International Review of Economics

The co-evolution of tax evasion, social capital and policy responses: A theoretical approach

--Manuscript Draft--

Manuscript Number:	IREC-D-17-00002R1
Full Title:	The co-evolution of tax evasion, social capital and policy responses: A theoretical approach
Article Type:	Research Article
Corresponding Author:	Luigi Bonatti Universita degli Studi di Trento ITALY
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	Universita degli Studi di Trento
Corresponding Author's Secondary Institution:	
First Author:	Luigi Bonatti
First Author Secondary Information:	
Order of Authors:	Luigi Bonatti
	Lorenza Alexandra Lorenzetti
Order of Authors Secondary Information:	
Funding Information:	
Abstract:	The dynamic model presented in this paper intends to account for the evidence, which appears to be particularly significant for Italy, of the incidence of tax evasion in a certain region being negatively correlated to the level of social capital existing in that region. Besides including social capital among the determinants of tax evasion, we extend the model so as to incorporate a mechanism whereby the existing volume of opportunistic behavior—which is proxied by the level of tax evasion—has negative effects on the formation of new social capital, thus helping to explain how regional differences in the endowment of social capital and in the incidence of tax evasion co-evolve and why they tend to be highly persistent. The model seeks also to capture the fact that in a democracy the political determination necessary to effectively repress tax evasion depends on the voters' propensity toward the phenomenon. Hence, one should expect that-in areas where a relatively large (small) number of citizens are tax cheaters—the consensus in favor of tough policies against tax evasion tends to be weak (strong) and short (long) lasting. Consistently with this intuition, the model shows that regions where social capital is relatively low and tax evasion is relatively high can do better in the long run (i.e., they can reach a steady state characterized by a higher level of social capital and a lower level of tax evasion) when tax-enforcement policies are determined at the national level rather than at the regional level. The opposite holds for regions where social capital is relatively high and tax evasion is relatively low.
Response to Reviewers:	Please, see the attached file for our response to the Reviewer.

The co-evolution of tax evasion, social capital and policy responses: A theoretical approach

Luigi Bonatti* and Lorenza Lorenzetti°

ABSTRACT: The dynamic model presented in this paper intends to account for the evidence, which appears to be particularly significant for Italy, of the incidence of tax evasion in a certain region being negatively correlated to the level of social capital existing in that region. Besides including social capital among the determinants of tax evasion, we extend the model so as to incorporate a mechanism whereby the existing volume of opportunistic behavior—which is proxied by the level of tax evasion—has negative effects on the formation of new social capital, thus helping to explain how regional differences in the endowment of social capital and in the incidence of tax evasion co-evolve and why they tend to be highly persistent. The model seeks also to capture the fact that in a democracy the political determination necessary to effectively repress tax evasion depends on the voters' propensity toward the phenomenon. Hence, one should expect that–in areas where a relatively large (small) number of citizens are tax cheaters—the consensus in favor of tough policies against tax evasion tends to be weak (strong) and short (long) lasting. Consistently with this intuition, the model shows that regions where social capital is relatively low and tax evasion is relatively high can do better in the long run (i.e., they can reach a steady state characterized by a higher level of social capital and a lower level of tax evasion) when tax-enforcement policies are determined at the national level rather than at the regional level. The opposite holds for regions where social capital is relatively high and tax evasion is relatively low.

KEY WORDS: Tax compliance, dynamic models, multiple equilibria, tax-enforcement policies.

JEL CLASSIFICATION CODES: D72, E14, H26.

ACKNOWLEDGMENTS: The authors are grateful to an anonymous reviewer for his/her precious suggestions. The usual disclaimer applies.

* University of Trento (corresponding author); email: luigi.bonatti@unitn.it

° University of Trento

1 INTRODUCTION

The economic literature on tax evasion can be roughly divided into two main strands: the first follows the neoclassical tradition, namely it is founded on the hypothesis that individual decisions concerning tax compliance are the result of expected utility maximization on the part of perfectly rational agents,[1] while the other is inspired by the idea that the conduct of individuals in these matters is very much influenced by the social environment in which they live, namely by the dominant social norms, cultural values, moral attitudes of their communities.[2] According to the first approach, government activities aimed at preventing and repressing tax evasion can effectively reduce its incidence by increasing the probability of evaders to be detected and the penalty in case of detection, while the second approach is much more skeptical about the results obtainable thanks to these activities, since the latter have no direct impact on the value system affecting individual behavior and may even undermine individuals' tax morale.[3]

The dynamic model presented in this paper tries to capture–in a unified formal setup–some of the basic intuitions characterizing these different paradigms. More precisely, it intends to account for the evidence, which appears to be particularly significant for Italy, showing that the incidence of tax evasion in a certain region tends to be negatively correlated to the level of social capital existing in the region. Besides including social capital among the determinants of tax evasion, we extend the model so as to incorporate a mechanism whereby the existing volume of opportunistic behavior—which is proxied by the level of tax evasion—has negative effects on the formation of new social capital, thus helping to explain how regional differences in the endowment of social capital and in the incidence of tax evasion co-evolve and why they tend to be highly persistent.

[1] Seminal paper of this strand of literature is Allingham and Sandmo (1972).
[2] The incorporation of tax morale sustained by peer pressure in models of tax evasion is due to Gordon (1989).
[3] For surveys of the literature on tax evasion see Andreoni et al. (1998), Sandmo (2005), Slemrod (2007), and Torgler (2007).

The record of governmental agencies in charge of enforcing tax compliance is generally poor in areas where tax evasion is persistently high. This raises another important issue, which is treated in our model, although it is generally neglected by the two above-mentioned approaches, namely the fact that in a democracy the political determination necessary to effectively tackle tax evasion depends on the voters' propensity toward the phenomenon. Indeed, one should realistically expect that–in areas where a relatively large (small) number of citizens are tax cheaters—the political consensus in favor of tough policies against tax evasion tends to be weak (strong) and short (long) lasting. Consistently with this intuition, our model shows that regions where social capital is relatively low and tax evasion is relatively high can do better in the long run (i.e., they can reach a steady state characterized by a higher level of social capital and a lower level of tax evasion) when tax-enforcement policies are determined at the national level rather than at the regional level. The opposite is true for regions where social capital is relatively high and tax evasion is relatively low.

Although Frey and Feld (2002) insist that a purely repressive attitude on the part of the tax authorities may undermine individuals' intrinsic motivations to pay taxes, they recognize that deterrence has to be the dominant strategy for reducing tax evasion when individuals' tax morale is low or does not exist at all. This point is incorporated in our model by showing that, whenever the economy is entrapped in a high tax evasion/low social capital equilibrium, a repressive strategy on the part of the authorities—if consistently adopted for a certain interval of time--can move the economy toward a lower tax evasion/higher social capital equilibrium. Once the economy approaches this more "virtuous" long-run equilibrium, the authorities can keep tax evasion at a low level by relying less on deterrence and more on the individuals' improved tax morale. Indeed, it is reasonable to think that, at a low tax evasion/high social capital equilibrium, the costs (which are not explicitly modeled in our setup) of a more repressive strategy tend to dominate the benefits associated to it.[4]

Another important intuition that is incorporated in our model is that individuals tend to adhere to the standard pattern of behavior that is prevailing in their social context. The implications of this conformity propensity for tax evasion are treated by Myles and Naylor (1996).[5] We share with their model the idea that in these contexts more than one social equilibrium can typically emerge and that, as a result of small changes in parameter values, the economy may suddenly "jump" from one equilibrium to another. However, our framework distances itself from their model by including the role that the policy makers can play in the emergence of these equilibria, and eventually in triggering such jumps. Above all, differently to Myles and Naylor (1996), we account for the fact that individuals conform to social norms that evolve over time in response to changing economic and social conditions. Under this respect, we follow the literature on the evolution of social norms and cultural values,[6] which analyzes norms and value dynamics by focusing on the existence of positive feedback loops between collective and individual behaviors. Applying this approach to tax evasion, we can also assess the long-term impact of (relatively) short-time policy shifts in matters of tax compliance on individual attitudes and aggregate outcomes.[7]

The rest of the paper is organized as follows: section 2 contains some motivating evidence and a preview of the model; section 3 presents the basic model; section 4 endogenizes the dynamics of social capital; section 5 assumes that the parameter determining the government's policy reaction is sensitive to the

[4] Together with the costs in terms of popularity that the political authorities may incur to fight tax evasion, these costs may include the resources directly devoted to enforcing tax laws (such as the salaries of auditors and similar), as well as non-pecuniary costs, such as infringement of privacy. The optimal policy rule should equate the marginal social benefit of reduced evasion to the marginal cost needed to obtain this reduction of evasion. See Slemrod (2016) for a review of the current research on these matters.

