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Tax havens compliance with international standards : a temporal perspective

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Abstract

This paper contributes to the debate centring on the fight against aggressive tax avoidance practices through the release of international standards. We develop a model in which identical tax havens decide upon their compliance date while competing for onshore capital. The timing of these decisions depends on the effects of two opposing forces. One force is linked to the tax sensitivity of international capital and the other to the reaction of nearby potential capital. When the former force dominates, asynchronous compliance arises, which occurs even with identical tax havens and perfect information. However, when the latter force dominates, tax havens comply simultaneously. In any case, the loss of the tax base within the onshore region is minimized when compliance is simultaneous and occurs at the earliest possible date. Surprisingly, when the adoption of new standards does not severely reduce the potential supply of capital and onshore capital is sufficiently tax sensitive, the compliance of a lone tax haven does not decrease the loss of tax base relative to the non-compliance of all the havens.

JEL classification: F21, F23, H23, H25, H26.

Keywords: Tax havens, International standards, Compliance, Timing.

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1 Introduction

The timing of adoption of new regulations, such as European Directives, can be an important strategic tool used to gain economic advantage over other countries. [1] In this respect, it is often claimed that being the first to move is crucial. Is this always so? Are there reasons to expect a second mover advantage (or to not)? We focus on how and when low tax jurisdictions decide to comply with international tax standards to investigate the use of timing as a strategic tool.

Recently, we have observed that different timing patterns are adopted across different jurisdictions. As illustrated by table 1, [2] after the release of OECD international standards in December 1999, a number of tax havens, such as Hong Kong, Panama, the British Virgin Islands and Singapore, varied regarding when they made the decision to endorse the released recommendations. However, we also observe that some tax havens such as Bermuda and Cayman Islands or Cyprus and Malta comply together relatively early while others such as Andorra, Belgium, Liechtenstein, Luxembourg and Switzerland do so relatively late.

In this paper, we use a game theoretical framework to explain how tax havens decide on their dates of compliance with international standards and the effects of those decisions on onshore countries. We aim to contribute to the debate on the fight against aggressive avoidance tax practices by focusing on the adoption timing of international tax standards.

In recent years, tax havens have been the subject of major political turmoil. Across the world, governments have long been concerned with aggressive tax avoidance practices that are understood to cause huge tax losses (Slemrod & Wilson, 2009, Zucman, 2013, and Keen & Konrad, 2014). Leading corporations, such as Amazon and Starbucks, have

[1] Luxembourg was the first European Union member state to implement the UCITS I Directive on 30 March 1988. This move (and its timing) transformed Luxembourg into a leading European domicile for cross-border distributed collective investment schemes.

[2] The data in table 1 are taken from Johannesen & Zucman (2014), in which the authors analyse the impact of Tax Information Exchange Agreements (TIEAs) on bank deposits in tax havens.

Table 1: List of main Tax Havens and Date of compliance with OECD Standard.

Andorra	March, 2009	Malta	May, 2000
Belgium	March, 2009	Marshall Islands	July, 2007
Bermuda	May, 2000	Nauru	January, 2003
British virgin Islands	February, 2002	Netherlands Antilles	November, 2000
Cayman Islands	May, 2000	Panama	April, 2002
Cyprus	May, 2000	Seychelles	February, 2001
Hong Kong	November, 2005	Singapore	February, 2009
Liechtenstein	March, 2009	Switzerland	March, 2009
Luxembourg	March, 2009	United States Virgin Islands	March, 2002

Source: Johannesen & Zucman (2014)

dominated international headlines based on their abusive use of secretive jurisdictions to lower their tax liability.

Since the end of the 1990s, the OECD has agreed on sweeping rules to crack down on the problem of abusive tax avoidance. In 2013, the OECD launched an initiative against base erosion and profit shifting (BEPS) by formulating and releasing taxation standards designed to realign taxation with economic substance and value creation. However, the OECD has no coercive power of enforcement, and the released rules function as recommendations that must be implemented into domestic legislation to have any effect. Nonetheless, as the fight against tax evasion has become a major priority, high tax (onshore) countries have exerted pressure on tax havens (through tactics such as public blacklisting and blame-and-shame campaigns) with the objective of undermining their reputations. Onshore countries have also increased pressure on their citizens who maintain accounts in offshore tax havens. In 2013, for instance, France decided to list Bermuda, the British Virgin Islands (BVI) and Jersey as non-cooperative because of their failure to comply with international tax standards. In addition, France introduced a withholding tax of up to 75 per cent on payments from France to non-cooperative jurisdictions. After this move, the OECD acknowledged that both Jersey and Bermuda had a responsive approach, whereas the BVI "experienced some difficulties obtaining and exchanging information for tax purposes" (for more information see The Financial Times, 2013). Moreover, the previous literature has established that blacklisting has been effective in terms of exerting pressure on non-cooperative jurisdictions (Sharman, 2009).

In this paper, we develop a model in which two tax havens, competing for international capital, decide when to comply with international tax standards that cannot be enforced by hard legislation. Compliance can be forced by international pressure campaigns against non-cooperative jurisdictions. The decision to adopt international tax standards is based on the discounted welfare resulting from compliance and depends on how other tax havens behave. Accordingly, we analyze the conditions under which various time patterns of compliance emerge.

Our main results may be summarized as follows. The timing of compliance decisions depends on the result of two opposing effects. One effect is caused by the tax sensitivity of international capital and the other emanates from the reaction of nearby potential capital. When the former effect dominates, tax havens comply at different dates, which occurs even with identical havens and perfect information. However, when the latter effect dominates, tax havens comply simultaneously. In any case, we demonstrate that the loss of tax base in the onshore region is minimized when compliance is simultaneous and occurs at the earliest possible date. Surprisingly, when adopting new standards does not severely reduce the potential supply of capital and onshore capital is sufficiently tax sensitive, the compliance of a lone tax haven does not decrease the loss of tax base relative to the non-compliance of both havens.

The industrial organization literature abounds with research on firms' timing related to market entry (Fudenberg *et al.*, 1983), to innovation (Dasgupta & Stiglitz, 1980), to the adoption of new technologies (Reinganum, 1981) and to other strategic decisions. However, to the best of our knowledge, there is no significant literature regarding the adoption timing of international tax standards and regulations. An exception is Elsayyad & Konrad (2012) who analyze how the fight against tax havens - particularly as engaged in through tax information exchange agreements that are imposed on havens by onshore countries - modifies competition among low-tax jurisdictions. If international standards are adopted sequentially, the authors show that the resulting elimination of only some tax havens increases market concentration among the remaining tax havens, which thereafter become more profitable and more resistant to compliance. In this case, actions taken against tax havens may be welfare-reducing for OECD countries.

Our paper is complementary to Elsayyad & Konrad (2012). In particular, we find that when only some havens comply with released international standards, the non-compliant jurisdictions gain market power to such an extent that they become more opposed to implementing standards seeking to eliminate aggressive tax avoidance. This situation arises when the effect of the tax sensitivity of international capital flows dominates the reduction effect of the potential capital supply. As a consequence, asynchronous compliance arises and tax havens differ in their compliance decisions. Our model also highlights simultaneous compliance when compliance has a salient reducing effect on the potential nearby capital supply.

