Tax Treaty Networks and Ownership Structures of Multinational Corporations

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Abstract

Multinational corporations can organize indirect ownership chains with intermediate subsidiaries, such as foreign equity holding companies, in countries with low taxes and favorable tax treaties. This paper examines the relationship between multinational ownership chains and tax treaty networks by building data on ownership chains of multinational corporations and by combining the ownership data with two treaty network variables obtained from a network analysis of tax treaties. The first treaty network variable, indicating the existence of a tax-minimizing direct route from one country to another, is negatively related to the use of a foreign intermediate subsidiary and the cross-border length of an ownership chain. The second treaty network variable, assessing the difference between the foreign tax rates of the direct route and a tax-minimizing route, and called the treaty shopping rate, is positively related to the use of a foreign intermediate subsidiary and the cross-border length.

JEL classification: F23, H25, H87

Keywords: tax treaty network, tax-minimizing route, treaty shopping rate, multinational corporation, ownership chain

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1 Introduction

Multinational corporations often organize complex and indirect ownership structures to operate subsidiary companies around the world. A number of economic and cultural factors can influence the ownership structures of multinational corporations. Examples of such factors are tax and corruption in countries where subsidiaries are operated. However, only a few studies have examined how multinational corporations organize their internal ownership structures and why they decide to set up complex and indirect structures with a series of intermediate subsidiaries, such as foreign equity holding companies.[1]

Multinational corporations can reduce global tax liabilities, for instance, by choosing transfer pricing rules and setting prices for transactions between related companies; by relocating intangible assets (possibly with cost-sharing agreements) and paying royalties to related companies in countries with low taxes; by using debt instruments (or even debt-equity hybrids) and deducting interest payments from taxable income of related companies in countries with high taxes.[2]

It is worthwhile to note that multinational corporations can use these tax planning techniques between any pair of related companies, less subject to the constraints of internal ownership structures. In contrast, dividend payments can be made only to the company that directly owns the shares of the company paying the dividends. In other words, multinational corporations need to organize internal ownership structures in advance to receive dividends from subsidiaries in a tax-efficient way. Moreover, after exhausting all the other tax planning techniques, dividend payments through ownership

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[1]Dyreng et al. (2015) and Lewellen and Robinson (2013) examine internal ownership structures of American multinational corporations. Mintz and Weichenrieder (2010) study the cases of German multinational corporations.

[2]There has been extensive research on tax-motivated profit shifting of multinational corporations. Dharmapala and Riedel (2013) estimate the magnitude of profit shifting with earnings shocks as an explanatory variable. For related studies, see Buettner et al. (2012), Huizinga et al. (2008), and Desai et al. (2004) on debt shifting, and see Griffith et al. (2014), and Dischinger and Riedel (2011) on intangible assets.

structures may be the last available option for multinational corporations to shift profits. In this context, it is important to better understand the factors that affect the internal ownership structures of multinational corporations.

Tax treaties can reduce taxes on income earned abroad and promote cross-border economic activity, such as foreign direct investment of multinational corporations. A group of tax treaties can be viewed as a network between countries. As a navigation device allows us to figure out the shortest routes (to minimize time or distance) in a transportation network, a network analysis of tax treaties can help find the most efficient routes (to minimize taxes) in a tax treaty network.[3] If multinational corporations consider tax as an important factor when organizing ownership chains to subsidiaries, the structure of tax-minimizing routes in treaty networks can influence the structure of multinational ownership chains.

In this paper I examine the relationship between multinational ownership chains and tax treaty networks. I construct data on ownership chains of multinational corporations and combine the ownership data with two treaty network variables obtained from a network analysis of tax treaties (Hong, 2017). The first treaty network variable, indicating the existence of a tax-minimizing direct route from one country to another, is negatively related to the use of a foreign intermediate subsidiary and the cross-border length of an ownership chain. Precisely, the existence of a tax-minimizing direct route is estimated to decrease the probability of using a foreign intermediate subsidiary by 15.3 percent, and to decrease the cross-border length by 0.487. The second treaty network variable, assessing the difference between the foreign tax rates of the direct route and a tax-minimizing route, and called the treaty shopping rate, is positively related to the use of a foreign intermediate subsidiary and the cross-border length of an ownership chain. Precisely, moving the treaty shopping rate from 0 to 5 percentage points is estimated to increase the probability of using a foreign intermediate subsidiary by 10.1 percent, and to increase the cross-border length by 0.300.

