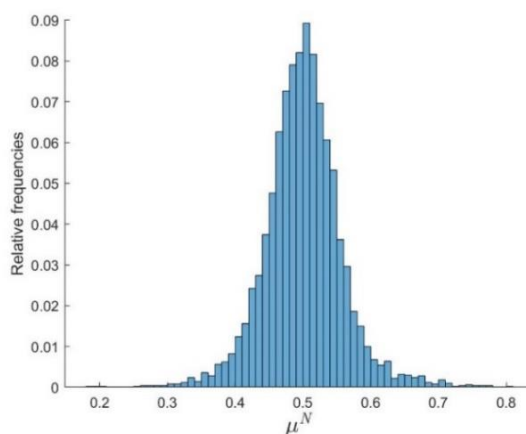
As for the speed of convergence, DeMarzo et al. (2003) have shown that if the sufficient conditions for convergence are verified, the updating process in (2) leads to convergence for any positive value of λ. The weight that individuals place on the information received from the reference group only affects the speed of convergence: the higher is λ the quicker is the convergence process (figure 3).[20]

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[18] The first condition (strong connectedness) requires that there exists a path between every pair of nodes i and j. This is more likely the higher is the parameter ϕ. The second condition (aperiodicity) means that the length of the greatest common divisor of all directed cycle is 1 (see Jackson 2010).

[19] If 'celebrities' have divergent evaluations of social reputation, their influence on the value of μ^N might balance and even cancel out. Recall that the number of celebrities in the network is affected by the value of the parameter γ.

[20] Without loss of generality, in our simulations we have set $\lambda = 0.5$.

(a) λ=0.3 (b) λ=0.5 (c) λ=1
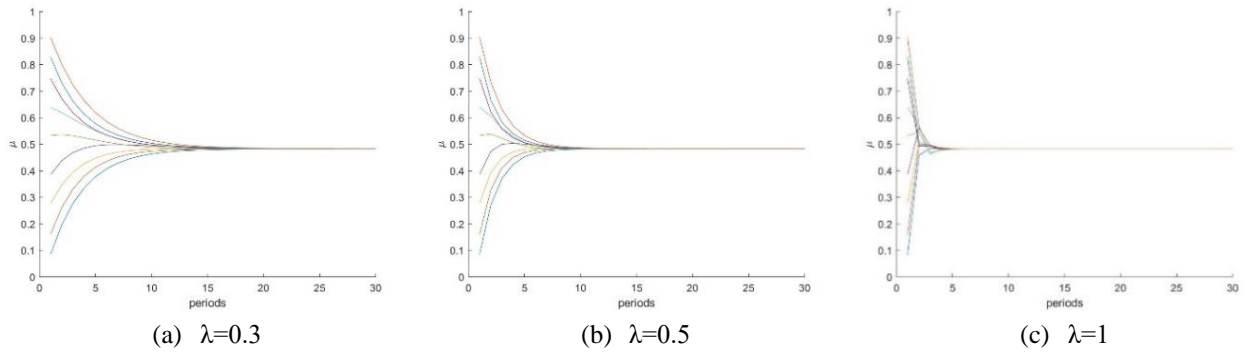
4.2 Tax compliance

To find the steady state share of taxpayers (C), we first consider the benchmark case in which all individuals have the same income. To this purpose, we set $y^H = y^L = \frac{1}{k}$. This ensures that $\mu^*_{i,t}$ and $\mu_{i,t}$ are both defined in the interval [0, 1].[21] By contrast, if individuals have different income levels, there is no way to ensure that $\mu^*_{i,t}$ and $\mu_{i,t}$ vary in the same interval. This fact might generate a bias in individuals' decisions: an *evasion bias,* if the maximum value of the threshold $\mu^*_{i,t}$ is higher than the maximum value of the reputation weight and a *compliance bias* if the threshold $\mu^*_{i,t}$ never reaches the maximum value of the reputation weight. The magnitude of the *evasion bias* can be measured by the value $\bar{\alpha}_{i,t}$ such that $\mu^*_{i,t}$ reaches 1, namely $k(1 - \bar{\alpha}_{i,t})y_i^R = 1$. The higher this value, the smaller is the share of tax-evaders required in the reference group to induce tax evasion.[22] Note that the evasion bias is higher for high-income individuals. To measure the *compliance bias,* note that, when all in the reference group evade ($\alpha_{i,t}$=0), the expected monetary net benefit of tax evasion falls short of the reputation gain from tax compliance if $\mu^*_{i,t} = ky_i^R < 1$. In this case, an individual might decide to comply even if all in the reference group evade. Differently from the evasion bias, the compliance bias - measured by $(1 - ky_i^R)$ - is higher for low-income individuals. This suggests that if $y^H > \frac{1}{k} > y^L$ there is an evasion bias for high-income individuals and a compliance bias for low-income individuals.