This paper contributes to various strands of the previous literature. The first and largest strand focuses on the negative effects of tax havens on onshore economies. In this vein, Slemrod & Wilson (2009) highlight the negative impact of parasitic tax havens on onshore countries' welfare. In their setting, tax havens waste resources by providing tax evasion services to firms, and tax administrations incur expenditures in attempting to limit tax evasion. Johannesen (2010) analyses the effects of tax havens on low - and high - tax jurisdictions within a framework of imperfect competition. In particular, he shows that an equilibrium may arise in which the tax rate of the low-tax country increases, while the tax bases of the onshore countries decrease. In the current paper, we analyze the welfare effects of tax havens within a setup accounting for the temporal aspects of compliance. We then show how the timing impacts the loss of tax base incurred by onshore countries. A second branch of the literature on tax havens analyses how effective implementing information exchange for tax purposes can be, highlighting the strategic interactions between offshore and onshore countries. [3] This literature

[3] Keen & Ligthart (2006a) present key issues in the debate on information exchange.

stream mostly analyzes whether tax havens that compete for international investors have the incentive to provide tax information to other governments. Bacchetta & Espinosa (2000) analyze the role of information sharing in a framework in which countries have repeated interactions with one another and find that small countries have less incentive than large countries to share tax information because small countries focus more on attracting foreign investors than on taxing their own residents. Using a model of repeated games Huizinga & Nielsen (2003) derive conditions under which information exchange can be a cooperative equilibrium. Keen & Ligthart (2006b) add revenue sharing to the model developed by Huizinga & Nielsen (2003) and find that a revenue-sharing agreement between the home and host country can be essential for information sharing to be implemented.

The paper is organized as follows. Section 2 presents the model. Section 3 focuses on the equilibrium analysis. In section 4, we analyze how tax havens compete for international capital and highlight how this impacts the timing of their decisions to comply. Section 5 focuses on the timing of compliance and foregone tax base in the onshore economy. Section 6 concludes.

2 The Model

Two tax havens, $h \in \{1, 2\}$, compete for foreign capital. They try to attract foreign investments by providing low taxation. Multinationals have different ways to exploit the favorable taxation provided by tax havens. On one side, they can obtain abusive tax concealment through offshore conduit (ephemeral) companies. On the other side they can lower their tax liabilities by developing substance based activities within tax havens.

Assume that anti tax avoidance rules are set out at a date $t = 0$ by an international body (e.g. the OECD). This decision requires the abandonment of aggressive tax concealment practices, which occur through artificial international profit shifting. It also requires extensive information exchange between national tax administrations. However, tax havens can still be attractive to substance based foreign investments since they continue to provide favorable (low) taxation to foreign multinationals. In other words, anti avoidance standards do not exclude international tax competition. [4]

However, international standards designed to eliminate aggressive tax avoidance cannot be legally enforced at the national level. It follows that tax havens have to decide when, if ever, to implement them into domestic legislation. Accordingly, we can define two regimes identified by the indicator variable $i \in \{0, 1\}$:

- when $i = 0$, the tax haven h does not comply with international regulation.
- when $i = 1$, the tax haven h complies and multinationals cannot use it for tax concealment practices anymore.

2.1 Compliance cost

The decision to comply with international tax standards involves implementation costs. In fact, the rules or standards released by international bodies are recommendations that need to be implemented into domestic legislation. Consequently, when new standards are released, countries can delay the decision to comply. One obvious reason for waiting is that compliance costs are delayed and consequently, their present value decreases. However, delaying compliance is costly too. Refusing to cooperate exposes the non compliant country to international political pressure that eventually results in reputation damage and sanctions, as highlighted above. Therefore, waiting to comply entails two opposite effects. On one side, it reduces the cost of implementation and on the other side, it augments the cost of non-compliance because the risk of being pressured increases as time goes by. To account for these opposing effects, we define the function $\rho(t)$ as the present value of the cost of complying at time t. [5] For sufficiently low values of t, $\rho(t)$ is decreasing in t because the reduction in implementation cost dominates the increase in

[4] In an interview with Fairfax Media in Brisbane, Saint-Amans, who is the OECD tax-policy head, said "BEPS puts an end to harmful tax competition, but not tax competition. Some countries might move to be more attractive by reducing their rates. We think that's fine."

[5] We assume $\rho(t)$ to be C^2 $\forall t$.

reputation damages. For sufficiently high values of t, the opposite will occur. Formally, $\rho' < 0 \quad \text{for } t < \bar{t} \;\; \textit{and} \;\; \rho' > 0$, otherwise.

2.2 Compliance decision

Let t_h be the date when country h complies. Three different scenarios can occur: *(i)* no tax haven complies : $t_h \to \infty, \forall h$; *(ii)* only one haven complies: $t_h \in (0, \infty)$ and $t_{-h} \to \infty$, with $h \in \{1, 2\}$; *(iii)* both havens comply: $t_h \in (0, \infty), \forall h$ with $t_h = t_{-h}$ or $t_h \neq t_{-h}$.

We now define $\omega_{i,j}$ as the per period welfare of tax haven h when it chooses regime i ($i = 0, 1$), while the other tax haven chooses regime j ($j = 0, 1$). Note that $\omega_{i,j}$ is the equilibrium welfare value resulting from the competition of the two tax havens for foreign investments that occurs at each period t (see section 4). This game unfolds at a second stage after that the tax havens have decided when (or not) to comply with the international tax regulations.

The following table contains the equilibrium welfare values,

		Tax haven	
sub-game	t	$h = 1$	$h = 2$
a	$0 \leq t \leq \min\{t_1, t_2\}$	$\omega_{0,0}$	$\omega_{0,0}$
b	$t_1 \leq t \leq t_2$	$\omega_{1,0}$	$\omega_{0,1}$
c	$t_2 \leq t \leq t_1$	$\omega_{0,1}$	$\omega_{1,0}$
d	$t \geq \max\{t_1, t_2\}$	$\omega_{1,1}$	$\omega_{1,1}$

Complying with international regulation induces a change in the welfare of the cooperative country. When the tax haven h is the first to implement new regulations, its welfare change equals

$$F = \omega_{1,0} - \omega_{0,0} \ . \tag{1}$$

When the tax haven h is the second to comply, its welfare change is

$$S = \omega_{1,1} - \omega_{0,1} \ . \tag{2}$$

If the sign of F and S are positive (negative), complying entails a welfare gain (loss). This sign is not *a priori* given. It depends on the equilibrium outcome of the second stage of the game unfolding at each t.

In order to analyze different compliance time patterns decided by the competing tax havens, we introduce the following definition.

Definition 1 The difference in welfare gains (losses) between being the first to implement new tax regulations and being the second is given by

$$\gamma = F - S = (\omega_{1,0} - \omega_{0,0}) - (\omega_{1,1} - \omega_{0,1}) \ . \tag{3}$$

Now, let us first introduce the welfare function of tax haven h. Accordingly, we denote by $\mathcal{W}(t_h, t_{-h})$ the present value of country's h when it implements the new international regulation at date t_h given that the other country $(-h)$ complies at date t_{-h}. If $\delta \in R^+$ represents the time discount rate, we have to distinguish two cases for each jurisdiction h.

- When $t_h \leq t_{-h}$, country h is the first (**f**) to comply and its present welfare value is

$$W_f(t_h, t_{-h}) = \int_0^{t_h} \omega_{0,0}\ e^{-\delta t}\, dt + \int_{t_h}^{t_{-h}} \omega_{1,0}\ e^{-\delta t}\, dt + \int_{t_{-h}}^{+\infty} \omega_{1,1}\ e^{-\delta t}\, dt - \rho(t_h). \tag{4}$$

- When $t_h \geq t_{-h}$, country h is the second (**s**) to comply and its present welfare value is

$$W_s(t_h, t_{-h}) = \int_0^{t_h} \omega_{0,0}\ e^{-\delta t}\, dt + \int_{t_{-h}}^{t_h} \omega_{0,1}\ e^{-\delta t}\, dt + \int_{t_h}^{+\infty} \omega_{1,1}\ e^{-\delta t}\, dt - \rho(t_h). \tag{5}$$

Definition 2 The welfare function of tax haven h is,

$$\mathcal{W}(t_h, t_{-h}) = \begin{cases} W_f(t_h, t_{-h}) & \textit{if} \quad t_h \leq t_{-h} \ , \\ W_s(t_h, t_{-h}) & \textit{if} \quad t_h \geq t_{-h} \ . \end{cases} \tag{6}$$

Notice that equation 6 is continuous in t_h for any fixed t_{-h} . However, it is only differentiable at $t_h = t_{-h}$ if $F = S$.