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[3]Hong (2017) and van't Riet and Lejour (2017) examine the structure of tax-minimizing (direct or indirect) routes in treaty networks.

This paper proceeds as follows. Section 2 provides background information on tax treaty networks and multinational ownership chains. Section 3 outlines the research design. Section 4 details the data construction and descriptive statistics. Section 5 presents the results. Section 6 concludes.

2   Background

2.1   Tax treaty networks

One of the purposes of tax treaties is to prevent double taxation on cross-border economic activity. To this end, tax treaties reduce withholding tax rates on various types of income, such as dividends, interest, and royalties, imposed by source countries.[4] For instance, the tax treaty between the United States and China requires that the withholding tax rate on dividends should not exceed 10 percent if the recipient of the dividends is a resident of either country. Because tax treaties can reduce taxes on income earned abroad, tax treaties are expected to promote cross-border economic activity, such as foreign direct investment (FDI). However, there is little evidence that the existence of a tax treaty significantly increases FDI.[5]

A group of tax treaties can be viewed as forming a network, where each node is a country and each link is given a weight representing a withholding tax rate on certain income. Let us consider a tax treaty network between China, Singapore, and the United States. According to the tax treaty between the United States and China, the withholding tax rate on dividends is 10 percent. However, the tax treaty between China and Singapore sets the withholding tax rate on dividends at 5 percent if the recipient owns at least 25 percent of the shares of the company paying the dividends. Singa-

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[4]Here the term "source" refers to a place where (individual or corporate) persons earn income from their activities and "home" refers to a place where they originally own the rights for their activities.

[5]Blonigen and Davies (2004) use an indicator variable for the existence of a tax treaty and find no significant relationship between tax treaties and FDI. Louie and Rousslang (2008) also use a treaty indicator variable and find no significant treaty effect on the rate of return from FDI. Blonigen et al. (2014) use the U.S. BEA data on multinational corporations and find no significant treaty effect on their activity.

pore imposes no corporate income tax on dividends earned abroad and no withholding tax on dividends paid to foreign shareholders.

Now imagine that an American corporation invests in a Chinese subsidiary and that the Chinese subsidiary remits dividends to the American parent. If owned directly, the Chinese subsidiary pays dividends directly to the American parent, and thus, the withholding tax rate is 10 percent. However, if owned indirectly through a holding company in Singapore, the Chinese subsidiary pays dividends to the holding company, which in turn pays dividends to the American parent. By using such an indirect ownership structure with a Singaporean holding company, the American parent can reduce the tax on dividends by 5 percentage points.[6] This indirect ownership structure through Singapore is an example of tax-minimizing investment structures (or investment routes) in a tax treaty network. Hong Kong, the Netherlands, and Luxembourg can also be locations for holding companies to minimize tax on dividends when an American corporation invests in China.[7]

In contrast to the case between the United States and China, depending on a pair of home and source countries, there may exist a tax-minimizing direct route in a tax treaty network. For example, the tax treaty between the United States and Japan allows the withholding tax rate on dividends to be 0 percent if the recipient of the dividends owns at least 50 percent of shares for 12 months. Thus, the direct route from the United States to Japan

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[6]When the Chinese subsidiary pays dividends to the Singaporean holding company, the withholding tax rate is 5 percent. The Singaporean holding company pays no corporate income tax on dividends received from the Chinese subsidiary. Moreover, Singapore imposes no withholding tax when the Singaporean holding company remits dividends to the American parent.

[7]Hong Kong, the Netherlands, and Luxembourg each has a tax treaty with China that reduces the withholding tax rate on dividends to 5 percent. These three countries impose no corporate income tax on dividends earned abroad. Furthermore, Hong Kong imposes no withholding tax on dividends. The Netherlands may impose no withholding tax on dividends paid to American residents according to the tax treaty between the two countries. Luxembourg imposes no withholding tax on dividends paid to a resident of a country that has a tax treaty with Luxembourg. The United States has a tax treaty with Luxembourg. Weyzig (2013) uses data on special purpose entities in the Netherlands and finds that reductions in withholding tax rates on dividends are significant determinants of FDI indirectly routed through the country.

can be tax-minimizing.