[5] See Chen (2003) for an endogenous-growth model with tax evasion that inserts the utility from conformity in the objective function of the representative individual.

[6] See Young (2015) and Gershman (2016) for recent surveys of this literature.

[7] Bonatti (2008) models the idea that policies or events affecting people's allocation of time for a limited period of time may have long-term effects on labor supply and economic growth by persistently change collective habits and social attitudes regarding time use. Giuliano and Spilimbergo (2014) show that the exposure to a relatively short-term shock such as a recession may have long-lasting effects on people's preference for redistribution.

level of tax evasion; section 6 compares the situation emerging when the tax-enforcement policy is determined at the national level to the situation when it is determined at the regional level; section 7 concludes.

2 SOME MOTIVATING EVIDENCE AND A PREVIEW OF THE MODEL

2.1 Supportive evidence

The notion of social capital used here is consistent with what Guiso et al. (2011) prefer to call "civic capital", which is made of all those "persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities". It has been argued that the level of civic capital tends to be positively correlated with the density of social networks and voluntary organizations. Indeed, the latter encourage civic engagement and contribute to turn individuals into citizens with a broader perspective and a stronger interest in the common good, thus improving the quality of the relationship between ordinary people and formal institutions. The role of a rich social texture in enhancing civicness and improving the quality of the relationship between ordinary people and formal institutions is captured by the notion of "linking social capital''. Sabatini (2009) provides a measure of linking social capital for the Italian regions which account not only for the density of voluntary associations, but also for the intensity of their members' involvement and participation (see table 1). In addition, Sabatini (2009) reports a measure of generalized trust (see table 1),[8] which gives us some information about how the Italian regions differ with respect to this cognitive dimension of social capital. According to both indicators, Southern regions—and in particular the four most populated ones

[8] This measure is the percentage of people aged 18-49 stating, in a survey conducted by the Italian National Institute of Statistics (ISTAT), that—generally speaking—most people can be trusted.

(Apulia, Calabria, Campania and Sicily) rank quite low in terms of both indicators, while at the top positions there are only Northern regions.

In table 1, one can also find measures of tax evasion in Italian regions. The first one is an index of tax compliance constructed by the Associazione Artigiani Piccole Imprese of Mestre (CGIA, 2016), which expresses the average of 5 indicators: the incidence of reported income on consumption expenditure, the ratio of reported income to disposable income, the percentage of irregular workers in total employment, the number of tax disputes, and the estimate of small firms' tax compliance. The second measure is an estimate of the VAT gap made by D'Agosto et al. (2014) for the years 2007-10. According to both measures, Southern regions appear to be the least virtuous in terms of tax compliance, while the top positions in the rankings are occupied by Northern regions.[9]

To the best of our knowledge, there is no empirical study investigating whether there exists in Italy a systematic relationship linking the political authorities' determination and effectiveness in fighting tax evasion to the estimated share of tax evaders among their constituency. Anecdotal evidence indicates that technocratic governments—such as that headed by Mario Monti in 2011-12—exhibit a tougher attitude towards tax enforcement relatively to governments composed by elected officials that respond more closely to voters, such as those that succeeded to Monti's cabinet.[10] Similarly, there is no way in Italy to corroborate the hypothesis that decentralizing the powers regarding tax compliance—which are now mainly in the hands of the central government—to locally elected authorities would differentiate tax

[9] The exception is Latium, that appears to be the most virtuous region in terms of VAT compliance. One should notice, however, that the figure for Latium is conditioned by the fact that many state and state-controlled entities have their registered offices in Rome, Italy's capital city, which is in this region.

[10] According to Battiston et al. (2016), the audit "blitzes" that took place in Italian cities in 2011-12 were deliberately designed to attract maximum media exposure by the Monti government, so as to show that the fight to tax evasion was an organic component of the consolidation efforts made necessary by the major public debt sustainability crisis that Italy was facing in that period. One may interpret the progressive limitation of the powers of Equitalia (the Italian publicly controlled agency that was in charge of tax debt collection), which has occurred in recent years until its final suppression, as a way to flatter the reluctant taxpayers. OECD (2016) points out that these limitations may have nurtured a culture of "evasion from collection", since thanks to them some taxpayer can be tempted to declare appropriately but then decide not to pay and put in place strategies to hide wealth.

enforcement policies, with a more lenient attitude on the part of politicians elected in areas where tax evasion is more widespread. However, this hypothesis seems quite plausible in the light of the experience concerning the different ways in which Italian municipalities use their substantial powers of law enforcement in matters of construction abuses. As a matter of fact, local authorities appear to be more severe towards illegal buildings in Northern Italy than in Southern Italy, where a disproportionally large number of total Italian abuses are located and where a high fraction of houses are without permit but widely tolerated by the locally elected politicians.

2.2 Preview of the model

The general framework that we use to model the dynamics of tax evasion is borrowed from catastrophe theory, where abrupt changes in dynamics occurs when control parameters are smoothly changed. In particular, the formal set-up adopted belongs to the family of the cusp catastrophe models. In our basic dynamic model, the amount of tax evasion characterizing a certain area tends to stabilize—in the absence of any policy action opposing it—at a steady-state level that depends negatively on the stock of social capital (civic norms, public ethics, generalized trust, etc.) existing in the area.

The policy response function of the authorities is introduced by assuming that their effort to fight tax evasion increases with the level of tax evasion according to a time-invariant parameter whose value is set by the authorities. We show that—depending on this parameter value—one may have: i) either a unique and stable steady state characterized by a low level of tax evasion, or ii) two stable steady states (one characterized by a low and the other by a high level of tax evasion, with an unstable steady state in between the two stable ones), or iii) a unique steady state characterized by a high tax-evasion level. Notice that in cases ii) and iii) the economy can be entrapped in the neighborhood of a high-tax evasion steady state. To remove the economy from such a trap, the authorities should undertake an intense tax-enforcement activity for a prolonged period of time, until the economy approaches its low-tax-evasion steady state. Once this steady state is reached, the authorities can reduce their intervention keeping their repressive effort at a normal level, that is sufficient to let the economy gravitate close to this stable long-term equilibrium.