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[21] In fact, with $ky = 1$ in (3) $\mu^*_{i,t}$ varies in the interval [0, 1], which is the support of $\mu_{i,t}$.

[22] If $\bar{\alpha}_{i,t} = 0$, there is no evasion bias. This happens if $y_i^R = \frac{1}{k}$. Note that $\bar{\alpha}_{i,t} = 1 - \frac{1}{ky_i^R} > 0$ implies $y_i^R > \frac{1}{k}$. This means that when all neighbours evade ($\alpha_{i,t}$=0) the monetary net benefit of tax evasion overcomes the reputation gain from tax compliance, which induces the individual to evade. By contrast, if all neighbours comply ($\alpha_{i,t}$=1) then $\mu^*_{i,t} = 0$ and all individuals pay their taxes, no matter their income.

In what follows, we focus on this case and, to balance the evasion bias of high-income individuals and the compliance bias of low-income individuals, we assume $y^H y^L = \frac{1}{k^2}$.[23] Moreover, unless otherwise specified, we assume an equal share of low and high-income individuals.

To set the stage, let us first consider the benchmark case in which there are no income differences. In this case, the two reference groups in the updating process coincide and, if the conditions for convergence are satisfied, all individuals end up sharing a common value of the reputation weight (μ^N). Moreover, since they all have the same income, their (expected) monetary cost of tax evasion is the same. It follows that, in equilibrium, they all take the same tax-paying decision: either they all pay (if $\mu^N > \mu_{i,t}^*$) or they all evade (if $\mu^N < \mu_{i,t}^*$).

Next, we consider the model with income differences. In case of an integrated society in which individuals follow others no matter their income, if the convergence conditions are satisfied, individuals end up sharing a common value of the reputation weight (μ^N) and it is possible to reach network conformity, either complete tax compliance ($C=1$) or complete tax evasion ($C=0$). However, with income differences, this is not always the case. In fact, although individuals reach a *consensus* on the weight to place on social reputation, the heterogeneity in the (expected) monetary cost of tax evasion might lead them to undertake different decisions: to evade if the gain from evasion is not enough to balance the reputation loss (if $\mu^N < \mu_{i,t}^*$) and to comply otherwise (if $\mu^N > \mu_{i,t}^*$). When tax compliance and tax evasion coexist, due to differences in the expected net benefit from tax evasion, it is more likely that low-income individuals pay than high-income do. Figure 4 shows the distribution of C over 5.000 runs (networks) assuming two different sets of income values.[24] In panel *(a)* $y^H = 3.5$ and $y^L = 2.7$; in panel *(b)* $y^H = 7.4$ and $y^L = 1.3$.[25]