Hong (2017) constructs a network of tax treaties between 70 countries and develops computation algorithms to examine the structure of tax-minimizing (direct or indirect) investment routes in the network. To present the results, he introduces two treaty network variables. First, $DIRECT_{ij}$ is an indicator variable for the existence of a tax-minimizing direct route from home country i to source country j. Second, $TSHOP_{ij}$ is the treaty shopping rate among routes from i to j, defined as the difference between the foreign tax rates of the direct route and a tax-minimizing route. Hong (2017) finds significant relationships between FDI and the treaty network variables. The inward FDI stock via a tax-minimizing direct route is about 2.14 times larger than the inward FDI stock via a direct route that is not tax-minimizing.
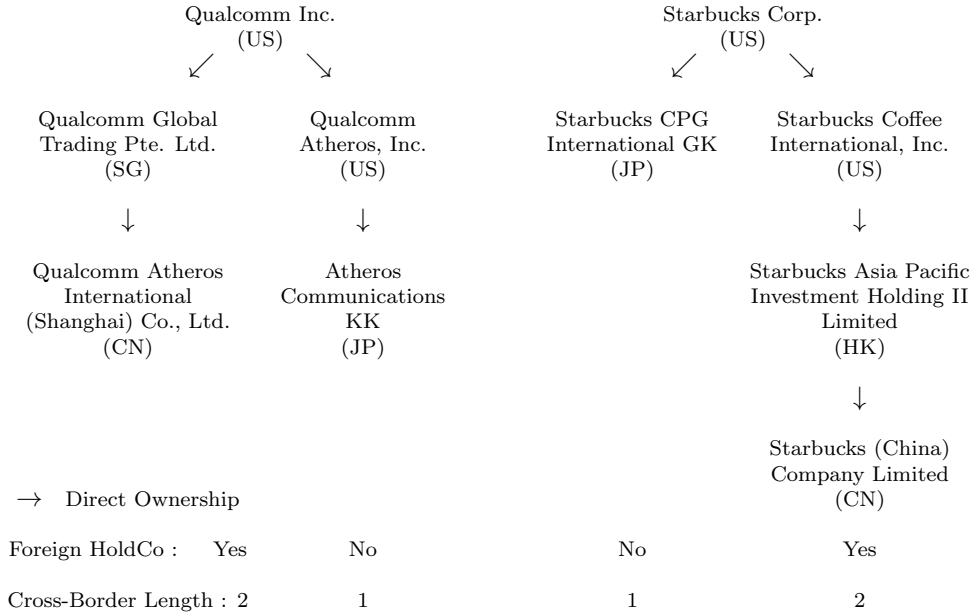
However, from bilateral FDI data, we cannot observe the structure of investment routes for FDI. For instance, we cannot distinguish between direct investment from Singapore to China and indirect investment through Singapore to China, which originates from another country, such as the United States. We may be able to overcome such a limitation by using data on internal ownership structures of multinational corporations.

2.2   Multinational ownership chains

Multinational corporations own and operate subsidiary companies in various countries around the world. While some multinational corporations tend to directly own their foreign subsidiaries, many other multinational corporations organize indirect ownership structures with holding companies. Multinational corporations often establish intermediate subsidiaries as holding companies, which own terminal operating subsidiaries. These related companies (parent or subsidiary) may be incorporated in different countries. Such hierarchical ownership structures can be viewed as a set of (direct or indirect) ownership chains from ultimate parents to terminal subsidiaries.