The basic model described above is extended so as to endogenizing the dynamics of social capital (whose stock is treated as fixed in the basic model), which has a crucial role in conditioning the spontaneous (net of policy intervention) evolution of tax evasion in the economy. Hence, the evolution of social capital is modelled so as to account for some stylized facts emphasized by the literature on the subject: i) the existing stock of social capital has positive effects on the formation of new social capital; ii) social capital decays without new "investment" in social capital, and iii) the existing volume of opportunistic behavior—which is proxied in our model by the level of tax evasion—has negative effects on the formation of new social capital. We check that in this extended model one may have a range of values of the (fixed) policy parameter for which the economy has two saddle-path stable steady states (one characterized by a high stock of social capital associated with a low-tax-evasion level and the other characterized by a low stock of social capital associated with a high tax-evasion level), separated by a stable steady state. Again, if the economy gravitates around a steady state characterized by a relatively low stock of social capital and a relatively high level of tax evasion, and the authorities want to move it toward the "virtuous" steady-state, they should exert an intense and prolonged effort to repress tax evasion until the economy will reach the saddle path leading to this virtuous long-term equilibrium. The general message coming from this extended model is that, when a society tends to be entrapped in a long-run equilibrium where opportunistic behavior is very diffuse and social capital is quite poor, a prolonged period of high deterrence aimed at reducing the expected return from opportunistic behavior can be necessary in order to make social capital increase over time. Once the society's endowment of social capital is richer, the level of opportunistic behavior can be kept low without the need of such intense—

and probably costly—repressive efforts on the part of the authorities. However, one may observe that, in a society where opportunistic behavior is very diffuse, the political consensus for this tough strategy might be weak, making it more likely that the “bad equilibrium” is perpetuated. We model this intuition in the subsequent section of the paper.

Indeed, another extension of the model amounts to endogenize—together with the dynamics of social capital—also the authorities’ policy parameter, so as to capture the intuition that their response to tax evasion tends to become weaker the larger is the fraction of the population consisting of tax cheaters, since under these circumstances a tough policy against tax evasion is less popular and thus less likely to be implemented. The simplest way to model this intuition is to treat the parameter determining the authorities’ reaction to tax evasion as a variable whose value diminishes when the measure of tax evasion increases. In this extended model, we present an example showing that the multiplicity of steady states that we observed when social capital adjusts in response to changes in tax evasion is eliminated if the authorities’ policy parameter decreases with the increase in tax evasion. Indeed, under these circumstances, at levels of tax evasion higher (lower) than the unique steady-state level, the authorities’ effort to fight tax evasion is too weak (strong) to allow these levels of tax evasion to be long-run equilibrium values.

This conclusion is better qualified in the last extension of the model, which accounts for the fact that in some countries (like Italy) there are large interregional differences in the endowment of social capital and in tax compliance, while the policy against tax evasion is decided at national level and is unique for the entire country (“one fits all”). In this context, it is reasonable to assume that the authorities’ policy parameter reflects the average propensity toward tax evasion of the voters of the entire country, while in different regions the levels of social capital and tax evasion may converge to different steady-state levels. As a consequence, in a region endowed with a relatively large (small) stock of social capital, the policy against tax evasion is less (more) severe if decided nationally than if decided locally. Hence, one should expect that such a region ends up having less (more) social capital and more (less) tax evasion that it would have if the policy reflected only the propensities of the local population.

TABLE 1 Italian regions: indicators of social capital and tax compliance (in parentheses the region's rank in terms of the relevant indicator)

Region	Linking social capital+ (factor scores)	Trust+	Index of tax compliance° (100= Italy)	VAT Gap# (percent)	Geographical location
Abruzzi	-1.88 (18)	12.2 (21)	101.3 (14)	25.21 (11)	South
Alto Adige*	6.13 (1)	24.3 (2)	166.4§ (1)	18.91§ (3)	North
Apulia	-1.48 (16)	18.8 (13)	95.6 (15)	32.58 (16)	South
Basilicata	0.06 (10)	15.5 (18)	94.5 (16)	35.26 (19)	South
Calabria	-1.95 (19)	15.0 (19)	73.8 (21)	36.34 (20)	South
Campania	-2.14 (21)	18.5 (14)	79.7 (19)	36.76 (21)	South
Emilia-Romagna	0.51 (6)	18.0 (16)	125.7 (6)	25.83 (12)	North
Friuli-Venezia Giulia	0.24 (9)	20.4 (10)	127.9 (5)	20.87 (5)	North
Latium	-1.38 (15)	21.9 (7)	92.1 (17)	16.30 (1)	Center
Liguria	-1.04 (14)	22.0 (6)	109.4 (13)	22.82 (8)	North
Lombardy	0.84 (4)	22.6 (4)	121.5 (8)	21.18 (6)	North
Marche	-0.69 (13)	19.0 (12)	114.1 (10)	27.57 (14)	Center
Molise	-1.59 (17)	20.9 (8)	80.4 (18)	34.34 (17)	South
Piedmont	-0.50 (12)	17.9 (17)	133.5 (4)	30.70 (15)	North
Sardinia	-0.23 (11)	18.1 (15)	113.5 (12)	21.79 (7)	South
Sicily	-1.95 (19)	14.5 (20)	78.0 (20)	34.85 (18)	South
Trentino*	4.66 (2)	32.1 (1)	166.4§ (1)	18.91§ (3)	North
Tuscany	0.63 (5)	20.6 (9)	114.0 (11)	23.36 (9)	Center
Umbria	0.30 (8)	19.9 (11)	117.2 (9)	24. 16 (10)	Center
Val d'Aosta	0.40 (7)	22.3 (5)	123.0 (7)	17.50 (2)	North
Veneto	1.04 (3)	23.0 (3)	133.5 (3)	27.19 (13)	North

* Autonomous province.

§ The figure is for Alto Adige and Trentino together.

Sources: + Sabatini (2009) (own elaboration based on data from ISTAT); ° CGIA (2016) (own elaboration based on data from Internal Revenue Agency, ISTAT, and Ministry of Economy and Finance); # D'Agosto et al. (2014) (own elaboration based on data from Internal Revenue Agency and ISTAT).

3 THE BASIC MODEL

The formal set-up adopted here is an adaptation of the "street gang" continuous-time model by Crane et al. (2000) to the dynamics of tax evasion:

$$\dot{\mathrm{N}}_{\mathrm{t}} = g(\mathrm{N}_{\mathrm{t}}) - p(\mathrm{N}_{\mathrm{t}}), \tag{1}$$

where $\mathrm{N_t}$ represents a measure of tax evasion at instant t (hence, $\dot{\mathrm{N}}_{\mathrm{t}}$ is the change in tax evasion at instant t), $g(\mathrm{N_t})$ is the intrinsic growth function and $p(\mathrm{N_t})$ is the policy response function, namely the function giving the change in tax evasion at instant t due to the efforts devoted by the authorities to fight tax evasion. The function $g(\mathrm{N_t})$ is given by

$$g(\mathrm{N_t}) = \mathrm{r}(\mathrm{N_t} + \mathrm{D})(1 - \mathrm{SN_t}), \tag{2}$$

where r, D and S are strictly positive constants. Notice that, in the absence of any policy action aimed at opposing tax evasion, the latter tends to stabilize at the level $\overline{\mathrm{N}}=\mathrm{S}^{-1}$. One may think that S is a measure of the amount of social capital (civic norms, public ethics, generalized trust, etc.) existing in the society. The policy function $p(\mathrm{N_t})$ is given by

$$p(\mathrm{N_t}) = \frac{\mathrm{aN_t^{\xi}}}{\mathrm{b+N_t^{\xi}}}, \tag{3}$$

where a, b and ξ are strictly positive constants. Notice that the effort to fight tax evasion increases with the level of tax evasion according to the parameter a, which is controlled by the authorities: a higher a means that for any level of tax evasion the authorities devote more efforts to reduce tax evasion.