In the first case (panel a), we observe almost always network conformity: complete compliance ($C=1$) or complete tax evasion ($C=0$). Having assumed an equal share of low and high-income individuals, C is (almost) equally distributed between $C=1$ and $C=0$. In the second case (panel b), although in many networks tax compliance and tax evasion coexist in equilibrium, in most simulations the steady state share of taxpayers is higher than 50%. This is due to having set y^L so low that, even when all in
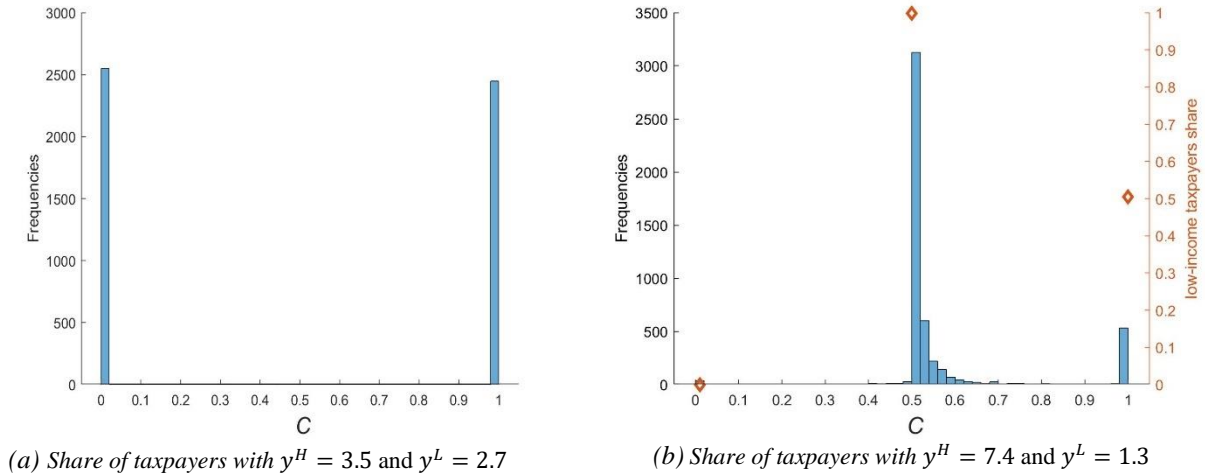
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[23] This is obtained by setting the evasion bias equal to the compliance bias: $1 - \frac{1}{ky^H} = 1 - ky^L$.

[24] The figure shows only the case in which there is convergence of the reputation weights. Otherwise, evaders and taxpayers might coexist.

[25] Both satisfy the no-bias condition: $y^H y^L = \frac{1}{k^2}$.

the reference group evade, the expected monetary net benefit of tax evasion for low-income individuals is not enough to balance the expected reputation loss (i.e. $y^L k < \frac{1}{2}$).[26]

Figure 4 - The frequency distribution of C, both-income reference group.

(a) Share of taxpayers with $y^H = 3.5$ and $y^L = 2.7$

(b) Share of taxpayers with $y^H = 7.4$ and $y^L = 1.3$

In this setting, the role of influencers is fundamental: the network is more likely to end up with a prevalence of taxpayers (tax-evaders) the higher (lower) is the weight placed on reputation by influencers and if their income is low (high).

The following graph shows the steady state of a network with 30 individuals, setting $y^H = 7.4$ and $y^L = 1.3$. It shows that, due to the divergence of the expected monetary cost of tax evasion implied by income differences, low-income individuals (circles) might comply (in green) even if they only follow (high-income) tax-evaders (in blue). This is, for instance, the case of individual 11, who, despite only following tax-evaders, does not evade.

Figure 5 - Triangles are for high-income and circles for low-income; green is for taxpayers and blue for tax-evaders

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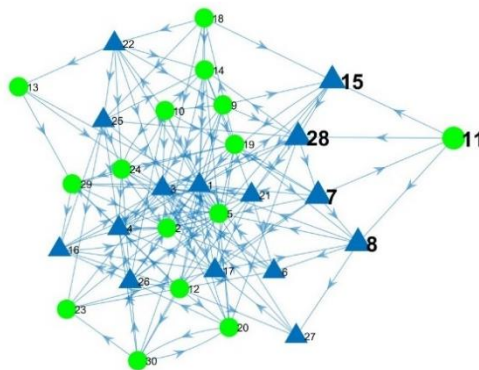
[26] In few cases, the limit value μ^N is lower than $y^L k = 0.4208$ and the outcome is complete tax evasion.

