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Essays on
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Scope

Broadly speaking, this dissertation studies fiscal policy mechanisms governments set to retrieve the revenues needed for public expenditure. More concretely, the main question is if these asymmetrical information mechanisms lead to a "desired purpose" and whether they are indeed optimal and fair for both governments and taxpayers. It appears that fiscal policies are among the main forces of unfairness and are an obstacle for new small businesses and practitioners and may also hamper the economic growth of most (developing) countries.

One topic of this research is on tax evasion which is the illegal non-payment or underpayment of tax. [1] It has been studied since it is an important costly phenomenon that affects any government behavior in terms of designing a proper tax structure and tax auditing policy that can reduce the extent of evasion. [2]

The first chapter discusses what we already know about tax evasion and the optimal choice of the latter. Although the scope of this thesis is to go beyond a comprehensive literature review, this initial phase builds an existing solid basis to the rest of the work. This first part presents the different processes of how

[1] A different concept is the one of tax-avoidance: "the arrangement of one's financial affairs to minimize tax liability within the law".

[2] See Slemrod (1990) and Slemrod & Yitzhaki (2002) for further discussion on optimal tax theory.

a taxpayer faces the "evasion choice", as well as the different analytical models which have been used in this field.

The second chapter focuses on a widespread practice for governments, which is to gather observable and measurable characteristics of taxpayers and to group the population into homogeneous categories in order to better estimate their real gross income. Although it is common to keep income estimates hidden, in Italy these are announced to the taxpayers before the latter are asked to fill in their tax declarations. The mechanism used in Italy is called Sector Studies (in Italian "Studi di Settore") and relies on taxpayers' gathered information both to partition the population into fairly homogeneous clusters and to determine their presumed income that they ought to declare. The Sector Studies mechanism relies on a cut-off policy: once the government choses and announces the estimated income, it is common knowledge that all taxpayers who declare less than this estimation are surely audited. Thus, it is an asymmetrical information mechanism where taxpayers enjoy the informational advantage.

The problem that a taxpayer faces when deciding their declaration in such a scenario is analyzed. The principal aim is to understand whether this cut-off policy is indeed optimal for the government and if it is fair to the taxpayers. Starting from what is happening in Italy - that is the greatest part of the population declares its estimated income but there is always a group that declares differently - a theoretical model is constructed where the income distribution is fixed and audits are costly for both government and taxpayers.

The main finding is the characterization of the solution to the taxpayer's problem. When taxpayers are risk-neutral and uniformly distributed in a given segment,

the cut-off policy gives rise to three different groups into which taxpayers are endogenously divided. The lowest group is audited with certainty, so that agents bear the audit cost and no individual dishonestly reports her income (Compliance Taxpayers). Reports in the middle group are equal to the estimated income (Over-Declaration) so that no one is audited but individuals pay more taxes than due (Fake Congruous). Declarations in the highest group are equal to the estimated income so that no one is audited but since individuals' real income is greater than the estimated one, they pay less taxes than due and so evade (Evaders).

The third chapter addresses another fiscal mechanism concerning the exchange of information and revenue-sharing in tax-treaties. Basically, the situation where firms of a developed country can produce some revenues in a developing one is modeled and analyzed. In such a situation, worldwide income taxation in the country of residence is the legal dogma of international taxation commonly used. This dogma is questioned from the perspective of relations with developing countries from a legal and economic perspective, and a modern and fair proposal for tax treaties is made. It is shown under which conditions a developing and a developed country will *voluntarily* sign a tax treaty where *information is exchanged truthfully* and whether they should *share revenues*. Moreover, it proves how the conclusion of a tax treaty can assist in the *implementation of a tax audit system*.

Chapter 1

Tax Evasion Literature Review

Tax evasion is the illegal non-payment or underpayment of tax[1]. It has been studied since it is an important costly phenomenon which affects any government behavior in terms of designing a proper tax structure and tax auditing policy that can reduce the extent of evasion[2]. All the previous studies on this topic can help us in understanding the rational economic behavior of criminals[3] but although tax evasion is a real crime it is considered a special kind of illegal act. People rank the crime of tax-evasion somewhere between stealing candies and stealing a motorbike. Why is it so? Well, maybe because it is a fraud against a very special economic agent who has the power to set some of the "*rules of the game*" (taxes and penalties, for instance), *the Government*. It is clear that the core of this topic lies in the "**evasion decision**" which is taken by each taxpayer and obviously involves a "**report**" (declaration) that can be view as a "*signal*" given to the government. It

[1] A different concept is the one of tax-avoidance: "the arrangement of one's financial affairs to minimize tax liability within the law".

[2] See Slemrod (1990) and Slemrod & Yitzhaki (2002) for further discussion on optimal tax theory.

[3] Hindriks & Myles (2006) provide in their book an excellent introductory chapter to this topic.

can be that the taxation system and its enforcement rules may induce the taxpayers to conceal or misrepresent part of their real income, and so evasion appears. Boadway & Sato (2000) also study how the tax (enforcement and policy) systems can affect **unintentional** compliance **errors** by taxpayers.
It can be shown that despite any likely moral commitment from a taxpayer to contribute to the public's expenditure, she could still be tempted to renege on her payment to the government. It seems that avoiding to contribute is in each person's interest, and since governments are not omniscient the only way to ensure socially responsible behaviors is to set a system of investigation and enforcement which can prevent the treat of non compliance decisions. Hence governments need to gather information in order to make up these systems. Thus governments must decide some main taxpayers characteristics upon which it seems suitable to condition the taxation and audit systems. On the other hand, taxpayers can try to manipulate some of their characteristics to their own advantage (create the appearance of malingering, for instance). From these interactions one can understand that the tax structure and the auditing and enforcement policies affect not only the amount of evasion but even its means and the root cause of individual refusal to comply.

Studying, from the view point of standard microeconomic analysis, how an individual taxpayer makes her decision, might be one of the main way to understand what could be the best policies against tax evasion. The aim of this chapter is to understand something of what we already know about tax evasion. There is a large literature on the topic of tax evasion. It has started by Allingham & Sandmo (1972) and surveyed by Cowell (1990) and Andreoni James & Jonathan (1998) which treat the evasion decision as a choice of consumption under uncertainty and that have studied how it is affected by the level of **real income** and the **risk aversion**. Two first important results are that people with *higher* risk aversion

tend to evade less and that rich people tend to evade more.
These results, as well as many powerful others reported in the literature of tax evasion, are founded on the assumption of UTILITY-MAXIMIZING behavior of agents. To understand how we can get such outcomes and what they are consequence of, let us consider a basic model, and let us start by an analysis of taxpayer's behavior. There is another interesting behavior: the government or revenue-authorities one, it will be briefly discussed later on.

Our aim is to analyze the choice problem of a RATIONAL taxpayer predisposed to be dishonest, i.e. without any moral surplus.
At the heart of such analysis lies an elementary lottery: "*Is it worth taking the chance of being caught and suffering a financial penalty?*" Assuming that the evasion decision involves only a single period, the taxpayer choice looks like one of the following: **comply** or **evade and how much**. This lottery generates two possible state of the world in one of which the taxpayer will be audited. So if she choses to comply the two states give rise to the same payoff c', if not, then there will be one state where she will be caught and she will get $c = c' - f$ (where f is a possible fine) as payoff, and another one where she will not be caught and so she will get c''; clearly $c'' \succ c' \succ c$. The exact nature of the lottery will be determined by:

- taxpayer's financial resources, i.e. her real gross income y;
- a set of tax enforcing parameters $\tau := (p, s, t)$, where p is the probability of being caught, s is the surcharge rate taxpayer has to pay for each unit of money she conceals and t is a proportional tax.

Let us assume that the taxpayer's payoff is her possible consumption, c, and since it can vary across states, it can be viewed as a stochastic variable (Cowell (1990)):

$$c = [1 - t]y + \mathbf{r} \cdot t \cdot e$$

where e is the difference between the gross income y and the declared income d (i.e. $e = y - d$) and $\mathbf{r}$ is the rate of return on each amount of money of evaded tax:

$$\mathbf{r} = \begin{cases} 1 & \text{with probability } (1-p) \\ -s & \text{with probability } p \end{cases}$$

Where p is the audit probability. Hence, the expected rate of return is $E(\mathbf{r}) = 1 - p - p \cdot s$. There can be three different cases:

1. **Full evasion** ($e = y$): in this case taxpayer's payoff will be equal to $c = (1-t-t\cdot s)y$ with probability p (if caught) and $c = y$ with probability $(1-p)$ (if not caught);

2. **Partial evasion** ($e = (y-d) > 0$): in this case taxpayer's payoff will depend on how much she wants to conceal so it will be equal to $c = y - t(y + s \cdot e)$ with probability p and $c = y + t(e - y)$ with probability $(1 - p)$;

3. **Full compliance** ($e = 0$): there will be no uncertainty and the taxpayer will get $c = (1 - t)y$ in both states of the world.

Hence $0 \leq e \leq y$, but the precise optimal point will depend on taxpayer's preferences since $e(\cdot)$ will be a function of her gross income and tax enforcing parameters, $e(\tau, y)$.

Let us denote with c' the consumption that the taxpayer can achieve if audited and with c'' the consumption that she can achieve if not audited. A common assumption in the literature is to use a *Von-Neumann Morgenstern* utility function, concave in consumption:

$$U(c', c'') = [1 - p] \cdot u(c') + p \cdot u(c'')$$

where $u(\cdot)$ is a concave cardinal utility function. It important to note that this assumption rules out both a state dependent utility, i.e. shame for being caught

or delight for a successful evasion, and misperceptions by the taxpayer about the probabilities of the two possible states of the world. Note that under these restrictions the absolute slope of any indifference curve at the point where it intersects the 45^o line must be exactly $\left(\frac{1-p}{p}\right)$[4]. Moreover concavity rules out the possibility of *risk-lovers*. In order to fully characterize the taxpayer behavior has been added a personal characteristic in addition to her gross income y, a sort of risk aversion measure, a, which measures the concavity of the utility function and on which the optimal evasion will also depend, $e(\tau, y, a)$. A first interesting result is that an increase of risk aversion will reduce evasion. If a^*-type has a greater risk aversion than a-type and if $e(\tau, y, a) > 0$ then:

$$e(\tau, y, a^*) < e(\tau, y, a).$$

Another common assumption is that the **Absolute Risk Aversion**, defined as $-\frac{u^a_{cc}(c)}{u^a_c(c)}$, is a decreasing function of c. It is well known that one important implication is that ceteris paribus, for any particular a,

$$e(\tau, y, a) < e(\tau, y^*, a)$$

if and only if $y < y*$. Hence an increase in the gross income y:

- will **increase** the amount of evasion e if the relative risk aversion, $-\frac{c \cdot u^a_{cc}(c)}{u^a_c(c)}$, is a decreasing function of c;
- will **not change** the amount of evasion e if the relative risk aversion is a constant function of c;
- will **decrease** the amount of evasion e if the relative risk aversion is an increasing function of c.

[4]To see this, observe that for any consumption prospect c, the marginal rate of substitution between consumption if caught, c'' and consumption if escape, c' is $\left[\frac{(1-p)\cdot u'(c')}{p \cdot u'(c'')}\right]$.

It is clear now that people with higher risk aversion tend to evade less. The result that people with higher income tend to evade more is derived under the assumption of decreasing relative risk aversion in consumption c.