Before analyzing in detail the welfare function, we introduce the following assumption

***Assumption* 1:**

1a. $\rho(t_h) > 0, \qquad \rho''(t_h) > \delta \max\{F, S\} e^{-\delta t_h}, \qquad -\rho'(0) > \max\{|F|, |S|\}.$

1b. $\exists\, \bar{t} \in [0, \infty)$ *such that* $\rho'(t_h) < 0$ for $t_h < \bar{t}_h$ and $\rho'(t_h) > 0$ for $t_h > \bar{t}_h$.

Assumption 1a guarantees that compliance costs are always positive and that $W_f(t_h, t_{-h})$ and $W_s(t_h, t_{-h})$ are strictly concave in t_h for a given t_{-h} . According to assumption 1b, the reduction of the implementation costs dominates the increase in reputation costs resulting from international political pressure for low values of t ($t_h < \bar{t}_h$), but the opposite occurs when t_h is large enough ($t_h > \bar{t}_h$). Without this assumption, tax havens may either postpone compliance forever or comply immediately. In other words, we exclude "corner solutions". We keep these assumptions throughout the paper.

Maximizing the welfare function $\mathcal{W}(\cdot)$ (eq. 6) of tax haven h with respect to t_h requires the following first order conditions

$$Fe^{-\delta t_h} = -\rho'(t_h) \quad \textit{if} \quad t_h < t_{-h} \ , \tag{7}$$

$$Se^{-\delta t_h} = -\rho'(t_h) \quad \textit{if} \quad t_h > t_{-h} \ . \tag{8}$$

The corresponding second order conditions are

$$\delta F e^{-\delta t_h} < \rho''(t_h) \quad \textit{if} \quad t_h < t_{-h} \ , \tag{9}$$

$$\delta S e^{-\delta t_h} < \rho''(t_h) \quad \textit{if} \quad t_h > t_{-h} \ . \tag{10}$$

Some interesting conclusions can be drawn from the above first order conditions. Even when complying first is welfare decreasing (i.e. $F < 0$) it can be optimal to be the first to adopt international standards if the impact of pressure on the compliance cost is high enough (i.e., $\rho(t_h)$ is increasing in t_h). Moreover, even if postponing compliance decreases $\rho(t)$, it can be optimal to comply first if implementing new international tax rules entails a per period welfare gain (i.e., $F > 0$).

3 Equilibrium analysis

The problem of tax haven h is to determine an optimal compliance date given that it faces a competing tax haven. Hence, a strategy for tax haven h is a scalar $t_h \in T_h$ where $T_h = (0, \infty)$ is the strategy space. A best response for tax haven h to the strategy t_{-h} of its rival is a mapping $\phi_h : T_{-h} \Rightarrow T_h$ for which $\mathcal{W}_h(t_h, t_{-h}) \geq \mathcal{W}_h(t_h^{\prime}, t_{-h})$, $\forall t_h^{\prime} \in T_h$.

A pair of strategies (t_h^N, t_{-h}^N) is a Nash equilibrium if each strategy is a best response to the other. Formally:

$$t_h^N = \phi_h(t_{-h}^N) \quad \textit{and} \quad t_{-h}^N = \phi_{-h}(t_h^N) \ .$$

In the following, we first establish the best response functions and then define the Nash equilibria accordingly.

3.1 The best response functions

In order to derive the tax havens' reaction functions, we analyze the specific shape of their welfare functions. For this purpose, we state the following results.

Proposition 1 (i) *There exist unique values $t^*, t^{**} \in (0, \infty)$ that respectively maximize $W_f(t_h, t_{-h})$ and $W_s(t_h, t_{-h})$ independently of t_{-h}.*

(ii) *Moreover, $t^* \geq t^{**}$ iff $\gamma \leq 0$ and $t^* < t^{**}$ iff $\gamma > 0$.*

Proof. (i) Let $W_i^{\prime}$ $(i = f, s)$ be the first derivative of W_i $(i = f, s)$ relative to t_h. By assumption 1, $lim_{t_h \to \infty} W_f^{\prime}(t_h, t_{-h}) = lim_{t \to \infty} (-Fe^{-\delta t_h} - \rho^{\prime}(t_h)) < 0$, while $lim_{t_h \to 0} W_f^{\prime}(t_h, t_{-h}) = lim_{t_h \to 0} (-Fe^{-\delta t_h} - \rho^{\prime}(t_h)) > 0$. Similarly, $lim_{t_h \to \infty} W_s^{\prime}(t_h, t_{-h}) < 0$ and $lim_{t_h \to 0} W_s^{\prime}(t_h, t_{-h}) > 0$. Therefore, by strict concavity and continuity of W_f and W_s, there exist unique values $t^*, t^{**} \in (0, \infty)$ verifying respectively the first order conditions

$$Fe^{-\delta t^*} = -\rho^{\prime}(t^*) \ \ \textit{and} \ \ Se^{-\delta t^{**}} = -\rho^{\prime}(t^{**}) \ ,$$

guaranteeing that W_f and W_s are maximized respectively.

The second part (ii) of the proposition follows by computing the first derivatives of W_i $(i = f, s)$ relative to t_h for given t_{-h} . We see that for any (t_h, t_{-h}), we have $W_s^{\prime}(t_h, t_{-h}) >$

$W'_f(t_h, t_{-h})$ when $\gamma > 0$. Consequently, for any t_{-h}, $W'_s(t^*, t_{-h}) > W'_f(t^*, t_{-h}) = 0$. By strict concavity of W_s (t_h, t_{-h}) and since $W'_s(t^{**}, t_{-h}) = 0$, it follows that $t^{**} > t^*$. When $\gamma < 0$, we have $W'_f(t^{**}, t_{-h}) > W'_s(t^{**}, t_{-h}) = 0$ for any t_{-h}. By strict concavity of $W_f(t_h, t_{-h})$ and since $W'_f(t^*, t_{-h}) = 0$, we conclude that $t^* > t^{**}$.

Lemma 1 *When $\gamma < 0$, then $W_s(t_h, t_{-h}) \lesseqqgtr W_f(t_h, t_{-h})$ as $t_h \gtreqqless t_{-h}$. When $\gamma > 0$, then $W_s(t_h, t_{-h}) \lesseqqgtr W_f(t_h, t_{-h})$ as $t_h \lesseqqgtr t_{-h}$.*

Proof. The proof results from the fact that $W_s(t_h, t_{-h}) - W_f(t_h, t_{-h}) = \frac{\gamma}{\delta}(e^{-\delta t_{-h}} - e^{-\delta t_h}) \leq 0$.

Proposition 1 characterizes the maximum values of the sub-functions (W_f and W_s) that constitute the welfare function $\mathcal{W}(\cdot)$ of tax haven h. Moreover, together with lemma 1, proposition 1 shows how the relative position of the sub-functions of $\mathcal{W}(\cdot)$ is affected by γ. This is essential to identify which part of the two sub-functions form a tax haven's welfare function $\mathcal{W}(\cdot)$. More precisely, when γ is negative, the welfare function $\mathcal{W}(\cdot)$ is the lower bound of the sub-functions W_f and W_s. [6] In this case, the welfare function has one unique maximum since at most one of two the sub-function maxima is in the definition domain of $\mathcal{W}(\cdot)$, for a given t_{-h}. When γ is positive, the welfare function $\mathcal{W}(\cdot)$ is the upper bound of the sub-functions.[7] In this case, the welfare function has two local maxima since the maxima of its sub-functions correspond to the definition domain of $\mathcal{W}(\cdot)$, for a given t_{-h}. When $\gamma = 0$, the sub-functions coincide.

Considering what we have just highlighted, we have to distinguish between the following cases: $\gamma = 0$, $\gamma < 0$ and $\gamma > 0$.

