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Modeling Tax Culture

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Abstract

The topic of tax culture introduced in the paper in hand appears at the intersection of the disciplines economics, sociology and history. Contrary to the few previous attempts in the literature, I suggest not to limit tax-cultural considerations to the side of taxpayers, but to widen its understanding by using an embeddedness approach considering the history of taxation and by that means explicating national tax-cultural diversity. Thus, a country-specific tax culture can be understood as the entirety of all relevant formal and informal institutions connected with the national tax system and its practical execution, including the dependencies and ties caused by their ongoing interaction.

One aim of the paper is to find a way of modeling tax culture and its disturbances in an adequate way. Approaches from the economics of crime, principal-agent theory, and (evolutionary) game theory will be reviewed for this purpose.

JEL Classification: H26, K34, P35, Z13

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1 Introductory Remarks

In view of today's progressive globalization, international coordination and the clash of different cultures and divergent tax systems caused thereby, one would think national "tax culture" to be a very fashionable topic of economics and public finance (particularly of taxation). Contrary to all expectations, this is (still) not the case at all[1]. While business administration makes extensive use of the latest findings from e.g. sociology and psychology, it has not been easy for the "time-honored" economics to follow suit in this trend. The topic of tax culture introduced in the paper in hand appears precisely at the intersection of the disciplines economics, sociology and history. So, as one might expect, the term "tax culture" is rarely found in economic literature. In section 2 a working definition of "tax culture" is introduced. Subsequently, in section 3, elements from related theories will be selected to establish a comprehensive model of how "tax culture" works. As work in progress is presented, a final model cannot be presented, yet. Instead, some basic models' possible acculturation will be discussed.

2 Working Definition of Tax Culture[2]

The "classical" understandings of a country's "tax culture" (e.g. SCHUMPETER 1929) was almost entirely restricted to the creators of the tax system. Taxpayers were not considered to be part of the "tax culture". More recent interpretations of the term "tax culture", though, place controversially either exclusively the taxpayers or the communication between the latter and the tax authorities at the center of their argumentation[3]. However, the exclusive and limited look at the interface of the two (groups of) actors also seems to be too restricted, because the evolutionary process of the tax system as well as the national culture remain unconsidered. The concept of tax culture presented here can best be explained from its conceptual dismantling in the individual terms "tax" and "culture".

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1 On the occasion of the Annual Meeting of the German Association for the History of Economics in Hamburg, Germany, May 10-11, 2001, Mark PERLMAN (Pittsburgh, PA) remarked that tax culture is a very interesting and important topic, especially in America – but nobody writes about it!

2 This parts has been taken from NERRÉ (2001g).

3 Compare CAMDESSUS' (1997) speech at the Moscow Institute of International Affairs on "tax-paying culture". His interpretation – as well as that of most transformation economists – seems to aim at SCHMÖLDERS' "tax mentality" (compare e.g. STRÜMPEL 1969 or SCHMÖLDERS 1970). Nevertheless, the formation of the "tax-paying culture" should be accompanied by substantial improvements on behalf of the tax authorities, even though their part is not seen in connection with the prevailing tax culture. This view is shared by MARTINEZ-VAZQUEZ & MCNAB (2000: 293), MARTINEZ-VAZQUEZ & WALLACE (2000: 11) und ALM & MARTINEZ-VAZQUEZ (2001: 34).

From the viewpoint of the "taxes" not only the tax system and the actual tax practice form part of a country's "tax culture", but also the relationship between the tax authorities and the taxpayers[4] accounts for its uniqueness. As regards the tax authorities, the structure of the individual levels' competencies must be taken into account – how are the tax revenues to be distributed between local and central bodies? How explicit and precise is the tax law on that account and how consequently are violations sanctioned? Which (rival) interest groups do exist?[5]

However, the component of "culture" is far more important: Although there is, according to Geert HOFSTEDE[6], no scientific language to define "culture", in the course of this work reference is made exclusively to the national culture[7] as such. In style of the "Shared Mental Models" à la DENZAU & NORTH (1994)[8] "culture" should be understood as "the collective programming of the mind" (HOFSTEDE 1983, 1991). The evolutionary character of "culture" cannot be overemphasized: The cultural factors are continuously in an ongoing modification process stimulated by external and internal inputs[9]. Consequently, culture itself is a dynamic phenomenon of interaction, not a fixed equipment of the actors[10].

The synthesis of the two terms "tax" and "culture" succeeds via the just mentioned evolutionary process: history is the linking or embedding variable. Namely, both subject areas are embedded in the national historical events (in the sense of GRANOVETTER'S "historical embeddedness"[11]). In this regard, already SCHUMPETER found that "every tax ideal has got its

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4 For a (partially game theoretical) overview concerning the interaction of tax authority and taxpayer see e.g. FREY & HOLLER (1998).

5 This (incomplete) list of questions is a particular important part of national tax culture, especially in transformation economies. Compare BERKOWITZ & LI (1999), BLANCHARD & SHLEIFER (2000), SHLEIFER & TREISMAN (2000) und TREISMAN (2000a,b) for the Russian context of these questions.

6 Compare HOFSTEDE (1983: 77).

7 A more detailed explication of the "national" culture might possibly implicate a closer look at the different local subcultures and their inclusion into the analysis, cf. NERRÉ (2001a, chapter 4). For the idea of "tax culture", this would be of importance if local differences in taxation were supposed to be explained and/or analyzed e.g. in a federal state, such as the USA. Concerning these problems CNOSSEN (1990: 475) remarks: „Actual tax practices [...] show that subnational tax systems can differ widely one from another. [...] A substantial degree of economic integration seems perfectly compatible with a high degree of tax diversity".