In order to proceed the argument of this chapter it is useful to consider a previous model by Shlomo (1974) which was one of the earliest and best-known models of tax evasion. The former authors were mainly interested in the effect of an higher tax rate t on the amount of evasion e. Their result, while intuitive, shows the difficulties and subtleties of studying tax compliance. Their model was really similar to the previous one but there was a change in the taxpayer payoff if caught: their penalty was not proportional to the amount of tax evaded $t \cdot e$, i.e. $-s \cdot e$ instead of $-s \cdot e \cdot t$. We now try to answer the following question: How does evasion e change with the tax rate t? Considering the following expected utility:

$$E\big(U\big) = [1-p] \cdot u\big((1-t) \cdot y + t \cdot e\big) + p \cdot u\big((1-t) \cdot y - s \cdot e\big)$$

Examining the expected utility the effect of an higher t is ambiguous. To understand why note that an increase in t has two distinct effects. First, it lowers taxpayer net income $(1-t)y$. Now, since by assumption the absolute risk aversion is a decreasing function of consumption c, then this change should make people more risk averse regarding any e and so less likely to accept more evasion. However, there is a second effect since as t rises, the return to evade goes up while the penalty to getting caught, s, stays unchanged. This asymmetry should encourage evasion. Allingham & Sandmo (1972) show which effects dominates depend on how fast the absolute risk aversion declines, i.e., on the third derivative of the utility function. Shlomo (1974) show that if the penalty is proportional to the amount of tax evaded, $-s \cdot t \cdot e$, as in the first version of the model, then the amount of

evasion e will be reduced when the tax rate t increases[5]. Another interesting result is that an increase in the probability of detection, p, must reduce tax evasion, e.

Since a gamble which has an expected value lower than zero will not be chosen by a risk-averse agent, the government just needs to assure such condition by setting the penalty rate, s sufficiently high; but in the real world governments don't set such high penalties.

A generalization of the simple Allingham-Sandmo model is to account for repeated nature of reporting decision. This is quite natural since declaring an income is an annual event in most of the countries and taxpayers may condition their reports not only on future expectation but also on past reports and audit experiences. For instance, Greenberg (1984) provides a simple example where the authority has one-period memory and the taxpayers are put into three different categories. Those in category 1 have an audit probability $p_1 = \frac{1}{2}\underline{p}$ where $\underline{p} = 1/[1+s]$. Those in category 2 have a smaller probability: p_2. Members in category 3 are *always* audited. In each period, taxpayers are shifted between groups: Those in category 1 who are caught cheating are moved to category 2; those in category 2 who are audited are returned to category 1 if found to be true but are put into category 3 if found cheating; category 3 is a *black hole* for habitual evaders, i.e., once in it, the taxpayer stays there. If the taxpayers know about this rule, then it can be shown that, in equilibrium, all the taxpayers will be disposed as a convex combination between category 1 and 2, that is, α taxpayers in category 1 where everyone cheats and $(1-\alpha)$ in category 2 where everyone comply, such that α is less than the arbitrarily small minimum tolerable amount of evasion and $\alpha p_1 = (1-\alpha)p_2$.

[5]This because for any given e, an increase in t makes the expected consumption fall and increases the variance so that compliance is more attractive.

There will be *no one* in category 3.

A limit of Allingham & Sandmo (1972) is that it considers a constant probability of audit. In Italy, for instance, audits are likely to rely on the amount of declared income rather than being purely random. In the literature, a general framework in which the probability of audit is a function of the declared income and so determined at equilibrium, has already been developed. This framework has been used for a twofold purpose: to generate both prediction about evasion and the optimal audit strategy. Following this general framework models in the literature generally fall into two groups. The first assumes that the revenue authorities can announce and commit to its audit rule before taxpayers declarations. [6] Contrastingly, the second type of models assume that since the revenue authority cannot announce and commit to its audit rule it decides which taxpayers to audit after all the incomes have been declared. [7] Andreoni James & Jonathan (1998) carefully explain these two different type of models. Previous studies in this area examine the possibility of using the profile of declarations as a signal for the government. For instance Sanchez-Villalba (2006), show that the optimal auditing strategy is (weakly) increasing in the other taxpayers' declarations. The higher these declarations, the more likely a low-income declared is an evader. This reasoning is assumed (Alm & McKee (2004)) to be behind the method used to determine which taxpayers to audit. But while Alm & McKee (2004) is a laboratory experiment where the (*ad hoc*) policy is contingent on the distribution of income declarations in Sanchez-Villalba (2006) the agency's optimal strategy is derived instead of assumed.

[6] These models have much in common with standard *principal-agent* problem.

[7] This kind of models make use of *sequential equilibrium* concept from standard game-theory.

Let us now consider the following extension of the previous model. Assume that there is a population of taxpayers and each of them receives a true income $y \in [l, h]$ (where l and h are respectively the lowest and the highest level of income). True income is distributed according to a density function $f(y)$ so that $F(\cdot)$ is the associated distribution function. The assumption of perfect detection is kept, i.e. that the government can learn the true income by performing an audit, moreover we introduce the fact that the government has an exogenously determined budget B and that each audit has a cost c.

The timing of this game is as follows: first each taxpayer makes her declaration d[8], and pays taxes accordingly $t(d)$, then the government audits a subset of them. For a taxpayer of true income y the expected utility is the following:

$$E\big(U(d)\big) = \big(1 - p(d)\big)U\big(y - t(d)\big) + p(d)U\big(y - t(d) - \vartheta[t(y) - t(d)]\big)$$

Where $p(d)$ is the probability of audit associated to the declaration d and $\vartheta[t(y) - t(d)]$ is the penalty (and $\vartheta[0] = 0$).

What is the objective of the government? Most of the literature assumes that government's objective is to maximize the expected net revenue (tax and penalty revenue less audit cost). Hence the government maximize the following:

$$\int_{\underline{d}}^{h} \left\{ p(d)E\Big[\big(t(y) + \vartheta[t(y) - t(d)]\big)\Big|d\Big] + \big(1 - p(d)\big)t(d) \right\} dF(d)$$

Where $E[\cdots|d]$ is the conditional expectation given the declaration d, $\underline{d}$ is the lowest declaration made by any taxpayer, and $F(d)$ is the induced distribution function over d.

[8]Which generally is at most equal to the true income, $d \leq y$, see Scotchmer (1986).

The government must meet the budget constraint:

$$c \int_{\underline{d}}^{h} p(d)\, dF(d) \leq B$$

An alternative to such a policy that we do not consider here, would be to allocate resources in order to maximize *social welfare*.

Consider now the situation where the tax authority commits to an audit rule before taxpayers make their declaration. In such a framework the optimal government strategy (for a fixed budget constraint) usually involves a *cut-off* rule. The cut-off rule was first introduced in the tax evasion literature by Reinganum & Wilde (1985), while Sanchez & Sobel (1993) provide a discussion of these types of models. The simplest cut-off rule consists in, a limit value w, and an audit policy with some audit probability p for declarations d below the threshold value w, but a zero audit probability for all the declarations above it. The limit value w is chosen so that the budget constraint is just exhausted at equilibrium. The audit probability p, is chosen to be just enough so that all the taxpayer with true gross income below w report truthfully. Moreover, if the tax and the penalty are linear and taxpayers are risk-neutral, the optimal value of p is $\frac{1}{(1+s)}$(Scotchmer (1986)), but when p is so, taxpayers with true gross income above w chose to declare precisely w, paying $t \cdot w$ and bearing no-risk of being audited.

Finally, Sanchez & Sobel (1993) show that such a simple cut-off audit rule maximizes the expected government net revenue only under quite restrictive assumptions such as *risk-neutral* taxpayers and linear penalty s.

Chapter 2

Tax Evasion and cut off policy - A Case Study in Italy: Sector Studies

This chapter analyzes a fiscal mechanism used in Italy, which in Italian is called "Studi di Settore" (Sector Studies). This mechanism relies on information gathered on taxpayers to both partition the population into fairly homogeneous clusters and to determine the presumed income they should declare. When this estimated income is announced, before taxpayers fill out their tax returns, their optimal declaration strategies lead the taxpayer population to be endogenously divided into three homogeneous groups, one of which pays more taxes than are due, the second group comply but bears the audit cost, while the third evades and it is not audited. This result is close to the Italian situation where the greatest number of taxpayers make a tax declaration according to the announced cluster income, but there are always those who declare less and so are audited.

2.1 Introduction

It is a widespread practice for governments to gather observable and measurable characteristics of taxpayers and to group the population into homogeneous categories in order to better estimate their real gross income. While it is common to keep those income estimations hidden (e.g. France), in Italy they are announced to the taxpayers before they are asked to fill their tax returns. This mechanism is called Sector Studies and it consists in a cut-off policy: once the government chooses and announces the estimated income, it is common knowledge that all those taxpayers who declare less than this estimation are surely audited.

The policy of introducing additional information eliminates uncertainty for the taxpayers. Once the estimated income is announced, taxpayers' payoff depend upon their own decisions; but it also gives a strong incentive to declare the estimated income.

This chapter focuses on the problem a taxpayer faces when deciding his tax declaration in such a scenario. The principal aim is to understand if this cut-off policy is indeed optimal for the government and if it is fair for the taxpayer. Starting from what is happening in Italy, that is the majority declare their estimated income but there is a minority who do not, a model is constructed where there is a fixed distribution of income in the economy and audits are costly for both government and taxpayers.

The first model on this topic was proposed by Allingham & Sandmo (1972), and their aim was to understand if higher tax rates generate more or less compliance. Their model was then generalized by Pencavel (1979), Cowell (1981) and Sandmo

(1981) which make income endogenous by adding labour supply [1]. The research in the area was then surveyed by Cowell (1990) and Andreoni James & Jonathan (1998).

Reinganum & Wilde (1985) first introduced the cut-off rule [2], but while in their model taxes and fines are lump-sum and audit are costly only for the government in the model developed here taxes and fines are set proportionally to the declared or real income and audits are costly for both the government and the taxpayer. These assumptions are more realistic and closer to the situation in Italy.

In a model with risk-neutral taxpayers[3] that are distributed in a given segment we prove that the cut-off policy gives rise to three different groups into which taxpayers are endogenously divided. **1)** A group is audited with certainty: these taxpayers bear the audit cost and no individual dishonestly reports their income (this group can be defined as Compliance Taxpayers). **2)** Tax reports in the middle group are equal to the estimated income so that no one is audited but individuals pay more taxes than are due (this group is a Fake Congruous group). **3)** Tax declarations in the highest group are equal to the estimated income so that no one is audited but since individuals' real income is greater than the estimated one, they pay less taxes than are due and so evade (this group is defined as Evaders).

The focus of this chapter is the taxpayer's behavior and in order to understand it

[1] Tonin (2011) builds a model of the labour market that predicts a spike in declared income at the minimum wage level, and supports this result with evidence based on Hungarian data.

[2] Also Sanchez & Sobel (1993) discuss these types of models.

[3] While Risk-Neutrality is a nice feature that simplify the discussion in this paper, it can be shown that all the results hold even without it. Note that there is not uncertainty about taxpayer payoff since all the elements of the game are common knowledge.

one needs to analyze the government problem. So also the solution to the government problem has been characterized. The optimal threshold value, as noted by Reinganum & Wilde (1985), is chosen so that the audit budget is just exhausted at equilibrium.

The next section briefly presents a description of the Italian system. Section 2.3 describes the model and characterizes the solution to taxpayer and government problems. Section 2.4 describes the equilibrium. Section 2.5 provides a discussion about the result and further research perspectives while section 2.6 concludes.

2.2 Description of the System

The Sector Studies were introduced in the Italian regulations in 1993[4] in order to overcome the incongruities of the old fiscal system[5] and to regulate and avoid possible conflicts between the revenue-authorities and taxpayers.

One can see the Sector Studies as an instrument which is used to estimate the capability of producing revenues of medium-small businesses and practitioners. The Sector Studies are accomplished with a systematic gathering of data. There are two types, fiscal and structural data, which characterize the taxpayer's activity and the economic framework where it is supposed to be developed. Therefore the **Sector Studies** allow one to **estimate** the **taxpayer's revenues**, identifying the potential taxpayer's capability of producing revenues and the features which can

[4]As reported by the *Societá per gli Studi di Settore* (Sose) they were introduced by *D.L. 30/08/1993, n. 331.*

[5]The previous fiscal system, in 1970, linked the determination of firm's and autonomous worker's income to the published accounts, in a way that the system favored the heedful evaders and penalized the honest but forgetful taxpayers.

affect it. Moreover, the Sector Studies take into account some peculiarities of the geographical area in which the taxpayers' activity is developed (externalities, etc.).