Case $\gamma = 0$: Complying first or second generates the same per-period welfare change for the two tax havens.

According to lemma 1, we see that $W_s(t_h, t_{-h}) = W_f(t_h, t_{-h})$ for all t_h and t_{-h}. It

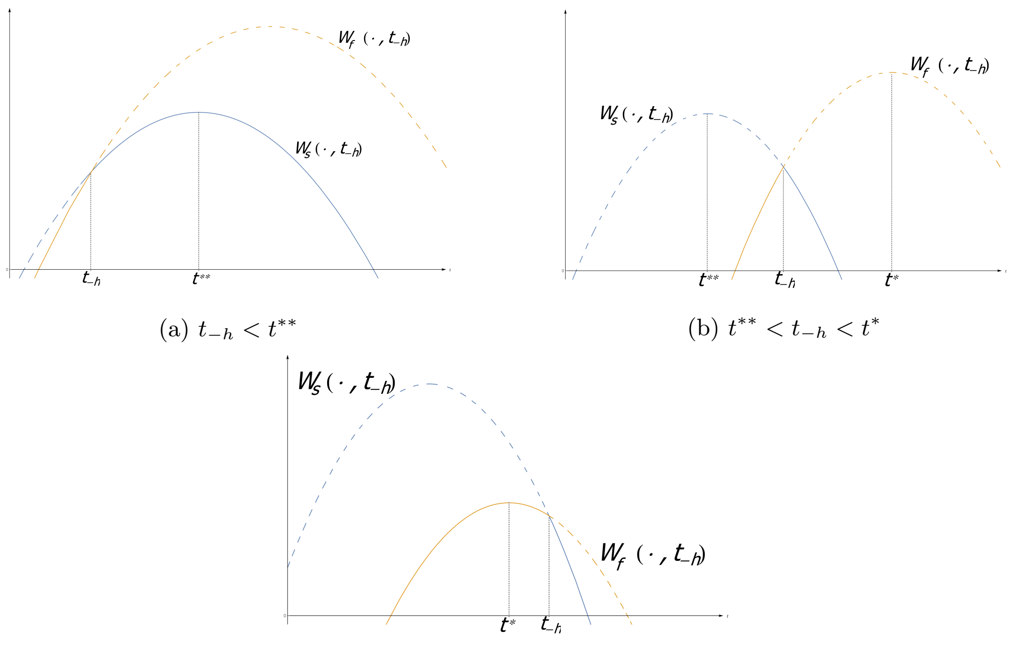
[6]This follows by definition 2 (i.e for $t_h < t_{-h}$, $\mathcal{W} = W_f$ and $\mathcal{W} = W_s$ otherwise) and from the fact that when $\gamma < 0$, $t^{**} < t^*$.

[7]This follows by definition 2 and from the fact that when $\gamma > 0$, $t^{**} > t^*$.

follows that, $t^* = t^{**}$ because of proposition 1. It follows that symmetric jurisdictions choose the same moment to comply: $t^S = t^* = t^{**}$.

Case $\gamma < 0$: The welfare change of complying first is smaller than the welfare change of complying second.
According to proposition 1, we know that in this case $t^* > t^{**}$. It follows that, a given rival's compliance date t_{-h} can be previous to t^{**} (i.e. $t_{-h} < t^{**}$), between t^{**} and t^* (i.e. $t^{**} \leq t_{-h} \leq t^*$) or subsequent to t^* (i.e. $t_{-h} > t^*$).

Under proposition 1, lemma 1 and assumption 1, [8] the welfare function of tax haven h has a unique maximum that depends on the choice of the other tax haven $-h$. When $\gamma < 0$ and for a given choice t_{-h} of the rival tax haven, figure 1 depicts the welfare of haven h as a function of t_h.



(a) $t_{-h} < t^{**}$

(b) $t^{**} < t_{-h} < t^*$

(c) $t^{**} > t^*$

Figure 1: tax haven h's welfare when $\gamma < 0$

By definition of $\mathcal{W}(t_h, t_{-h})$ (see definition 2), t^{**} corresponds to the maximum payoff

[8] Assumption 1 assures strict concavity of $W_f\,(t_h, t_{-h})$ and $W_s\,(t_h, t_{-h})$.

of country h (Figure 1a). It follows that the best reply of country h to t_{-h} is t^{**},when $t_{-h} < t^{**}$. When $t^{**} \leq t_{-h} \leq t^{*}$ (Figure 1b), the best response of tax haven h is to choose the same timing as country $-h$. Finally, when $t^{**} < t^{*} < t_{-h}$ (Figure 1c), the maximum payoff corresponds to t^{*}that is the best response of country h.

We can summarize the above results in the following proposition.

Proposition 2 *When $\gamma < 0$, the best response function of tax haven h is,*

$$\phi_h(t_{-h}) = \begin{cases} t^{**} & for \quad t_{-h} < t^{**}, \\ t_{-h} & for \quad t^{**} \leq t_{-h} \leq t^{*}, \\ t^{*} & for \quad t_{-h} > t^{*} \ . \end{cases}$$

By symmetry, the best response of tax haven $-h$ is,

$$\phi_{-h}(t_h) = \begin{cases} t^{**} & for \quad t_h < t^{**}, \\ t_h & for \quad t^{**} \leq t_h \leq t^{*}, \\ t^{*} & for \quad t_h > t^{*} \ . \end{cases}$$

Proof. In the Appendix A.

Case $\gamma > 0$: The welfare change of complying first is higher than the welfare change of complying second.

Under proposition 1, lemma 1 and assumption 1,[9] the welfare function of tax haven h has two local maxima (i.e. t^{*} and t^{**}). The best response of tax haven h has to be one which the global maximum is attained. Since there exist two candidate-values, t^{*} and t^{**}, the tax haven h selects the one with the highest yield. In other words, it compares $W_f(t^{*}, t_{-h})$ with $W_s(t^{**}, t_{-h})$. The following lemma demonstrates how these payoffs depend on the other haven's choice.

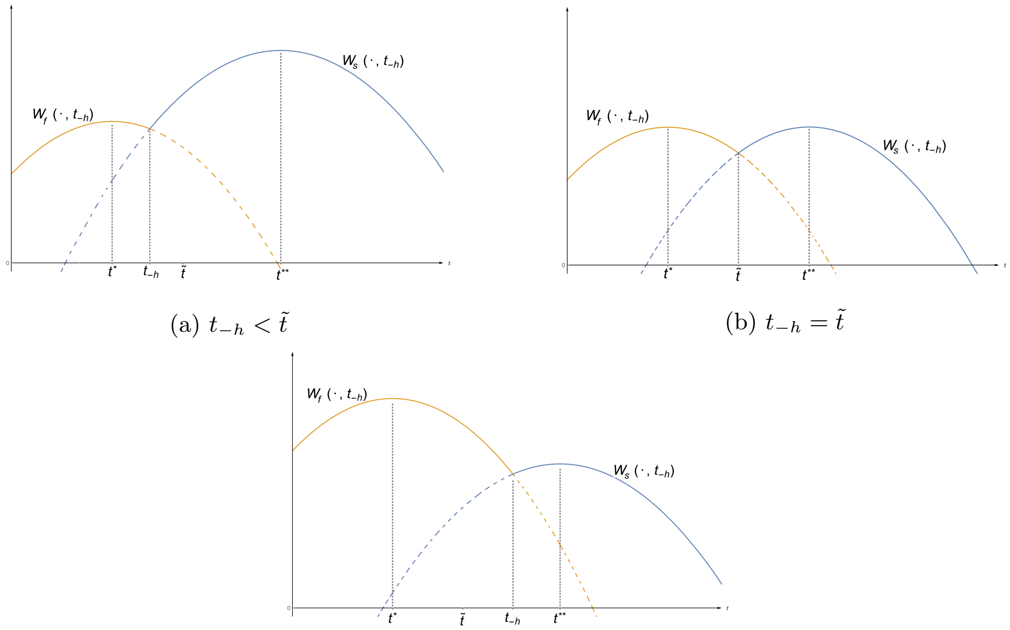
Lemma 2 *When $\gamma > 0$, there exists a value $\tilde{t} \in (t^{*}, t^{**})$ such that $W_f(t^{*}, t_{-h}) \leq W_s(t^{**}, t_{-h})$ if $t_{-h} \leq \tilde{t}$ and $W_f(t^{*}, t_{-h}) > W_s(t^{**}, t_{-h})$ if $t_{-.h} > \tilde{t}$.*

[9]Assumption 1 assures strict concavity of $W_f\left(t_h, t_{-h}\right)$ and $W_s\left(t_h, t_{-h}\right)$.