By defining $\tau \equiv \mathrm{rt}$, $n_\tau \equiv \mathrm{SN_t}$, $s \equiv \mathrm{SD}$, $\alpha \equiv \frac{\mathrm{aS}}{\mathrm{r}}$, $\beta \equiv \mathrm{bS^{\xi}}$, equation (1) can be rewritten as

$$\frac{dn_\tau}{d\tau} = f(n_\tau) = (n_\tau + s)(1 - n_\tau) - \frac{\alpha n_\tau^{\xi}}{\beta + n_\tau^{\xi}}. \tag{4}$$

The steady-state values (fixed points) of n are the solutions to:

$$(n+s)(1-n)=\frac{\alpha n^{\xi}}{\beta+n^{\xi}}. \tag{5}$$

The equation of the boundary between the domains in the parameter space in which (4) has either one or three fixed points can be found by solving the system consisting of (5) and

$\frac{d}{dn}(n+s)(1-n)=\frac{d}{dn}\frac{\alpha n^{\xi}}{\beta+n^{\xi}}$, that is,

$$1-s-2n=\frac{\xi\alpha\beta n^{\xi-1}}{(\beta+n^{\xi})^2}. \tag{6}$$

The parametric equation of the boundary is thus $\alpha=\frac{\xi(n+s)^2(1-n)^2}{(2-\xi)n^2+(\xi-1)(1-s)n+\xi s}$ and

$\beta=\frac{n^{\xi+1}(1-s-2n)}{(2-\xi)n^2+(\xi-1)(1-s)n+\xi s}$. Therefore, one can have three possible cases.

In the first case, there is a unique and stable steady state characterized by a low level of tax evasion. In the second case, there are two stable steady states, one characterized by a low and the other by a high level of tax evasion, with an unstable steady state in between the two stable ones. In the third case, there is a unique steady state characterized by a high tax-evasion level.

Case 1: One stable low-tax-evasion steady state (see Figure 1)

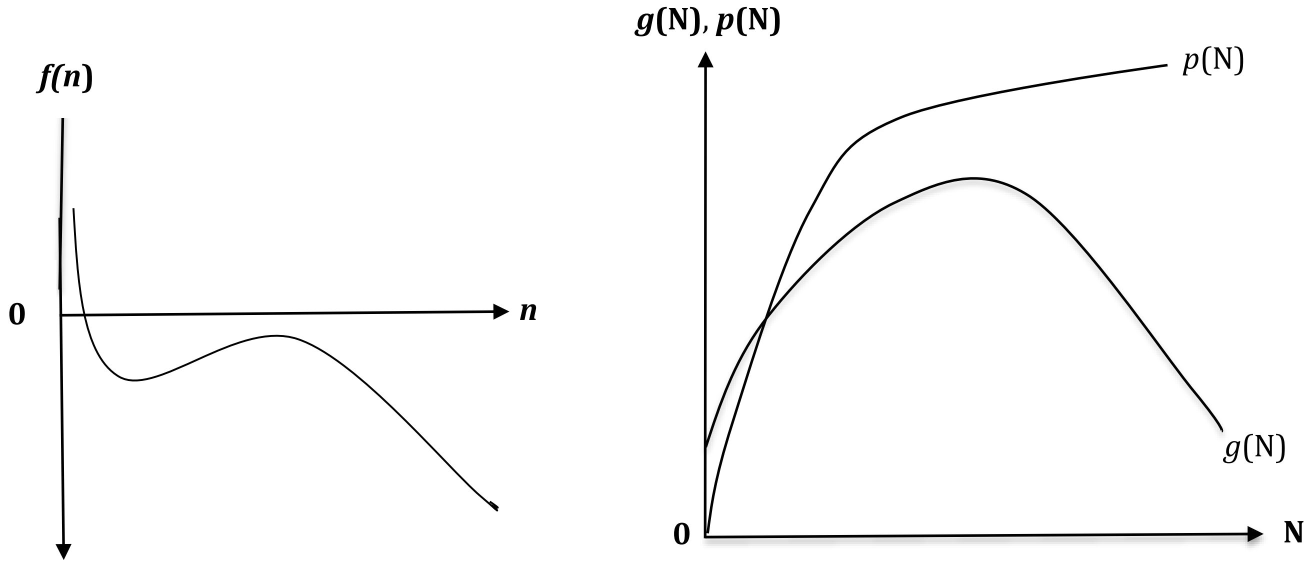
Let us assume that s=0.05=β, ξ=1 and α=0.4. In this case, at steady state one has:

$$n^3-0.9n^2+\frac{121}{400}n-\frac{1}{400}=0\Rightarrow\bar{n}=0.0084762.$$

One can check that $\bar{n}$ is locally stable by linearizing (4) around it:

$$\left.\frac{df(n_\tau)}{dn_\tau}\right|_{n_\tau=\bar{n}} \approx 0.9339466 - 6.84038(1 - 0.14495) < 0.$$

Figure 1 **One stable steady state with low tax evasion**



Case 2: Two stable steady states (one at low-tax-evasion level and the other at high-tax-evasion level), separated by an unstable steady state (see Figure 2)

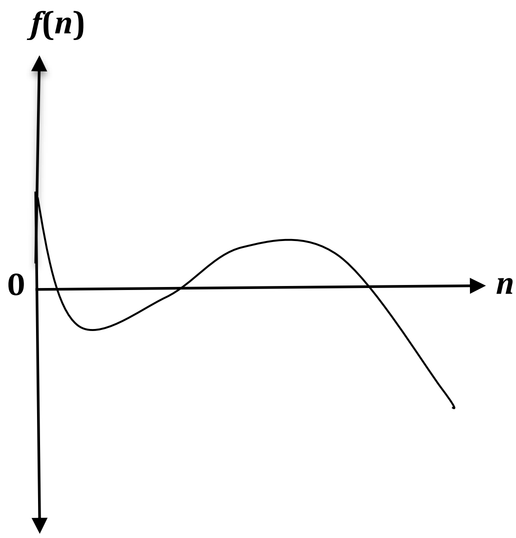
Let us now assume that s=0.05=β, ξ=1 and α=0.25. In this case, at steady state one has:

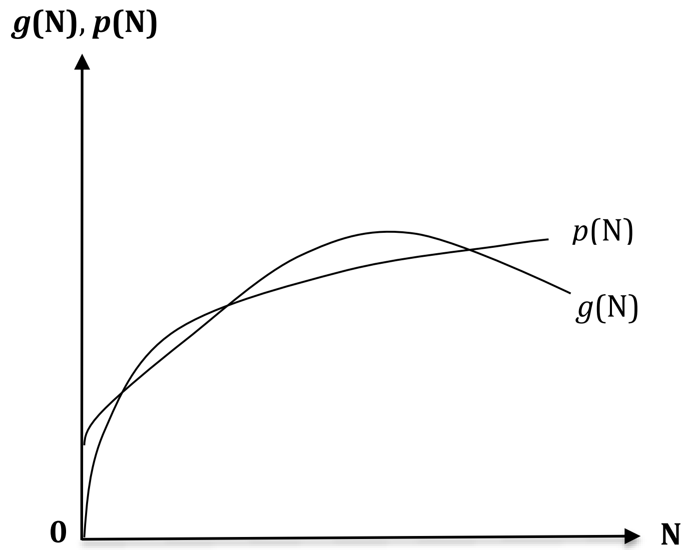
$$n^3 - 0.9n^2 + \frac{61}{400}n - \frac{1}{400} = 0 \Rightarrow \begin{cases} n' = 0.0183375 \\ n'' = 0.2 \\ n''' = 0.681662. \end{cases}$$

Notice that three values of n solve the equation above. Moreover, one can check that n' and n''' are locally stable, and that n'' is locally unstable:

$$\begin{cases} \left.\dfrac{df(n_\tau)}{dn_\tau}\right|_{n_\tau=n'} \approx \dfrac{2283}{2500} - \dfrac{625}{171}\left(1-\dfrac{46}{171}\right) < 0 \\ \left.\dfrac{df(n_\tau)}{dn_\tau}\right|_{n_\tau=n''} \approx 0.55 - \left(1-\dfrac{4}{5}\right) > 0 \\ \left.\dfrac{df(n_\tau)}{dn_\tau}\right|_{n_\tau=n'''} \approx -0.41 - \dfrac{25}{73}\left(1-\dfrac{0.68}{0.73}\right) < 0. \end{cases}$$