The **single** Sector Study is achieved through the following legal process:

Data gathering. The data gathering uses two different sources depending on the Sector Study. If it is a new one, an initial version is created using data collected from **questionnaires** which **taxpayers** are asked to compile. Instead, an advanced form of data gathering is used for an *already achieved* Sector Study through an analysis of previous declarations. Independently of the approach used, data are screened so that only significant information will continue to the next stage in the process.

Significant Data Elaboration. A first analysis leads to the choice of the main variables through which homogeneous groups (called **clusters**) of taxpayers are detected. Then any cluster is **normalized** in the sense that outliers are not considered in its definition.

Performing Gerico. Gerico is the software which applies the Sector Studies, processing information and computing the foreseen revenues. At this stage it assigns to any of the former clusters a function (for instance, $F : C_i \to \mathcal{R}_+$, where C_i can be a single cluster) which gives the expected income for that cluster.

Implementing the Sector Study. Finally gerico assigns every taxpayer to one or more clusters, according to her *structural features*, which are objective so that taxpayers cannot choose them at this stage, is assigned through gerico . The foreseen income is computed and produced by Gerico through a regression on the taxpayers features taking into account also some feasible correctives (environmental factors for instance).

The following tables present some important empirical data concerning the Sector Studies:

Tab 1 - The Sector Studies audience (Sose 2005)

Fiscal Year	Number of Sector Studies	Obliged Taxpayers	Non-obliged Taxpayers	Total Taxpayers
1998	45	1.442.351	3.736.799	5.179.150
1999	86	2.128.336	3.041.430	5.169.766
2000	129	3.023.068	2.136.405	5.159.473
2001	168	3.786.079	1.366.416	5.152.495
2002	202	4.197.813	949.794	5.147.607
2003	228	4.424.498	716.920	5.141.418
2004	206	4.440.108	701.277	5.141.385

Tab 2 - Data concerning the overall audience (Sose 2005)

	2003			**2004**			**2003/2004**
	Non congruous	Congruous	Tot	Non congruous	Congruous	Tot	% rising
Taxpayers	901.980	2.221.199	3.123.179	1.003.562	2.189.613	3.193.175	2,24%
% composition	28,88%	71,12%	100,00%	31,43%	68,57%	100,00%	
% of Fitted	36,36%			46,90%			28,99%

The previous tables shows that italian taxpayers use to declare a *congruous* income so that the Sector Studies prophecy is almost always realized, but still there is a group who declare a *non congruous* income. Our objective is to understand, through a specific model, why this is so.

2.3 Model

The model developed here focuses both on the *evasion decision* and on the *optimal government threshold value* within a given cluster. For simplicity one assumes that there is a population of taxpayers each of which possesses a true income I_i which can be viewed as the taxpayer's type. There is a continuum of types since true income is distributed along a continuum between l and h (where l and h are respectively the lowest and the highest level of income within a given cluster[6])

[6]One assumes the lowest level of income l to be high enough to assure a non negative profit so that there is not exit in the model.

according to the density function $f(I)$ where $F(\cdot)$ is the associated distribution function. *Perfect detection* is assumed, i.e. the government can learn a taxpayer's type (their true income) by performing a costly audit [7].

The timing of this game[8] can be represented as follows: first, the government, knowing $f(I)$, choses and announces the **gerico income**, g, to the taxpayers. Then, each taxpayer, knowing their type I_i, submits their income declaration d_i, and pays taxes accordingly. In doing so, each taxpayer knows that the probability of being audited is zero if the declared income is congruous (i.e. at least equal to the gerico's one) and it is equal to one if not[9]. Finally, the revenues-authorities, knowing both the *gerico income* and all the declarations, undertake **audits** accordingly to the already committed audit rule, and collect fines where due.

It should be clear that the revenues-authorities in this setup do not make any choice since the *cut-off rule* which fixes the audit probability to one for all those who have declared less than the *gerico income*, but leaves unaudited all that have declared it or more, is exogenously stated by law.

2.3.1 Taxpayer Problem

Taxpayer i's problem consists of choosing how much income to declare in order to maximize their utility function.

[7] A different assumption is used by Snow & Warren (2005) who show how an increase in taxpayer uncertainty about the amount of tax evasion that will be detected affects the choice of evasion.

[8] One assumes that the Sector Study under analysis have already been completed and approved.

[9] Even if the Italian regulation states that declaring a congruous income does not exclude one from an audit, in practice the probability of an audit is drastically reduced to nearly zero.

Taxpayers are uniformly distributed on the $[l, h]$ segment and their income is their type. Taxpayers are assumed to be risk-neutral, so that their utility function is linear in disposable income:

$$u_i = I_i - td_i - a_i \Big[\max \big\{0, (I_i - d_i)\big\}(t + f) + c \Big] \tag{2.1}$$

where I_i is taxpayer $i's$ gross income, $t \in (0, 1)$ is the tax rate, $d_i \in [0, +\infty)$ is taxpayer $i's$ income declaration, $a_i \in \{0, 1\}$ is a boolean value defined as:

$$a_i = \begin{cases} 1 & \text{if } d_i < g \text{ and so taxpayer } i \text{ is audited} \\ 0 & \text{if } d_i \geq g \text{ and so taxpayer } i \text{ is not audited} \end{cases} \tag{2.2}$$

and $f \in (0, 1)$ is the additional rate taxpayer i should pay if caught cheating while $c \in \Re^+$ is the fixed cost each taxpayer suffers if audited.

All the parameters of the problem are common knowledge. Moreover, since at this decision node the threshold value g is already decided and announced by the government, the taxpayers have *no uncertainty*. This lack of uncertainty is due to both the fact that taxpayers know about the cut-off policy and the assumption of perfect detection.

Therefore, once taxpayer i knows about her type I_i, her problem is to maximize (2.1) choosing d_i. Since there is no uncertainty, the optimal declaration will be a function of the taxpayer's type I_i. Hence two cases need to be considered: one is when $I_i \geq g$ and the other is when $I_i < g$. In both cases, taxpayer i has to decide how much to declare.

The first case is straightforward and it is characterized in the following lemma:

Lemma 2.1 *High type taxpayers ($I_i \geq g$) always choose to declare the threshold*

value g, paying tg and bearing no risk of an audit. Formally,

$$d^*(I_i, g) = g \qquad \forall I_i \geq g \tag{2.3}$$

Proof. From the comparison of the utilities a high type taxpayer ($I_i \geq g$) gets, when they declare less than g ($u_i^{d_i<g} = (1-t)I_i - (I_i - d_i)f - c$), more than g ($u_i^{d_i>g} = I_i - td_i$) or exactly g ($u_i^{d_i=g} = I_i - tg$). ■

In the second case, i.e. when $I_i < g$, since there is no uncertainty, a threshold g declaration leads to an utility of $u_i^{d_i=g} = I_i - tg$. Of course, even for low type taxpayers, this strategy strictly dominates declaring more than g. This follows by the fact that the audit probability is a step function (2.2) . Moreover, also by the previous fact, it follows that cheating, i.e. $d_i < I_i$ or declaring more than real income, but less than g, are both strictly dominated strategies by the *compliance strategy*, i.e. declaring I_i, paying tI_i of taxes and c as audit cost. Hence, it is clear that the cut-off policy, by setting an audit probability equal to one if the declaration d_i is below the threshold g, eliminates evasion making compliance much more attractive than evasion. However, since being audited is not costless for the taxpayer, the cut-off policy allows them to avoid such cost c, by a *congruous declaration*. It follows by the previous argument that the cheapest *congruous declaration* is the *threshold declaration* $d_i = g$.

Low type taxpayers' decisions depend on the comparison between *compliance* and *threshold declaration* as follows:

$$d^*(I_i, g) = \begin{cases} I_i & \text{if } I_i < \bar{I} \\ \in \{I_i, g\} & \text{if } I_i = \bar{I} \\ g & \text{if } I_i > \bar{I} \end{cases} \tag{2.4}$$

where $\bar{I} := g - \frac{c}{t}$ is the type which is indifferent between the two strategies.

Jointly the lemma 1 and the equation (2.4) present the solution to the taxpayer problem.

Intuitively, high type taxpayers evade since they bear no risk of an audit, while low type taxpayers are split into two groups, i.e. there is a gross income level $\bar{I}$ below which taxpayers comply and above which taxpayers declare the threshold value g. This implies that a taxpayer's declaration is (strictly) increasing for income levels $I_i \in [l, \bar{I})$ and constant for $I_i \in (\bar{I}, h]$.

The latter results are summarized in the following lemma:

Lemma 2.2 *A taxpayer's optimal declaration strategy is: (1) (weakly) increasing in their type I_i. and (2) it is the same for all taxpayers. Formally:*

$$(1) \qquad \frac{\partial d^*(I_i, g)}{\partial I_i} \geq 0 \tag{2.5}$$

Proof. The first follows by direct inspection of equation (2.5). For the second part, it is the result of $\bar{I}$ being a constant that is independent of the taxpayer's type whose strategy has being analysed. ■

To a characterize further the taxpayers optimal declaration strategy, the next proposition shows how it is influenced by the threshold value g:

Proposition 2.1 *Given a type I_i, (1) there exists a critical value $\bar{g} := I_i + \frac{c}{t}$ for which taxpayers' optimal declaration strategy makes a downward jump. Moreover, taxpayers' optimal declaration strategy is (2) (weakly) increasing in the threshold*

value g, below $\bar{g}$ and (3) constant above it. Formally:

$$(1) \quad d^*(I_i, g) = \begin{cases} g & \text{if } g < \bar{g} \\ \in \{I_i, g\} & \text{if } g = \bar{g} \\ I_i & \text{if } g > \bar{g} \end{cases} \tag{2.6}$$

$$(2) \quad \frac{\partial d^*(I_i, g)}{\partial g} \geq 0 \qquad \text{if } g \in [l, \bar{g}) \tag{2.7}$$

$$(3) \quad \frac{\partial d^*(I_i, g)}{\partial g} = 0 \qquad \text{if } g \in (\bar{g}, h] \tag{2.8}$$

Proof. For the first part, it is simply expressing the equation 2.4 in terms of g. The second and the third follow by direct inspection of equation 2.6. ■

The idea is straightforward: given a type I_i, as the threshold value g increases the optimal declaration increases accordingly up to the point where declaring g and paying tg is as costly as declaring I_i, paying tI_i and suffering the cost c of an audit. Above such point, a taxpayer of type I_i prefers to comply rather than being congruous. It is important to note that the model gives rise to an empty segment in the distribution of the tax declarations.

2.3.2 Government Problem

The government's objective is to raise revenue by choosing the threshold value g taking into account the distribution of income $F(I)$ and that the cut-off policy is already stated. Moreover, assume that the government has a budget B which is exogenously determined, and since any single audit has a cost of k the government's expenditure can be at most B. For a taxpayer of true income d_i the expected utility is the following:

$$E\big(U(d_i)\big) = td_i + Pr(d_i < g)\Big[\max\big\{0, (I_i - d_i)\big\}(t + f) - k\Big] \tag{2.9}$$

The government anticipates taxpayers' strategies, and since the gross income's density function $f(I)$ is common knowledge, the government knows that to any given threshold value g, it has to audit each taxpayer whose declaration is below the critical level of income $\bar{I} = g - \frac{c}{t}$, and it gains tI_i [10] for each of them. Moreover, all the other taxpayers (that is above $\bar{I}$) will declare the threshold value g so that the government will acquire tg from each of them.

Therefore the government solves the following problem

$$\max_{g} \quad \int_{l}^{\bar{I}} (tI - k)\, dF(I) + \int_{\bar{I}}^{h} tg\, dF(I) \tag{2.10}$$

$$\text{subject to} \qquad k \int_{l}^{\bar{I}} dF(I) \leq B \tag{2.11}$$

The solution to this problem depends on the actual income distribution and in order to characterize the solution recall the assumption of a uniformly distributed taxpayer on the $[l, h]$ segment.