8 "Mental models are the internal presentations that individual cognitive systems create to interpret the environment" (DENZAU & NORTH 1994).

9 At this point reference should be made to evolutionary game theory. Jones (1995: 274 – 275) points out that "cultures [...] may persist in their current form only while there is no challenge. [...] Gradual modifications take place even in Western societies".

10 Similarly GRANOVETTER (1985: 486) notes that "culture is not a once-for-all influence but an ongoing process".

11 Cf. e.g. GRANOVETTER (1985: 486). The general idea of embeddedness can already be found with SCHUMPETER (1950). Other forms of embeddedness are e.g. structural, cognitive, cultural, political (compare ZUKIN & DIMAGGIO 1990: 14 ff. and SMELSER & SWEDBERG 1994), and regional embeddedness (cf. NERRÉ 2001a: 107 ff.).

historical, economic and sociological boundaries"[12]. In this way, the existence or creation of a universal and "objectively good" system of taxation becomes implicitly impossible[13]. Thus, a "tax culture" specific to a particular country emerges – coined by the tradition of taxation (e.g. an accentuation of [in-]direct taxes) on the one hand, and by the interaction of the actors and the cultural values[14] like "honesty", "justice" or also "sense of duty" on the other hand.

The latter resembles the – by definition taken more narrowly – tax *mentality* that consists of the two components of tax *morale* and tax *discipline* and solely aims at the relationship of the taxpayer to the tax state. Above all, the German Cologne school around Guenter SCHMÖLDERS and his students treated this subject during the fifties and the sixties comprehensively. A passable overview in this regard is given by TRETTER (1974), who gives the following definition: "Tax mentality includes all attitudes and also all patterns of behavior which the tax-paying citizens hold against (or with?) the tax and the state"[15]. In general tax *morale* is used as a term connected with a certain "willingness-to-pay taxes", a feeling of obligation to the state (according to the benefit principle) or the obligation to the general public or community (with tax moral according to the ability-to-pay principle), respectively. Tax *discipline* then reflects the attitudes of the taxpayer in his or her actions.

Working Definition: Tax Culture

A country-specific tax culture is the entirety of all relevant formal and informal institutions connected with the national tax system and its practical execution, which are historically embedded within the country's culture, including the dependencies and ties caused by their ongoing interaction.

Accordingly, tax culture contains even more than „culture of *taxation*" and „*tax-paying* culture". A simplified overview – which could easily be enhanced by more details – is presented in figure one. It shows the embeddedness of the actors into the national culture with its subset of tax culture.

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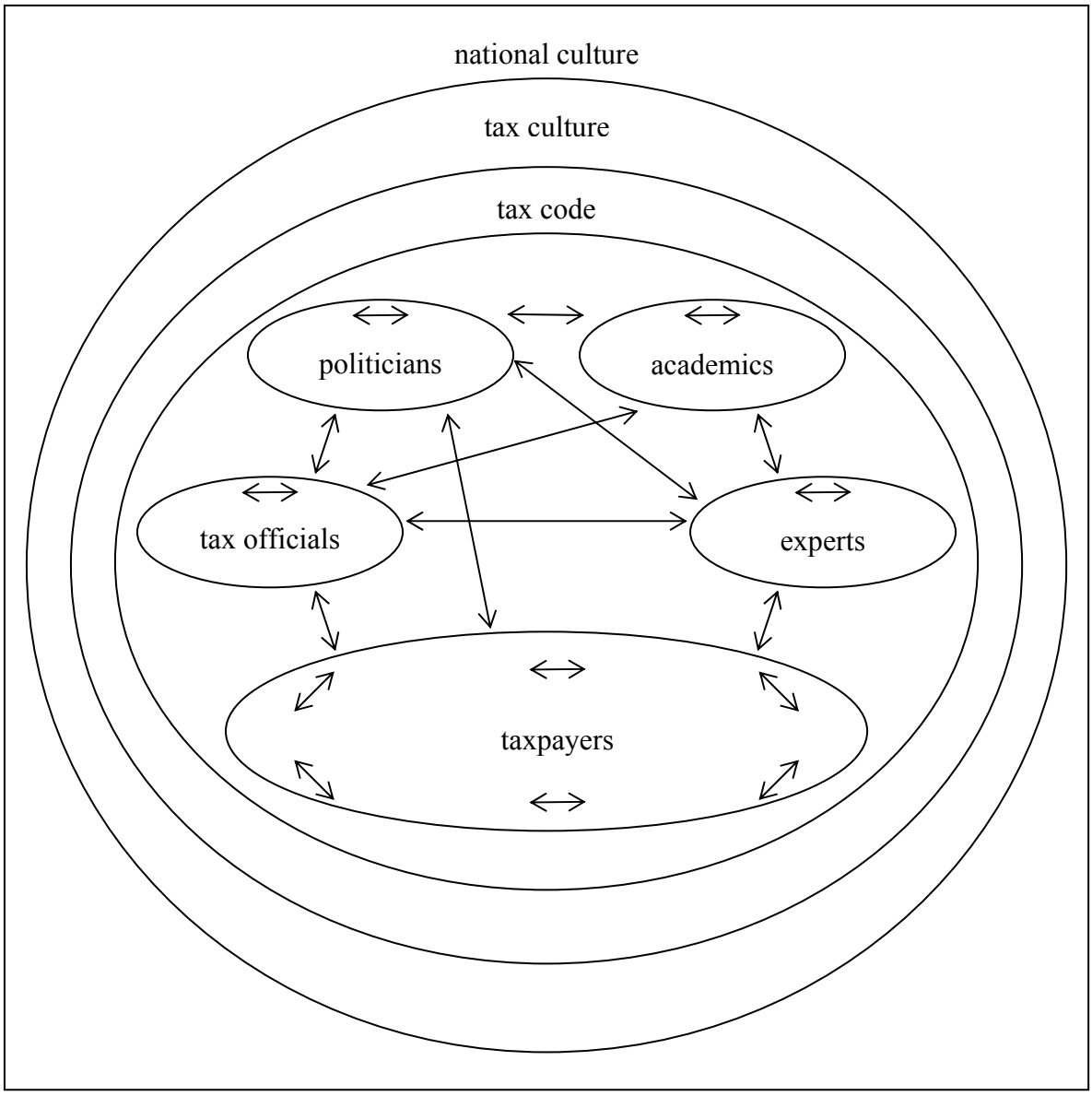
[12] SCHUMPETER (1929: 383, translation BN). In the context of taxation guidelines, SCHEER (1996: 156, translation BN) points out unmistakably: "One surely cannot expect that the guidelines for a 'right' taxation are independent of time and location".

