Strategic Treaty Shopping*

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Abstract

Treaty shopping refers to the use of indirect investment structures through countries with favorable tax treaties. This paper examines a game-theoretic model of treaty shopping in tax treaty networks. An investor can choose an investment route across national borders to minimize tax while a tax agency can choose to audit the investor to find out the route. The audit is costly but it can give additional revenue to the tax agency. This paper analyzes the equilibrium of the model, computes tax revenue loss due to treaty shopping, and shows the payoff dominance of a random audit rule. This paper also analyzes the structure of tax-minimizing investment routes in a real-world network of tax treaties between selected countries. While about 76 percent of tax-minimizing indirect routes pass through countries with no withholding tax, about 21 percent of tax-minimizing indirect routes pass through countries with tax treaty networks favorable to certain residence countries. To prevent treaty shopping countries may amend tax treaties with possible pass-through countries.

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1 Introduction

The main purpose of a tax treaty is to mitigate double taxation by reducing rates of withholding tax imposed on income and capital earned across national borders. To promote international trade and investment, countries maintain extensive and complex tax treaty networks. For example, South Korea has 91 tax treaties in force with various reduced rates from zero to fifteen percent depending on contracting countries and income types.[1] However, due to the complexity of tax treaty networks, combined with the diverse structures of national tax laws, unintended situations may occur. One such situation is an abuse of tax treaties for tax avoidance, which is often called treaty shopping. Generally, treaty shopping refers to the use of indirect investment structures through countries with favorable tax treaties.

More precisely, treaty shopping may occur in circumstances such as the following: An individual or a company, who is a resident of country 1, establishes an intermediary entity in country 2 to operate a business and earn a type of income, such as dividends, in country 3. Countries 2 and 3 have a tax treaty that reduces taxes on the income earned in country 3. Countries 1 and 2 also have a favorable tax treaty. However, countries 1 and 3 have no tax treaty or have a less favorable tax treaty. The intermediary entity claims the application of the tax treaty between countries 2 and 3 to obtain tax reductions in country 3. However, the intermediary entity is owned or controlled by a resident of country 1 who is not entitled to the tax treaty benefits. Furthermore, the intermediary entity pays no or low taxes in country 2 on the income earned in country 3. In these circumstances, the tax authority of country 3 may be able to apply a general anti-abuse rule and impose a penalty on the resident of country 1 for tax avoidance.[2]

[1] As of February 2017, the United States has 66 tax treaties in force; China 99 treaties; the United Kingdom 137 treaties with reduced rates from zero to 25 percent.

[2] General anti-abuse rules allow tax authorities to recharacterize a series of transactions mainly designed to obtain tax benefits as one taxable transaction. For instance, see Section §7701 (o) of the Internal Revenue Code of the United States; Part 5 of Finance Act 2013 of the United Kingdom; Article 14 (3) of Basic Act for National Taxes of South Korea.

Treaty shopping is considered to be an improper use of tax treaties.[3] In this paper I analyze a game-theoretic model of treaty shopping in tax treaty networks. I would like to address the following questions: How can investment structures be designed for tax minimization? Which countries play important roles in tax-minimizing investment structures? How often do investors use such structures? How much does treaty shopping affect tax revenue in a source country? How can tax authorities deal with treaty shopping?

Let us imagine a world with n countries. An investor lives in country 1 and plans to invest in country n. From this investment the investor will earn a type of income in country n and repatriate his income to country 1. The investor intends to minimize tax, i.e., to maximize his after-tax income, by choosing an investment route from country 1 to country n. The investor can choose a direct route or an indirect route, which incorporates intermediary entities established in other countries. Tax treaties, as well as national tax laws, determine taxes paid along an investment route. Meanwhile, the tax agency of country n can choose to audit the investor to find out the investment route. The audit is costly but it can give additional revenue to the tax agency if it reveals that the investor chose an indirect route for tax avoidance. The tax agency imposes a penalty tax on the investor by applying a general anti-abuse rule. This situation can be viewed as a simultaneous-move game between the tax agency and the investor in a network of tax treaties.

First I characterize the (Nash) equilibrium of this model. In equilibrium the two players choose mixed strategies. The equilibrium probability p of the tax agency auditing the investor is calculated with tax rates. The equilibrium probability q of the investor choosing tax-minimizing indirect routes is calculated as the ratio of audit cost to penalty tax.

The comparative statics of the equilibrium shows interesting implications. The audit probability p is increasing in the tax rate of the direct route, decreasing in the tax rate of a tax-minimizing indirect route, and independent

[3]OECD (2015) states that treaty abuse is one of the most important sources of concerns regarding the Base Erosion and Profit Shifting (BEPS) project.

of the income. If the income changes, the investor adjusts q in equilibrium, and the tax agency stays indifferent between no audit and audit. Thus, p remains unchanged. Moreover, the indirect-route probability q is increasing in the audit cost, decreasing in the penalty tax rate, and independent of the withholding tax rates at source n. If the withholding tax rates change in the source country, the tax agency adjusts p in equilibrium, and the investor stays indifferent between the direct route and tax-minimizing indirect routes. Thus, q remains unchanged. Therefore, if countries aim to attract more investment by signing a new treaty, it is important to make the direct route tax-minimizing. If the new treaty still makes indirect routes tax-minimizing, investment activity may remain unmotivated between the countries, because investors use the direct route with the same probability as before.

By subtracting the equilibrium payoff of the tax agency from the maximum tax revenue achieved when only the direct route is available, I compute the loss of tax revenue from treaty shopping in my model. This equilibrium loss of tax revenue is determined by the tax rate spread, which is defined as the average difference of withholding tax rates imposed by the source country in the direct route and in tax-minimizing indirect routes. Interestingly, if the penalty tax rate is greater than the tax rate spread, the tax agency raises more revenue by adopting the equilibrium random audit strategy than by sticking to non-random audit strategies.

In a sequential variation of the model, if the tax agency can distinguish whether or not the investor chose the direct route when choosing whether to audit, there is a unique (subgame perfect Nash) equilibrium where the tax agency prevents treaty shopping by selectively auditing the investor who chose an indirect route.

Next I analyze the structure of tax-minimizing investment routes in a real-world network of tax treaties between fifteen selected countries. Tax treaties can reduce withholding tax rates. I focus on withholding tax rates on dividends by presuming that investors establish companies to earn and remit their income as dividends.

If foreign investors plan to invest in countries with no withholding tax on dividends, they can minimize tax by investing directly. However, if there is a withholding tax on dividends, foreign investors may be able to minimize tax by investing indirectly, e.g., by investing through intermediary entities established in other countries. Among the fifteen countries, eight countries impose withholding taxes on dividends: Belgium, China, Japan, South Korea, the Netherlands, Saudi Arabia, Switzerland, and the United States. I construct a matrix of withholding tax rates and analyze tax-minimizing investment routes to these countries. I also calculate tax rate spreads, which can be viewed as a proxy for tax revenue loss due to treaty shopping.