Proof. Set $\psi(t_{-h}) = W_f(t^*, t_{-h}) - W_s(t^{**}, t_{-h})$. It follows from proposition 1 and lemma 1 :

1. $\psi(t^*) < 0$ because $W_s(t^{**}, t^*) \underset{Prop.1}{>} W_s(t^*, t^*) \underset{Lemma1}{=} W_f(t^*, t^*)$,
2. $\psi(t^{**}) > 0$ because $W_f(t^*, t^{**}) \underset{Prop.1}{>} W_f(t^{**}, t^{**}) \underset{Lemma1}{=} W_s(t^{**}, t^{**})$.

Hence, $\psi(t^*) < 0$ for $t_{-h} = t^*$ and $\psi(t^{**}) > 0$ for $t_{-h} = t^{**}$. Since $\psi(t_{-h})$ is monotonically increasing [10] in t_{-h}, there exists a unique value $\tilde{t} \in (t^*, t^{**})$ such that $\psi(t_{-h}) = 0$ for $t_{-h} = \tilde{t}$. Consequently, $\psi(t_{-h}) < 0$ for $t_{-h} < \tilde{t}$ and $\psi(t_{-h}) > 0$ for $t_{-h} > \tilde{t}$



(a) $t_{-h} < \tilde{t}$

(b) $t_{-h} = \tilde{t}$

(c) $t_{-h} > \tilde{t}$

Figure 2: tax haven h's welfare when $\gamma > 0$

It is now easy from lemma 2 to define the best response of tax haven h. When $t_{-h} < \tilde{t}$ (Figure 2a), the best reply of tax haven h is to comply at date t^{**}, because it yields the maximum payoff. When $t_{-h} > \tilde{t}$ (Figure 2c), the best response of haven h is

[10] Indeed, $\frac{\partial \psi}{\partial t_{-h}} = \gamma e^{-\delta t_{-h}} > 0$.

to comply first at t^*. Finally, when $t_{-h} = \tilde{t}$ (Figure 2b), both $t_h = t^*$ and $t_h = t^{**}$ entail the same payoff which makes country h indifferent between the two dates. In this case, it is indifferent to comply first or second.

We summarize the above results in the following proposition.

Proposition 3 . *When $\gamma > 0$, the best response of tax haven h to its rival strategy t_{-h} is*

$$\phi_h(t_{-h}) = \begin{cases} t^{**} & for \quad t_{-h} < \tilde{t}, \\ \{t^*, t^{**}\} & for \quad t_{-h} = \tilde{t}, \\ t^* & for \quad t_{-h} > \tilde{t}\ . \end{cases}$$

By symmetry, the best response function of tax haven $-h$ is

$$\phi_{-h}(t_h) = \begin{cases} t^{**} & for \quad t_h < \tilde{t}, \\ \{t^*, t^{**}\} & for \quad t_h = \tilde{t}, \\ t^* & for \quad t_h > \tilde{t}\ . \end{cases}$$

Proof. See Appendix A.

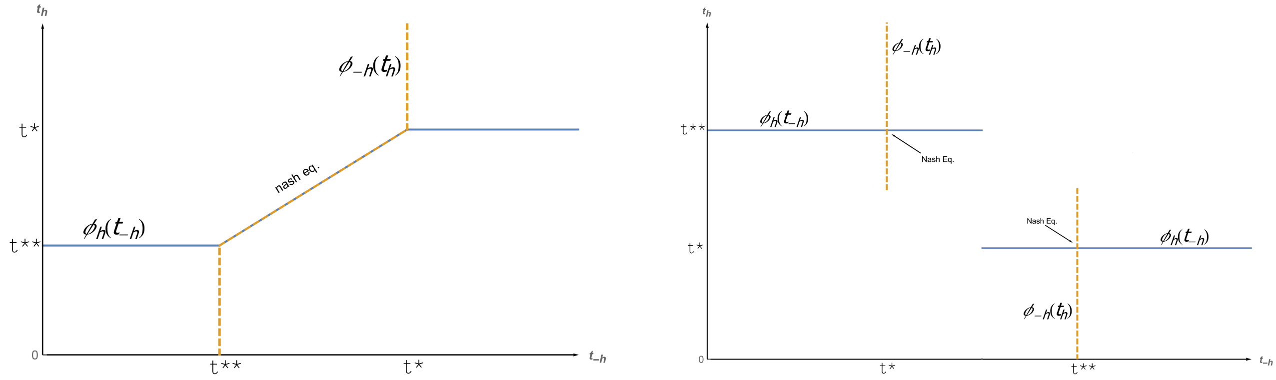
3.2 Nash equilibria

When $\gamma < 0$, the best response correspondences (see 2) of countries h and $-h$ cross in the interval $[t^{**}, t^*]$ (see figure 3a). When $\gamma > 0$, the best response correspondences (see 3) of countries h and $-h$ cross at (t^*, t^{**}) and (t^{**}, t^*) (see figure 3b).

The possible Nash equilibria of the compliance game are summarized in the following proposition.

Proposition 4 (i) *When complying first or second induces the same per-period welfare change, i.e. $\gamma = 0$, there exists a unique symmetric equilibrium in pure strategies where both havens comply at time $t_h^N = t_{-h}^N = t^* = t^{**}$;*

(ii) *When, in each period, the welfare change of being the second to comply dominates the welfare change of being first, i.e. $\gamma < 0$, there exist multiple symmetric Nash equilibria : $t_h^N = t_{-h}^N = t^N \quad with \quad t^N \in [t^{**}, t^*]$;*



(a) Case $\gamma < 0$

(b) Case $\gamma > 0$

Figure 3: Best response correspondence

(iii) When, in each period, the welfare change of being the first to comply dominates the welfare change of being the second, i.e. $\gamma > 0$*, there exist two asymmetric Nash equilibria :* $(t_h^N, t_{-h}^N) = (t^*, t^{**})$ *and* $(t_h^N, t_{-h}^N) = (t^{**}, t^*)$.

Proof. The proof follows by direct inspection of the best responses highlighted in propositions 2and 3.

4 Competition for international capital

In the above sections, we highlighted the importance of the parameter γ that captures the welfare change of complying first or second. For example, tax haven h has an advantage to comply first if γ is positive, but it is advantageous to comply second if γ is negative. The sign of γ was exogenously given so far. In this section, we highlight how this sign results from strategic interactions among tax havens. To this end, assume that both havens use low taxation to attract foreign capital from a large onshore region, given that they have already chosen when to comply with international tax standards (for example, by removing bank secrecy and the implementation of automatic exchange of information for tax purposes). Because we identified different timing patterns regarding compliance, we have to consider three possible cases; (i) no haven has complied, (ii) only one haven has complied and (iii) both havens have complied.

As we me mentioned above, the tax havens attract capital by providing low taxation relative to the onshore region. [11] We assume that there are two ways for onshore investors to take advantage of low tax jurisdictions. When a tax haven does not comply with international standards, investors (firms) avoid taxes in the origin country by just offshoring capital. [12] When a haven complies, investors (firms) who want to lower their tax liabilities set real activities in the low tax country. In other words, havens can provide shelter for tax evaders or a location for low-tax real activities.