[13] An opposing position is taken by e.g. Manfred ROSE, who scientifically supervised the introduction of a consumption-oriented income tax in Croatia and holds the opinion that solely economic factors are to be considered for the design of any tax system; cf. e.g. ROSE (1998). This is a contradiction to the observation of a gap within economics between pure fiction and cultural reality, and as well to the above mentioned "embeddedness" argument.

[14] BUCHANAN (1995: 195) states appropriately: "Differences in cultural history must exert behavioral consequences".

[15] TRETTER (1974: 39, translation BN).

Figure 1: The Embeddedness of Tax Culture



Cultural norms and historically developed institutions both determine the tax code. The latter sets the environment and the constraints, i.e. the rules for the tax game. Players include (among others) taxpayers, politicians, tax officials, expert (e.g. tax advisors), and academics. The arrows indicate interaction between the different groups of players as well as between the members of one and the same group (e.g. academics meet at academic conferences). By the ongoing interaction, social ties and dependencies are developed over time[16].

[16] I have left out an interaction arrow between academics and taxpayers, because I am not sure about the relationship between both groups (academics tend to model taxpayers far differently than they act in reality, taxpayers seem to know that and thus do not care about the propositions academics make).

3 Selecting elements from related theories[17]

The task for future research is to find a set of models that can adequately show how tax culture works. Several possibilities will be reviewed here to select the relevant elements from them[18].

As with any attempt to set up a model, some restricting assumptions will have to be made. From figure 1 it becomes clear, that there are too many actors to be included in a simple model. Therefore, we will only look at a reduced interpretation of tax culture, the simplified model of tax culture. It consists of three actors: the government, the tax authority, and the taxpayers. We will assume that academics and advisors only change the actors' level of information.

Obviously, the process of tax culture can be divided into several subroutines. Firstly, there is the government defining the rules of the game that tax authorities and taxpayers play. Secondly, there are taxpayers interacting with the tax officials, i.e. members of the tax authority. Further, taxpayers interact with each other, as well. Lastly, taxpayers are voters and therewith have a possibility to determine partly the future rules of the tax game. The taxpayers' interaction and the voting process will not be discussed in this paper, though.[19]

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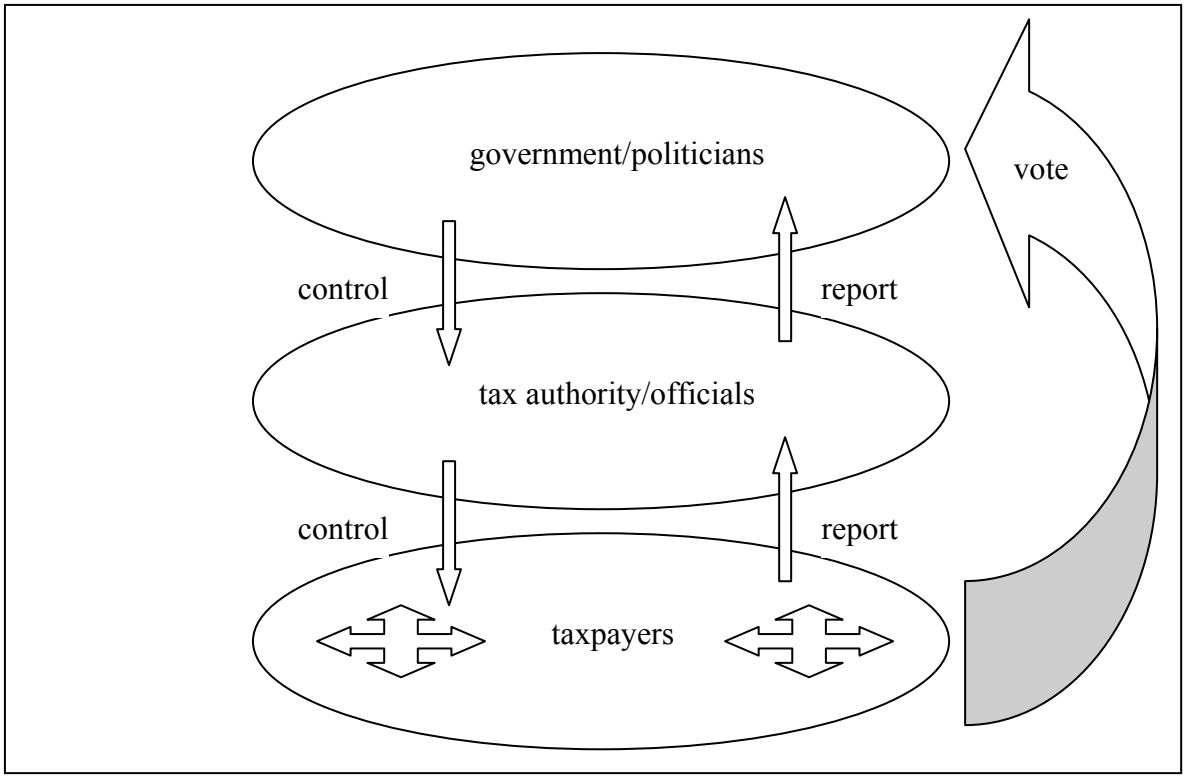
[17] I am still working intensively on this part. I'd particularly welcome suggestions here.