In total I discover 176 tax-minimizing indirect routes between all pairs of countries. While some pairs of countries have no such indirect route between them (because direct routes are tax-minimizing), other pairs often have more than one tax-minimizing indirect route. About 76 percent (134 routes) of tax-minimizing indirect routes pass through one of five countries with no withholding tax: Hong Kong, Ireland, Luxembourg, Singapore, and the United Kingdom. These indirect routes can maximize an investor's after-tax income because there are source countries that set the minimum tax treaty rate for these countries. However, about 21 percent (37 routes) of tax-minimizing indirect routes pass through any one of Belgium, the Netherlands, or Switzerland. These countries play a significant role as a pass-through country by maintaining tax treaties favorable to certain residence countries, such as Japan, while generally imposing withholding taxes.

To assess the importance of a country in tax-minimizing routes, I use a group of network centrality measures including betweenness centrality.[4] Each centrality measure ranks countries in a different way. However, by all the three aggregate centrality measures used here, the United Kingdom and Ireland are ranked first and second, respectively. These two countries are followed by Hong Kong, Luxembourg, Switzerland, and the Netherlands in aggregate centrality rankings.

[4]The betweenness centrality of country k is defined as the sum of the proportions of tax-minimizing indirect routes passing through country k over all pairs of other countries.

Some countries aim to prevent treaty shopping by amending tax treaties to include anti-abuse provisions.[5] Because pass-through countries can be identified by analyzing the structure of tax-minimizing investment routes, countries may focus on tax treaties with pass-through countries, which can be abused for treaty shopping. Countries may also assign priorities to certain tax treaties based on centrality measures to work on the amendments.

The contribution of this paper is twofold.

Firstly, this paper contributes to the body of literature on the economics of international taxation. The main focus of this literature has been on strategic interactions between countries, which can choose tax rates, as well as tax relief rules, such as foreign tax credit and deduction. Bond and Samuelson (1989) introduce a model where countries can apply differentiated tax rates on foreign income, and show that a certain relief rule can achieve a higher level of world welfare than other rules.[6] Another focus of this literature is to examine theoretical and empirical relations between tax treaties and Foreign Direct Investment (FDI). For instance, Chisik and Davies (2004) study the effects of FDI on tax treaty bargaining by using a cooperative bargaining solution, and show that asymmetry in FDI stocks may lead to higher tax treaty rates.[7] In contrast to these existing studies, this paper analyzes the network effects of tax treaty rates on strategic interactions between a taxpayer and a tax authority by combining a game-theoretic model with a network analysis.

Secondly, this paper contributes to the literature on tax havens and international tax avoidance. This growing body of literature includes both positive and negative views on the effects of tax havens on world economy. Slemrod and Wilson (2009) develop a model of tax competition to show that the elimination of tax havens can increase world welfare. Desai et al. (2006)

[5]OECD (2015) discusses anti-abuse provisions, such as limitation on benefits and principal purpose test, to deal with treaty shopping.

[6]For related studies, see Janeba (1995), Konan (1997), Davies (2003), Stöwhase (2013), and Eggert and Itaya (2014).

[7]Conversely, Blonigen and Davies (2004) examine the effects of tax treaties on FDI to and from the United States, and discover substantial heterogeneity in treaty effects across contracting countries though the average treaty effect is not statistically significant.

empirically examine the characteristics of American multinational companies with affiliates in tax havens, and discover that tax havens are used more intensively by companies with more intra-firm trade and larger R&D investment.[8] However, these existing studies have dealt with the general relationship between tax havens and tax avoidance. In contrast, this paper focuses on a specific type of tax avoidance behavior, treaty shopping, and examines the role of tax havens in treaty shopping.[9]

The rest of this paper is organized as follows. Section 2 develops a game-theoretic model of treaty shopping. Section 3 analyzes the equilibrium of this model and studies comparative statics. Section 4 analyzes the structure of tax-minimizing investment routes in a real-world network of tax treaties. Section 5 concludes.

2 Model

Let us imagine a world with $n \geq 3$ countries. An investor lives in country 1 and plans to invest in country n. From this investment the investor will earn a type of income $m > 0$ in country n and repatriate his income to country 1. Country 1 is called the residence country while country n is called the source country. The investor intends to minimize tax when he remits his income to country 1, i.e., the investor intends to maximize his after-tax income in the residence country. The investor can choose an investment route (or simply a route) from country 1 to country n. A route is defined as a sequence of countries, $1, i, \ldots, j, n$, from country 1 to country n. If the investor chooses a *direct route* $1, n$, he invests directly in country n. If the investor chooses an *indirect route* $1, i, \ldots, j, n$, he invests in country n by establishing entities in countries i through j and making his investment through these entities.

[8] Dharmapala (2008) provides an overview of the literature on tax havens. For related studies, see Hines and Rice (1994), Clausing (2009), Desai and Dharmapala (2009, 2011), Dharmapala and Hines (2009), Gravelle (2009), Elsayyad and Konrad (2012), and Johannesen (2012).

[9] Treaty shopping has received growing attention. For instance, see Mintz and Weichenrieder (2010), Lewellen and Robinson (2013), Weyzig (2013), and Hong (2016).

Given an indirect route $1, i, \ldots, j, n$, countries i through j are called pass-through countries. A route $1, i, \ldots, j, n$ is often written as

$$1 \to i \to \cdots \to j \to n$$

when it is necessary to highlight the direction of the route. When the investor remits his income from country n to country 1, the remittance route follows the reverse order of the countries in the investment route.

The investor will earn income m as dividends. The investor knows a tax rate t_i in country i and a tax rate t_{ij} on dividends under the tax treaty between countries i and j. A withholding tax is imposed by country i at the tax treaty rate t_{ij} when an entity in i remits dividends to another entity in j. A tax rate matrix is defined as follows:

$$T = \begin{bmatrix} t_1 & t_{12} & \cdots & t_{1n} \\ t_{21} & t_2 & \cdots & t_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{n1} & t_{n2} & \cdots & t_n \end{bmatrix}$$

In country 1, if the investor chooses the direct route $1, n$, the after-tax income is $(1-t_{n1})(1-t_1)m$. However, if the investor chooses an indirect route $1, i, \ldots, j, n$, the after-tax income is $(1-t_{nj})(1-t_j)\cdots(1-t_i)(1-t_{i1})(1-t_1)m$ in the residence country.[10]

The tax agency of country n is informed of the inbound investment. The tax agency knows that the investor is a resident of country 1 and expects that the investor's earning will be m in country n. When the investor chooses the direct route $1, n$, the revenue of the tax agency is $t_{n1}m$. When the investor chooses an indirect route $1, i, \ldots, j, n$, the revenue is $t_{nj}m$.

Here I assume that the tax agency does not know which route the investor chose. Later I will examine a two-stage game by relaxing this assumption.[11]

[10]Note that there is no tax credit for foreign dividends in the residence country. This assumption is restrictive but not unrealistic because there is a growing number of countries, such as Japan and the United Kingdom, adopting exemption systems for foreign dividends.

[11]The tax agency may obtain some information about the investor's route choice, e.g., immediate shareholders (or recipients of dividends) of the firm in country n, from tax and financial statements.