We assume that each tax haven faces *a nearby* market of investors. [13] These investors have a preference for the closest tax haven, but this does not prevent them to move their capital to the more distant low tax jurisdiction when tax differentials are sufficiently high. These movements are however not perfectly responsive to any tax difference across the havens. The reason is that investors are heterogeneous in their preference for spatial proximity and that the cost of offshoring capital increases with the distance from havens.

The low tax jurisdictions only compete for tax evaders when they do not comply or they only compete for investments in real activities when they comply with international tax regulation. It is important to notice that the two offshore centers also compete when one of them complies and the other does not. The reason is that investors can choose the way to mitigate their tax liabilities, which depends on existing tax differentials across havens and the cost of moving capital.

Since tax havens face spatially separated markets, we assume that they behave like differentiated duopolists (Dixit, 1979) when they compete in tax rates. [14]

Let us denote by τ_h and τ_{-h} the tax rates of countries h and $-h$, respectively and

[11] Taxation in the onshore country is exogenously given to the tax havens.

[12] In this we follow Hines (2014) by assuming that this is the cheapest way to lower tax liabilities relative to developing real activities for tax purposes.

[13] For example, the Cayman Islands and the Bahamas host the largest banking services directed towards U.S. clients, Jersey and Guernsey towards British customers, Hong Kong towards various other Southeast Asian countries, Luxembourg towards its neighboring countries Germany, France and Belgium, Liechtenstein towards Germany, etc.

[14] If offshoring capital is costless, havens compete à la Bertrand.

let $S_h(\tau_h, \tau_{-h})$ and $S_{-h}(\tau_{-h}, \tau_h)$ stand for the capital supply faced by the jurisdictions h and $-h$. Given symmetry between tax havens, we focus on country h only. The function $S_h(\tau_h, \tau_{-h})$ depends negatively on τ_h and positively on τ_{-h} . For sake of tractability, we assume linearity (for a similar treatment, see Singh & Vives, 1984).

As we explained above, capital supply can have two different sources. Capital originates from tax dodgers when the country h does not comply with international tax regulation. However, when the haven h complies, capital supply is emanating from onshore firms willing to set up real activities in low tax jurisdictions.

Consequently, we can write

$$S_h(\tau_h, \tau_{-h}) = \begin{cases} a_1 - b_1\left(\tau_h - \varepsilon\tau_{-h}\right) & \text{if } h \text{ complies} \\ a_0 - b_0\left(\tau_h - \varepsilon\tau_{-h}\right) & \text{if } h \text{ does not comply} \end{cases}, \tag{11}$$

where, a_1, b_1, a_0, b_0 and ε are positive parameters. The coefficients a_1 and a_0 stand for the highest value of capital tax havens can attract from their nearby markets when they comply and they do not comply, respectively . The coefficients b_1 and b_0 measure the direct marginal effect of tax rates on the capital supply respectively when tax havens comply and they do not comply. The parameter ε accounts for cross effects induced by tax rates between the competing havens. More precisely, $b_1\varepsilon$ and $b_0\varepsilon$ measure the cross marginal effects of tax rates on the capital supply, correspondingly, when tax havens comply and when they do not. Note that $\varepsilon \leq 1$, because the cross-effect cannot exceed the direct effect resulting from a tax change.

We further impose that $a_0 > a_1$ and $b_0 > b_1$. This results from the fact that taking advantage of low taxation is costlier when it occurs through the location of real business activity in a low-tax country rather than by using aggressive tax avoidance strategies. In this case, it is reasonable to assume that a haven's potential nearby market and the sensitivity to low tax rates are highest when the mitigation of tax liability is carried out by artificial tax avoidance.

Moreover, we assume that the low tax jurisdictions are revenue maximizers. This does not necessarily mean that governments are Leviathans. Like (Kanbur & Keen (1993)), we adopt a classical welfarist approach in which agents put a very high marginal valuation on public goods that are funded by collected taxes. The total tax revenues by h equal $\tau_h S_h(\tau_h, \tau_{-h})$ and accordingly, the welfare of tax haven h is,

$$\omega_{i,j}(\tau_h, \tau_{-h}) = \tau_h S_h(\tau_h, \tau_{-h}) \ . \tag{12}$$

4.1 No haven complies

If no tax haven complies, agents only use tax havens to conceal their assets in order to evade high tax rates. This results from the fact that the tax havens do not disclose information to onshore tax administrations. Concealment is thus the easiest option to lower the tax burden.

Each tax haven chooses the tax rate that maximizes its tax revenues by taking as given the rival's tax rate. In particular, tax haven h chooses τ_h that maximizes $\tau_h \left(a_1 - b_1\tau_h + \varepsilon b_1 \tau_{-h}\right)$ by taking as given the rival's tax rate τ_{-h} .

The equilibrium tax rates are

$$\tau_h^* = \tau_{-h}^* = \tau_{0,0}^* = \frac{a_0}{(2-\varepsilon)\, b_0} \ ,$$

Each country's welfare equals

$$\omega_{0,0}^* = \frac{a_0^2}{b_0\,(2-\varepsilon)^2} \ . \tag{13}$$

4.2 Only one tax haven complies

In this case, each tax haven specializes in serving a specific market segment. More specifically, the non compliant tax haven will face tax evaders and the compliant jurisdiction will host onshore investors willing to set up real businesses. Note that the supplies to one tax haven depend on the tax rate of the rival jurisdiction. Hence, cross effects are not excluded. In fact, nothing prevents agents from shifting their capital to the more distant haven if moving costs are not perceived too high.

The payoff function of the non compliant haven is,

$$\omega_{0,1} = \left(a_0 - b_0\tau_h + \varepsilon b_0 \tau_{-h}\right) \tau_h. \tag{14}$$

The payoff function of the compliant haven is

$$\omega_{1,0} = (a_1 - b_1\tau_h + \varepsilon b_1\tau_{-h})\,\tau_h. \tag{15}$$

The havens maximizes their respective tax revenues by taking as given the rival's rate. Assuming without loss of generality that country h does not comply, the equilibrium tax rates are given as follows

$$\tau_h^* = \tau_{0,1} = \frac{2a_0b_1 + \varepsilon a_1 b_0}{(4-\varepsilon^2)\,b_0b_1},$$
$$\tau_{-h}^* = \tau_{1,0} = \frac{2a_1b_0 + \varepsilon a_0 b_1}{(4-\varepsilon^2)\,b_0b_1}.$$

The resulting equilibrium welfare are,

$$\omega_{0,1}^* = \frac{(2a_0b_1 + \varepsilon b_0a_1)^2}{b_1^2b_0\,(4-\varepsilon^2)^2}, \tag{16}$$
$$\omega_{1,0}^* = \frac{(2b_0a_1 + \varepsilon a_0b_1)^2}{b_0^2b_1\,(4-\varepsilon^2)^2}. \tag{17}$$

4.3 Both tax havens comply

In this scenario, tax dodgers can no longer use the tax havens that now focus on attracting real activities. Each tax haven chooses the tax rate that maximizes its tax revenues by taking as given the rival's tax rate. In particular, tax haven h chooses τ_h that maximizes $\tau_h\,(a_1 - b_1\tau_h + \varepsilon b_1\tau_{-h})$ for a given τ_{-h}.