[18] For reasons of space, time, and simplification, some also promising related theories have not been given attention to in this paper. Among them Avner GREIF'S (1994) "*cultural beliefs*", BERKOWITZ & LI'S (1999) discussion of different government levels' tax rights and tax shares, KENNY & WINER'S (2001) attempt of estimating tax structures in OECD countries, approaches from *economic psychology*, e.g. CULLIS & LEWIS (1997), and an analysis from *mathematical biology* by DAVIS/HECHT/PERKINS (2001). The latter is certainly of interest, because whereas in public choice evasion is commonly perceived as the *cure* to the decease of leviathan, evasion is modeled as the *decease* in mathematical biology. Furthermore, *bargaining* is a common element in some tax cultures, especially in transition economies. MUTHOO (1999: 81 ff.) models a bargaining process (based on RUBINSTEIN 1982) between a tax official and a taxpayer. I have tried to model bargaining in the Russian tax culture in NERRÉ (2002).

[19] Taxpayers' interaction can be modeled e.g. by coordination games (ALM & MCKEE 2001). For the voting process one might look at models of political culture (KATAYAMA & URSPRUNG 2000, HILLMAN & URSPRUNG 2000).

Figure 2: The Simplified Model of Tax Culture



3.1 Stage One: Government versus Tax Authority

One group of models deals with the question in how far the government can either control or rather build up the right incentives for the tax authorities to fulfill their task as intended by law. In microeconomics, this situation is modeled by principal-agent approaches[20]. HOLLER (1993) developed a principal-agent-controller model which was subsequently applied for the taxation setting by FREY & HOLLER (1998).

The government (or the parliament) as the principal is responsible for the rules of the game that takes place between taxpayers and the tax authority (see stage two), i.e. the (tax) law. However, the principal cannot completely control the agent, which is the tax authority. He is unable to observe the action of the agent, but instead observes some output, in this specific setting the overall tax revenue **T** (to keep the analysis simple we will assume that there is only a finite number of output levels $\mathbf{[T_1,\ldots,T_i,\ldots,T_n]}$). Accordingly, the situation is one of hidden action and moreover one of a (monopsonistic[21]) monopoly solution. Let **A** and **B** denote two different actions, and let the utility of the government be highest if the agent

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[20] Compare VARIAN (1992: chapter 25).

[21] In some countries the situation is evidently not of monopsonistic character. This holds true for such cases when there is more than one institution that is responsible for tax collection. In some Eastern European countries, e.g., there coexist a tax authority and a special tax police.

performs action **B**, i.e. $\mathbf{U_{G,max} = U_G(T_{max}) = U_G(B) > U_G(A)}$ (in fact, one can think of A as a set of alternative actions here). The costs to the agent in performing one of these actions are **c(A)** and **c(B)**. Further, let $\boldsymbol{\pi_{iA}}$ and $\boldsymbol{\pi_{iB}}$ denote the probabilities that the principal observes output **i** when the agent chooses action **A** and **B**, respectively. Additionally, the principal's payment to the agent of output $\mathbf{T_i}$ is observed is indicated by $\mathbf{s_i = s(T_i)}$. For the situation of tax collection the income of the agent will most probably be independent of $\mathbf{T_i}$ but rather depend on age or time of service in the institution. Assuming a risk-neutral principal, the expected net tax revenue to the government if the agent chooses action **B** equals

$$(1) \qquad \sum_{i=1}^{n} (\mathbf{T_i - s_i})\boldsymbol{\pi_{iB}} \ .$$

As in all principal-agent relations, the principal has to fulfill the agent's *participation constraint* and to keep track of his *incentive compatibility constraint*, as well. The second kind of constraint seems also obvious for the taxation case – it just means that the tax authority will try to maximize overall revenue **T** subject to the given tax law. What might seem a little strange on first sight is the assumption of a participation constraint. In general principal-agent models, the participation constraint prescribes that the agent has to have at least the same level of utility if he participates in the relationship which he would be able to obtain in an alternative relationship or action. For the specific case of tax collection, the agent only starts acting for the principal if he receives a wage that is somehow comparable with an alternative wage of the private sector (the reservation level of utility $\bar{\mathbf{u}}$). Especially in developing and transition countries, this might very well not be the case.

Let us assume a risk-averse agent who seeks to maximize a Von-Neumann-Morgenstern utility function $\mathbf{U_{TA}(s_i)}$, and that the costs of his action enter linearly into it.
Consequently, one obtains the following constraints:

$$(2) \qquad \sum_{i=1}^{n} \mathbf{U_{TA}(s_i)}\boldsymbol{\pi_{iB}} - \mathbf{c(B)} \geq \mathbf{U_{TA}(s_i)}\boldsymbol{\pi_{iA}} - \mathbf{c(A)} \qquad \text{(incentive compatibility constraint)}$$

$$(3) \qquad \sum_{i=1}^{n} \mathbf{U_{TA}(s_i)}\boldsymbol{\pi_{iB}} - \mathbf{c(B)} \geq \bar{\mathbf{u}} \qquad \text{(participation constraint)}$$

If condition (2) or (3) is not satisfied, the tax authority will not act as desired by the government. If the participation constraint is not fulfilled a situation of an understaffed and hardly qualified tax authority might emerge. Corruption might lead to the effect that the incentive compatibility is not given. This dilemma might initiate a vicious circle of low compliance and low wages for the officials who will receive side-payments from corrupt taxpayers.