The tax agency of country n can choose whether to audit the investor to find out the route. The cost of audit is $c > 0$. After the audit, if the tax agency finds that the investor chose an indirect route, the tax agency imposes a penalty tax on income m at rate r by applying a general anti-abuse rule. The investor must pay the penalty tax rm to the tax agency. The cost of audit is smaller than the penalty tax, i.e., $c < rm$. If the tax agency finds that the investor chose the direct route, the tax agency receives no additional revenue.

The tax agency and the investor play a simultaneous-move game. The tax agency (or player A) chooses a strategy $a \in \{0, 1\}$ to specify whether to audit. If $a = 1$, the tax agency audits the investor. Otherwise, the tax agency does not. The investor (or player B) chooses a strategy b to specify the investment route from country 1 to country n. If $b = 1, n$, the investor chooses the direct route. Otherwise, the investor chooses an indirect route $b = 1, i, \ldots, j, n$. The tax rate of an investment route b is defined as follows:

$$t(b) = \begin{cases} t_{n1} & \text{if } b = 1, n \\ 1 - (1 - t_{nj})(1 - t_j) \cdots (1 - t_i)(1 - t_{i1}) & \text{if } b = 1, i, \ldots, j, n \end{cases}$$

To summarize, the payoff functions of the tax agency (A) and the investor (B) can be written as follows:

(i) $a = 1$ and $b = 1, i, \ldots, j, n$
$u_A(a, b) = t_{nj}m + rm - c$ and $u_B(a, b) = (1 - t(b))(1 - t_1)m - rm$

(ii) $a = 1$ and $b = 1, n$
$u_A(a, b) = t_{n1}m - c$ and $u_B(a, b) = (1 - t(b))(1 - t_1)m$

(iii) $a = 0$ and $b = 1, n$
$u_A(a, b) = t_{n1}m$ and $u_B(a, b) = (1 - t(b))(1 - t_1)m$

(iv) $a = 0$ and $b = 1, i, \ldots, j, n$
$u_A(a, b) = t_{nj}m$ and $u_B(a, b) = (1 - t(b))(1 - t_1)m$

3 Equilibrium Analysis

In this section I characterize the (Nash) equilibrium of the model and examine comparative statics. I also calculate tax revenue loss in equilibrium and compare random audit rules with non-random rules.

Given a tax rate matrix T, a route b^* is tax-minimizing if for each route b, $t(b^*) \leq t(b)$. In the next section I will show how to find tax-minimizing routes in tax treaty networks. Here I assume that there is a tax-minimizing indirect route b^* such that $t(b^*) < t_{n1}$. Thus, the direct route is not tax-minimizing. Because $t(b^*) < t_{n1}$ implies $(1 - t_{n1})(1 - t_1)m < (1 - t(b^*))(1 - t_1)m$, the investor can earn higher after-tax income by choosing b^* than by choosing the direct route. I also assume that $(1-t(b^*))(1-t_1)-(1-t_{n1})(1-t_1) < r$, i.e., the penalty tax rate is greater than the difference in rates of after-tax income. The investor prefers the direct route if he will have to pay the penalty tax after using b^*. Now I show that there is a unique equilibrium where the tax agency and the investor play mixed strategies.

Proposition 1. *If there is a unique tax-minimizing indirect route b^*, there is a unique equilibrium where the tax agency audits the investor with probability p and the investor chooses the indirect route b^* with probability q as follows:*

$$p = \frac{(t_{n1} - t(b^*))(1 - t_1)}{r} \tag{1}$$

$$q = \frac{c}{rm} \tag{2}$$

If there is more than one tax-minimizing indirect route, in equilibrium, q is the total probability of the investor choosing tax-minimizing indirect routes. The tax agency's equilibrium strategy remains the same.

The proof of Proposition 1 is presented in the Appendix. In equilibrium, the probability p of the tax agency auditing the investor is calculated with model parameters such as tax rates, and the probability q of the investor

choosing tax-minimizing indirect routes is calculated as the ratio of audit cost to penalty tax.

The comparative statics of the unique equilibrium shows interesting implications. If the tax rate t_{n1} of the direct route increases, while the other parameters are fixed, the audit probability p increases. If the tax rate $t(b^*)$ of a tax-minimizing indirect route b^* increases, then p decreases. Even if the investor's income m changes, p remains the same.

If the audit cost c increases, while the other parameters are fixed, the indirect-route probability q increases. If the penalty tax rate r increases, then q decreases. Even if the tax rates t_{ni} of country n change, q remains the same. These findings are summarized in the following proposition.

Proposition 2. *In equilibrium: (i) The audit probability p is increasing in the tax rate t_{n1} of the direct route, decreasing in the tax rate $t(b^*)$ of a tax-minimizing indirect route b^*, and independent of the income m. (ii) The indirect-route probability q is increasing in the audit cost c, decreasing in the penalty tax rate r, and independent of the tax rates t_{ni} at source n.*

The proof of Proposition 2 is straightforward from (1) and (2), and omitted. It is interesting to observe that the audit probability p is independent of the income m. When m changes, the investor adjusts q in equilibrium, and the tax agency stays indifferent between no audit and audit. Thus, p remains unchanged.

Moreover, the indirect-route probability q is independent of the tax rates t_{ni} in the source country. When t_{ni} changes, the tax agency adjusts p in equilibrium, and the investor stays indifferent between the direct route and tax-minimizing indirect routes. Thus, q remains unchanged. Table 1 shows the comparative statics of the unique equilibrium.

These equilibrium results are not in contradiction with the situation when the signing of a tax treaty induces more investment activity, i.e., when the investor chooses the direct route more frequently to obtain the benefits of the new tax treaty.

Table 1. Comparative statics

parameter increase	audit probability p	indirect-route probability q
$t(b^*)$	$\downarrow$	-
t_{n1}	$\uparrow$	-
t_1	$\downarrow$	-
r	$\downarrow$	$\downarrow$
c	-	$\uparrow$
m	-	$\downarrow$

Remark 1. Propositions 1 and 2, as well as the comparative statics in Table 1, hold when $t(b^*) < t_{n1}$, i.e., when the direct route is not tax-minimizing. If countries 1 and n sign a new tax treaty to make the direct route tax-minimizing, the investor can maximize his after-tax income by choosing the direct route with probability 1. Thus, the probability for the investor to choose the direct route increases from $1 - q$ to 1 as the new treaty enters into force. However, if the new treaty still makes an indirect route tax-minimizing, Proposition 2 (ii) implies that the probability to choose the direct route remains the same as before.

By subtracting the tax agency's equilibrium payoff from the maximum possible revenue, I compute the equilibrium loss of tax revenue in my model.[12]

Remark 2. If there are $\ell \geq 1$ tax-minimizing indirect routes, and if each tax-minimizing indirect route is played with equal probability $\frac{c}{rm} \cdot \frac{1}{\ell}$ in equilibrium, the tax agency's payoff is $t_{n1}m - \frac{c}{r}\frac{1}{\ell}\sum_{k=1}^{\ell}(t_{n1} - t_{nj_k})$, where j_k is the last pass-through country in each tax-minimizing indirect route $1, i_k, \ldots, j_k, n$ for $k = 1, \ldots, \ell$. The tax agency's revenue would be $t_{n1}m$ if only the direct route was available to the investor. Therefore, the equilibrium loss of tax revenue is $\frac{c}{r}\frac{1}{\ell}\sum_{k=1}^{\ell}(t_{n1} - t_{nj_k})$.