Figure 2 **Two stable steady states separated by an unstable steady state**





Case 3: One Stable High-Tax Evasion Steady State (see Figure 3)

Finally, let us assume that s=0.05=β, ξ=1 and α=0.1. In this case, at steady state one has:

$$n^3 - 0.9n^2 + \frac{1}{400}n - \frac{1}{400} = 0 \Rightarrow \bar{\bar{n}} = 0.900307.$$

To check that $\bar{\bar{n}}$ is locally stable, one can compute:

$$\left.\frac{df(n_\tau)}{dn_\tau}\right|_{n_\tau=\bar{\bar{n}}} \approx -0.85 - 0.105229(1 - 0.85029) < 0.$$

Figure 3 **One stable steady state with high tax evasion**

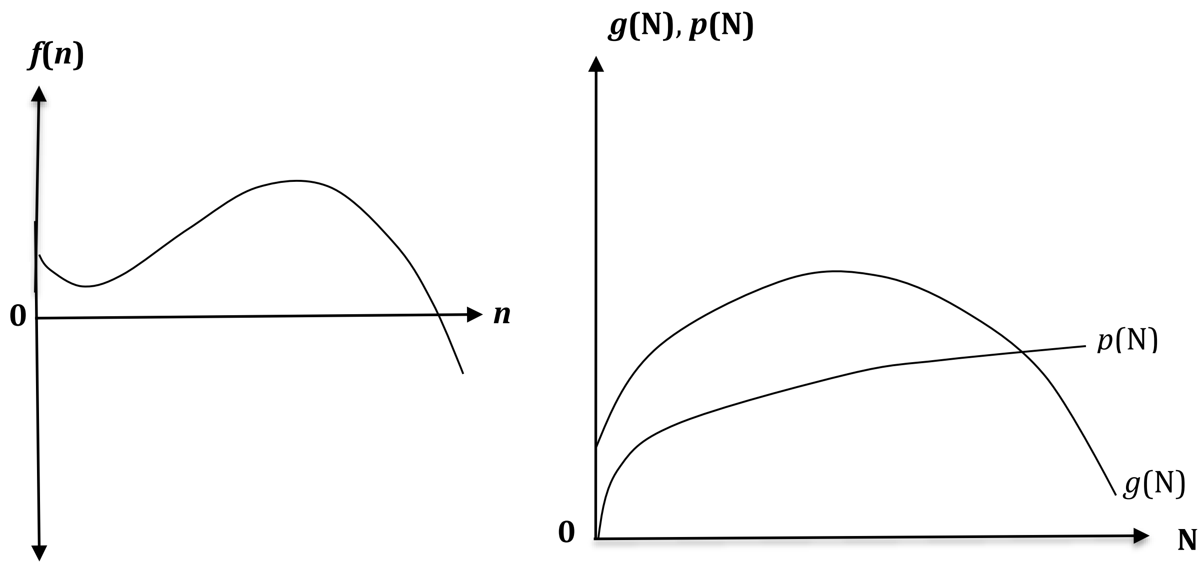


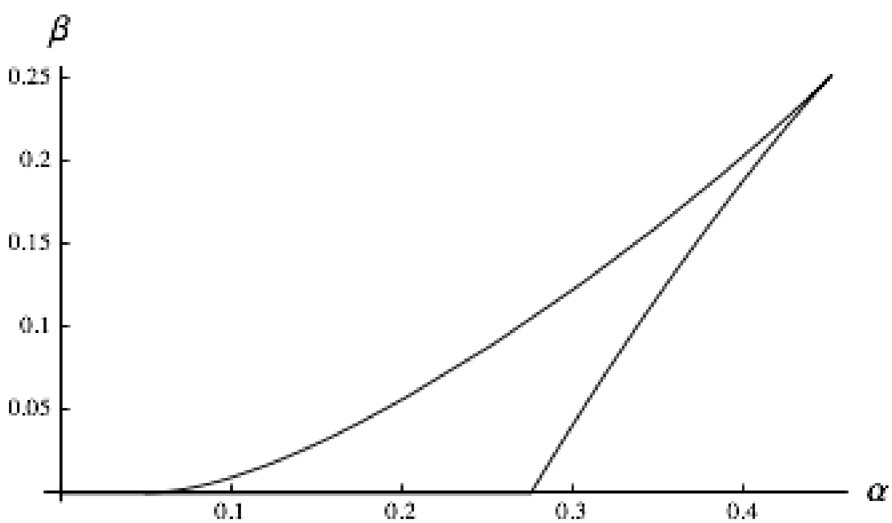
Figure 4 shows the existence of a cusp catastrophe in the parameter space of the three cases examined above.[11] When α and β assume values inside the cusp, there exist three steady states (case 2); while when their values are outside the cusp, there exists only one (stable) steady state that can be characterized or

---

[11]The three cases examined above satisfy $\xi > 1\text{-}\left[{2\sqrt{\mathrm{D}}}\big/{(1+\mathrm{D})}\right]$. If $\xi < 1\text{-}\ {2\sqrt{\mathrm{D}}}\big/{(1+\mathrm{D})}$, we do not have a cusp (see Crane et al., 2000).

by a low level of tax evasion whenever the values of α and β are at the right of the cusp (case 1) or by a high level of tax evasion whenever they are at the left of the cusp (case 3).

Figure 4 The cusp for values of α and β



Furthermore, it is worth to notice that i) the three cases analyzed above differ only with respect to the value of α, namely only because of the different strength through which the authorities react to tax evasion, and ii) in cases 2 and 3 the economy can be entrapped in the neighborhood of a high-tax evasion steady state. To remove the economy from such a trap, the authorities can keep α high, namely they can undertake a high level of tax-enforcement activity, until the economy approaches its low-tax-evasion steady state. Once this steady state is reached, the authorities can reduce their intervention since the economy will remain close to it, which is stable.

4 ENDOGENIZING THE DYNAMICS OF SOCIAL CAPITAL

An interesting extension of the model amounts to endogenize the dynamics of S, which has a crucial role in conditioning the spontaneous (net of policy intervention) evolution of tax evasion in a society. Hence, we assume that the stock of social capital existing in the economy varies over time and that its evolution is such that i) the existing stock of social capital has positive effects on the formation of new social capital; ii) social capital decays without new "investment" in social capital, and iii) the existing volume of opportunistic behavior—which is proxied by the level of tax evasion—has negative effects on the formation of new social capital. Consistently, one can model the dynamics of S_t according to

$$\dot{S}_t = m(S_t, N_t) = \gamma \frac{S_t^{\sigma}}{N_t} - \delta S_t,\ \gamma > 0,\ 0 < \sigma < 1,\ 0 < \delta < 1,\ S_0 \text{ given,} \tag{7}$$

where γ is a parameter determining the productivity of the existing stock of social capital in the formation of new capital, σ is an elasticity parameter and δ is the rate at which the stock of social capital decays in the absence of new "investment".

The dynamics of tax evasion is now governed by

$$\dot{N}_t = v(S_t, N_t) = h(S_t, N_t) - p(N_t), \tag{8}$$

where $p(N_t)$ is given by (3) and $h(S_t, N_t) = r(N_t + D)(1 - N_t S_t)$.

The economy evolves in time according to the system of differential equations (7)-(8). The fixed points (steady states) (S, N) can be found by setting $\dot{S}_t = 0$ in equation (7) and $\dot{N}_t = 0$ in equation (8). From $\dot{S}_t = 0$ one obtains $S = \left(\frac{\gamma}{\delta N}\right)^{\frac{1}{1-\sigma}}$ (at steady state, the stock of social capital and the level of tax evasion are linked by an inverse relation), which can be used to write $\dot{N}_t = 0$ as

$$y(N) = r(N + D)\left(1 - N\left(\frac{\gamma}{\delta N}\right)^{\frac{1}{1-\sigma}}\right) - \frac{aN^{\xi}}{b + N^{\xi}} = 0. \tag{9}$$

Solving the model for ξ=1 and σ=0.5, equation (9) can be rewritten as a cubic equation in N:

$$N^3 + \left[b + D - \left(\frac{\gamma}{\delta}\right)^2 - \frac{a}{r}\right] N^2 + \left[bD - \left(\frac{\gamma}{\delta}\right)^2 (b + D)\right] N - \left(\frac{\gamma}{\delta}\right)^2 bD = 0. \tag{10}$$

Again, one may have parameter values for which the system has only one steady state and parameter values for which the system displays three steady states. We focus here on the case in which the system has three steady states.