Figure 1 illustrates examples of ownership chains. Qualcomm Inc. and Starbucks Corp. organize indirect ownership chains with foreign equity hold-

Figure 1. Examples of ownership chains

Qualcomm Inc. (US)		Starbucks Corp. (US)	
↙ ↘		↙ ↘	
Qualcomm Global Trading Pte. Ltd. (SG)	Qualcomm Atheros, Inc. (US)	Starbucks CPG International GK (JP)	Starbucks Coffee International, Inc. (US)
↓	↓		↓
Qualcomm Atheros International (Shanghai) Co., Ltd. (CN)	Atheros Communications KK (JP)		Starbucks Asia Pacific Investment Holding II Limited (HK)
			↓
			Starbucks (China) Company Limited (CN)
→ Direct Ownership			
Foreign HoldCo : Yes	No	No	Yes
Cross-Border Length : 2	1	1	2

ing companies to Chinese terminal subsidiaries. However, both Qualcomm and Starbucks use ownership chains with no foreign equity holding companies to Japanese terminal subsidiaries. Later I will explain how to construct ownership chains by using data from electronic filings of multinational corporations.

Qualcomm Inc., an American corporation providing telecommunications equipment and semiconductors, owns Qualcomm Global Trading Pte. Ltd. in Singapore. This intermediate subsidiary then owns a Chinese terminal subsidiary, called Qualcomm Atheros International Co., Ltd. and plays the role of a foreign equity holding company. The cross-border length of this ownership chain is 2. Qualcomm Inc. also owns Qualcomm Atheros, Inc. in the United States. This intermediate subsidiary then owns a Japanese terminal subsidiary, called Atheros Communications KK. Because Qualcomm Atheros is incorporated in the United States, it is not a foreign equity holding company. The cross-border length of the ownership chain is 1 from Qualcomm Inc. to Atheros Communications KK.

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Starbucks Corp., an American corporation operating a coffee chain store, owns a Japanese terminal subsidiary, called Starbucks CPG International GK. There is no intermediate subsidiary. The cross-border length of this ownership chain is 1. Starbucks Corp. also owns Starbucks Coffee International, Inc. in the United States. This intermediate subsidiary then owns another intermediate subsidiary in Hong Kong, called Starbucks Asia Pacific Investment Holding II Limited. This foreign equity holding company owns a Chinese terminal subsidiary, called Starbucks Company Limited. The cross-border length of this ownership chain is 2.

Multinational corporations may want to minimize tax on dividends from foreign subsidiaries. Together with national tax laws of relevant countries, tax treaties determine whether or not it is tax-minimizing for multinational corporations to use direct ownership chains (or direct routes) to terminal subsidiaries.

As discussed before, the tax treaty between the United States and Japan allows direct ownership chains to be tax-minimizing between the two countries. As in Figure 1, both Qualcomm Inc. and Starbucks Corp. use ownership chains with no foreign equity holding companies to terminal subsidiaries in Japan.

However, the tax treaty between the United States and China does not allow direct ownership chains to be tax-minimizing. Moreover, it is tax-minimizing to use ownership chains with holding companies in either Singapore, Hong Kong, the Netherlands, or Luxembourg. As in Figure 1, Qualcomm Inc. and Starbucks Corp. use indirect ownership chains with holding companies in Singapore and Hong Kong, respectively, to terminal subsidiaries in China.

Dyreng et al. (2015) examine foreign ownership chains of American multinational corporations. They discover that the withholding tax rate on dividends from source to home countries is positively related to the use of a foreign equity holding company in an ownership chain. The corruption level in a source country is also positively related to the use of a foreign equity

holding company. In other words, multinational corporations are more likely to use foreign equity holding companies, as the withholding tax rate increases, and as the corruption level increases in the source country. However, there is no significant relationship between the existence of a tax treaty and the use of a foreign equity holding company.

Lewellen and Robinson (2013) find that tax considerations, such as minimization of withholding taxes imposed abroad, are important factors in organizing foreign ownership chains of American multinational corporations. Mintz and Weichenrieder (2010) find that German multinational corporations set up indirect ownership chains to foreign subsidiaries for tax motives.

Previous studies tend to use only tax treaty dummies and withholding tax rates as explanatory variables. Indeed, the existence of a tax treaty can influence the organization of a multinational ownership chain as the tax treaty reduces the withholding tax rate on dividends. However, some tax treaties do not reduce withholding tax rates on dividends at all, and some other treaties do not reduce the rates effectively. Such tax treaties may not affect multinational ownership chains. To overcome the limitations of this approach, we may focus on whether a tax treaty reduces a withholding tax rate effectively so that the treaty allows a direct ownership chain to be tax-efficient. We may also consider how much more an indirect chain reduces tax than a direct chain does when a direct chain is not tax-efficient.