Finally, we consider the case of a segregated society in which the reference group only contains individuals from the *same-income* group. Segregation hinders the diffusion process because information does not freely spread around the network and individuals do not receive all the information available. Therefore, it is unlikely that the first condition for convergence of $\mu_{i,t}$ is satisfied. Figure 6 shows the frequency distribution of the steady state compliance share for the same set of income values as before. In panel *(a)*, where $y^H = 3.5$ and $y^L = 2.7$, the distribution is symmetric around its mean ($\bar{C} = \frac{1}{2}$) and network conformity is quite rare (around 25%), with a similar frequency of 'all taxpayers' and 'no taxpayers'. Moreover, as expected, among taxpayers the share of low-income individuals (orange diamonds on the right scale) is much higher than the share of high-income individuals - for example, when the compliance share is 50% (*C=0.5*) the orange diamond indicates that around 95% of taxpayers are low-income (right scale). Differently, in panel *(b)*, where $y^H = 7.4$ and $y^L = 1.3$, network conformity is almost never reached. What we observe is that, no matter the compliance share, taxpayers are all low-income, while high-income individuals never pay.[27] The reason for non-compliance of high-income individuals is twofold: *i)* their monetary incentive for tax evasion is high and *ii)* they only communicate among themselves.

Figure 6 – The frequency distribution of C, same-income reference group

(a) *Share of taxpayers with $y^H = 3.5$ and $y^L = 2.7$* (b) *Share of taxpayers with $y^H = 7.4$ and $y^L = 1.3$*
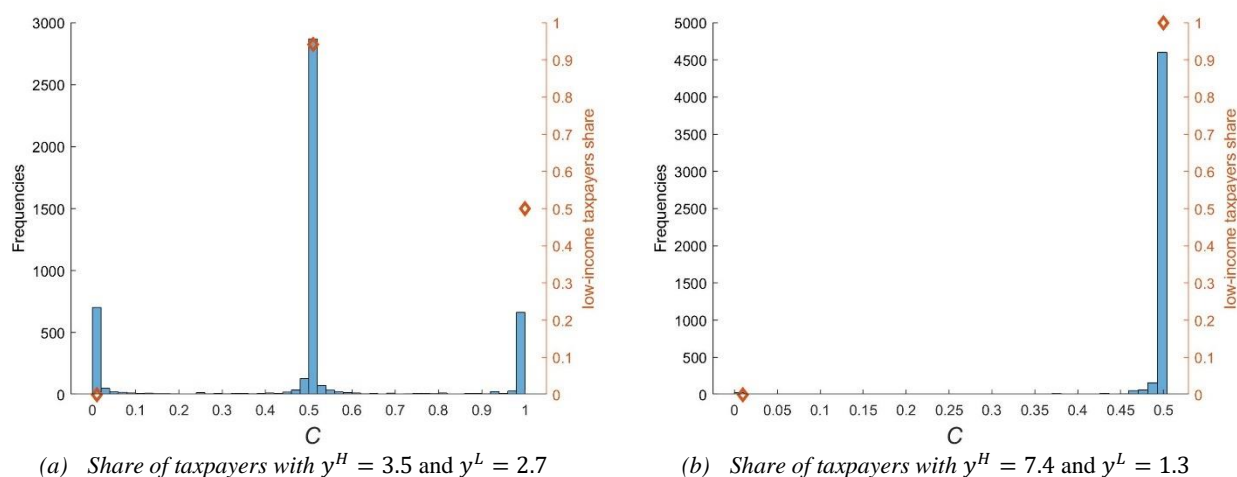
To compare the results obtained in an integrated society and in a segregated society, the following graphs illustrate the dynamics of tax-paying decisions in a network with 30 individuals and assuming $y^H = 3.5$ and $y^L = 2.7$. Panel *(a)* describes the initial state of the network, with the directed edges, individuals' income, and their tax paying behaviour: triangles indicate high-income and circles low-income; green is for taxpayers and blue for tax-evaders. Panel *(b)* shows the final network

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[27] The figure on the right exhibit also cases in which a small share of low-income individuals evades. See footnote 26 where we mention the reasons because it may happen.

configuration when the reference group only contains peers with the *same-income*. Individual 5, who belongs to the high-income group, breaks the communication between low-income individuals 22 and 18. The latter are 'celebrities' in the red and in the black sub-network, respectively. In the final network configuration, individuals in the 'red' sub-network end up paying because of the influence of individual 22, a taxpayer celebrity; in the 'black' sub-network all individuals end up evading, because of the influence of individual 18, a tax-evader celebrity. By contrast, as shown in panel *(c)*, when individuals follow *both-income* types, individual 5 acts as a bridge between the two low-income celebrities (22 and 18) and information freely spreads between the two sub-networks (and more generally around the network). This adds to the positive effect of the most influential individual (individual 1, a high-income taxpayer) and generates network conformity (in this specific case compliance).