3.2 Stage Two: Taxpayer versus Tax Authority

The relationship between taxpayers and tax authorities has been subject to far more and several different kinds of research than the government versus tax authority setting. We will look at an economics of crime approach, a classical game theoretic setting and an evolutionary approach.

3.2.1 Economics of crime

One strikingly buoyant segment of literature is based on GARY BECKER's (1968) economics of crime approach and deals with the economics of (esp. income) tax evasion (the classic paper is ALLINGHAM & SANDMO 1972).

Let **Y** denote an individual's fixed amount of income which is taxable at rate **t** on the amount **D** declared at the revenue office and **p** the probability that the individual is audited by the tax authorities. In the case of true reporting or the case of no audit, the individual earns $\mathbf{Y_N}$:

(4) $\mathbf{Y_N = Y - tD}$ (and $\mathbf{D \leq Y}$).

If the individual is caught cheating he has to pay a penalty rate $\mathbf{f > 1}$ on each euro he failed to pay and thus gets $\mathbf{Y_C}$:

(5) $\mathbf{Y_C = Y - tD - f[t(Y-D)]}$.

Assuming that utility **U(Y)** is a function exclusively of income the taxpayer chooses **D** to maximize his expected utility

(6) $\mathbf{EU(Y) = pU(Y_C) + (1-p)U(Y_N)}$.

This economics of crime approach leads to the insight that the taxpayer complies *only* because of the fear of detection and punishment[22]. Cultural values are not included in the basic model which has been extended in various different ways[23].

Recently, ALM & MARTINEZ-VAZQUEZ (2001) have introduced a value for "socials norms" to the standard evasion model. They emphasize two arguments which may justify to consider a modified tax compliance model for a (partial) analysis of tax culture: (a) "the social *norm* of compliance *differs* [.] *across countries*" and (b) "it seems likely that there is a *constant interaction* between social norms and tax administration" (emphases added BN). Both facts make up a part of a countries specific tax culture (s.a.).

ALM & MARTINEZ-VAZQUEZ classify the various influences of the social norm of compliance into two basic categories: "internal norms" and "external norms". Internal norms relate to the individual taxpayers programming of the mind, i.e. how he judges her own compliances behavior against the prevailing tax-cultural setting. External norms relate to how the taxpayer feels about the government, i.e. the degree in how far the *do ut des* (*quid pro quo*) principle of taxation is satisfied.

In ALM & MARTINEZ-VAZQUEZ's modification the individuals (denoted by **i**) receive an equal share **s** of the single public good provided by the government[24]. The total amount of the public good is determined by the sum of the individuals' tax payments (based on declared income) increased by a multiplier **m**. A multiplier greater than one reflects a positive consumer surplus from the government's activities, whereas a multiplier less than one implies x-inefficiencies or waste in government provision. Assuming risk neutrality (only for reasons of simplification) the individual maximizes the expected value $\mathbf{EV_i}$ of the evasion gamble by choosing the amount of declared income **D**:

$$(7) \qquad \mathbf{EV_i = Y_i - tD_i + mst\ (\sum_j D_j) - pft\ (Y_i - D_i)}$$

The term $\mathbf{mst\ (\sum_j D_j)}$ represents the amount of the public good returned to each individual (measured in dollars). Deriving the first order condition for a maximum yields that taxpayers will optimally report all income if

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22 This result resembles the Russian understanding of tax culture which can be summarized as "compliance by fear"; compare NERRÉ (2001d, 2001f) and KOCHETOV (2001).

23 Compare ANDREONI/ERARD/FEINSTEIN (1998: 824).

24 In the case of a pure public good the share of each taxpayer would equal the total amount of the public good provided. Assuming different shares to the individual taxpayer implies some kind of imputed or perceived utility share of the public good.

(8) $\mathbf{ms + pf > 1}$

while he will declare no income at all if the inequality is reversed.

As "the simplest way"[25] to introduce a parameter for social norms in the model ALM & MARTINEZ-VAZQUEZ chose KAHNEMANN & TVERSKY'S (1979: 274) "reference point" in prospect theory. If an individual does not achieve the reference point, which is culturally embedded, it suffers a loss in utility (a phenomenon they call "loss aversion"). Slightly deviating from ALM & MARTINEZ-VAZQUEZ we do not assume that full compliance is the social norm, even though it may be one possibility for a norm. On the contrary, one could think of zero compliance as the norm, as well. Therefore, we use a different parameter to measure the psychological loss in expected income. Let $\mathbf{C_i = C_i\,(D/Y)}$ denote a function that assigns a number $\boldsymbol{\theta}$ to any relative compliance level $\mathbf{D/Y}$ where $\boldsymbol{\theta}$ takes a positive sign for tax cultures where compliance is the norm and people suffer a psychological loss in expected income because of undisclosed taxes, whereas $\boldsymbol{\theta}$ has a negative sign for those tax cultures where evasion is the norm rather than the exception and taxpayers suffer a loss because of – from a tax-cultural view – "excessive" tax payments. The parameter $\boldsymbol{\theta}$ enters the maximization of the modified expected value via $\mathbf{C_i}$ in the following form:

(9) $$\begin{aligned} \mathbf{EV_i^*} &= \mathbf{Y_i - tD_i + mst\,(\textstyle\sum_j D_j) - pft\,(Y_i - D_i) - tC_i(D_i/Y_i)} \\ &= \mathbf{EV_i - tC_i(D_i/Y_i)}. \end{aligned}$$

Taking the cultural value into account, deriving the first order condition for a maximum yields that taxpayers will optimally report all income if

(10) $$\mathbf{ms + pf > 1 - \frac{\partial C_i}{\partial D_i}}.$$

The first derivative of $\mathbf{C_i}$ with respect to $\mathbf{D_i}$ represents the change in $\boldsymbol{\theta}$ if there is a marginal change in declared income, and it will be greater than zero in compliance-oriented societies and less than zero in evasion-oriented tax cultures leading to an additional psychological profit to the individual if he underreports his income. Thus, equation (10) is

[25] ALM & MARTINEZ-VAZQUEZ (2001).

more easily satisfied than the basic equation (8) if $\frac{\partial \mathbf{C_i}}{\partial \mathbf{D_i}} > \mathbf{0}$ and harder to satisfy in the opposite case, i.e. the probability that an individual will honestly report all income is higher in compliance-oriented tax cultures (which is straightforward).

Unfortunately, the tax authority only enters the model via the parameter **p** (the policy makers indirectly influence the audit probability via the budget they grant to the authorities). **f** and **m** are exogenous variables that are set unilaterally by the government. Therefore, using exclusively a modified economics of crime approach does not seem appropriate for modeling tax culture. It has at least to be extended and supplemented by some evolutionary component.

3.2.2 Traditional game theory: A Prisoner's Dilemma Setting

One can easily model the situation of the taxpayer – tax authority interaction by a 2-player-2-strategy setting (FREY & HOLLER 1998) as well-known from the classic prisoner's dilemma. This setting fits the situation at the revenue office quite well. Every single taxpayer has to deal with one tax official (or the tax authority as an entity, if e.g. a tax commission decides about his declaration), and faces two basic strategies in this one-shot game: either to report his true income, or to cheat on the authorities and underreport his income. The taxpayer randomizes about his two strategies with probabilities **p** (to cheat) and **1-p** (not to cheat). The tax authority faces two strategies, as well. With probability **q** it will audit the taxpayer, whereas with probability **1-q** it will not.

Let the taxpayer's payoffs be denoted by Latin letters and those to the tax authority by Greek ones.

Matrix 1: The Taxpayer-Tax Authority Game

			Tax authority (TA)	
			q	(1-q)
			audit (A)	not audit (NA)
Taxpayer (TP)	p	cheat (C)	(a,α)	(b,β)
	(1-p)	not cheat (NC)	(c,γ)	(d,δ)

Source: adopted from FREY & HOLLER (1998)

FREY & HOLLER assume the following ranking of the payoffs indicated in matrix 1:

(i) **b > a, b > d, c > a, c > d** (for the taxpayer)

(ii) $\alpha > \beta, \alpha > \gamma, \delta > \beta, \delta > \gamma$ (for the tax authority)

Most of the relationships indicated above are straightforward – from a Western point of view. Two of them still need a further specification, though. Firstly, $\alpha > \gamma$ expresses a catch premium for the tax authority. This may be a monetary payment from the government to the tax official (fixed in the employment contract) or some form of official praise making the successful tax official feel honored and proud. Furthermore, $\alpha > \gamma$ has a motivational interpretation, as well: If tax officials would audit only honest taxpayers they would become frustrated and feel superfluous. Secondly, $c > d$ needs to be specified. On the one hand, honest taxpayers may prefer to be audited sometimes for equity reasons. On the other hand, $c > d$ might parallel "the pleasure potential smugglers enjoy at the border when they get searched by the custom officer but do not carry hot goods with them"[26].

FREY & HOLLER derive Nash (denoted by superfix *) and maximin (denoted by superfix +) solutions. The players' equilibrium payoffs of both solutions are equal in 2x2-games with mixed strategies[27].

(11) $$U_{TP}(q^*) = U_{TP}(p^+) = (ad - bc)/(a - b - c + d)$$

(12) $$U_{TA}(p^*) = U_{TA}(q^+) = (\alpha\delta - \beta\gamma)/(\alpha - \beta - \gamma + \delta)$$

Most revealingly, both taxpayers' and tax authority's equilibrium payoffs are independent of the probability of audit. Accordingly, deterrence might not work as proposed by the simple economics of crime model (section 3.2.1).

Different tax cultures might be expressed by different relationships of the payoffs than indicated by (i) and (ii). Due to the one-shot character of the game, evolution cannot be included in the model, though.

3.2.3 Evolutionary game theory

At this place we will make use of the so-called market game of evolutionary game theory[28] and adopt it for the analysis of tax declaration filing. Again, like in traditional game theory, we consider a two-player game. But this time the game is repeated with an infinite time horizon. The following assumptions will be made: Players meet in pairs and each of

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[26] FREY & HOLLER (1998: 29).
[27] Cf. HOLLER (1990) for the proof of this equality.

them has two pure strategies. Taxpayers can either be honest or cheating and tax officials can either audit a taxpayer or choose not to audit him. Further, if we allow for mixed strategies, let p denote the fraction of those tax officials who will audit in any case and q denote the share of honest taxpayers ($\mathbf{0 \leq p \leq 1}$ and $\mathbf{0 \leq q \leq 1}$).