The resulting equilibrium taxes are

$$\tau_h^* = \tau_{-h}^* = \tau_{1,1} = \frac{a_1}{b_1\,(2-\varepsilon)},$$

and each country's welfare equals

$$\omega_{1,1}^* = \frac{a_1^2}{b_1\,(2-\varepsilon)^2}\ . \tag{18}$$

4.4 Discussion

The welfare change induced by complying respectively first and second is,

$$F^* = \omega^*_{1,0} - \omega^*_{0,0} = \frac{(2b_0 a_1 + \varepsilon a_0 b_1)^2}{b_0^2 b_1 (\varepsilon^2 - 4)^2} - \frac{a_0^2}{b_0 (2-\varepsilon)^2}, \tag{19}$$

$$S^* = \omega^*_{1,1} - \omega^*_{0,1} = \frac{a_0^2}{b_1 (2-\varepsilon)^2} - \frac{(2a_0 b_1 + \varepsilon b_0 a_1)^2}{b_1^2 b_0 (\varepsilon^2 - 4)^2}. \tag{20}$$

Consequently, the welfare change of complying first relative to the welfare change of complying second (see Definition 1) is given as follows

$$\gamma^* = F^* - S^* = \frac{\Psi(\varepsilon)}{b_0^2 b_1^2 (\varepsilon - 2)^2 (\varepsilon + 2)^2} \ , \tag{21}$$

where

$$\Psi(\varepsilon) = (\alpha - \beta)\, a_0 b_0 \left[((b_0 - b_1)(a_1 b_0 + b_1 a_0))\, \varepsilon^2 + (4 b_1 b_0 (a_0 - a_1))\, \varepsilon \right] \ ,$$

and

$$\alpha = \frac{a_1}{a_0} \ \text{ and } \ \beta = \frac{b_1}{b_0} \ .$$

We see that the sign of γ^* is identical to the sign of the difference $\alpha - \beta$. To understand the underlying intuition, it is important to remember that compliance relative to non compliance with international tax regulation entails *size and tax sensitivity effects.* The *size effect* consists in a decrease of the potential nearby market size ($\alpha < 1$) of the compliant haven, whereas the tax sensitivity effect involves a reduction of the tax sensitivity of the onshore capital supply ($\beta < 1$). In other words, on the one hand, complying decreases the potential size of the nearby capital supply and on the other hand, it makes the capital supply less sensitive to taxation. This last impact allows the compliant haven to extract more tax revenue. When the just mentioned effects are equal ($\alpha = \beta$), it is irrelevant to be the first or the second to comply. It follows that $\gamma^* = 0$. If the tax sensitivity effect dominates the capital size effect ($\alpha > \beta$), there is an incentive to comply first because the loss in potential capital supply is compensated by a greater ease of extracting capital tax. This explains why being the first to move yields a higher per period welfare gain than being second ($\gamma^* > 0$). If the size effect dominates the tax sensitivity effect ($\alpha < \beta$), the loss of complying first is not compensated by the opportunity to extract more revenue. In other words, we have $\gamma^* < 0$.

The following proposition concludes,

Proposition 5 *When the tax sensitivity effect induced by compliance is equal, higher or lower than the nearby market size effect, the net welfare gain of complying first (γ) is zero (simultaneous compliance), positive (asynchronous compliance) or negative (simultaneous compliance). Formally,*

$$\begin{array}{rclcl} \alpha & = & \beta & \longrightarrow & \gamma^* = 0, \\ \alpha & > & \beta & \longrightarrow & \gamma^* > 0, \\ \alpha & < & \beta & \longrightarrow & \gamma^* < 0. \end{array}$$

Proof. By direct inspection of equation 21 we see that

$$\text{sign} \quad \gamma^* = \text{sign}\left(\frac{a_1}{a_0} - \frac{b_1}{b_0}\right) = \text{sign}\left(\alpha - \beta\right) \ .$$

5 The timing of compliance and the foregone tax base.

In this section we focus on how the time pattern of compliance impacts the tax base in the onshore region. Given that the onshore tax rate on capital is assumed exogenous, the foregone tax base in the onshore region coincides with the amount of capital outflow. In the following, we denote by $S_{i,j}$ the equilibrium capital inflow of country h ($h = 1, 2$) that is in regime i ($i = 0, 1$) given that country $-h$ is in regime j ($j = 0, 1$), remembering that regime 0 refers to no compliance and regime 1 to compliance.

We know that when $\gamma \leq 0$ both tax havens comply simultaneously and that complying at each date within the interval $[t^{**}, t^*]$ is a Nash equilibrium. In this case, it is easy to demonstrate that complying simultaneously at the earliest possible date decreases the loss of tax base. To this end, we need to prove that at a date t, we have $S_{0,0} - S_{1,1} = \frac{a_0 - a_1}{2 - \varepsilon} > 0$, which is readily proved being assumption $a_0 > a_1$.

When $\gamma > 0$, compliance is asynchronous. In this case, it is convenient to demonstrate that simultaneous compliance reduces the loss of tax base relative to partial compliance. To this end, we have to prove that $2S_{1,1} - (S_{1,0} + S_{0,1}) < 0$. Note that,

$$2S_{1,1} - (S_{1,0} + S_{0,1}) = -\frac{a_0}{4-\varepsilon^2}\left(2(1-\alpha) + \frac{\varepsilon}{\beta}\left(\beta^2 - 2\alpha\beta + \alpha\right)\right) .$$

Since, $\alpha, \beta < 1$ and $\beta^2 - 2\alpha\beta + \alpha > 0$[15] we get $2S_{1,1} - (S_{1,0} + S_{0,1}) < 0$. *It follows that simultaneous compliance of both havens always reduces the loss of tax base.*

We now analyze whether partial compliance is able to reduce the loss of tax base relative to no compliance. First, we calculate how capital outflows change after that only one tax haven complies with international tax regulation. For the compliant tax haven we have

$$S_{1,0} - S_{0,0} = -a_0 \frac{2(1-\alpha) + \varepsilon(1-\beta)}{(4-\varepsilon^2)} < 0.$$

For the non compliant country we get

$$S_{0,1} - S_{0,0} = \varepsilon a_0 \frac{\alpha - \beta}{\beta(2-\varepsilon)(\varepsilon+2)} > 0 .$$

Since $\alpha, \beta < 1$ and $\alpha > \beta$, it turns out that the compliant haven looses in terms of capital inflows while the non compliant tax haven gains. The change in the aggregate offshored capital (tax base) equals

$$2S_{0,0} - (S_{1,0} + S_{0,1}) = \frac{a_0}{4-\varepsilon^2}\left(2(1-\alpha) - \frac{\varepsilon}{\beta}(\alpha - \overline{\alpha})\right) .$$

From this equation we can deduce a paradoxical result. Partial compliance can increase the loss of tax base relative to non compliance, namely $2S_{0,0} - (S_{1,0} + S_{0,1}) > 0$ if $\alpha > \overline{\alpha} = \beta(2-\beta)$ and $\varepsilon > \overline{\varepsilon} = \frac{2\beta(1-\alpha)}{\alpha - \beta(2-\beta)}$. In other words, partial compliance is worse than non compliance regarding the loss of tax base if the nearby capital supply of the cooperative haven does not decreases enough ($\alpha > \overline{\alpha}$) and tax cheaters are tax sensitive enough ($\varepsilon > \overline{\varepsilon}$) to be inclined to move their tax base to the non cooperative haven. This result is reminiscent of Elsyyad and Konrad (2012) who demonstrate that closing

[15]Notice that the quadratic equation in β has a zero discriminant.

down tax havens sequentially rather than simultaneously can be harmful to the onshore countries.

The previous results are summarized in the following proposition.

Proposition 6 *(i) The loss of tax base in the onshore countries is at its undermost level when tax havens comply simultaneously and at the earliest possible date. (ii) When only some tax havens comply with international tax regulation, the loss of tax base can increase relative to non compliance if the nearby capital supply of the cooperative tax havens does not shrink too much and if capital supply is tax sensitive enough.*

Proof. In the text.

6 Conclusions

This paper contributes to the debate on the fight against aggressive tax avoidance practices through the release of international standards. When new standards are released, tax havens must determine when (if ever) to adopt them. This decision is based on the discounted welfare resulting from compliance and on the behavior of other tax havens. Notably, tax havens differ widely in the timing of their compliance decisions. Some havens adopt new standards simultaneously, whereas others adopt them at different dates.