Figure 7 – The dynamics of tax paying decisions

(a) t=0
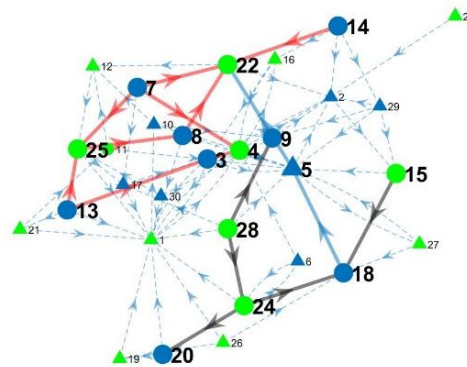
(b) Same-income reference group – end period

(c) Both-income reference group – end period
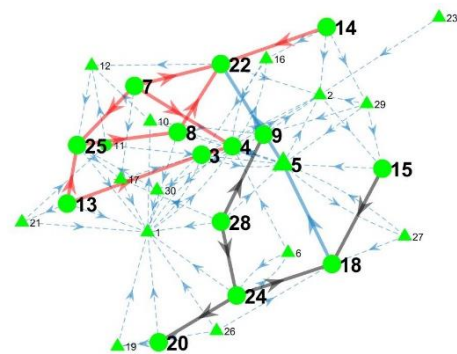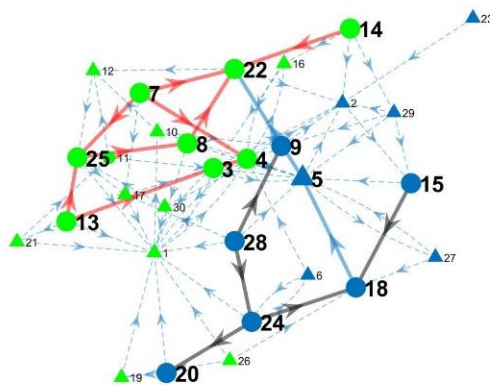
5.Policy implications

We now consider the possibility that, exploiting the diffusion process in the network to promote tax compliance, a tax authority aims at increasing individuals' concern for social reputation. To this

purpose, imagine that the tax authority organises a media campaign in which a celebrity illustrates the social harm caused by tax evasion, emphasising the social stigma associated with it. We describe such a policy as an increase in the value of the initial reputation weight of the most influential individual and simulate the diffusion process in the two societies considered in this chapter. The results are graphically illustrated for an integrated (figure 8) and for a segregated society (figure 9). As compared with figure 4 and 6, in both cases we observe an increase in the average steady state compliance share, more pronounced when the information freely spreads around the network (integrated society). When the reference group contains both income types, the celebrity's message about the importance of social reputation increases the average value of C by 20% (from 0.5 to 0.6) when the income differences are relatively low (figure 8a) and by 7% (from 0.56 to 0.6) when income inequality is more pronounced (figure 8b). If the reference groups is only made of same-income peers, the policy increases the average value of C by 10% (from 0.5 to 0.55), when income differences are relatively low (figure 9a) and it has no effect on compliance when income inequality is relatively high (figure 9b). This suggest that a policy intervention that exploits celebrities' influence in a social network to boost tax compliance, is more effective in situations in which information diffusion and imitation are not hindered by social segregation. In a more cohesive society, and especially if income inequality is low, an influencer's endorsement for tax compliance might nudge a widespread socially responsible tax behaviour.