Case with two saddle-path stable steady states (one characterized by a high stock of social capital associated with a low-tax-evasion level and the other characterized by a low stock of social capital associated with a high tax-evasion level), separated by a stable steady state (see Figure 5)

Let us assume that D=0.0257, a= ξ=1, b=9.724, r=0.0934, σ=0.5, γ=0.01, δ=0.1. Given these parameter values, equation (10) becomes:

$$N^3 - 0.9N^2 + \frac{61}{400}N - \frac{1}{400} = 0 \Rightarrow \begin{cases} N' = 0.0183 \\ N'' = 0.2 \\ N''' = 0.6817. \end{cases}$$

In other words, in this case we end up having three steady states: (S'=29.7385, N'=0.0183), (S''=0.25, N''=0.2) and (S'''=0.0215, N'''=0.6817).

By linearizing the system (7)-(8) around its steady states, one can obtain the characteristic equation of the linearized system:

$$\left[\left.\frac{\partial m(S_t,N_t)}{\partial S_t}\right|_{\substack{S_t=S\\N_t=N}} - \mu\right]\left[\left.\frac{\partial v(S_t,N_t)}{\partial N_t}\right|_{\substack{S_t=S\\N_t=N}} - \mu\right] - \left[\left.\frac{\partial m(S_t,N_t)}{\partial N_t}\right|_{\substack{S_t=S\\N_t=N}}\right]\left[\left.\frac{\partial v(S_t,N_t)}{\partial S_t}\right|_{\substack{S_t=S\\N_t=N}}\right] = 0, \tag{11}$$

where the μs are the eigenvalues of the system and all derivatives are evaluated at steady state.

Evaluated at (S'=29.7385, N'=0.0183), equation (11) becomes

$$\mu^2 + 0.2328\mu - 0.0032 = 0 \Rightarrow \begin{cases} \mu_1 = 0.0129 \\ \mu_2 = -0.2457. \end{cases}$$

Considering the signs of the two eigenvalues and the fact that the system has only one initial condition (S_0 is given), one can conclude that in a neighborhood of (S', N') the system is saddle-path stable.

Evaluated at (S''=0.25, N''=0.2), equation (11) becomes

$$\mu^2 + 0.0647\mu + 0.0002 = 0 \Rightarrow \begin{cases} \mu_1 = -0.003 \\ \mu_2 = -0.061. \end{cases}$$

Considering the signs of the two eigenvalues, one can conclude that in a neighborhood of (S'', N'') the system is stable.

Finally, evaluated at (S'''=0.0215, N'''=0.6817), equation (11) becomes

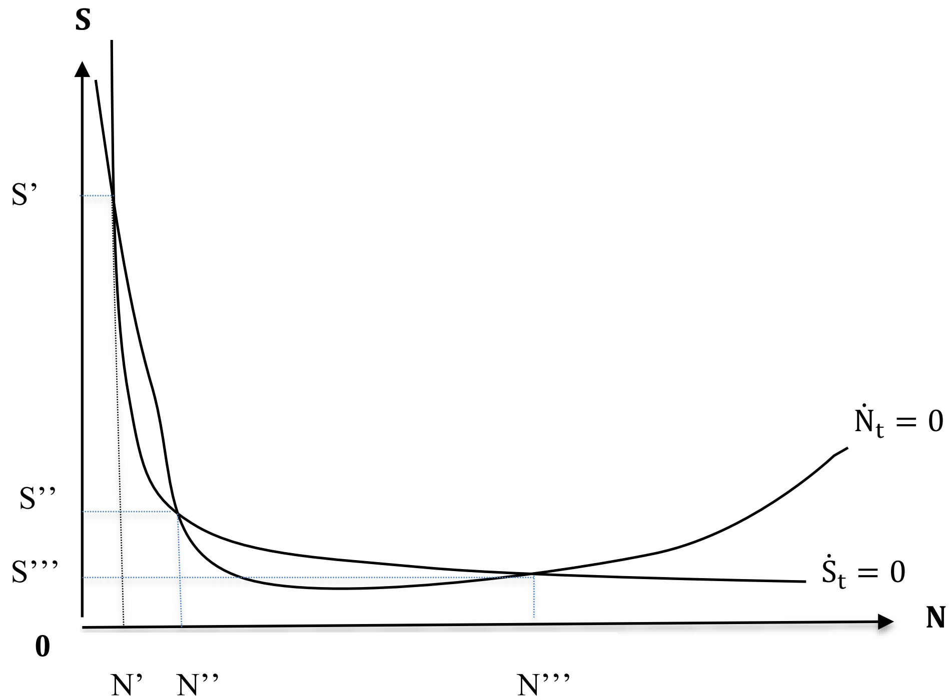
$$\mu^2 + 0.0486\mu - 0.0002 = 0 \Rightarrow \begin{cases} \mu_1 = 0.004 \\ \mu_2 = -0.0527. \end{cases}$$

Considering the signs of the two eigenvalues and the fact that the system has only one initial condition (S_0 is given), one can conclude that in a neighborhood of (S''', N''') the system is saddle-path stable.

Notice that in the case analyzed above it is likely that the economy ends up gravitating around (S'', N''), that is the steady state characterized by intermediate values of S and N, since (S'', N'') is an attractor. One way for the authorities to move the economy from (S'', N'') towards the virtuous steady state (S', N') characterized by a high stock of social capital and a low level of tax evasion is to make an intense effort in the repression of tax evasion for a prolonged period of time, until the economy will reach the saddle path leading to (S', N'). More technically, the authorities could set the policy parameter a at a level higher than the level at which they are assumed to keep it in the long run—which is 1 in this numerical example—for an interval of time sufficient to lead the economy on the saddle path converging to (S’, N’). Once this saddle path has been reached, the authorities could set again a=1 and let the economy move to (S’, N’).

Therefore, the general message coming from the extended model is that, when a society tends to be entrapped in a long-run equilibrium where opportunistic behavior is very diffuse and social capital is quite poor, a prolonged period of high deterrence lowering the expected return from opportunistic behavior can be necessary in order to make social capital increase over time. Once the society’s endowment of social capital is richer, the level of opportunistic behavior can be kept low without the need of such intense—and probably costly—repressive efforts on the part of the authorities. However, one may observe that, in a society where opportunistic behavior is very diffuse, the political consensus for this tough strategy might be weak, making it more likely that the “bad equilibrium” is perpetuated. We model this intuition in the next subsection.

Figure 5 **Endogenous social capital: One stable and two saddle-path stable steady states**



5 ENDOGENIZING THE DYNAMICS OF THE POLICY FUNCTION'S PARAMETER

The political economy of tax evasion may suggest that the response of the authorities to such a phenomenon tends to become weaker when more people are involved in this kind of behavior, since under these circumstances a tough policy against tax evaders is less popular and thus less likely to be implemented. To capture this intuition, we treat a, the parameter determining the authorities' reaction to tax evasion, as a variable whose value diminishes when the measure of tax evasion increases:

$$a_t = H - \frac{N_t}{L}, \tag{12}$$

where H and L are strictly positive constants.