3   Research Design

If multinational corporations consider tax as an important factor when organizing ownership chains to subsidiaries, the structure of tax-minimizing routes in a treaty network can influence the structure of multinational ownership chains. For instance, the use of a foreign equity holding company in an ownership chain may depend on whether a direct route is tax-minimizing and on how much an indirect route can reduce tax. These conditions can be summarized by treaty network variables, such as $DIRECT_{ij}$ and $TSHOP_{ij}$, for a pair of countries i and j. These treaty network variables may also affect

the complexity (i.e., cross-border length) of an ownership chain.

Before presenting my research design, I introduce some definitions and notations for ownership chains. Within a multinational corporation, a set of ownership chains can describe how the multinational corporation owns its subsidiaries. A corporate entity is called a subsidiary if it is owned directly or indirectly by a multinational corporation.[8] A subsidiary is called terminal if it owns no other subsidiaries. A subsidiary is called intermediate if it is not terminal, i.e., if it owns another subsidiary.

It is worthwhile to note that, in an ownership chain, an intermediate subsidiary is often more than simply an equity holding company.[9] However, from ownership data, it is not straightforward to determine whether an intermediate subsidiary is simply an equity holding company. In this paper I use these two terms interchangeably.

Each ownership chain k connects a multinational corporation in country i to a terminal subsidiary in country j directly or indirectly through intermediate subsidiaries. Given an ownership chain, the multinational corporation is also called the ultimate parent. Given an ownership chain, a foreign intermediate subsidiary is a subsidiary incorporated in a country other than where the ultimate parent or the terminal subsidiary is incorporated.

The cross-border length of an ownership chain is defined as the number of subsidiaries owned by a foreign entity in the chain. If the cross-border length of an ownership chain is equal to one, there is no foreign intermediate subsidiary in the chain. If the cross-border length of an ownership chain is greater than one, there is a foreign intermediate subsidiary in the chain.

For each ownership chain k, $HOLDCO_k$ denotes an indicator variable for the existence of a foreign intermediate subsidiary, or a foreign equity holding company. Precisely, for each ownership chain k, $HOLDCO_k = 1$ if there is a

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[8]A corporate entity is owned directly or indirectly by a multinational corporation if the multinational corporation can control more than 50 percent of the shares of the entity.

[9]An intermediate subsidiary may earn income from its own operations and from the operations of other subsidiaries it owns. An intermediate subsidiary can be thought of as simply an equity holding company if it earns income mostly from the operations of other subsidiaries it owns.

foreign intermediate subsidiary in the chain and $HOLDCO_k = 0$ otherwise. For each ownership chain k, $LENGTH_k$ denotes the cross-border length of the chain. Here it is straightforward that $HOLDCO_k$ and $LENGTH_k$ are defined for each ownership chain k. Hence, for the simplicity of the notations, I use $HOLDCO$ and $LENGTH$ by suppressing the subscript k.

For each ownership chain k, country i denotes the home country, where the ultimate parent is incorporated. Country j denotes the source country, where the terminal subsidiary is incorporated.

Now I use logistic regression models with $HOLDCO$ as the dependent variable. A benchmark specification, described in Equation (1), is motivated by Dyreng et al. (2015).

$$HOLDCO \;=\; f(TREATY_{ij}, WHT_{ji}, CIT_j, CORRUPT_j) \qquad (1)$$

Here $TREATY_{ij}$ is an indicator variable for the existence of a tax treaty between countries i and j. WHT_{ji} is the withholding tax rate on dividends paid from an entity in country j to an entity in country i. CIT_j is the corporate income tax rate in country j. $CORRUPT_j$ is an index of perceived corruption in country j.

The independent variables of interest are $TREATY_{ij}$ and WHT_{ji}. If there is a tax treaty between i and j, a multinational corporation in i can obtain the benefits of the treaty (e.g., taxpayer protection based on treaty clauses) by using a direct ownership chain without a foreign intermediate subsidiary. Thus, one can expect that the existence of a tax treaty is negatively related to the use of a foreign intermediate subsidiary. However, previous studies have found little evidence to support this relationship.