Finally, note that regardless of the type of society - segregated or cohesive - the policy is more effective where there exists a lower income inequality.
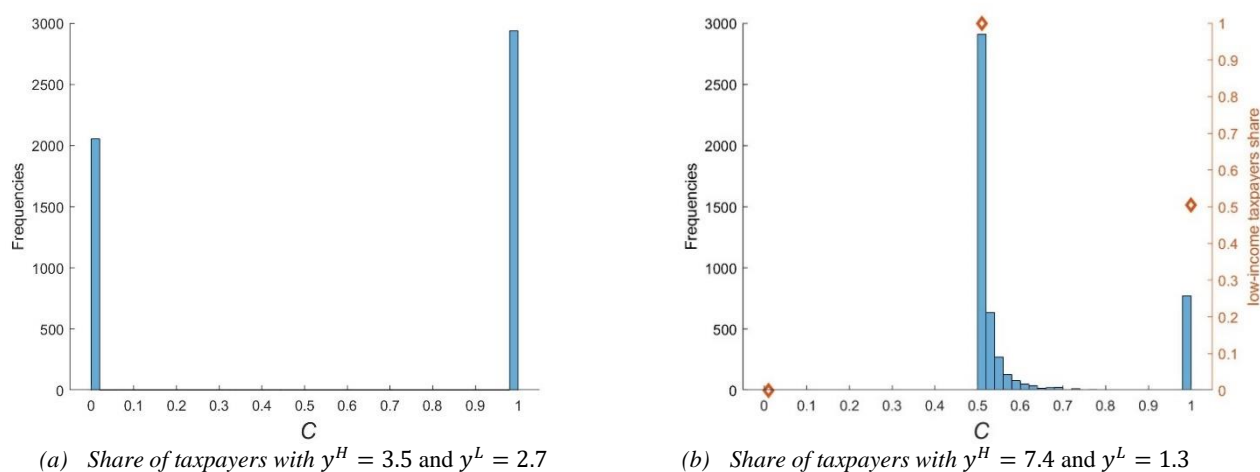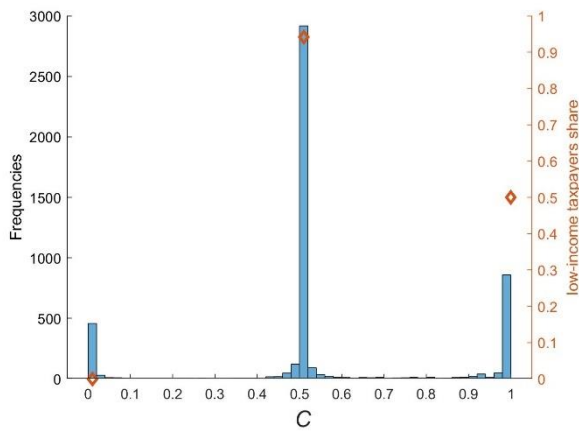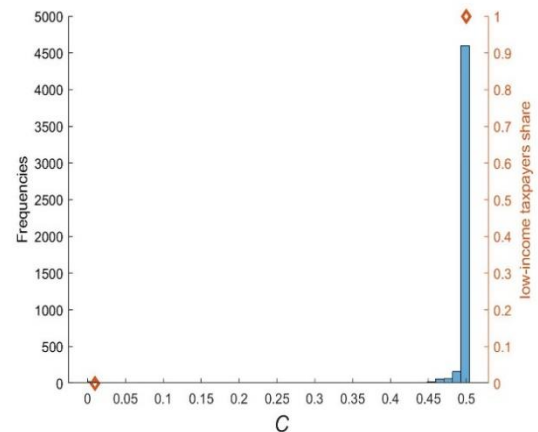
Figure 8 - Policy with both-income reference group

(a) *Share of taxpayers with $y^H = 3.5$ and $y^L = 2.7$*   (b) *Share of taxpayers with $y^H = 7.4$ and $y^L = 1.3$*

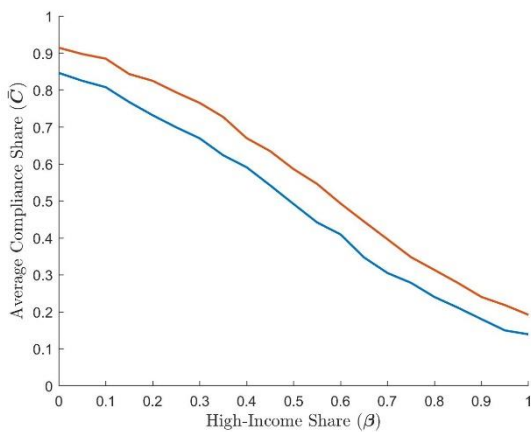*Figure 9 - Policy with same-income reference group*