Given (13), equation (9) can be rewritten as

$$\dot{\mathrm{N}}_t = z(\mathrm{S}_t, \mathrm{N}_t) = h(\mathrm{S}_t, \mathrm{N}_t) - \left(\mathrm{H} - \frac{\mathrm{N}_t}{\mathrm{L}}\right)\frac{\mathrm{N}_t^{\xi}}{\mathrm{b}+\mathrm{N}_t^{\xi}}. \tag{13}$$

Now, the economy is governed by the differential equations (7) and (13). At steady state, (13) can be written as

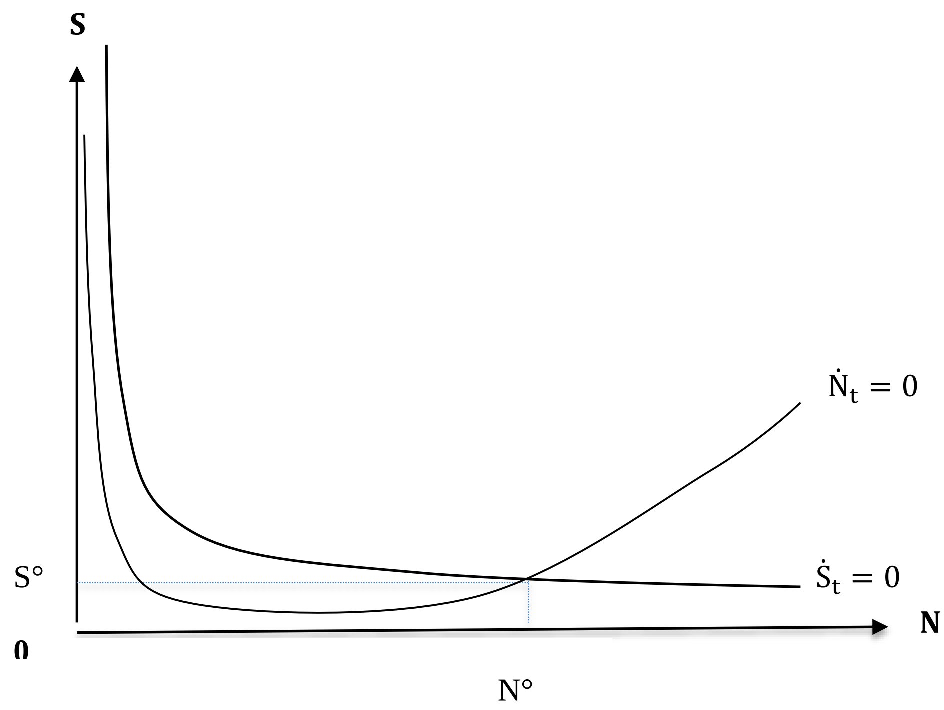
$$w(\mathrm{N}) = \mathrm{r}(\mathrm{N}+\mathrm{D})\left(1 - \mathrm{N}\left(\frac{\gamma}{\delta \mathrm{N}}\right)^{\frac{1}{1-\sigma}}\right) - \left(\mathrm{H} - \frac{\mathrm{N}}{\mathrm{L}}\right)\frac{\mathrm{N}^{\xi}}{\mathrm{b}+\mathrm{N}^{\xi}} = 0. \tag{14}$$

Solving again the model for ξ=1 and σ=0.5, equation (14) can be rewritten as

$$\mathrm{N}^3\left(1 + \frac{1}{\mathrm{rL}}\right) + \left[\mathrm{b} + \mathrm{D} - \left(\frac{\gamma}{\delta}\right)^2 - \frac{\mathrm{H}}{\mathrm{r}}\right]\mathrm{N}^2 + \left[\mathrm{bD} - \left(\frac{\gamma}{\delta}\right)^2(\mathrm{b}+\mathrm{D})\right]\mathrm{N} - \left(\frac{\gamma}{\delta}\right)^2\mathrm{bD} = 0. \tag{15}$$

Adding H=2 and L=0.681662 to the parameter values of the numerical example given in the previous subsection (D=0.0257, ξ=1, b=9.7243, r=0.094, σ=0.5, γ=0.01, δ=0.1), equation (15) becomes $16.6089\mathrm{N}^3 - 11.54\mathrm{N}^2 + \frac{61}{400}\mathrm{N} - \frac{1}{400} = 0 \Rightarrow \mathrm{N}^\circ = 0.6817$, entailing S°=0.0215, where "°" denotes the steady-state value of a variable when the policy parameter is determined according to (12) (see Figure 6).

Figure 6 Endogenous policy parameter: One saddle-path stable steady state



By linearizing the system consisting of (7) and (13) around ($S° = 0.0215$, $N° = 0.6817$), one can obtain the characteristic equation of the linearized system:

$$\left[\frac{\partial m(S_t,N_t)}{\partial S_t}\Bigg|_{\substack{S_t=S°\\N_t=N°}} - \mu\right]\left[\frac{\partial z(S_t,N_t)}{\partial N_t}\Bigg|_{\substack{S_t=S°\\N_t=N°}} - \mu\right] - \left[\frac{\partial m(S_t,N_t)}{\partial N_t}\Bigg|_{\substack{S_t=S°\\N_t=N°}}\right]\left[\frac{\partial z(S_t,N_t)}{\partial S_t}\Bigg|_{\substack{S_t=S°\\N_t=N°}}\right] = 0. \qquad (16)$$

Considering the parameter values, equation (16) becomes

$$\mu^2 - 0.0475\mu - 0.005 = 0 \Rightarrow \begin{cases} \mu_1 = 0.0984 \\ \\ \mu_2 = -0.051. \end{cases}$$

Considering the signs of the two eigenvalues and the fact that the system has only one initial condition (S_0 is given), one can conclude that in a neighborhood of (S°, N°) the system is saddle-path stable.

Notice that by endogenizing the authorities' policy parameter, we obtain a unique steady state: the multiplicity of steady states that we observed when social capital adjusts in response to changes in tax evasion is eliminated if the authorities' policy parameter decreases with the increase in tax evasion. Indeed, under these circumstances, at levels of tax evasion higher (lower) than the unique steady-state level, the authorities' effort to fight tax evasion is too weak (strong) to allow these levels of N to be long-run equilibrium values. In general, one should expect that, introducing a negative feedback from the level of tax evasion to the authorities' reactiveness to it, levels of tax evasion that were potential long-run equilibria when the authorities' reactivity parameter was independent of the level of tax evasion are not any longer steady states, because at these levels a vicious (virtuous) process of further increasing (declining) levels of tax evasion is now under way.

6 REGIONAL VERSUS NATIONAL POLICY AGAINST TAX EVASION

Assume that each of the J regional economies making up the national economy has its own endowment of social capital S_{jt}, whose motion is governed by

$$\dot{S}_{jt} = m(S_{jt}, N_{jt}) = \gamma_j \frac{S^{\sigma_j}}{N_{jt}} - \delta_j S_{jt}, \quad \gamma_j > 0,\ 0 < \sigma_j < 1,\ 0 < \delta_j < 1,\ S_{j0} \text{ given},\ j=1,\ldots,J, \tag{17}$$

where γ_j, σ_j and δ_j are the parameters determining the dynamics of social capital in region j.

The regional dynamics of tax evasion is governed by

$$\dot{N}_{jt} = z(S_{jt}, N_{jt}, a_{jt}) = h(S_{jt}, N_{jt}) - \frac{a_{jt} N_{jt}^{\xi}}{b + N_{jt}^{\xi}},\ j=1,\ldots,J. \tag{18}$$

If the regional policy against tax evasion responded only to local conditions, one could argue that—consistently with (12)—the policy parameter a_{jt} would be determined in each region according to

$$a_{jt} = H - \frac{N_{jt}}{L}, \; j=1,\ldots,J. \tag{19}$$

In contrast, if the policy against tax evasion is decided at national level and is unique for the entire country ("one fits all"), it is reasonable to assume that in each t the authorities' policy parameter reflects a weighted average of the propensity toward tax evasion of the voters of the different regions:

$$a_{1t} = a_{2t} = \ldots = a_{Jt} = H - \frac{\sum_{j=1}^{J} w_j N_{jt}}{L}, \quad \sum_{j=1}^{J} w_j = 1 \; , \tag{20}$$

where w_j is the weight of region j in the authority's policy function.