Matrix 1: Fitness Matrix of the Tax Declaration Game

Tax official		**Taxpayer**	
		honest (q)	cheating (1-q)
	audit (p)	(α, a)	(γ, c)
	no audit (p-1)	(β, b)	(δ, d)

Every tax culture is coined by different relations between the fitnesses of the players in the tax declaration game.[29] From a tax-political view it turns out to be interesting, how a tax culture changes. For example, the effectiveness of certain measures to improve tax compliance crucially depends on the time horizon: If no improvements can be observed in the short run, there should at least occur some progress in the long run – otherwise, the unsuccessful policy should be cancelled. Thus, in the next analytical step, attention is paid to the speed of evolution in tax-cultural development: How does the number of (dis)honest taxpayers increase or decrease in time? Having defined a polymorph population of taxpayers and tax officials, the suitable tool for such an analysis is that of replicator dynamics of evolutionary biology, i.e. the rate at which a certain species reproduces in a population. In the tax declaration game this can be interpreted as the rate at which one of the two strategies (cheating or not cheating, and auditing or not auditing, respectively) seems to prove "better" to the individual having learned from earlier rounds.

WEIBULL (1994) has shown that in general evolutionary game theory we obtain the following replicator dynamics:

$$(11) \qquad \frac{\dot{\mathbf{x}}_i(\mathbf{t})}{\mathbf{x}_i(\mathbf{t})} = \mathbf{u}_i(\mathbf{x}(\mathbf{t})) - \bar{\mathbf{u}}(\mathbf{x}(\mathbf{t})) \qquad \text{and } \mathbf{t} \geq 0$$

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[28] Compare e.g. HOLLER & ILLING (2000: 364).

[29] To verify these relations, time- and money-consuming opinion polls would have to be executed in a country that is under investigation. Possibly, complicated econometric estimations could serve as a substitute for opinion polls. Anyhow, this is a completely different story and will not be made a subject of discussion in this paper.

The fitness of a singular player of type i (i = TP, TO) is denoted by $\mathbf{u_i}$ and the average fitness of all type i players by $\bar{\mathbf{u}}$. The left hand side of (11) shows the growth rate of the share of type i players in the population, i.e. $\mathbf{x_i(t)}$ denotes the share of type i players at time **t** and $\dot{\mathbf{x}}_\mathbf{i}\mathbf{(t)}$ the first derivative of **x** with respect to **t**.

For the special setting of the tax declaration game the growth rates for **p** and **q** have to be analyzed. Therefore, the (expected) fitness of the tax official will have to be calculated for the case that audits the taxpayer with probability 1 (**p = 1**) and for the case that he will not audit him with probability one (i.e. **p = 0**). The same has to be done for the taxpayer (**q = 1** and **q = 0**, respectively). Taking the individual fitness from matrix 1 we obtain the following results:

For the *tax official*

(12a) $\mathbf{u_{TO}(p=1) = \alpha q + \gamma\,(1-q) = (\alpha-\gamma)q + \gamma}$

(12b) $\mathbf{u_{TO}(p=0) = \beta q + \delta\,(1-q) = (\beta-\delta)q + \delta}$

and for the *taxpayer*:

(13a) $\mathbf{u_{TP}(q=1) = ap + (1-p)b = (a-b)p + b}$

(13b) $\mathbf{u_{TP}(q=0) = cp + (1-p)d = (c-d)p + d}$

The *average fitness* for the tax official can be derived from (12a) and (12b):

(14) $$\begin{aligned}\bar{\mathbf{u}}_{\mathbf{TO}} &= \mathbf{p[(\alpha-\gamma)q + \gamma] + (1-p)[(\beta-\delta)q + \delta]} \\ &= \mathbf{p(\alpha-\gamma)q + p\gamma + (\beta-\delta)q + \delta - p(\beta-\delta)q - p\delta} \\ &= \mathbf{\delta + (\beta-\delta)q + p[(\gamma-\delta) + q(\alpha-\beta-\gamma+\delta)]}\end{aligned}$$

and that for the taxpayer from (13a) and (13b)

(15) $$\begin{aligned}\bar{\mathbf{u}}_{\mathbf{TP}} &= \mathbf{q[(a-b)p + b] + (1-q)[(c-d)p + d]} \\ &= \mathbf{q(a-b)p + qb + [(c-d)p + d] - q(c-d)p - qd} \\ &= \mathbf{d + (c-d)p + q[(b-d) + p(a-b-c+d)]}\end{aligned}$$

Let $\dot{\mathbf{p}}$ and $\dot{\mathbf{q}}$ denote the first derivative of p and q with respect to the time **t**. If the replicator dynamics (11) are applied the growth rate of those *tax officials always auditing* is

$$(16) \qquad \frac{\dot{\mathbf{p}}}{\mathbf{p}} = \mathbf{u_{TO}(p=1)} - \bar{\mathbf{u}}_{\mathbf{TO}} = \mathbf{\{(\alpha-\gamma)q + \gamma\} - \{\delta + (\beta-\delta)q + p[(\gamma-\delta) + q(\alpha-\beta-\gamma+\delta)]\}}$$

$$= \mathbf{(\alpha-\gamma)q + (\gamma-\delta) - (\beta-\delta)q - p(\gamma-\delta) - pq(\alpha-\beta-\gamma+\delta)}$$
$$= \mathbf{(1-p)(\gamma-\delta) + (1-p)q(\alpha-\beta-\gamma+\delta)}$$
$$= \mathbf{(1-p)[(\gamma-\delta) + q(\alpha-\beta-\gamma+\delta)]}$$
$$= \mathbf{(1-p)[(1-q)\,(\gamma-\delta) + q(\alpha-\beta)]}$$