[12]However, if a tax agency is expected to audit investors frequently, investors may adjust their investment as well as their income, which is assumed to be given and fixed in my model. This adjustment may affect tax revenue loss as well.

For residence country 1 and source country n, if there are $\ell \geq 1$ tax-minimizing indirect routes, the tax rate spread s_{n1} is defined as the average difference of withholding tax rates imposed by country n in the direct route and in the indirect routes, that is, $s_{n1} = \frac{1}{\ell}\sum_{k=1}^{\ell}(t_{n1} - t_{nj_k})$. The equilibrium loss of tax revenue is determined by the tax rate spread s_{n1}, provided that each tax-minimizing indirect route is played with equal probability. I will compute tax rate spreads for selected pairs of countries in Table 3.

In practice the tax agency may not be allowed to use any random audit strategy due to certain statutory or administrative constraints. However, the tax agency can raise more revenue by adopting the equilibrium random audit strategy than by sticking to pure strategies.

Proposition 3. *When each tax-minimizing indirect route is played with equal probability, if the penalty tax rate is greater than the tax rate spread, i.e., if $r > s_{n1}$, the tax agency raises more revenue by adopting the equilibrium random audit strategy than by sticking to non-random audit strategies.*

The proof of Proposition 3 is presented in the Appendix. In equilibrium, the investor's payoff is $(1-t_{n1})(1-t_1)m$. If the tax agency always chooses to audit and the investor always chooses the direct route, the investor's payoff is $(1 - t_{n1})(1 - t_1)m$. Therefore, if the penalty tax rate is greater than the tax rate spread, the tax agency raises more revenue by adopting the equilibrium random audit strategy than by always auditing the investor, while the investor earns the same payoff.

In classical studies on random audits, e.g., Border and Sobel (1987) and Mookherjee and Png (1989), a taxpayer's avoidance technique is based on income underreporting. In this paper, the tax avoidance technique is based on indirect routing. Even if the investor reports his income truthfully, if he can use a tax-minimizing indirect route, the tax agency can design a random audit rule with a sufficiently high penalty tax rate to raise more revenue.

Until now I examined the model where the tax agency and the investor move simultaneously. Even if these two players do not choose their strategies

exactly at the same time, if they do not know each other's choice when making their own choices, it is reasonable to assume that they move simultaneously.[13]

However, in some cases, tax authorities may be able to obtain certain information about investment structures. For instance, if a company's financial statements show that dividends are paid directly to entities in the residence country, tax authorities can presume that investors use direct investment structures and can choose not to audit. If dividends are paid to entities in countries other than the residence country, tax authorities can presume that investors use indirect investment structures and can choose to audit.

This situation can be thought of as a two-stage (sequential-move) game between a tax agency and an investor. In the first stage, the investor chooses a direct or indirect investment route. In the second stage, the tax agency knows whether or not the investor chose the direct route and chooses whether to audit.[14] Next I present the (subgame perfect Nash) equilibrium in this two-stage game.

Proposition 4. *In the two-stage game where the investor moves first, there is a unique equilibrium where the investor chooses the direct route and the tax agency selectively audits the investor who chose an indirect route.*

The proof of Proposition 4 is presented in the Appendix. In the two-stage game, the tax agency enjoys the second mover's advantage by observing whether or not the investor chose the direct route. In the unique equilibrium, the tax agency can prevent treaty shopping by selectively auditing the investor who did not choose the direct route.

4 Network Analysis

In this section I analyze the structure of tax-minimizing investment routes in a real-world network of tax treaties between fifteen selected countries:

[13]This model can be viewed as an extreme environment for the tax agency where it has to make an audit choice without having information useful for making the choice.

[14]Even if the tax agency knows that the investor chose an indirect route, the tax agency may still have to conduct an audit to gather sufficient evidence to impose a penalty tax.

Belgium (BE), Bermuda (BM), Cayman Islands (KY), China (CN), Hong Kong (HK), Ireland (IE), Japan (JP), South Korea (KR), Luxembourg (LU), the Netherlands (NL), Saudi Arabia (SA), Singapore (SG), Switzerland (CH), the United Kingdom (GB), and the United States (US).[15] Based on this analysis, network centrality measures are introduced to assess the importance of a country in tax-minimizing investment routes.

4.1 Tax-minimizing routes

Tax treaties between countries, as well as their national tax laws, specify rates of withholding tax on various types of income, such as dividends, interest, royalties, and capital gains. The rates of withholding tax can be reduced by tax treaties. In the context of international taxation, a withholding tax refers to a tax on income and on capital imposed by a source country. Here I focus on the rates of withholding tax on dividends by presuming that investors establish companies to earn and remit their income as dividends.

Table 2 shows the matrix of withholding tax rates as a percentage.[16] The tax rate t_{ij} is applied if dividends are paid from country i to country j. For example, in Table 2, the BE-BM rate is 25 percent, which is applied when a company in Belgium pays out dividends directly to an entity in Bermuda. Note that the tax rate matrix in Table 2 is asymmetric. Even if the BE-BM rate is 25 percent, the BM-BE rate is zero percent.

There is no withholding tax on dividends in seven countries: Bermuda

[15]This list of countries can be categorized as follows: large countries (in terms of GDP) such as the United States, China, Japan, and the United Kingdom; medium-sized countries such as South Korea, the Netherlands, Saudi Arabia, Switzerland, and Belgium; small countries with developed financial sectors such as Singapore, Hong Kong, Ireland, and Luxembourg; and tax haven countries such as Bermuda and Cayman Islands. These countries are selected as the most frequent countries investing to or from South Korea.

[16]This matrix is constructed from the PwC Worldwide Tax Summaries (accessed at taxsummaries.pwc.com) and based on minimum withholding tax rates. A minimum rate is often applied when an investor holds at least a certain percentage of shares. In a country with a dividend imputation system, there may be a difference between tax incidence and withholding tax on dividends, because no withholding tax may be imposed on dividends from companies paying corporate income taxes. An example of such a country is Australia. However, among the fifteen countries in my analysis, no country has an imputation system.