(a) *Share of taxpayers with $y^H = 3.5$ and $y^L = 2.7$*
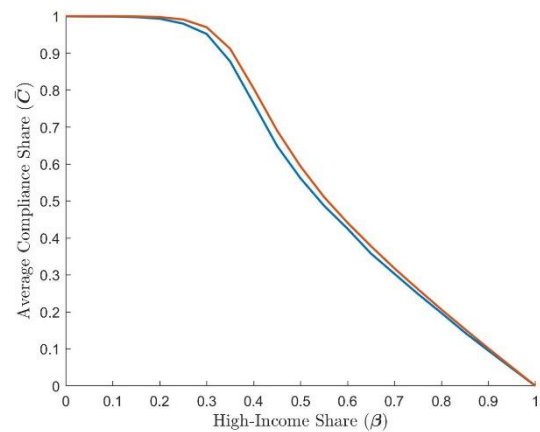
(b) *Share of taxpayers with $y^H = 7.4$ and $y^L = 1.3$*

Figures 10 and 11 illustrate the average compliance share ($\bar{C}$) as a function of the share of high-income individuals in the network (β), with and without the media campaign (orange and blue lines respectively).[28]

Figure 10 – Both-income reference group – Average compliance share and share of high-income individuals – without intervention (blue line) and with the social media campaign (orange line).

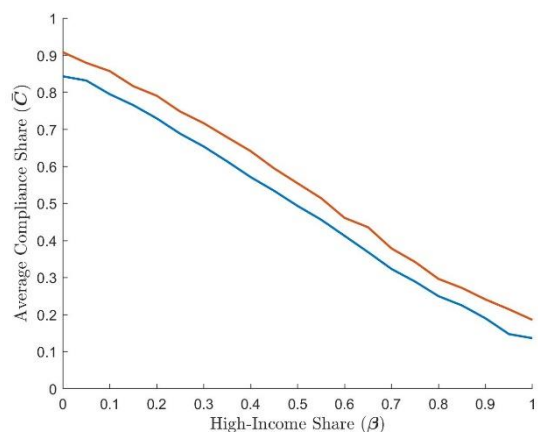(a) *Share of taxpayers with $y^H = 3.5$ and $y^L = 2.7$*

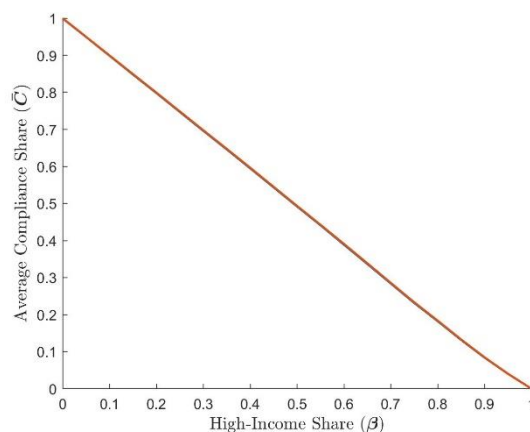(b) *Share of taxpayers with $y^H = 7.4$ and $y^L = 1.3$*

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[28] Each point in the graph represents the average compliance share $\bar{C}$ – computed over 5.000 networks - for a given share of *high-income* individuals in the population and following the simulation protocol in section 4.

Figure 11 - Same-income reference group – Average compliance share and share of high-income individuals – without intervention (blue line) and with the social media campaign (orange line).