In the derived expression (16), three terms are positive by definition, namely $\mathbf{(1-p) > 0}$, $\mathbf{q > 0}$, and $\mathbf{(1-q) > 0}$. The sign of the growth rate of auditing tax officials thus depends on $\mathbf{(\gamma-\delta)}$ and on $\mathbf{(\alpha-\beta)}$. $\mathbf{(\gamma-\delta)}$ represents the utility surplus to a tax official auditing a cheater above not auditing him. Even though there might exist subtle differences between different tax cultures, it seems reasonable to assume $\boldsymbol{\gamma > \delta}$, i.e. the official is better off catching a cheater (not taking into account the possibility of bribes and bargaining, s.b.). Therefore, $\mathbf{(\gamma-\delta) > 0}$.[30] $\mathbf{(\alpha-\beta)}$ need some further explanation: $\mathbf{(\alpha-\beta)}$ is the utility shortfall (or surplus) of auditing an honest taxpayer. Remember that **p** is the proportion of officials that always audit. $\mathbf{(\alpha-\beta) > 0}$ would indicate some motivational utility surplus by choosing audit above not auditing. The reason for such a behavior might be rooted not only in a sense of duty of the tax official, but also in culturally inherited mistrust, pompous behavior, or the like. On the other hand, if laziness among officials is the tax-cultural norm, $\mathbf{(\alpha-\beta) < 0}$. Therefore, the sign of $\mathbf{(\alpha-\beta)}$ is unpredictable.

By analogy with the growth rate of auditing tax officials, the growth rate of *honest taxpayers* equals

$$(17) \qquad \frac{\dot{\mathbf{q}}}{\mathbf{q}} = \mathbf{u_{TP}(q=1)} - \bar{\mathbf{u}}_{\mathbf{TP}} = \mathbf{\{(a-b)p + b\} - \{d + (c-d)p + q[(b-d) + p\,(a-b-c+d)]\}}$$

$$= \mathbf{(a-b)p + (b-d) - (c-d)p - q(b-d) - qp(a-b-c+d)}$$
$$= \mathbf{(1-q)(b-d) + (1-q)p(a-b-c+d)}$$
$$= \mathbf{(1-q)[(b-d) + p(a-b-c+d)]}$$
$$= \mathbf{(1-q)[(1-p)(b-d) + p(a-c)]}$$

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[30] For the case of auditing a "small" cheater, i.e. somebody who would have to pay only a marginal fine being caught, one would have to assume that there are no costs of audit to ensure that $\boldsymbol{\gamma > \delta}$.

Just like the derived expression (16), three terms of expression (17) are positive by definition, namely **(1-q) > 0**, **p > 0**, and **(1-p) > 0**. The growth rate of honest taxpayers thus depends on **(b-d)** and **(a-c)**. **(b-d) < 0**, because **b** is the utility of not being audited in case of honesty while **d** is the utility of not being audited in the case of cheating. **(a-c) > 0**, because being audited while cheating yields a lower payoff **c** (one might think of a penalty here) than that of being audited if honest, **a**. Depending on the tax culture prevailing in a country, cheating or honesty may evolve to be the social norm.

The focal points (dynamic equilibria), i.e. those points, where **p** and **q** do not change anymore over time ($\dot{\mathbf{p}} = \mathbf{0}$ and $\dot{\mathbf{q}} = \mathbf{0}$) are determined by the following pairs **(p,q)** which can be derived from (16) and (17): $\left(\frac{(b-d)}{(a-b-c+d)}, \frac{(\gamma-\delta)}{(\alpha-\beta-\gamma+\delta)}\right)$, **(0,0)**, **(1,1)**, **(1,0)**, and **(0,1)**.

These equilibria might look frustrating at first sight, because what they seem to state is that if there does exist a proportion of zero of honest taxpayers chances might be very bad to enhance tax compliance. Still – the focal points represent equilibria that can be changed by external forces, by mutants (represented by international consultants).

This evolutionary model is interesting as it can explain why it has proved to be so difficult in many transition countries to establish a revenue-bearing tax system. If there has not been a tangible tax system before transformation starts, the initial starting point might well be one of **(0,0)** which would be the case if non-compliance and no audit are the norm. Even by mutant strategies, i.e. foreign advice and supervision, the process of tax-cultural changes may prove to be very slow in progress.[31] That can be due to unfavorable utilities – more precisely, utility *differences* – leading to very low growth rates in the shares of compliant taxpayers and auditing tax officials, both indispensable for sufficient tax revenues.[32]

4 Outlook on future research

When using the expression "tax culture" in public discussion, a useful and understandable definition has not been strived for, yet. For further research I propose that a national tax culture should comprehensively be defined as the entirety of all interacting formal and informal institutions connected with the national tax system and its practical

[31] Here the possibility of tax culture shocks or tax culture lags has to be mentioned, compare NERRÉ (2001g).

[32] For further research it will be interesting to adopt this evolutionary model also for the interaction among taxpayers themselves.

execution, which are historically embedded within the country's culture, including the dependencies and ties caused by their ongoing interaction. From this working definition it becomes evident that to understand a specific county's tax culture requires a lot of research effort, because a lot of actors and institutions have to be studied as well as the procedures and processes when they interact.

As a first step towards a comprehensive model of tax culture, the simplified model of tax culture has been introduced which is still "under construction". To express the relationship between the different actors several approaches have been reviewed, some still remain for future review. It has become clear, though, that a simple economics of crime approach cannot explain the phenomenon of tax culture. Most probably, evolutionary approaches for all stages of interaction will have to be analyzed and adapted. A lot of work remains to be done, especially in modeling the voting process. But still – there seem to be enough existing theories which can be made use of for a comprehensive model of tax culture. Any suggestions are most welcome.

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