Table 2. Tax rate matrix

	BE	BM	KY	CN	HK	IE	JP	KR	LU	NL	SA	SG	CH	GB	US
BE	-	25	25	5	0	0	0	0	0	0	25	0	0	0	0
BM	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0
KY	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0
CN	5	10	10	-	5	5	10	5	5	5	5	5	5	5	10
HK	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0
IE	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0
JP	7	7	7	7	5	7	-	5	5	0	5	5	0	0	0
KR	15	20	20	5	10	10	5	-	10	10	5	10	5	5	10
LU	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0
NL	0	15	15	5	0	0	0	10	0	-	5	0	0	0	0
SA	5	5	5	5	5	0	5	5	5	5	-	5	5	5	5
SG	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0
CH	0	35	35	10	0	0	0	5	0	0	35	5	-	0	5
GB	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0
US	0	30	30	10	30	5	0	10	5	0	30	30	0	0	-

Note: minimum withholding tax rate as a percentage; - same country pair

(BM), Cayman Islands (KY), Hong Kong (HK), Ireland (IE), Luxembourg (LU), Singapore (SG), and the United Kingdom (GB). This implies that investors can minimize tax on dividends by investing directly to these countries. However, the other countries impose withholding taxes on dividends, whose rates can be reduced by tax treaties: Belgium (BE), China (CN), Japan (JP), South Korea (KR), the Netherlands (NL), Saudi Arabia (SA), Switzerland (CH), and the United States (US). Investors may be able to minimize tax on dividends by investing indirectly to these countries, e.g., by investing through intermediary entities established in other countries.

Given the tax rate matrix in Table 2, tax-minimizing investment routes can be obtained for each pair of residence and source countries. To highlight the effect of tax treaty rates on the structure of tax-minimizing investment routes, I assume that every country i maintains a sufficiently low tax rate $t_i = \epsilon > 0$. Note that in Table 2 every source country i sets the lowest tax treaty rate t_{ij} for some country j with no withholding tax. For instance, when Belgium (BE) is the source country, the lowest tax treaty rate is zero percent, and it is applied for countries with no withholding tax, such as Hong Kong (HK), Ireland (IE), Luxembourg (LU), Singapore (SG), and the United

Kingdom (GB). Once investors transfer their income to these countries, they can remit it, with no withholding tax, to their residence country. So it only makes investors pay more tax to add another pass-through country. Therefore, every tax-minimizing route passes through at most one country. In other words, if an indirect route passes through two or more countries, the indirect route is not tax-minimizing. This observation, summarized in the following remark, is also supported by empirical evidence.[17]

Remark 3. Given a tax rate matrix, if each country sets the lowest tax treaty rate for some country with no withholding tax, and if each country maintains a sufficiently low tax rate, then every tax-minimizing route passes through at most one country.

Table 3 shows tax-minimizing investment routes. In Table 3, residence countries are in the top row, whereas source countries are in the leftmost column. Each asterisk ($*$) indicates that a direct route is tax-minimizing. However, if an indirect route is tax-minimizing, the corresponding pass-through country is specified in Table 3, and the corresponding tax rate spread is shown as a percentage in parentheses. Empirical studies provide comparable results to identify pass-through countries in international ownership structures, i.e., investment routes.[18]

The most striking case is observed when Saudi Arabia (SA) is the source country. As shown in Table 2, Saudi Arabia (SA) generally imposes a five-

[17]Lewellen and Robinson (2013, Table 1 Panel A) discover that the median length of ownership paths from US parent firms to their foreign subsidiaries is 2, i.e., there is only one pass-through entity between parent firms and bottom subsidiaries. Mintz and Weichenrieder (2010, Table 4.4) show a similar finding for German multinational firms. However, there also exists a relatively small number of multinational firms whose length of ownership paths (or investment routes) is longer than 2. These multinational firms may establish intermediary entities in a third country for reasons other than treaty shopping. Such intermediary entities often carry on some real and substantial business activities.

[18]Lewellen and Robinson (2013, Table 5) discover that US firms establish intermediaries frequently in the following ten countries: the Netherlands, the United Kingdom, Germany, Bermuda, Canada, Hong Kong, Cayman Islands, Singapore, Panama, and Mauritius. Mintz and Weichenrieder (2010, Table 4.5) also find that German firms use intermediaries frequently in the following ten countries: the Netherlands, Switzerland, Austria, the United States, the United Kingdom, France, Sweden, Luxembourg, Belgium, and Singapore.

Table 3. Tax-minimizing investment routes

	BE	BM	KY	CN	HK	IE	JP	KR	LU	NL	SA	SG	CH	GB	US
BE	-	HK IE LU SG GB (25)	HK IE LU SG GB (25)	HK IE LU SG GB (5)	*	*	*	*	*	*	HK IE LU SG GB (25)	*	*	*	*
CN	*	HK IE LU SG GB (5)	HK IE LU SG GB (5)	-	*	*	BE HK IE LU NL SG CH GB (5)	*	*	*	*	*	*	*	BE HK IE LU NL SG GB (5)
JP	NL CH GB US (7)	GB (7)	GB (7)	GB (7)	NL CH GB (5)	NL CH GB (7)	-	GB (5)	NL CH GB (5)	*	GB (5)	NL GB (5)	*	*	*
KR	CH GB (10)	GB (15)	GB (15)	*	CH GB (5)	SA CH GB (5)	*	-	CH GB (5)	JP CH GB (5)	*	GB (5)	*	*	JP GB (5)
NL	*	HK IE LU SG GB (15)	HK IE LU SG GB (15)	HK IE LU SG GB (5)	*	*	*	BE HK IE LU SG GB (10)	*	-	HK IE LU SG GB (5)	*	*	*	*
SA	IE (5)	IE (5)	IE (5)	IE (5)	IE (5)	*	IE (5)	IE (5)	IE (5)	IE (5)	-	IE (5)	IE (5)	IE (5)	IE (5)
CH	*	HK IE LU GB (35)	HK IE LU GB (35)	HK IE LU GB (10)	*	*	*	BE HK IE LU GB (5)	*	*	HK IE LU GB (35)	BE HK IE LU NL GB (5)	-	*	BE HK IE JP LU NL GB (5)
US	*	GB (30)	GB (30)	GB (10)	BE NL CH GB (30)	BE NL CH GB (5)	*	BE GB (10)	BE NL CH GB (5)	*	GB (30)	BE NL GB (30)	*	*	-

Note: residence in top row; source in leftmost column; $*$ direct route; - same country pair

percent withholding tax on dividends with only the exception of Ireland (IE). The SA-IE rate is zero percent. Moreover, Ireland (IE) imposes no withholding tax on dividends. Therefore, investors pay no tax at all on dividends by establishing an intermediary entity in Ireland (IE) and investing indirectly to Saudi Arabia (SA). For example, if an investor is a resident of the United States (US) and plans to invest in Saudi Arabia (SA),

$$\text{US} \rightarrow \text{IE} \rightarrow \text{SA}$$

is the only tax-minimizing route and it is an indirect route.

However, there may be more than one tax-minimizing indirect route. For example, from Bermuda (BM) to Belgium (BE), there are five tax-minimizing indirect routes:

$$\text{BM} \rightarrow \text{HK} \rightarrow \text{BE}$$

Here HK can be replaced with any one of IE, LU, SG, or GB. These five indirect routes pass through countries with no withholding tax on dividends. Among all tax-minimizing indirect routes (176 routes) shown in Table 3, there are 134 indirect routes (about 76 percent) passing through such countries. These indirect routes can maximize an investor's after-tax income because some source countries set the minimum tax treaty rate for these countries.