Proposition 2.2 *The best response of the government to taxpayers strategies is to set a threshold value equal to:*

$$g^* = l + \frac{c}{t} + \frac{B}{k}(h - l) \tag{2.12}$$

We obtain the following lemma:

Lemma 2.3 *The optimal government threshold strategy is : (1) increasing in its budget B, (2) increasing in taxpayers audit cost c, (3) decreasing in the tax rate t,*

[10] This because the government knows that all such taxpayers will declare truthfully.

(4) decreasing in its audit cost k, (5) increasing in the highest cluster income level h, (6) decreasing in the lowest cluster income level l. Formally:

$$\begin{array}{lll} (1) \quad \dfrac{\partial g^*(\cdot)}{\partial B} > 0 & (2) \quad \dfrac{\partial g^*(\cdot)}{\partial c} > 0 & (3) \quad \dfrac{\partial g^*(\cdot)}{\partial t} < 0 \\ (4) \quad \dfrac{\partial g^*(\cdot)}{\partial k} < 0 & (5) \quad \dfrac{\partial g^*(\cdot)}{\partial h} > 0 & (6) \quad \dfrac{\partial g^*(\cdot)}{\partial l} < 0 \end{array} \tag{2.13}$$

Proof. By direct inspection of equation (2.12). ■

Intuitively, since the government cannot overreach its budget B, and since, by law, it has to audit all the taxpayers who are declaring less than the threshold value, g^* will be chosen so that the audit budget B is just exhausted in equilibrium, and hence the g^* will be an increasing function of the audit budget.

Furthermore, it is straightforward to show that if one assumes an unconstrained maximization for the government, the threshold value g is not set to the highest cluster income level h (see appendix A).

2.4 Equilibrium

Once the private information variables (the government's budget B and each taxpayer's type I_i) are realized, the equilibrium appears to be *unique*: partial overdeclaration. The taxpayers are divided into three groups:

1. **Evaders** ($h \geq I_i > g^*$): these taxpayers declare the threshold value g^*, pay tg^* and since they are not audited they evade an amount of tax, $t(I_i - g^*)$;

2. **Fake Congruous** ($\bar{I}^* \leq I_i < g^*$)[11]: taxpayers in this gorup declare the threshold value g^* and pay tg^* even if their real income I_i is lower. Hence

[11] Where $\bar{I}^* = g^* - \frac{c}{t}$.

they pay an extra amount of tax $t(g^* - I_i)$ (over-declaration) and they are not audited;

3. **Compliance Taxpayers** ($l \leq I_i \leq \bar{I}^*$): these taxpayers comply, truthfully reporting their real gross income I_i and paying tI_i but since they are audited they bear a cost c.

Therefore, the government bears a total cost of $k \int_{l}^{\bar{I}^*} dF(I)$ without earning any fines since evaders are not caught. Note that the establishment of the **Fake Congruous** group is due to the taxpayers audit cost c. The previous result are summarized in the following proposition:

Proposition 2.3 *The unique equilibrium appears to be the case of partial over-declaration: high type taxpayers ($I_i > g*$) evade and are not audited as middle type taxpayers ($\bar{I}^* \leq I_i < g^*$) who declare more than their real income, while low type taxpayers ($l \leq I_i \leq \bar{I}^*$) comply and are audited with certainty.*

Proof. Follows directly from the definition of the payoff function of the players (equation 2.1 and 2.10), their optimal strategies (lemma 2.2 and 2.3 and proposition 2.2) and the assumption of a uniform distribution. ■

The proposition highlights the fact that the chosen cut-off policy, although allows for optimal government strategy, penalizes **low-type** taxpayers either in bearing the audit cost or in paying more than due taxes. On the other hand, it gives a great incentive to evade for **high-type** taxpayers who are never audited.

2.5 Discussion and Future Research Perspectives

The model developed here gives a plausible explanation of what is happening in Italy. It is easy to see how a lot of small businesses and practitioners flatten

their declaration to the gerico value, but there are still those who declare a non congruous income. While this model gives a twofold explanation to the former phenomenon, that is either taxpayers have a greater real income than the gerico's one or they prefer to pay taxes accordingly to the sector study in order not to bear the cost of an audit, it gives one motivation to the latter, i.e. they prefer to bear the cost of an audit rather than paying taxes accordingly to the sector study, since it is less costly for them to do so.

Finally, the model captures the importance of the **partial over-declaration** phenomenon which follows by the cut-off policy decided by the Italian regulatory authority. Consider that there might be a case where, within a cluster, the total amount declared could actually exceed total income because of the fake congruous over-declaring.

An open question is why the Sector Studies set the audit probability equal to one for reports below the threshold value? It is true that this gives to taxpayers whose type is lower than the threshold value the incentive for honest declarations. However using the model in this paper one can notice that the probability that eliminates evasion which gives the same incentives is lower than one, although it implies a reduction of the *fake congruous* group. We give some hints on this point in the appendix B where we characterize the solution to the taxpayer's problem in such scenario. The idea can be that the government wants to keep this group as numerous as possible. It may be also possible that the explanation is political or maybe it lies in the income distribution. Maybe the income variability within a cluster is very low and so the government is almost sure about its estimation or perhaps it is just what it wanted to show. If the former hypothesis is correct then the audit probability would be a decreasing function of the income distribution

variance. This question is left open for further investigation.

2.6 Conclusions

The question of a taxpayers' optimal strategy in the presence of this kind of cut-off rule is relevant because it is not unusual for such policies to be the main source of unfairness and an obstacle for new small businesses and practitioners. Implementing this policy requires a lot of information to be gathered by the government and, under these circumstances, while the governments best policy consists of setting a threshold value accordingly to its audit budget, a taxpayer's optimal strategy consist of either declaring the threshold value or declaring their true income according to their type. Taxpayers are therefore divided, accordingly to their types, into three homogeneous groups; one of which pays more taxes than due (over-declaration), another complies but bears the audit cost, while the third evades and it is not audited.

Chapter 3

Tax treaties and the allocation of taxing rights between developed and developing countries

Global income taxation in the country of residence is a legal dogma of international taxation. This chapter questions this dogma from the perspective of relations with developing countries from a legal and economic perspective, and makes a modern and fair proposal for tax treaties. This work will show under which conditions a developing and a developed country will *voluntarily* sign a tax treaty where *information is exchanged truthfully* and whether they should *share revenues*. Moreover, it will demonstrate how the conclusion of a tax treaty can assist in the *implementation of a tax audit system*.

3.1 Motivation

Worldwide income taxation in the country of residence is a global legal dogma of international taxation (see Mc Daniel (2007); Fleming *et al.* (2009)). Conceived to fit relations between countries with symmetrical flows of capital, this dogma gradually spread throughout the world (see Christians (2010)). This research questions this dogma from the perspective of relations between developed and developing countries for two reasons. From a legal perspective, expanding the taxing sovereignty beyond the national borders leads to overlaps with the sovereignty of the state of source and international double taxation may arise. From a tax policy perspective, the deduction of the foreign tax by the country of residence[1], reduces the possibility of developing countries to attract foreign capital through tax policy. A reduction of such tax by the country of source turns into a lower deduction against taxes due in the country of residence. This achieves capital export tax neutrality, but eliminates the possibility to reduce taxes by countries in order to attract foreign capital.

This chapter regards this outcome in conflict with international tax justice and a fair allocation of taxing powers (see Pistone & Goodspeed (2010)). In particular, in the presence of unidirectional flows of income or capital, as is typically the case for relations with developing countries, worldwide income taxation by the country of residence allows capital exporting countries to link up to their taxing jurisdiction income that has in fact been sourced or produced outside of its borders. This mechanism therefore interferes with the tax policy decisions of the country in connection with those territories where the income was generated. The ambition of this work is to present a solution to replace the worldwide income tax principle. A modern view, that takes information sharing seriously, is needed to make use of tax

[1] i.e. relief for juridical double taxation by the so-called foreign tax credit method.

treaties as an instrument for a fairer allocation of taxing powers and co-operation between developing and developed countries.

3.2 Related legal and economic literature

The features of the *worldwide income taxation in the country of residence* policy can be summarized as follows: When - as it is often the case - taxes levied in the developing country are lower than those applicable in the developed country, the latter will in fact levy its own taxes on income produced in the territory of the developing country under the noble justification that this will discourage developing countries from negotiating a race to the bottom with powerful multinational enterprises (see Brooks (2007); Pistone (2010)).

Remarkably, developed countries often abstain from compensating their more favorable domestic tax regimes. Even more remarkable, is the effect that this international scenario has on multinational enterprises that are stimulated to invest in complex (and expensive) international tax planning schemes in order to repatriate the investment of their capital through high tax jurisdictions that exempt foreign source income and an appropriate use of the diversity of tax treaties around the world (see Commission (2009)).

This work aims at considering whether the allocation of taxing powers can be reshaped in a way that allows the developing country to have a "fair share" [2] of the revenue originated from the exploitation of its territory (Benshalom (2010), Brauner (2010), Brooks (2009)). The goal of the joint legal and economic analysis is to secure for each developing country a sound and sustainable tax policy, based

[2] To be defined below.

upon the certainty of financial resources, sourced within the same country, consistently with the national policy objectives of that country and without external interferences (Brauner (2010), Christians (2010), Dagan (2010)).

From a legal perspective, states are free to decide whether or not to conclude a tax treaty. However, if a treaty exists, the contracting states are obliged to execute it in good faith, in compliance with the requirements of the Vienna Convention on the Law of Treaties. Therefore, insofar as a treaty exists and includes a clause on the exchange of information, the supply of information will be an ordinary consequence of the obligation to execute the treaty in good faith. Nevertheless, some years ago the OECD has clarified that requests for information not duly backed up by accurate documentation, gathered in accordance with the framework of a preliminary auditing activity, are to be regarded as a "fishing expedition" and thus do not imply any obligation for the requested contracting state to supply the information.

From an economic perspective, information asymmetries where a developing country will have information on firms tax-resident in a developed country can be solved by giving the developing country the right incentives to share this information. These information sharing theories can be implemented in tax treaties. In these theories, information is considered a tradable good, and thus revenue sharing inevitably will come alongside the exchange of information. Until now such (economic) theories have received a limited attention among legal taxation experts.

Bacchetta & Espinosa (2000) have analyzed the problem of information sharing for capital income taxation, demonstrating that information exchange can be supported only if governments interact repeatedly. Keen & Ligthart (2007) apply the

concept of information exchange to the EU savings directive. They compare a scenario without information exchange to a situation with the exchange of information, where a country can unilaterally set a withholding tax to retain part of the tax revenues. Whilst they do not explicitly state it in their paper, the model could be used to analyze the benefits of signing a tax treaty with revenue sharing and information exchange, and can thus be considered a special case of the analysis carried out here.

The first empirical application that investigates the motives for countries to sign a tax treaty has been carried out by Voget *et al.* (2011). They find that apart from reducing or eliminating cross-border double taxation, tax treaties are also signed to obtain a legal instrument for the exchange of tax information. In this respect, Voget *et al.* (2011) provide evidence for the theory presented in this chapter.

The current concern about the move towards global fiscal transparency has increased the general awareness of the importance to secure an effective exchange of information through tax treaties. Therefore, regardless of whether tax treaties in fact affect foreign direct investment, this study aims at establishing a fair and effective exercise of the taxing sovereignty on the basis of tax treaties in relations with developing countries through a mechanism that pursues an effective exchange of information (Barthel *et al.* (2010)).

This work regards tax treaties as the only instrument through which developed countries can obtain the sufficient and objectively reliable information to exercise their sovereignty on revenue from developing countries (Christians (2005)). However, developing countries do not necessarily have the relevant infrastructure and auditing systems for supplying such information, which also entails substantial

costs for them. Furthermore, insofar as the tax treaty flow of information does not work properly, developed countries find themselves in a similar situation to that arising in the absence of a tax treaty. Accordingly, for instance, they would be unable to check whether transfer pricing within multinational groups effectively corresponds to the function performed by companies in developing countries with respect to income sourced in those countries. In such cases, firms may more easily hide all or a part of their revenues.