(*a*) *Share of taxpayers with* $y^H = 3.5$ *and* $y^L = 2.7$

(*b*) *Share of taxpayers with* $y^H = 7.4$ *and* $y^L = 1.3$

As expected, due to the income related monetary cost of tax evasion, the share of taxpayers is higher when the number of high-income individuals is lower. Comparing panel (a) and (b) in the two graphs, we see that when income differences are more pronounced (panel b), due to the effects of the compliance and evasion biases discussed in section 4.2, the relationship is steeper.[29]

Finally, Figure 11-panel *b)* confirms that the social media campaign has no effect when the reference group only contains same-income peers and income inequality is relatively high.

We now compare the media campaign policy with a more conventional punishment strategy that permanently increases the audit probability. Note that in our framework increasing the value of the audit probability (or equivalently, the fine to be paid in case of detection) produces two effects. On the one hand, it reduces the expected monetary net benefit from tax evasion;[30] on the other hand, it simultaneously increases the compliance bias and decreases the evasion bias.[31] Both these effects encourage tax compliance.

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[29] In fact, in panel (b) $\bar{C} = 1$ for $\beta = 0$ and $\bar{C} = 0$ for $\beta = 1$ while in panel (a) $\bar{C} < 1$ for $\beta = 0$ and $\bar{C} > 0$ for $\beta = 1$. The reason is that, unlike the case of equal income considered in section 4 - in which there is no bias having set $y^H = y^L = \frac{1}{k}$ - here when $\beta \to 0$ the compliance bias overcomes the evasion bias. Similarly, when $\beta \to 1$ the evasion bias overcomes the compliance bias. As discussed in section 4, this effect is amplified when income differences are more pronounced (panel b). In this case, when $\beta = 0$ and all have the same income ($y = 1.3$), the compliance bias is so strong that in all networks we observe complete compliance. Similarly, when $\beta = 1$ and all individuals have income $y = 7.4$, the evasion bias is so strong that in all networks we observe complete tax evasion.

[30] In fact, an increase in p or f reduce the value of k.

[31] Recall that the evasion bias is measured by: $1 - \frac{1}{ky^H}$; while the compliance bias by: $1 - ky^L$.

To replicate the results obtained with the media campaign in the case of an integrated society - namely an increase in the expected compliance share by 20% - the tax authority would have to increase the audit probability from 5% (in basic set-up) up to (around) 9%.

If the two income groups are segregated, the same increase in the audit probability would rise the average value of *C* by 10% when income differences are relatively low and it would have no effect on compliance when income inequality is relatively high,[32] the same effect obtained with the celebrity's endorsement.

This is not an indication that media campaigns starring celebrities should be a substitute for audits; it rather suggests that behavioural strategies could be an effective complement to more traditional policies.

6.Concluding remarks

We have presented an agent-based model to study tax evasion in a social network where individuals differ in income and concern for social reputation. The analysis is based on the consequence of individuals, who differ in their income type and the weight they assign to reputation, possessing social connections through which information about fiscal behaviour and social stigma associated to tax compliance are transmitted. Through numerical simulation, we characterise the steady state under two alternative settings, which differs in the individuals' reference group. Our results suggest that in an integrated society in which individuals observe all the neighbours, no matter their income, network conformity is reached. By contrast, a segregated society, in which individuals observe only neighbours with same income, generates obstacles to the diffusion process of information around the network and, as a result, tax evasion and tax compliance might coexist.

In term of policy implication, our results highlight the importance for a tax authority to acquire information on social network in order to design policies which might increase tax compliance through social pressure. Notably, we suggest that tax authority can use the diffusion process of information to implement a reputational policy. What we have in mind is a media campaign according to which tax authority engages celebrities to promote prosocial behaviour, for instance by illustrating the social harm caused by tax evasion, or emphasising the social stigma associated with it.

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[32] As before discussed, in this case, high-income individuals never pay (also) because the high monetary benefit that they gain from evasion. According to our simulations, in this specific case tax authority would have to increase the audit probability from 5% (in basic set-up) to at least 15% to induce some high-income individuals to pay taxes, rising the average value of compliance.

In this chapter we have focused on few individuals and two income types, it would be of interest, for future works, to create more sophisticated agent-based models, which reflects the real demographic and financial characteristics existing in a real and social networks. Although they might require a significant computing power, if properly constructed these models will provide an ideal testing place for policy intervention that cannot be immediately tested in practice.

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