In addition there are 42 tax-minimizing indirect routes passing through countries that generally impose withholding taxes. Interestingly, most of these indirect routes (37 routes; about 21 percent of all tax-minimizing indirect routes) pass through either Belgium (BE), the Netherlands (NL), or Switzerland (CH). These countries maintain tax treaties favorable to certain residence countries, such as Japan. For example, from Japan (JP) to China (CN), there are eight tax-minimizing indirect routes:

$$\text{JP} \rightarrow \text{BE} \rightarrow \text{CN}$$

Here BE can be replaced with any one of HK, IE, LU, NL, SG, CH, or GB. China (CN) has tax treaties with these countries that offer a five-percent

withholding tax rate, which is the minimum rate among all tax treaty rates of China. In turn, Belgium (BE), the Netherlands (NL), and Switzerland (CH) have tax treaties with Japan (JP) under which withholding tax rates are reduced to zero percent. While generally imposing withholding taxes, by maintaining tax treaties preferential for certain residence countries, Belgium (BE), the Netherlands (NL), and Switzerland (CH) play a significant role as a pass-through country in international investments.

Table 3 shows no tax-minimizing indirect routes passing through Bermuda (BM) and Cayman Islands (KY). It is rather puzzling to see that Bermuda and Cayman Islands play no role as a pass-through country. As indicated in Table 2, the reason may be that many countries maintain higher withholding tax rates to the residents of these tax havens. Therefore, it may be effective for source countries to maintain higher withholding tax rates against tax havens to prevent them from being pass-through countries. However, higher withholding tax rates may not lead to greater tax revenue in source countries because residents in tax havens are able to use tax-minimizing indirect routes to source countries, as shown in the BM and KY columns of Table 3.

It is worthwhile to note that tax-minimizing routes may be asymmetric. Even if a direct route $j \to i$ is tax-minimizing, $i \to j$ may not be tax-minimizing. Even if an indirect route $j \to k \to i$ is tax-minimizing, $i \to k \to j$ may not be tax-minimizing. For example, in Table 3, JP $\to$ BE $\to$ CN is tax-minimizing but not CN $\to$ BE $\to$ JP.

4.2 Centrality measures

To assess the importance of a country in tax-minimizing investment routes, I introduce a group of network centrality measures including betweenness centrality.[19] Each centrality measure can be defined from the perspective of a source country as well as from that of all source countries in aggregate.

First, for each source country i, a centrality measure $\alpha_i(k)$ of a country $k \neq i$ is defined as

[19]For more detailed discussion on network centrality, see Jackson (2008).

$$\alpha_i(k) = \sum_{j \neq i,k} \ell_{ij}(k) \tag{3}$$

where $\ell_{ij}(k)$ is the number of tax-minimizing indirect routes from residence country j to source country i passing through country k. Let $\alpha_i(i) = 0$. Because every tax-minimizing route passes through at most one country, as shown in Table 3, if there is a tax-minimizing route $j \to k \to i$, $\ell_{ij}(k) = 1$. Otherwise, $\ell_{ij}(k) = 0$. An aggregate centrality measure $\alpha(k)$ is defined as the sum of $\alpha_i(k)$ over all source countries, that is, $\alpha(k) = \sum_i \alpha_i(k)$. For example, from Table 3, we observe that four tax-minimizing indirect routes pass through Ireland (IE) and head to China (CN), i.e., $\alpha_{\text{CN}}(\text{IE}) = 4$. In aggregate, $\alpha(\text{IE}) = 33$.

Second, for each source country i, a centrality measure $\beta_i(k)$ of a country $k \neq i$ is defined as

$$\beta_i(k) = \sum_{j \neq i,k} \frac{\ell_{ij}(k)}{\ell_{ij}} \tag{4}$$

where ℓ_{ij} is the number of all tax-minimizing indirect routes from residence country j to source country i. Let $\beta_i(i) = 0$. An aggregate centrality measure $\beta(k)$ is defined as the sum of $\beta_i(k)$ over all source countries, i.e., $\beta(k) = \sum_i \beta_i(k)$, and called the betweenness centrality of country k. In words, the betweenness centrality $\beta(k)$ of country k is defined as the sum of the proportions of tax-minimizing indirect routes passing through country k over all pairs of other countries. From Table 3, we can check that $\beta_{\text{CN}}(\text{IE}) = \frac{1}{5} + \frac{1}{5} + \frac{1}{8} + \frac{1}{7} \approx 0.67$ and $\beta(\text{IE}) = 16.94$.

Third, for each source country i, a centrality measure $\gamma_i(k)$ of a country $k \neq i$ is defined as

$$\gamma_i(k) = \sum_{j \neq i,k} \frac{s_{ij}\ell_{ij}(k)}{\ell_{ij}} \tag{5}$$

Table 4. Centrality measures

(a) China

k	$\alpha_i(k)$	$\beta_i(k)$	$\gamma_i(k)$
BE	2	0.27	1.34
BM	0	0	0
KY	0	0	0
CN	0	0	0
HK	4	0.67	3.34
IE	4	0.67	3.34
JP	0	0	0
KR	0	0	0
LU	4	0.67	3.34
NL	2	0.27	1.34
SA	0	0	0
SG	4	0.67	3.34
CH	1	0.13	0.63
GB	4	0.67	3.34
US	0	0	0

(b) Aggregate

k	$\alpha(k)$	$\beta(k)$	$\gamma(k)$
BE	11	2.53	30.55
BM	0	0	0
KY	0	0	0
CN	0	0	0
HK	20	3.94	60.30
IE	33	16.94	125.30
JP	3	0.98	4.88
KR	0	0	0
LU	20	3.94	60.30
NL	13	3.41	32.80
SA	1	0.33	1.67
SG	13	2.43	29.01
CH	13	4.29	31.38
GB	48	21.94	277.05
US	1	0.25	1.75

where s_{ij} is the tax rate spread for residence country j and source country i. Let $\gamma_i(i) = 0$. An aggregate centrality measure $\gamma(k)$ is defined as the sum of $\gamma_i(k)$ over all source countries, that is, $\gamma(k) = \sum_i \gamma_i(k)$. In other words, $\gamma(k)$ is the betweenness centrality weighted by tax rate spreads. From Table 3, we can check that $\gamma_{\text{CN}}(\text{IE}) = \frac{5}{5} + \frac{5}{5} + \frac{5}{8} + \frac{5}{7} \approx 3.34$ and $\gamma(\text{IE}) = 125.30$.

Table 4 (a) shows centrality measures for $i = \text{CN}$. Table 4 (b) shows aggregate centrality measures. For β and γ, numbers are rounded to the nearest hundredth. From the perspective of China, as shown in Table 4 (a), Hong Kong (HK), Ireland (IE), Luxembourg (LU), Singapore (SG), and the United Kingdom (GB) are ranked on the top by the three centrality measures.

Table 4 (b) shows that the United Kingdom (GB) and Ireland (IE) are ranked first and second, respectively, by the three aggregate centrality measures. These two countries are followed by Hong Kong (HK), Luxembourg (LU), Switzerland (CH), and the Netherlands (NL) in aggregate rankings.