3.3 Scope of the work

This work elaborates a model that allows for an effective and sustainable exchange of information in situations with unidirectional flows of income and capital, assuming this to be the most frequently occurring situation between developed and developing countries. The analysis also takes into account the possible impact of an effective exchange of information on the mobility of investment by multinational enterprises at the international level, assuming two scenarios in which firms respectively (i) can and (ii) cannot move to other developing countries.

The mechanism contemplated in this study allocates taxing powers in a way that makes it affordable for developing countries to sustain the costs of an effective audit carried out to the standards required by global fiscal transparency (and in certain cases even to introduce such a system of auditing) and exercise their tax sovereignty in compliance with their own internal policy. The allocation of taxing powers allows one contracting state (normally the developed country) to tax the income up to arm's length value and the other contracting state (normally the

developing country) to tax the remaining part of the income. [3]

In the following, the design for a modern and fair tax treaty will be presented. The treaty is modern in the sense that it takes information sharing between contracting states seriously. It is fair in the sense that it will comprise revenue sharing of tax revenues collected by the developed country. It is assumed that both contracting states are small, and one can therefore treat tax rates as given. For the sake of simplicity governments are assumed to be Leviathan, and therefor maximize their own revenues.

The chapter proceeds as follows. The next section, discusses the situation where firms are immobile. Though this scenario may not be realistic, it is simple and yet permits one to show all the main results. This assumption is relaxed in section 3.5. Within each section, four distinguished cases are needed to be solved, depending on whether a treaty exists or not, and whether the developing country audits firms and gathers the necessary data for information sharing or not. The benchmark case without a treaty is described in the first subsection. Here it is assumed that the developed country adopts the tax credit method, and unilaterally allows full deduction of all tax payments to the developing state. [4] The second subsection, will discuss the alternative case of a treaty, where it is assumed that countries split the tax base according to the arm's length transfer pricing principle. In order to obtain information about its taxpayers from the developing country, the developed country may be willing to share part of its tax revenues, and this work will indicate the range of revenue sharing where a tax treaty is feasible.

[3] A good example of this is the predetermined mechanism currently applicable on a unilateral basis for determining transfer pricing in the Brazilian tax system.

[4] This scenario covers the vast majority of all potential international tax cases.

3.4 The model economy without firm relocation

Consider $n \in \Re^+$ identical multinational firms that produce a fixed quantity, q, of a homogeneous good in a developing country U. For the ease exposition assume that firms sell the q goods in a developed country D at a price $p_d \in \Re^+$.[5] The sales price p_d is constant and known to both countries and normalized to $p_d = 1$.

Firms produce with constant marginal costs $\tilde{c}_i$. These costs, by hypothesis, are stochastic and unknown to both countries. For the sake of simplicity each $\tilde{c}_i$ is a random variable which can assume two values: $high$ $\big($with probability $\rho \in [0,1]\big)$ or low $\big($with probability $(1-\rho)\big)$, i.e. $\tilde{c}_i \in \{c_l, c_h\}$. [6] Note that the developed country cannot observe the true realization of individual production cost $\tilde{c}_i$, but knows the probability ρ, so that it can foresee the number of firms producing with a low and high marginal costs.

As quantity neither influences marginal costs nor the sales price, one can assume that each firm produces exactly one unit of the good, $q = 1$ without loss of generality. Expected gross operating profits of firms are therefore given by $1 - \overline{c}$, where $\overline{c} = E(\tilde{c}_i) = \rho c_h + (1-\rho)c_l$. In the absence of a tax audit system, firms can claim any reasonable cost to either country. [7]

Both countries can and - in the absence of a tax treaty - will tax each firm i's realized global gross profits $1 - \tilde{c}_i$. [8] Thus, headquarter shopping are excluded. Finally, assume that there are no firms that produce in D and sell in U.

[5] Consumers in D are assumed immobile.

[6] With $0 < c_l < c_h < p_d = 1$.

[7] In our case, firms can claim at most costs of c_h.

[8] For the sake of simplicity assume that D can levy a corporate income tax on revenues in D even in absence of a subsidiary.

The developing country U can learn the actual realization of each firm's $\tilde{c}_i$ bearing a (sunk) cost $M(n)$, with $\frac{\partial M(\cdot)}{\partial n} > 0$. By assumption there are fixed costs of implanting a tax audit system (i.e $M(0) > 0$). The developed country D cannot observe or learn the true realization of $\tilde{c}_i$ and must therefore trust either the firm or the developing country U's claim. In legal terms, country U's claim can be dismissed for the absence of any legal obligation of country D to consider it. However, country D may also find it unsatisfactory to passively import data from the firms without being able to verify them. This situation has allowed international tax planning to make use of artificial structures and tax driven schemes for several decades. This practice is judged highly undesirable in the framework of global fiscal transparency, which is making considerable progress with the support of the G20.

3.4.1 No Treaty

In the absence of a tax treaty and firm relocation, the developing country must still decide whether to implement a tax audit system and thereby reveal information about its resident firms, in particular about their true costs of production.

The developing country U will decide to audit if and only if tax revenues with implementation of an audit system, (i.e. T_u^{na},) are (weakly) greater than tax revenues without audit, T_u^{nn},

$$T_u^{na} = nt_u(1 - \overline{c}) - M(n) \geq nt_u(1 - c_h) = T_u^{nn} \tag{3.1}$$

where $t_u \in [0, 1]$ is the tax rate in country U.

Lemma 3.1 *In absent of a tax treaty, developing country U will decide to implement an audit system if and only if audit costs are (weakly) inferior to the tax*

revenue gain. Formally,

$$M(n) \leq nt_u(c_h - \bar{c}) \tag{3.2}$$

Proof. By the comparison of what country U gets with or without an audit system. ■

If no treaty is signed and therefore no information is exchanged, country D has to rely on each firm i's declaration about costs, irrespective of the implementation of an audit system in the developing country U. From a legal perspective, this type of information is generally considered of limited relevance, due to the low reliability of data that cannot be cross-checked with tax authorities. A different conclusion is generally only possible for publicly available information, such as for instance in respect of data required for companies quoted on the stock exchange, or where the facts are common knowledge. In such circumstances courts generally acknowledge the right of country D to apply disproportionate measures to prevent the occurrence of abusive practices (i.e. tax avoidance and evasion).[9]

In this situation the developed country D does not have the necessary information about the true realization of firms costs and no way to procure it, so:

Lemma 3.2 *In absence of a tax treaty all firms will declare high costs to the developed country,*

$$c_i = c_h \qquad \forall i \in n$$

and will deduct taxes payed in country U that depends on the implementation decision of country U.

Proof. Derives from both the fact that each firm i expected profit, $E(\pi_i) = (1 - E(\tilde{c})) - (1 - c_i)t_d$, is increasing in the declared cost $c_i = (c_l, c_h)$ (i.e. $\frac{\partial \pi_i}{\partial c_i} > 0$) and the absence of uncertainty. ■

[9] see European Court of Justice, decision 18 December 2007, case C-101/05, A.

In the absence of a tax audit system in the developing country, both countries will tax the same tax base, and tax revenues in country D will be equal,

$$T_d^{nn} = n(t_d - t_u)(1 - c_h) \tag{3.3}$$

where $t_d \in [0, 1]$ is the tax rate in country D. By contrast, if U has implemented a tax audit system, firms will declare true costs to country U and therefore deduct higher taxes in country D. In this case tax revenues will equal,

$$T_d^{na} = n(t_d - t_u)(1 - c_h) - nt_u(c_h - \bar{c}) \tag{3.4}$$

In the absence of audit, firms hide part of their revenues and therefore evade an amount of taxes equal to $nt_d(c_h - \bar{c})$.

Without an audit system the global tax revenues are:

$$T^{nn} = T_u^{nn} + T_d^{nn} = nt_d(1 - c_h) \tag{3.5}$$

In the presence of audit, the global tax revenues is:

$$T^{na} = T_u^{na} + T_d^{na} = nt_d(1 - c_h) - M(n) \tag{3.6}$$

It is important to understand that without a treaty the global taxation is a decreasing function of the audit sunk cost $M(n)$. A developed country therefore has no incentive to support auditing in the developing economy. Global tax revenues are a function of the tax rate in the developed country, but not of the tax rate in the developing country due to the foreign tax credit. From a tax policy perspective of the developing country this may imply that whatever goal is regarded as relevant and whatever measures can apply for tax purposes, the outcome is simply random and impossible to predict in advance, thus generating a negative impact on tax reforms that such country may want to implement for enhancing its tax governance in compliance with international standards.

3.4.2 A Treaty

Tax treaties with developing countries typically follow the UN model tax treaty, where countries agree to exchange information and eliminate double taxation by splitting firm revenues according to the arm's length transfer pricing rule. The arms length principle defines the just transfer price as average production costs plus a mark-up. Assume that this transfer price equals $\alpha\tilde{c_i}$, where $\alpha > 1$.

Both countries will lose part of the tax base when signing a treaty. The developed country D could gain from a double tax treaty if this reveals true production costs of firms. However, the developing country U would unconditionally lose from a tax treaty, as it could observe true production costs even in the absence of a treaty through auditing. Developing countries will therefore only voluntarily sign tax treaties if an element of revenue sharing is included in the treaty.

From a legal perspective traditionally there is opposition against including revenue sharing in tax treaties, since ex post a contracting state is obliged to execute a treaty in good faith according to the obligations and regardless of what this may entail. [10] Nonetheless, there are several examples that include elements of revenue sharing in bilateral tax treaties. A good example, frequently included in Swiss tax treaties, can be found for taxing income of frontier workers. Another example arises in the EU directive (transitional regime) and international agreements on the taxation of savings. A third example can be found in the Australian tax treaty practice at the level of the memorandum of understanding that is generally annexed to tax treaties. Accordingly, this work will now propose that revenue sharing is to be included in a fair tax treaty with a developing country.

[10] This may obviously lead to the fact that a contracting state may refrain from signing a treaty ex ante.

In order to obtain a voluntary agreement, the developed economy, D, will propose a compensation fee f for the revelation of information about every firm. Developed country will offer f_l if revealed costs of the firm are *low* and f_h if revealed costs are *high*.

The timing is as follows: first the developed country D chooses and announces f_h and f_l. [11] Then the developing country U decides whether to sign the treaty or not. Finally, after realization of $\tilde{c}_i$ (which is not observable by the developed country), if U signed the contract, it audits the firms, collects taxes if any are due and pays $\eta \cdot f_h + (n - \eta) f_l$ (where $\eta \in [0, n]$ is the number of firms whose actual $c_i = c_h$) to D.

In order to induce U to sign the treaty and to give a true declaration about the actual realization of each c_i, the developed country D needs to choose the lump sum fee vector f according to the following condition:

1. *Incentive compatibility (IC)* When a state π_η [12] actually happened, the tax revenues of the developing country when it declares π_η must be (weakly) greater then its tax revenues when it declares π_j for all $j \in [0, n]$ different from η;[13]

[11] So $f_h \leq f_l$.

[12] In this state of the world just η firms have a low revenue while the others $(n - \eta)$ have the high one.

[13] One can firmly believe that this condition is not met in the agreements that Switzerland has signed in 2011 with Germany and the United Kingdom on the single taxation of savings in the country of source. Such agreements, designed to preserve anonymity of investors, give the state of residence, which for the purpose of this research is in a similar situation to country D, no possibility of cross-checking cases of misreporting or of loose enforcement of taxes by Switzerland.

2. *Participation constraint (PC)* the expected tax revenues of the developing country when it accepts the treaty must be (weakly) greater than what it gets when it refuses.

If we return to the relations between countries D and U, one can believe that this structural deficiency of the potential risk of misreporting can be overcome by using the incentive compatibility condition.