To see the implications of having a centralized policy against tax evasion (rather than policies decided at the regional level) in the presence of structural differences across regions in the formation of social capital, let J=2, H=1, L=109.001, D=0.0257, ξ=1, b=9.7243, r=0.094, $\sigma_1 = \sigma_2 = 0.5$, $w_1 = w_2 = 0.5$, $\gamma_1 = 0.01$, $\delta_1 = 0.1$, $\gamma_2 = 0.0095$, $\delta_2 = 0.108$. In this numerical example, one has 2 regions whose weight in the national authority's policy function is the same ($w_1 = w_2 = 0.5$). However, notice that in region 1 the existing stock of social capital is more capable of generating new social capital and less subject to erosion than in region 2 ($\gamma_1 > \gamma_2$, $\delta_1 < \delta_2$).

Given the comparative advantage of region 1 in the process of formation of social capital, one can check that if the policy against tax evasion were decided locally, i.e. according to (19), one would have in the long run a larger stock of social capital in region 1 than in region 2: $S_1^{\#} = 0.2227 > S_2^{\#} = 0.0915$, where "#" denotes the steady-state value of a variable when the policy parameter is determined according to (19) (i.e., when the policy is decentralized at regional level).

In the case in which the policy against tax evasion is determined at national level, one has: $N_1^* = 0.212 < N_2^* = 0.2861$, where "*" denotes the steady-state value of a variable when the policy parameter is determined according to (20). Notice than in region 1 (the more virtuous region) the steady-state level of tax evasion is higher when policy is determined at national level $(N_1^* = 0.212 < N_1^{\#} = 0.21)$, while the opposite is true in region 2 ($N_2^* = 0.286 < N_2^{\#} = 0.290$). Consistently, the steady-state stock of social capital of region 1 is lower when the policy against tax evasion is determined at national level $(S_1^{\#} = 0.2227 > S_1^* = 0.2225)$), while the opposite is true for region 2 $(S_2^{\#} = 0.0915 < S_2^* = 0.0942)$.

7 CONCLUSIONS

In the model presented in this paper we have introduced mechanisms linking tax evasion to social capital and governing the accumulation and erosion of social capital. In this context, a high degree of persistence can be generated, i.e., temporary shocks may have long-lasting effects on social capital and on the diffusion of opportunistic behavior such as tax cheating. In particular, policy interventions may move the economy from a long-term equilibrium to another: especially when a society is entrapped in a long-run equilibrium where opportunistic behavior is very diffuse and social capital is quite poor, a period of high deterrence lowering the expected return from opportunistic behavior can be necessary in order to make social capital increase over time. In general, a special attention should be dedicated to design policies that may favor the formation and preservation of social capital, thus "avoiding policies that, while producing short-term benefits, undermine civic capital, with negative long-term effects. For example, a tax pardon, which grants immunity for past tax evasions in exchange for a small fee, can be a very smart fiscal policy in the short term, since it will increase tax revenues without increasing the marginal tax rates, but it might deteriorate the stock of civic capital of a nation, with very negative long-term consequences" (Guiso et al., 2011: p. 484).

However, the model presented here accounts also for the fact that when opportunistic behavior is very diffuse, the political consensus for tax enforcement tends to be weak, thus loosening the policy response that would be necessary for reducing tax evasion and fostering social capital. This implies that, in the presence of substantial regional differences in the endowment of social capital and incidence of tax evasion, the fact that tax-enforcement policies are determined at the national level may improve the situation of those regions where social capital is lower and tax evasion is more diffuse, but at the cost of reducing the long-run level of social capital and increasing the long-run level of tax evasion in the more virtuous regions. The general message here is that policy responses are not independent of the civic values and social norms prevailing in a society, and that raising the level at which policy decisions are taken can only partially solve the conundrum arising from the close link that connects the dominant culture of a society to the quality of its institutions and policies.

Conflict of interest: The authors declare that they have no conflict of interest

REFERENCES

Allingham Michael and Sandmo Agnar (1972), "Income Tax Evasion: A Theoretical Analysis", *Journal of Public Economics*, 1: 323–338.

Andreoni James, Erard Brian and Feinstein Jonathan (1998), "Tax Compliance", *Journal of Economic Literature,* 36: 818–860.

Battiston Pietro, Duncan Denvil, Gamba Simona and Santoro Alessandro (2016), "The Italian Blitz: A Natural Experiment on Audit Publicity and Tax Compliance", FBK-IRVAPP Working Paper No. 2016-10, Research Institute for the Evaluation of Public Polices.

Bonatti Luigi (2008), "Evolution of preferences and cross-country differences in time devoted to market work", *Labour Economics*, 15: 1341–1365.

CGIA (2016), "La fedeltà fiscale sta al Nord", http://www.cgiamestre.com/wp-content/uploads/2016/04/FEDELTA-FISCALE.pdf.

Chen Been-Lon (2003), "Tax evasion in a model of endogenous growth", *Review of Economic Dynamics*, 6: 381–403.

Crane Jonathan, Boccara Nino and Higdon Keith (2000), "The Dynamics of Street Gang Growth and Policy Response", *Journal of Policy Modeling*, 22: 1-25.

D'Agosto Elena, Marigliani Massimiliano and Pisani Stefano (2014), "Asymmetries in the Territorial VAT Gap", Discussion Topics No. 02/2014,· Italian Revenue Agency.

Frey Bruno S. and Feld Lars (2002), "Deterrence and Morale in Taxation: an Empirical Analysis". CESifo Working Paper No. 760.

Gershman Boris (2016), "Long-Run Development and the New Cultural Economics", American University Working Paper Series, Working Paper 2016-06.

Giuliano Paola and Spilimbergo Antonio (2014), "Growing up in a Recession", *The Review of Economic Studies*, 81: 787–817.

Gordon James P. P. (1989). "Individual Morality and Reputation Costs as Deterrents to Tax Evasion", *European Economic Review*, 33: 797–805.

Guiso Luigi, Sapienza Paola and Zingales Luigi (2011), "Civic Capital as the Missing Link", in Jess Benhabib, Alberto Bisin and Matthew O. Jackson (edited by), *Handbook of Social Economics*, Volume 1A, Amsterdam, Elsevier B.V.: 417-480.

Myles Gareth D. and Naylor Robin A. (1996), "A Model of Tax Evasion with Group Conformity and Social Customs", *European Journal of Political Economy*, 12: 49–66.

OECD (2016), *Italy's Tax Administration. OECD Review of Institutional and Organisational Aspects*, Paris: OECD.

Sabatini Fabio (2009), "Il capitale sociale nelle regioni italiane: un'analisi comparata", *Rivista di Politica Economica*, 99 (2): 167-220

Sandmo Agnar (2005), "The Theory of Tax Evasion: A Retrospective View", *National Tax Journal*, 58: 643–663.

Slemrod Joel B. (2007). “Cheating Ourselves: The Economics of Tax Evasion”, *Journal of Economic Perspectives*, 21: 25–48.

Slemrod Joel B. (2016). “Tax Compliance and Enforcement: New Research and Its Policy Implications”, Ross School of Business Paper No. 1302.

Torgler Benno (2007), *Tax Compliance and Tax Morale: A Theoretical and Empirical Analysis*, Cheltenham (UK) and Northampton (MA): Edward Elgar.

Young H. Peyton (2015), “The Evolution of Social Norms,” *Annual Review of Economics*, *7*: 359–387.