We propose a framework to analyze the conditions under which different compliance patterns can occur and how they affect the onshore tax base. More precisely, we develop a model in which similar tax havens must decide when to adopt international tax rules while competing for onshore capital, and the main results may be summarized as follows. When the effect of compliance on the tax sensitivity of international capital flows dominates the reduction of the nearby potential capital supply, asynchronous compliance can arise, which occurs even when tax havens are identical and information is perfect. Conversely, when the negative size effect induced by compliance dominates, tax havens comply simultaneously. In any manner, the loss of tax base in the onshore region is minimized when compliance is simultaneous and occurs at the earliest possible date. Surprisingly, when adopting new standards does not severely reduce the potential supply of capital and when onshore capital is sufficiently tax sensitive, the compliance of only one haven does not decrease the loss of tax base relative to the non-compliance of all the havens.

Our paper offers insights on how the time pattern of international tax compliance affects onshore countries' revenue losses. Our findings can provide more accurate information to improve policy implementation of new international tax standards.

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Appendix A : proof of proposition 2 and 3

Proof of proposition 2 (Case $\gamma < 0$) : We show the best response of tax haven h for the possible choices t_{-h} of the other tax haven.

- Assume $t_{-h} < t^{**}$ then,

on one hand, if $t_h < t_{-h}$, country h complies first and we can write $W(t_h, t_{-h}) = W_f$ (t_h, t_{-h}). The best choice of country h is then to choose t_{-h}. The reason is that t^* maximizes $W_f(t_h, t_{-h})$ and according to proposition 1 $t^* > t^{**}$. It follows that $t^* > t_{-h}$, which means according to assumption 1 that $W_f(t_h, t_{-h})$ is increasing with t_h at t_{-h}.

On the other hand, if $t_h > t_{-h}$, country h complies second and we have $\mathcal{W}(t_h, t_{-h}) = W_s(t_h, t_{-h})$. The best choice of country h is then t^{**} because $W_s(t^{**}, t_{-h}) > W_s(t_{-h}, t_{-h})$ for $t_{-h} < t^{**}$.

Consequently, the best response of country h to t_{-h} is t^{**} because $W_s(t^{**}, t_{-h}) > W_s(t_{-h}, t_{-h}) = W_f(t_{-h}, t_{-h})$ for $t_{-h} < t^{**}$ (see figure 1a).

- Assume $t^{**} \leq t_{-h} \leq t^*$ then,

when $t^{**} \leq t_h < t_{-h}$, country h complies first and we have $\mathcal{W}(t_h, t_{-h}) = W_f(t_h, t_{-h})$. The best choice of country h is then to choose t_{-h} because t_{-h} is (weakly) smaller than t^* which maximizes $W_f(t_h, t_{-h})$ and because $W_f(t_h, t_{-h})$ is strictly concave (by assumption 1).

When $t_{-h} < t_h \leq t^*$, country h complies second and $\mathcal{W}(t_h, t_{-h}) = W_s(t_h, t_{-h})$. The best choice of country h is again to choose t_{-h} because at t_{-h} the function $W_s(t_h, t_{-h})$ is decreasing in t_h. This results from the fact that t_{-h} is larger than t^{**}

which maximizes $W_s(t_h, t_{-h})$ and because of the strict concavity (by assumption 1).

Consequently, the best response of country h to t_{-h} is also t_{-h} ($t_{-h} < t_h \leq t^*$) (see Figure 1b).

- Assume $t_{-h} > t^*$ then,

When $t_h < t_{-h}$, country h complies first and $\mathcal{W}(t_h, t_{-h}) = W_f\ (t_h, t_{-h})$. The best choice of country h is then to choose t^* because $W_f(t^*, t_{-h}) > W_f(t_{-h}, t_{-h})$ for all $t_h \in [t^*, t_{-h}]$.

When $t_h > t_{-h}$, country h complies second and $\mathcal{W}(t_h, t_{-h}) = W_s\ (t_h, t_{-h})$. The

best choice of country h is then to choose t_{-h} because $W_s\ (t_h, t_{-h})$ is decreasing with t_h for $t_h > t_{-h}$ (strict concavity assumption).

Consequently, the best response of country h to t_{-h} is t^* because $W_f(t^*, t_{-h}) > W_f(t_{-h}, t_{-h})$ for $t_{-h} > t^*$ (see Figure 1c).

Proof of proposition 3 (Case $\gamma > 0$) : We show the best response of tax haven h for the possible choices t_{-h} of the other tax haven,

- Assume $t_{-h} < \tilde{t}$ then,

when $t_h < t_{-h}$, we know from definition 2 that $\mathcal{W}(t_h, t_{-h}) = W_f\ (t_h, t_{-h})$. It follows from proposition 1 that $argmax\,(W_f(t_h, t_{-h}))$ equals t^* and by lemma 1 $W_s(t_h, t_{-h}) < W_f(t_h, t_{-h}) < W_f(t^*, t_{-h})\ \ \forall t_h \neq t^*$.

When $t_h > t_{-h}$, according to definition 2 $W(t_h, t_{-h}) = W_s(t_h, t_{-h})$ and $argmax\,(W_s(t_h, t_{-h})) = t^{**} > \tilde{t}$. It follows from proposition 1 that $W_s(t_h, t_{-h}) < W_s(t^{**}, t_{-h})\ \ \forall t_h \neq t^{**}$.

Additionally, according to lemma 2, we know that $W_s(t^{**}, t_{-h}) > W_f(t^*, t_{-h})$ when $t_{-h} < \tilde{t}$.

Consequently, the best response of tax haven h to its rival strategy t_{-h} is $\phi_h(t_{-h}) = t^{**}$ (see Figure 2a).

- Assume $t_{-h} = \tilde{t}$ then,

when $t_h < t_{-h}$, by definition 2 $W(t_h, t_{-h}) = W_f(t_h, t_{-h})$ and because $t^* < \tilde{t} = t_{-h}$, we have by proposition 1 $argmax\,(W_f(t_h, t_{-h})) = t^*$.

When $t_h > t_{-h}$, $W(t_h, t_{-h}) = W_s(t_h, t_{-h})$ (by proposition 1) and because $t^{**} > \tilde{t} = t_{-h}$, we have $argmax\,(W_s(t_h, t_{-h})) = t^{**}$.

Finally, according to lemma 2, we know that $W_s(t^{**}, t_{-h}) = W_f(t^*, t_{-h})$ when $t_{-h} = \tilde{t}$.

Consequently, the best response of tax haven h to its rival strategy t_{-h} is $\phi_h(t_{-h}) = \{t^*, t^{**}\}$ (see Figure 2b).

- Assume $t_{-h} > \tilde{t}$ then,

when $t_h < t_{-h}$, we know from definition 2 that $W(t_h, t_{-h}) = W_f(t_h, t_{-h})$. It follows from proposition 1 that $\text{argmax}(W_f(t_h, t_{-h})) = t^*$ and $W_f(t_h, t_{-h}) < W_f(t^*, t_{-h})\ \forall t_h \neq t^*$.

When $t_h > t_{-h}$, by definition 2 $W(t_h, t_{-h}) = W_s(t_h, t_{-h})$ and by proposition 1 $\text{argmax}(W_s(t_h, t_{-h}))$ equals t^{**} or t_{-h} and $\text{max}W_s(t_h, t_{-h}) \leq W_s\ (t^{**}, t_{-h})$.

According to lemma 3, we know that $W_f\ (t^*, t_{-h}) > W_s\ (t^{**}, t_{-h})$ when $t_{-h} >$ $\tilde{t}$. Consequently, the best response of tax haven h to its rival strategy t_{-h} is $\phi_h(t_{-h}) = t^*$ (see Figure 2c).