Lemma 3.3 *Developed country D will to set a unique fee*

$$f = f_l = f_h$$

Proof. Derives directly from the *Incentive Compatibility (IC)* constraint. Suppose that D sets $f_h \neq f_l$, then U has an incentive to misreport the correct transfer price in order to make an unfair profit. So, in order to satisfy the IC and therefore give the incentive to share the correct information to U, a unique fee must be set. ■

In order to satisfy the Participation Constraint (PC) the choice of f depends on whether in the absence of a treaty with the developing country audits or not, lemma (3.1). In the following we first analyze the case where condition (3.2) is satisfied, and thereafter the case when it is not satisfied.

A treaty with audit already in place

If the *tax revenue gain* from auditing is (weakly) greater than *audit costs* (that is condition (3.2) is satisfied), then implementing a monitoring system does not depend on the treaty, since it will be implemented anyway. If this is the case, then the developing country U will sign the treaty if tax revenues plus revenue sharing nf^{ta} exceeds tax revenues in the absence of a treaty,

$$T_u^{ta} = nt_u(\alpha - 1)\overline{c} - M(n) + nf^{ta} \geq T_u^{na} \tag{3.7}$$

Lemma 3.4 *If an audit system is already in place, the developing country U will sign the treaty if and only if the tax revenue loss of the reduced tax base and audit costs are (weakly) inferior to the tax revenue gain. Formally, the participation constraint is satisfied if and only if,*

$$\underline{f}_u^{ta} = t_u(1 - \alpha\bar{c}) \leq f^{ta} \tag{3.8}$$

where $\underline{f}_u^{ta}$ is the minimum level of revenue sharing for which country U with an audit system will be willing to sign the treaty.

Proof. By direct inspection of equation (3.7) .■

The developed country D will sign the treaty when audit is already in place if and only if the tax revenues it receives with the treaty, T_d^{ta}, are greater than tax revenues received if it were not signed,

$$T_d^{ta} = nt_d(1 - \alpha\bar{c}) - nf^{ta} \leq n(t_d - t_u)(1 - c_h) - nt_u(c_h - \bar{c}) = T_d^{na} \tag{3.9}$$

This gives the maximum fee the developed country is willing to pay,

$$\overline{f}_d^{ta} = t_d(c_h - \alpha\bar{c}) + t_u(1 - \bar{c}) \geq f^{ta} \tag{3.10}$$

where $\overline{f}_d^{ta}$ is the maximum level of revenue sharing for which country D will be willing to sign the treaty with a developing country with an audit system.

A different conclusion can only be reached when country D wants to promote good tax governance of country U regardless of an actual return, thus including for instance an element of development aid. In fact the European Union, currently the major financial donor in the world, has followed this strategy since 2009.

A treaty is therefore feasible and fiscally rewarding if and only if conditions (3.8) and (3.10) are both satisfied, i.e. $\underline{f}_u^{ta} \leq f^{ta} \leq \overline{f}_d^{ta}$.

A treaty initially without audit

If *audit costs* are greater than the *tax revenue gain*, U will not implement the audit system in the absence of the treaty. This means that in the absence of a treaty it will get a payoff of T_u^{nn}, defined in equation (3.1), since each firm i will declare high costs c_h (lemma 3.2), and it will get T_u^{tn} if it signs the treaty. The problem of the developing country U consists of choosing whether or not to sign the treaty in order to maximize its tax revenues. It will accept the treaty if and only if:

$$T_u^{tn} = nt_u(\alpha - 1)\bar{c} - M(n) + nf^{tn} \geq nt_u(1 - c_h) = T_u^{nn} \tag{3.11}$$

Lemma 3.5 *If an audit system is not yet in place, the developing country U will sign the treaty if and only if the fee plus the net tax revenues gain are (weakly) greater than the cost of the audit system. Formally,*

$$\underline{f}_u^{tn} = t_u(1 - \alpha\bar{c}) + \frac{M(n)}{n} - t_u(c_h - \bar{c}) \leq f^{tn} \tag{3.12}$$

where $\underline{f}_u^{tn}$ is the minimum level of revenue sharing for which country U without an audit system will be willing to sign the treaty.

Proof. By direct inspection of equation (3.11) .■

This pattern is in substance linked to the recent developments concerning the Global Forum on Fiscal Transparency. Since 2009 countries are willing to sign tax treaties with exchange of information provisions in order not to be listed in the groups of uncooperative tax jurisdictions and be internationally blamed for not effectively countering tax avoidance and evasion. For this reason a developing country may be willing to sign a tax treaty with an exchange of information clause even when it knows that such clause will in fact not yield any advantage with respect to its tax revenue. However, the developing country, even in such circumstances, will not effectively carry out tax audits unless it believes that it

may gain from them.

Comparing lemma 3.4 and lemma 3.5 it is now clear that in addition to the compensation of the loss of tax base as in condition (3.8), the developed country must now also compensate the developing country for the implementation of a tax audit system, which is the last part of the above condition (3.12) and replicates condition (3.2).

Similarly as above, the developed country D will sign the treaty when audit was not already in place if and only if the tax revenues it receives with the treaty exceed tax revenues without the treaty,

$$T_d^{tn} = nt_d(1 - \alpha\bar{c}) - nf^{tn} \geq n(t_d - t_u)(1 - c_h) = T_d^{nn} \tag{3.13}$$

which leads to,

$$\overline{f}_d^{tn} = t_d(c_h - \alpha\bar{c}) + t_u(1 - c_h) \geq f^{tn} \tag{3.14}$$

where $\overline{f}_d^{tn}$ is the maximum level of revenue sharing for which country D will be willing to sign the treaty with a developing country without an audit system.

The first term is the tax gain when a treaty is signed. The second term by contrast is the tax revenue loss due to the ceasure of taxing rights to the developing country U. The two conditions for the developed economy, equations (3.10) and (3.14), differ only by the amount $t_u(c_h - \bar{c})$. If no audit system was in place before the treaty, the developed country can offer a lower compensation for the developing country U, as it can fully appropriate the higher tax revenues of the developing country U resulting from auditing.

A treaty is feasible if and only if conditions (3.12) and (3.14) are both satisfied, i.e. $\underline{f}_u^{tn} \leq f^{tn} \leq \overline{f}_d^{tn}$.

3.4.3 Discussion

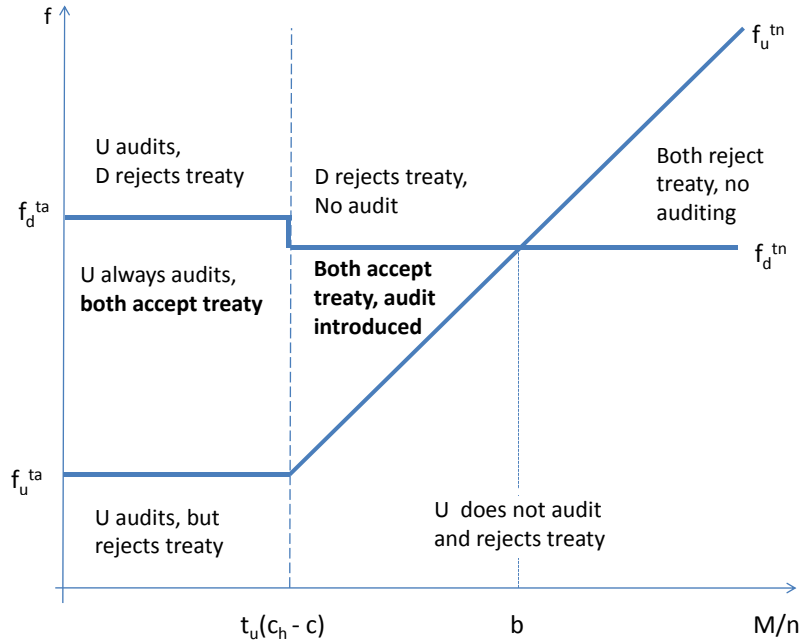
Jointly equations (3.10) and (3.14) give the maximum level of revenue sharing, f_d, for which developed country D will sign the treaty:

$$f_d = \begin{cases} t_d(c_h - \alpha\bar{c}) + t_u(1 - \bar{c}) = \overline{f}_d^{ta} & \textit{if audit is already in place} \\ \overline{f}_d^{ta} - t_u(c_h - \bar{c}) = \overline{f}_d^{tn} & \textit{if audit is not in place} \end{cases} \tag{3.15}$$

Lemma 3.4 and lemma 3.5 define the minimum level of revenue sharing, f_u, that the developing country U is willing to accept.

$$f_u = \begin{cases} t_u(1 - \alpha\bar{c}) = \overline{f}_u^{ta} & \textit{if audit is already in place} \\ \overline{f}_u^{ta} + \frac{M(n)}{n} - t_u(c_h - \bar{c}) = \overline{f}_u^{tn} & \textit{if audit is not in place} \end{cases} \tag{3.16}$$

We can plot these conditions in a graph in the f to $\frac{M(n)}{n}$ space.



The model implies an unambiguously positive level of revenue sharing. The compensation will therefore be the result of a bargaining process and - depending on the bargaining power of the two parties - fall in between the minimum level of revenue sharing required by the developing economy U and the maximum level of revenue sharing offered by the developed country D (blue lines in the graph above).

Let us define the difference between the maximum revenue sharing fee offered by the developed country and the minimum revenue sharing fee requested by the developing country as:

$$b = \begin{cases} \overline{f}_d^{ta} - \underline{f}_u^{ta} = t_d(c_h - \alpha\overline{c}) + t_u(\alpha - 1)\overline{c} = b^{ta} & \textit{if audit is already in place} \\ \overline{f}_d^{tn} - \underline{f}_u^{tn} = b^{ta} - M(n)/n = b^{tn} & \textit{if audit is not in place} \end{cases} \tag{3.17}$$

The following proposition is obtained:

Proposition 3.1 *(1) A tax treaty is welfare improving for both countries if and only if* $b \geq 0$. *(2) When tax rates in developed countries exceed tax rates in developing countries,* $t_d > t_u$, *the bargaining space* b *is a decreasing function in the transfer price* α.

Proof. The first part is trivial and the second is derived by direct inspection of equation (3.17). ■

The first part of proposition 3.1 holds always but for the unlikely case that the average arm's length price exceeds the maximum cost by a very large amount, one can ensure that a tax treaty is possible.

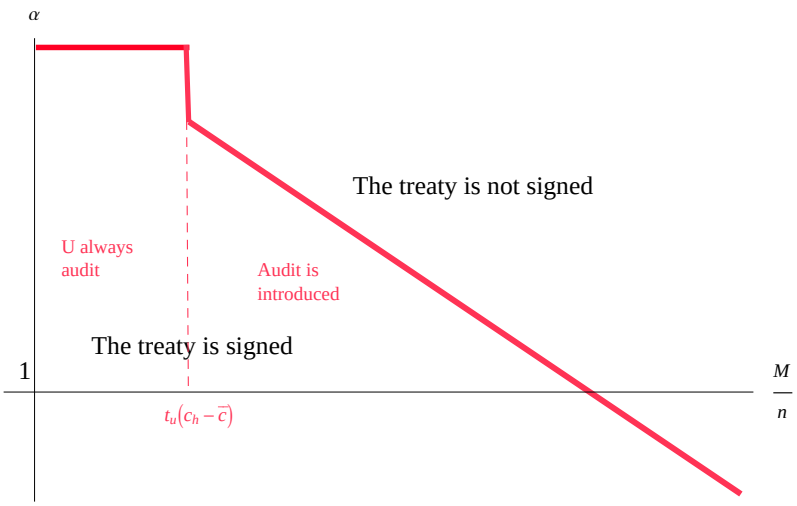
Proposition 3.1 shows that the transfer price α plays a central role on both countries decision to sign the treaty. After the treaty is signed the transfer price becomes the driver that splits the tax base between the two countries.

In fact α is an income tax base multiplier for the developing country U, since the treaty gives the right to U to tax firm's income produced in its region (i.e. $(\alpha\overline{c} - \overline{c})$), but it is a cost multiplier for the developed country D which has a tax base equal to $(1 - \alpha\overline{c})$.