5 Conclusion

Finally I discuss the implications of my analysis by giving answers to my motivating questions.

How can investment routes be designed for tax minimization? In this paper I construct a tax rate matrix to describe a treaty network between selected countries and analyze the structure of tax-minimizing routes in this network. Every tax-minimizing route passes through at most one country in the network. Most of tax-minimizing indirect routes pass through either countries with no withholding tax on dividends or countries with tax treaties favorable to capital-exporting countries.

Which countries play important roles in tax-minimizing routes? Network centrality measures show that the United Kingdom, Ireland, Hong Kong, Luxembourg, Switzerland, and the Netherlands are important in tax-minimizing indirect routes.

How often do investors use tax-minimizing routes? I examine a game-theoretic model of treaty shopping and compute the equilibrium probability of an investor using tax-minimizing indirect routes, which is calculated as the ratio of audit cost to penalty tax.

How much does treaty shopping affect tax revenue in a source country? I compute the equilibrium loss of tax revenue due to treaty shopping. This revenue loss is mainly determined by the tax rate spread. I also numerically compute the tax rate spread by using the network analysis.

How can tax authorities deal with treaty shopping? Tax authorities can adopt the equilibrium random audit strategy with a high enough penalty tax rate to raise more tax revenue. Moreover, if tax authorities can distinguish whether or not investors used indirect routes when choosing whether to audit, tax authorities can prevent treaty shopping by selectively auditing the investors who used indirect routes.

Tax authorities can also prevent treaty shopping by amending tax treaties with possible pass-through countries to include anti-abuse provisions, such as limitation on benefits and principal purpose test, as discussed in OECD

(2015). However, it is not a practical approach for tax authorities to amend tax treaties simultaneously with all possible pass-through countries, because it is an onerous task to renegotiate and amend a tax treaty. Tax authorities may assign priorities to certain tax treaties based on centrality measures to work on the amendments.

If source countries aim to attract more foreign investment by signing a new treaty or by amending an existing treaty, it is crucial to make direct routes tax-minimizing. By doing so, source countries can also eliminate the possibility of treaty shopping. However, if a new or amended treaty still makes indirect routes tax-minimizing, investment activity may remain unaffected between contracting countries, because investors use direct routes with the same probability as before.

In this paper, for simplicity of analysis, I have made two implicit assumptions. For future research, it will be interesting to examine more realistic models by relaxing these assumptions.

The first assumption is that an investor's after-tax income is determined only by taxable income and tax rates. However, the after-tax income may also be affected by other systemic factors, such as foreign tax credit and deduction. For example, if an investor is a resident of a country with high tax rates and sufficiently generous foreign tax credit, the investor's after-tax income may not be critically affected by the choice of an investment route, because the amount of foreign taxes paid along the investment route will be deducted from tax liability in the residence country.

The second assumption is that an investor earns his foreign income as dividends. However, the investor can also earn other types of income, such as interest, royalties, and capital gains. Thus, we can define various types of tax treaty networks, where tax rates depend on income types, and examine the structure of tax-minimizing routes in these networks. It will be interesting to study hybrid indirect routes along which types of income can be altered to further reduce tax, for example, from capital gains to dividends.

Appendix

Proof of Proposition 1. This proof proceeds in four steps.

Step 1. Find dominated strategies. Let b denote an indirect route that is not tax-minimizing. Because b^* is tax-minimizing, $(1-t(b))(1-t_1)m < (1-t(b^*))(1-t_1)m$, which implies that $u_B(0,b) < u_B(0,b^*)$ and $u_B(1,b) < u_B(1,b^*)$. Regardless of whether the tax agency audits the investor ($a=1$) or not ($a=0$), the investor is better off by choosing b^* than by choosing b. Thus, b is dominated by b^*. Note that in equilibrium the investor does not play a dominated strategy. Therefore, in equilibrium, the investor will choose either the direct route or a tax-minimizing indirect route.

Step 2. Show that there is no pure-strategy equilibrium. Given $a=1$, because $(1-t(b^*))(1-t_1)-r < (1-t_{n1})(1-t_1)$, the investor's best response is to choose the direct route $b=1,n$. Given $b=1,n$, because $c>0$, the tax agency's best response is no audit $a=0$. Given $a=0$, because $(1-t_{n1})(1-t_1) < (1-t(b^*))(1-t_1)$, the investor's best response is to choose a tax-minimizing indirect route b^*. Given b^*, because $c<rm$, the tax agency's best response is to audit $a=1$. Thus, there is no pure-strategy equilibrium.

Step 3. Suppose that there is a unique tax-minimizing indirect route b^*. It is sufficient to show that each player is indifferent between the pure strategies played with positive probability. Given p, the investor is indifferent between the direct route $b=1,n$ and the tax-minimizing indirect route $b^*=1,i,\ldots,j,n$, because $u_B(p,b)=(1-t_{n1})(1-t_1)m=u_B(p,b^*)$. Given q, the tax agency is indifferent between no audit $a=0$ and audit $a=1$, because $u_A(0,q)=t_{n1}m-\frac{c}{r}(t_{n1}-t_{nj})=u_A(1,q)$. Therefore, (p,q) characterizes a unique equilibrium.

Step 4. Suppose that there are $\ell \geq 2$ tax-minimizing indirect routes. Each of the tax-minimizing indirect routes is denoted by $b^k=1,i_k,\ldots,j_k,n$, where $k=1,\ldots,\ell$, and is played with probability q_k, where $\sum_{k=1}^{\ell} q_k = q$. Given $(q_1,\ldots,q_\ell)$, the tax agency is indifferent between no audit $a=0$ and au-

dit $a = 1$, because $u_A(0,(q_1,\ldots,q_\ell)) = t_{n1}m - \sum_{k=1}^{\ell} q_k(t_{n1} - t_{nj_k})m = u_A(1,(q_1,\ldots,q_\ell))$. Given p, the investor is indifferent between the direct route $b = 1,n$ and a tax-minimizing indirect route $b^k = 1,i_k,\ldots,j_k,n$, because $u_B(p,b) = (1-t_{n1})(1-t_1)m = u_B(p,b^k)$. Therefore, $(p,(q_1,\ldots,q_\ell))$ characterizes a unique equilibrium.

Proof of Proposition 3. Because each tax-minimizing indirect route is played with equal probability, in equilibrium, the tax agency's payoff is $t_{n1}m - \frac{c}{r}s_{n1}$. To compare payoffs, suppose that the tax agency can only choose a pure strategy. First, consider a case where the tax agency does not audit the investor at all, and knowing this, the investor always uses tax-minimizing indirect routes. Because the investor uses $\ell \geq 1$ tax-minimizing indirect routes with equal probability $\frac{1}{\ell}$, the tax agency's payoff is $\frac{1}{\ell}\sum_{k=1}^{\ell} t_{nj_k}m$, where j_k is the last pass-through country in each tax-minimizing indirect route $1,i_k,\ldots,j_k,n$ for $k = 1,\ldots,\ell$. Because $c < rm$ and $s_{n1} = \frac{1}{\ell}\sum_{k=1}^{\ell}(t_{n1} - t_{nj_k})$, it holds that $\frac{1}{\ell}\sum_{k=1}^{\ell} t_{nj_k}m < t_{n1}m - \frac{c}{r}s_{n1}$, i.e., the tax agency raises more revenue by adopting the equilibrium strategy. Second, consider another case where the tax agency always audits the investor, and knowing this, the investor always chooses the direct route. In this case, the tax agency's payoff is $t_{n1}m - c$. Because $r > s_{n1}$ implies $t_{n1}m - c < t_{n1}m - \frac{c}{r}s_{n1}$, the tax agency raises more revenue by adopting the equilibrium strategy.