One can identify the transfer price for which both countries are indifferent between signing the treaty or not:

$$\alpha = \begin{cases} \frac{1}{\overline{c}(t_d - t_u)}\left(t_d c_h - t_u \overline{c}\right) & \text{if } M(n) \leq n t_u (c_h - \overline{c}) \text{ with audit system} \\ \frac{1}{\overline{c}(t_d - t_u)}\left(t_d c_h - t_u \overline{c} - \frac{M(n)}{n}\right) & \text{if } M(n) \geq n t_u (c_h - \overline{c}) \text{ without audit system} \end{cases}$$

One can plot these conditions in the following graph:



The bold line on the graph above represents at each possible cost of audit $M(n)$ the maximum level of the transfer price for which both countries are just willing to sign the treaty. The intuition is that the greater the cost of auditing $M(n)$ the greater the developed country D share of tax base has to be (i.e. a lower α) for the treaty to be signed. If audit costs exceed the potential minimum gain from negotiating a treaty, $M(n)/n > b \Leftrightarrow \underline{f}_u^{tn} > \overline{f}_d^{tn}$, then no treaty will voluntarily be

signed.

Interestingly, a treaty can stimulate a developing country to introduce a tax audit system together with a tax treaty, even if initially an audit system is too expensive to be implemented, $\overline{f}_d^{tn} - \underline{f}_u^{ta} \Leftrightarrow t_d \geq t_u$. This convenience is enhanced when additional funds are made available by international organizations or supranational entities, like the EU, for the specific purpose of improving compliance with standards of good governance and thus increase the ability of the developing country to raise sufficient revenue from taxes collected within its jurisdiction. As long as the tax level is given the treaty acts as it increases the tax rate in U and the tax base in D. Moreover a treaty can end the evasion phenomenon since firms will declare truthfully. Obviously, there will be no treaty with developing countries that exhibit excessive audit costs.

Another interesting results is presented by the following proposition:

Proposition 3.2 *A treaty is feasible and welfare improving if and only if total tax revenues are increasing with the treaty. Formally,*

$$T^t \geq T^n \leftrightarrow b \geq 0$$

Proof. Summing either equations 3.7 and 3.9 or 3.11 and 3.13 yields global tax revenues with a treaty irrespective of the initial audit decision,

$$T^t = T_u^{ta} + T_d^{ta} = T_u^{tn} + T_d^{tn} = nt_d(1 - \alpha\overline{c}) + nt_u(\alpha - 1)\overline{c} - M(n) \tag{3.18}$$

we find that $T^t = T^{na} + nb^{ta} = T^{nn} + nb^{tn}$ which shows that total taxation (weakly) increases with the treaty if and only if $b \geq 0$. ■

Results above show under which conditions countries are willing to sign a tax treaty voluntarily where they truthfully exchange information. As proved above

such treaties will only come to place if the country in need of information is willing to share a nonzero part of these additional revenues with the other country. The discussion above has also proven that the developing country has no convenience to misreport information to the developed country. Moreover the conclusion of a treaty can induce the developing country to implement a tax audit system. The next section, analyzes whether these conclusions hold under the condition (and real possibility) that firms may leave (or enter) a country that has just signed a treaty.

3.5 The model economy with the decision to relocate

Capital is internationally mobile , and firms can relocate their production at will to any third country upon bearing a relocation cost k. For simplicity, assume that third countries levy the same tax rate t_u as the developing country U under consideration.

3.5.1 No treaty

First, suppose that the developing country has neither a tax treaty nor an efficient tax audit system. Then the firm will claim as before high costs in both countries (lemma 3.2 still holds) and be taxed according to the global income principle, yielding expected profits of

$$\pi^{nns} = (1 - \overline{c}) - t_d(1 - c_h) \tag{3.19}$$

in case it decides to stay. Profits are given by revenues (normalized to unity) minus expected production costs $\overline{c}$, and minus tax payments on declared profits to the developed country D, since taxes payed in U can be deducted. Suppose, now, that

firms can move paying a reallocation cost k. The profit of a single firm in case it decides to move to another country without audit and treaty will be

$$\pi^{nnn} = \pi^{nns} - k \tag{3.20}$$

In the absence of a proper tax audit or a tax treaty, the foreign tax credit method impedes firms to relocate, as profits of relocating firms (3.20) are weakly lower than profits of remaining firms (3.19), $\pi^{nnn} \leq \pi^{nns}$. Note that the foreign tax credit method impedes tax competition between developing countries, as their respective tax rates are irrelevant for the locational decision of foreign firms, equations (3.19) and (3.20). Tax revenues in the developed and the developing country respectively are $T_u^{nns} = nt_u(1 - c_h)$ and $T_d^{nns} = n(t_d - t_u)(1 - c_h)$.

Second, suppose now that the developing economy implements a tax audit system, but does not communicate the findings to the developed economy due to the lack of a treaty. If the developed country D offers tax deductions following the foreign tax credit method, firms can deduct all the taxes payed in country U. Profits in the case where firms do not relocate are identical to the case in the absence of auditing (3.19), $\pi^{nas} = \pi^{nns}$. Profits in the case where firms relocate are also identical to the case in the absence of auditing (3.20), $\pi^{nan} = \pi^{nnn}$. Firms will again decide to remain in the developing country U given (weakly) positive moving costs, $k \geq 0$.

Lemma 3.6 *Independently of the developing country U audit decision, each firm's best strategy is to decide not to relocate to another developing country U for any possible (weakly) positive moving cost* $k \geq 0$.

Proof. From the comparison of what each firm gets if it decides to relocate or not (discussion above). ■

If an audit system is already in place, tax revenues in the developed country differ since firms deduct a higher amount of taxes. Tax revenues in the developed country equal $T_d^{nas} = nt_d(1 - c_h) - nt_u(1 - \bar{c})$, whereas for the developing country they change to $T_u^{nas} = nt_u(1-\bar{c}) - M(n)$. As opposed to the case without auditing, the developed country D will now receive lower tax revenues as firms will now deduct higher tax payments to the developing country U of the amount $t_u(c_h - \bar{c})$. The developing country by contrast gains these tax revenues, but has to pay auditing costs of $M(n)$. The developing country U prefers to implement a tax audit system if $T_u^{nas} \geq T_u^{nns}$, or

$$M(n) \leq nt_u(c_h - \bar{c}). \tag{3.21}$$

This means that an audit system will be implemented if the tax gain is greater than the auditing costs. Again we obtain the result already presented in lemma 3.1.

3.5.2 A Treaty

As in the absence of a relocation decision, a treaty with information exchange and revenue sharing is considered. Note that in the absence of auditing, the developed economy will not benefit from a treaty, and will therefore not be willing to share tax revenues. This case is therefore identical to the no treaty/no audit case discussed in section 3.4.1 above.

With the conclusion of a tax treaty, firms are now aware that information about their true cost structure will be shared with the developed economy. By contrast, a treaty eliminates double taxation according to the worldwide income taxation principle with foreign tax credit[14], and firms will now declare part of their prof-

[14]Considering that tax treaties generally apply the ordinary tax credit method, this is possible only to the extent that taxes, as it is often the case levied by the developing country (usually

its in the developing country U, which might offer lower tax rates. If the prior effect dominates, firms can expect to pay higher taxes and may consider relocation.

In order to prevent capital flight, the developing country U may consider the possibility to pay a subsidy, s, in order to induce firms to stay. One can think of these subsidies either as a reduction in the tax rate offered to firms considering relocation, where the effective tax rate will be $\tau_u = t_u - s/(\alpha\bar{c} - \bar{c})$, or a transfer in kind (e.g. infrastructure), which would reduce production costs. In either case, the subsidy given is a form of tax competition. [15] Profits in case the firm leaves are given by equation (3.20) above, whereas if the firm remains they are given by

$$\pi^{tas} = (1 - \bar{c}) - t_u(\alpha - 1)\bar{c} - t_d(1 - \alpha\bar{c}) + s \tag{3.22}$$

The optimal subsidy to firms from the perspective of the developing country U now equals

$$s \geq t_u(\alpha - 1)\bar{c} + t_d(c_h - \alpha\bar{c}) - k \tag{3.23}$$

The first part represents taxes payed in U, whereas the second term controls for taxes evaded in D in the absence of a treaty, and the last part is the moving cost. Firms can therefore claim all taxes paid to the developing country U short of relocation costs k, and will receive the additional taxes paid to the developed country D back from the developing country through the subsidy s. With very high relocation costs, this subsidy could, in theory, be negative, and developing countries could in principle appropriate these rents. Substituting subsidies from

the country of source) are lower than those levied by the developed country.

[15] However, in several parts of the world this option remains merely theoretical, since some legal obstacles may prevent its implementation. This is certainly the case of the European Union, where this type of incentives is in principle incompatible with the provision of state aids and needs an explicit *ex-ante* approval by the European Commission in order to lawfully apply.

above, one finds that tax revenues will equal

$$T_u^{tas} = n\underline{f}_u^{tas} + nk - nt_d(c_h - \alpha\bar{c}) - M(n) \tag{3.24}$$

Note that tax revenues depend on tax rates in the developed economy due to the subsidy. The developed economy will receive revenues equal to

$$T_d^{tas} = nt_d(1 - \alpha\bar{c}) - n\overline{f}_d^{tas} \tag{3.25}$$

3.5.3 Discussion

Once again, one has to distinguish two cases indicated by condition (3.21), whether audit is already in place before signing the treaty, $M(n) \leq nt_u(c_h - \bar{c})$, or not. On the one hand, if audit was already in place before signing the treaty, the developing country will accept the treaty if and only if tax revenues under a treaty exceed tax revenues without a treaty, $T_u^{tas} \geq T_u^{nas}$ or

$$\underline{f}_u^{tas} \geq t_d(c_h - \alpha\bar{c}) + t_u(1 - \bar{c}) - k$$

The developed country will accept the treaty if and only if tax revenues under a treaty exceed tax revenues without a treaty, $T_d^{tas} \geq T_d^{nas}$ or

$$\overline{f}_d^{tas} \leq t_d(c_h - \alpha\bar{c}) + t_u(1 - \bar{c})$$

Note that $\underline{f}_u^{tas} = \overline{f}_d^{tas} - k$. Hence the developed country D will be willing to offer a revenue sharing fee that will exceed the revenue sharing fee requested by the developing country U for any nonnegative relocation costs $k \geq 0$. The treaty surplus b, that was generated in the absence of firm relocation, is now entirely absorbed by firms through subsidies, where applicable. By contrast, the relocation costs k generate a different rent that opens a new bargaining space k. Let us define global taxation as the sum of both countries' tax revenues: $T^{nas} = T_d^{nas} + T_u^{nas} =$

$nt_d(1-c_h) - M(n)$ is the global taxation if no treaty is signed and $T^{tas} = T_d^{tas} + T_u^{tas} = nt_d(1-c_h) + nk - M(n)$. So:

$$T^{tas} \geq T^{nas} \rightarrow k > 0$$

This means that the global taxation is increasing in the treaty if and only if there exists a positive cost for each firm to move.

On the other hand, if auditing was initially not in place and condition (3.21) was not satisfied, $M(n) \geq nt_u(c_h - \bar{c})$, the developing country will accept the treaty if and only if tax revenues under a treaty exceed tax revenues without a treaty, $T_u^{tns} = T_u^{tas} \geq T_u^{nns}$ or

$$\underline{f}_u^{tns} \geq t_d(c_h - \alpha\bar{c}) + t_u(1-c_h) + M(n)/n - k$$

The developed country by contrast will accept the treaty if and only if tax revenues under a treaty exceed tax revenues without a treaty, $T_d^{tns} = T_d^{tas} \geq T_d^{nas}$ or

$$\overline{f}_d^{tns} \leq t_d(c_h - \alpha\bar{c}) + t_u(1-c_h)$$

The minimum revenue sharing fee acceptable for the developing country will be lower than the maximum revenue sharing fee offered by the developed country if

$$M(n) \leq nk - nt_d(1-c_h)$$

Together with condition (3.21), this identifies the space were a treaty is feasible even if there was no auditing initially, namely when relocation costs are high, or

$$k \geq t_d(1-c_h) + t_u(c_h - \bar{c})$$

As before global taxation in the absence of a tax treaty equals $T^{nns} = T_d^{nns} + T_u^{nns} = nt_d(1-c_h)$ and $T^{tns} = T_d^{tns} + T_u^{tns} = nt_d(1-c_h) + nk - M(n)$ under a treaty.

Global tax revenues under a treaty are larger if relocation costs exceed auditing costs, or

$$T^{tas} \geq T^{nas} \rightarrow nk > M(n)$$

This means that global taxation is increasing with the treaty if and only if the cost for each firm to move is greater than the cost for the developing country to audit it.

The following proposition summarize all the results presented in the previous discussion:

Proposition 3.3 *A treaty is welfare improving if and only global taxation is increasing with the treaty. This is always true if the cost for each firm to move is greater than the cost for the developing country to audit it, and in particular for any positive moving cost if an audit system is already in place. Formally:*

$$T^t \geq T^n \leftrightarrow \begin{cases} k \geq 0 & \text{if audit is already in place} \\ k \geq \frac{M(n)}{n} & \text{if audit is not in place} \end{cases} \tag{3.26}$$

Proposition 3.3 shows a very similar result to the one given in proposition 3.2.

Note that for the common case where tax rates in the developed economy exceed tax rates in the developing economy, $t_d > t_u$, the subsidy is increasing in the arm's length pricing mark-up α. Developing countries need not pay a subsidy if the mark-up is defined according to

$$\alpha = \frac{t_d c_h - t_u \overline{c} - k}{(t_d - t_u)\overline{c}}$$

Substituting the minimum subsidy feasible from equation (3.23) into the profit function (3.22), one finds that net profits will equal $\pi^{tas} = (1 - \bar{c}) - t_d(1 - c_h) - k$. Together, the developed and the developing country can levy at most the developed

countries tax rate on the minimum declarable tax base $1-c_h$ and skim off relocation costs. Tax revenues in the developing economy will consist of profit taxation of firms, revenue sharing from the developed country, minus subsidies to firms and audit costs.

3.6 Conclusions

This chapter has departed from the observation that worldwide income taxation in the country of residence is a global legal dogma of international taxation. This work has questioned this dogma from the perspective of relations with developing countries from a legal and economic perspective, and made a modern and fair proposal for tax treaties. It has supported a new vision of how taxing rights should be allocated in a treaty between a developed and a developing country. It argues that developed countries should share tax revenues with developing countries, as this is mutually beneficial. Developing countries will receive revenues, and developed countries obtain information on its tax subjects through voluntary exchange of information. The proposal for a new allocation of taxing powers reflects inter-state fairness that should secure consistency with international tax justice goals and achieve and objective standard of splitting taxing powers on cross-border income in compliance with internationally accepted standards, such as the arm's length principle. This research has shown under which conditions a developing and a developed country will voluntarily sign a tax treaty where information is exchanged truthfully and when they should share revenues. Moreover, this work has demonstrated how the conclusion of a tax treaty can assist in the implementation of a tax audit system.

Concluding Remarks and Future Research

Understanding the effects of fiscal policies is important since they have the potential to be used for economic growth and stabilization. Clearly governments have not lost their taste for using fiscal policy aimed at short-term objectives, while taxpayers can always behave illegally.

The question of a taxpayers' optimal strategy in the presence of the cut-off rule described in chapter two is relevant because it is not unusual for such a policy to be the main source of unfairness and an obstacle for new small businesses and practitioners. Implementing this policy requires a lot of information to be gathered by the government and, under these circumstances, while the governments best policy consists of setting a threshold value accordingly to its audit budget, a taxpayer's optimal strategy consist of either declaring the threshold value or declaring their true income according to their type. Taxpayers are therefore divided, accordingly to their types, into three homogeneous groups; one of which pays more taxes than due (Over-Declaration), another complies but bears the audit cost, while the third evades and it is not audited.

Chapter three, starting from the fact that worldwide income taxation, in the coun-

try of residence is a global legal dogma of international taxation, has questioned this dogma from the perspective of relations with developing countries from a legal and economic perspective. Since such a dogma hampers growth, a modern and fair proposal for tax treaties has been proposed. The chapter has supported a modern vision of how taxing rights should be allocated in a treaty between a developed and a developing country. It argues that developed countries should share tax revenues with developing countries, as this is mutually beneficial. Developing countries will receive revenues, and developed countries obtain information on its tax subjects through voluntary exchange of information. The proposal for a new allocation of taxing powers reflects inter-state fairness that should be consistent with international tax justice goals and achieve the standard objective of splitting taxing powers on cross-border income in compliance with internationally accepted standards, such as the arm's length principle. This research has shown under which conditions a developing and a developed country will voluntarily sign a tax treaty where information is exchanged truthfully and when they should share revenues. Moreover, it has demonstrated how the conclusion of a tax treaty can assist in the implementation of a tax audit system.

The deduction of the foreign tax by the country of residence [16] reduces the possibilities of developing countries to attract foreign capital through tax policy. Thus tax competition between developing countries is hampered since a reduction of such tax by the country of source (developing country) turns into a lower deduction against taxes due in the country of residence (developed country). Intuitively in such a situation, as the analysis in chapter three has already showed, firms do not take into account the tax rates of the developing countries when they have to choose where to allocate their production. For this reason, any tax policy develop-

[16] i.e. relief for juridical double taxation by the so-called foreign tax credit method.

ing countries could think of, has no effect on the number of firms in their territory. Thus Tax competition is hampered.

Interestingly, this is not the case if the developing countries, where the firms are active, sign a tax treaty that states a clear allocation of taxing rights between the country of source and residence. If a treaty, such as the one proposed in chapter three is signed, the taxes due to the developing country became final and so firms become concerned about them. Here tax competition is created.

While tax competition has been viewed from the literature as a "wasteful competition" for scarce capital, that governments engage because they act independently following their own country interests, that results in a reduction of public expenditure and tax rate levels (Oates (1972), p. 143), it would be interesting to know if these conclusions [17] still hold in the game of the noncoperative choice of taxes developing countries could use to attract foreign capital. This could be object to further research.

[17] One of the predicted outcomes from the models in tax competition is the so called "race to the bottom", if all countries starts with a positive capital tax.

Appendix A

Unconstrained Government Problem

In this appendix we keep all the previous assumptions of the model described in the second chapter but we now assume that the government has no budget problem. Therefore the government's problem is now the following:

$$\max_{g} \quad \int_{l}^{\bar{I}} (tI - k)\, dF(I) + \int_{\bar{I}}^{h} tg\, dF(I) \tag{A.1}$$

The first order condition is:

$$t \cdot \frac{\int_{h}^{\bar{I}} f(I)\, dI}{f(\bar{I})} = -k - c \tag{A.2}$$

Using the assumption of uniformly distributed income, we get:

$$g^* = h - \frac{k}{t} \tag{A.3}$$

Therefore we get the following proposition:

Proposition A.1 *The optimal government threshold strategy is : (1) increasing*

in the highest cluster income level h, (2) decreasing in its audit cost k, (3) increasing in the tax rate t. Formally:

$$(1) \quad \frac{\partial g^*}{\partial h} > 0 \qquad (2) \quad \frac{\partial g^*}{\partial k} < 0 \qquad (3) \quad \frac{\partial g^*}{\partial t} > 0$$

Proof. By direct inspection of equation (A.3). ■

The equation (A.3) highlights the fact that the threshold value g^* can be equal to the highest cluster income level h only if either the government's audit cost is equal to zero ($k = 0$) or the tax rate is infinity ($t = +\infty$).

As one can easily notice the fine f has no impact on the threshold choice, neither in the constraint problem nor in this one. This is due to the fact that in our case any evaders are caught.

Appendix B

Augmenting the Model with the Audit Probability Choice

The aim of this appendix is to analyze the taxpayer evasion decision in a framework where one keeps all the previous assumptions of the model presented in the second chapter but now one assumes that the government can chose not only the threshold value but also the audit probability reports below it bear. So, first the government choses and announces both the threshold value g and the audit probability for reports below it, ρ.

Therefore, a taxpayer of type I_i, solves the following problem:

$$\max_{d_i} \qquad u_i = I_i - td_i - b_i\Big[\max\big\{0,(I_i - d_i)\big\}(t+f) + c\Big] \tag{B.1}$$

Where b_i is a step function defined as follows:

$$b_i = \begin{cases} \rho & \text{if } d_i < g \\ 0 & \text{if } d_i \geq g \end{cases} \tag{B.2}$$

and $\rho \in [0,1]$ is the audit probability.

Now, the optimal declaration will be a function of the taxpayer's type and the audit probability. Again, the same two cases need to be considered, when taxpayer i's type is low, $I_i < g$ and when it is high, $I_i \geq g$.

Since the audit probability is unchanged for reports above the threshold value, the same argument presented in section 2.3.1 can be applied, and so conclude that "declaring the threshold value g" strictly dominates "declaring more than g", independently of agent's type.

By the previous argument a high type taxpayer's decision depends on the comparison between a full evasion declaration $d_i = 0$ and a threshold declaration $d_i = g$. This case is characterized by the following proposition:

Proposition B.1 *High type taxpayers ($I_i > g$) always evade, the amount of their evasion will depend on the audit probability ρ. Formally:*

$$d^*(I_i, g, \rho) = \begin{cases} 0 & \text{if } \rho < \hat{\rho} \\ g & \text{if } \rho \geq \hat{\rho} \end{cases} \tag{B.3}$$

where $\hat{\rho} := \frac{tg}{((t+f)I_i+c)}$.

Proof. From the comparison of the expected utilities a high type agent ($I_i > g$) gets when they declare the threshold value g ($u_i^{d_i=g} = I_i - tg$) and when they report a zero income declaration ($u_i^{d_i=0} = I_i - \rho \cdot ((t+f)I + c)$).

Intuitively, if the audit probability ρ is not too high, *high-type* taxpayers ($I_i > g$) fully evade making a zero income declaration. This implies that their optimal declaration is (weakly) increasing in the audit probability ρ.

A low type taxpayer's decision depends on the comparison between a full evasion declaration $d_i = 0$, truthful declaration $d_i = I_i$ and a threshold declaration $d_i = g$, as follows:

$$d^*(I_i, g, \rho) = \begin{cases} 0 & \text{if } \rho < \rho^* \\ \in \{0, I_i\} & \text{if } \rho = \rho^* \text{ and } I_i < \tilde{I} \\ I_i & \text{if } \rho > \rho^* \text{ and } I_i < \tilde{I} \\ g & \text{if } \rho \geq \rho^* \text{ and } \tilde{I} \leq I_i < g \end{cases} \tag{B.4}$$

where $\rho^* := \frac{t}{(t+f)}$ is the probability that eliminates evasion for low type agents, and $\tilde{I} := g - \rho \cdot \frac{c}{t}$ is the taxpayer who is indifferent between declaring her real income I_i or the threshold value g. From the equation (B.4) it is clear that a *low-type* taxpayer's declaration is (weakly) increasing in the audit probability and in her gross income.

Low type taxpayers evade only if the probability is not too high, i.e $\rho < \rho^*$. If it is not the case, that is the audit probability is at least ρ^*, then the critical type $\tilde{I}$ enters the picture. A taxpayer i of that type is indifferent between declaring her real income or the threshold value. Note that this critical type inversely depends on the audit probability. This implies that its minimum value is reached when ρ is equal to one as in the original model. When it is so, the *fake (over-declaring) congruous* group will reach its limit. The idea is that reducing the audit probability ρ, the interval of income types who prefer to pay taxes accordingly to gerico rather than comply and bear the audit cost, decreases.

Jointly proposition B.1 and equation B.4 completely characterize the solution to the taxpayer's problem in the situation where the government decides both the threshold value and the audit probability.

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