Proof of Proposition 4. The unique equilibrium is constructed by backward induction. Because the tax agency knows whether or not the investor chose the direct route, there are two subgames in the second stage. In the subgame after the investor chose the direct route, the tax agency earns a greater payoff by choosing not to audit, because $u_A(1,b) = t_{n1}m - c < t_{n1}m = u_A(0,b)$ for the direct route $b = 1,n$. In the subgame after the investor chose an indirect route, the tax agency earns a greater payoff by auditing the investor, because $c < rm$ implies that $u_A(0,b) = t_{nj}m < t_{nj}m + rm - c = u_A(1,b)$ for an indirect route $b = 1,i,\ldots,j,n$. Thus, in the second stage, the tax agency selectively audits the investor who chose an indirect route. By backward induction, in the first stage, if the investor chooses the direct

route, the payoff is $(1 - t_{n1})(1 - t_1)m$. If the investor chooses an indirect route, the payoff is at most $(1-t(b^*))(1-t_1)m-rm$, which is obtained when the investor chooses a tax-minimizing indirect route b^*. In the first stage, because $(1-t(b^*))(1-t_1)-(1-t_{n1})(1-t_1) < r$, the investor earns a greater payoff by choosing the direct route. Therefore, in the unique equilibrium of the two-stage game, the investor chooses the direct route and the tax agency selectively audits the investor who chose an indirect route.

References

[1] Blonigen, Bruce A., and Ronald B. Davies. 2004. "The Effects of Bilateral Tax Treaties on U.S. FDI Activity." *International Tax and Public Finance*, 11(5): 601–622.

[2] Bond, Eric W., and Larry Samuelson. 1989. "Strategic Behaviour and the Rules for International Taxation of Capital." *Economic Journal*, 99(398): 1099–1111.

[3] Border, Kim C., and Joel Sobel. 1987. "Samurai Accountant: A Theory of Auditing and Plunder." *Review of Economic Studies*, 54(4): 525–540.

[4] Chisik, Richard, and Ronald B. Davies. 2004. "Asymmetric FDI and Tax-Treaty Bargaining: Theory and Evidence." *Journal of Public Economics*, 88(6): 1119–1148.

[5] Clausing, Kimberly A. 2009. "Multinational Firm Tax Avoidance and Tax Policy." *National Tax Journal*, 62(4): 703–725.

[6] Davies, Ronald B. 2003. "The OECD Model Tax Treaty: Tax Competition and Two-Way Capital Flows." *International Economic Review*, 44(2): 725–753.

[7] Desai, Mihir A., and Dhammika Dharmapala. 2009. "Taxes, Institutions and Foreign Diversification Opportunities." *Journal of Public Economics*, 93(5-6): 703–714.

[8] Desai, Mihir A., and Dhammika Dharmapala. 2011. "Dividend Taxes and International Portfolio Choice." *Review of Economics and Statistics*, 93(1): 266–284.

[9] Desai, Mihir A., C. Fritz Foley, and James R. Hines Jr. 2006. "The Demand for Tax Haven Operations." *Journal of Public Economics*, 90(3): 513–531.

[10] Dharmapala, Dhammika. 2008. "What Problems and Opportunities are Created by Tax Havens?" *Oxford Review of Economic Policy*, 24(4): 661–679.

[11] Dharmapala, Dhammika, and James R. Hines Jr. 2009. "Which Countries Become Tax Havens?" *Journal of Public Economics*, 93(9-10): 1058–1068.

[12] Eggert, Wolfgang, and Jun-Ichi Itaya. 2014. "Tax Rate Harmonization, Renegotiation, and Asymmetric Tax Competition for Profits with Repeated Interaction." *Journal of Public Economic Theory*, 16(5): 796–823.

[13] Elsayyad, May, and Kai A. Konrad. 2012. "Fighting Multiple Tax Havens." *Journal of International Economics*, 86(2): 295–305.

[14] Gravelle, Jane G. 2009. "Tax Havens: International Tax Avoidance and Evasion." *National Tax Journal*, 62(4): 727–753.

[15] Hines Jr., James R., and Eric M. Rice. 1994. "Fiscal Paradise: Foreign Tax Havens and American Business." *Quarterly Journal of Economics*, 109(1): 149–182.

[16] Hong, Sunghoon. 2016. "Taxation of Unknown Beneficial Owners: Treaty Shopping with Incomplete Information." working paper.

[17] Jackson, Matthew O. 2008. *Social and Economic Networks*. Princeton, NJ: Princeton University Press.

[18] Janeba, Eckhard. 1995. "Corporate Income Tax Competition, Double Taxation Treaties, and Foreign Direct Investment." *Journal of Public Economics*, 56(2): 311–325.

[19] Johannesen, Niels. 2012. "Optimal Fiscal Barriers to International Economic Integration in the Presence of Tax Havens." *Journal of Public Economics*, 96(3-4): 400–416.

[20] Konan, Denise Eby. 1997. "Strategic Taxation of the Multinational Enterprise: A New Argument for Double Taxation." *Journal of Public Economics*, 63(2): 301–309.

[21] Lewellen, Katharina, and Leslie Robinson. 2013. "Internal Ownership Structures of U.S. Multinational Firms." working paper.

[22] Mintz, Jack M., and Alfons J. Weichenrieder. 2010. *The Indirect Side of Direct Investment.* Cambridge, MA: MIT Press.

[23] Mookherjee, Dilip, and Ivan Png. 1989. "Optimal Auditing, Insurance, and Redistribution." *Quarterly Journal of Economics*, 104(2): 399–415.

[24] OECD. 2015. *Preventing the Granting of Treaty Benefits in Inappropriate Circumstances, Action 6 – 2015 Final Report, OECD/G20 Base Erosion and Profit Shifting Project.* OECD Publishing.

[25] Slemrod, Joel, and John D. Wilson. 2009. "Tax Competition with Parasitic Tax Havens." *Journal of Public Economics*, 93(11-12): 1261–1270.

[26] Stöwhase, Sven. 2013. "How Profit Shifting May Increase the Tax Burden of Multinationals: A Simple Model with Discrete Investment Choices." *Journal of Public Economic Theory*, 15(2): 185–207.

[27] Weyzig, Francis. 2013. "Tax Treaty Shopping: Structural Determinants of Foreign Direct Investment Routed Through the Netherlands." *International Tax and Public Finance*, 20(6): 910–937.