As the withholding tax rate on dividends from j to i increases, a multinational corporation in i can reduce the withholding tax more easily by using an indirect ownership chain with a foreign intermediate subsidiary. Thus, I expect that the withholding tax rate on dividends is positively related to the use of a foreign intermediate subsidiary.

Equations (2) and (3) include either one of the treaty network variables $DIRECT_{ij}$ and $TSHOP_{ij}$ as an independent variable.

$$HOLDCO = f(DIRECT_{ij}, CIT_j, CORRUPT_j) \qquad (2)$$

$$HOLDCO = f(TSHOP_{ij}, CIT_j, CORRUPT_j) \qquad (3)$$

Here $DIRECT_{ij}$ is an indicator variable for the existence of a tax-minimizing direct route from country i to country j. $TSHOP_{ij}$ is the treaty shopping rate among routes from i to j, defined as the difference between the foreign tax rates of the direct route and a tax-minimizing route.

If there is a tax-minimizing direct route from i to j, a multinational corporation in i can minimize tax on dividends by using a direct ownership chain without a foreign intermediate subsidiary. Thus, I expect that the existence of a tax-minimizing direct route is negatively related to the use of a foreign intermediate subsidiary.

As the treaty shopping rate among routes from i to j increases, by definition, the difference becomes larger between the foreign tax rates of the direct route and a tax-minimizing indirect route. Hence, a multinational corporation in i will consider a direct ownership chain less attractive than a tax-minimizing ownership chain with a foreign intermediate subsidiary. Thus, I expect that the treaty shopping rate is positively related to the use of a foreign intermediate subsidiary.

Next I use OLS regression models with $LENGTH$ as the dependent variable. Equation (4) includes $TREATY_{ij}$ and WHT_{ji} as independent variables. Equations (5) and (6) include either $DIRECT_{ij}$ or $TSHOP_{ij}$ as an independent variable.

$$LENGTH = f(TREATY_{ij}, WHT_{ji}, CIT_j, CORRUPT_j) \qquad (4)$$

$$LENGTH = f(DIRECT_{ij}, CIT_j, CORRUPT_j) \qquad (5)$$

$$LENGTH = f(TSHOP_{ij}, CIT_j, CORRUPT_j) \qquad (6)$$

For the independent variables of interest, I expect that the relationship with $LENGTH$ remains similar to the relationship with $HOLDCO$.

When a multinational corporation, or an ultimate parent, organizes an ownership chain to a terminal subsidiary, certain (unobserved) characteristics of the ultimate parent can play an important role. To control for such characteristics, I use an indicator variable for each ultimate parent. This variable is referred to as a parent dummy.

4   Data

I construct a sample of multinational corporations with ownership data from electronic filings posted on the U.S. Securities and Exchange Commission (SEC) website. Precisely, I use Exhibit 21 from Form 10-K of the corporations in the S&P 500 index. The SEC requires these corporations to disclose the lists of subsidiaries. While many corporations disclose only the lists of subsidiaries, some corporations report the lists with detailed information on ownership structures and countries of incorporation. I find 116 corporations that have ever reported such information in Exhibit 21 since 2005 on the SEC's EDGAR system.[10] In the Appendix, Figure A.1 shows an example of Exhibit 21, which is disclosed by Tiffany & Co. in 2016.

If a corporation has reported detailed information more than once, I use the information from the latest year available. Henceforth, each corporation is also referred to as an ultimate parent.

I construct data on ownership chains of the 116 corporations as follows: (i) For each corporation, or for each ultimate parent, find and list all terminal subsidiaries. (ii) For each terminal subsidiary, identify a corporate shareholder. If this corporate shareholder is an ultimate parent, complete an ownership chain. (iii) If not, the corporate shareholder is an intermediate subsidiary. Identify a corporate shareholder of this intermediate subsidiary and check whether or not it is an ultimate parent. (iv) Repeat the previous step until we reach an ultimate patent and complete an ownership chain.

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[10]Accessed at www.sec.gov/edgar/searchedgar/companysearch.html

Table 1. Number of firms by countries of incorporation

Country	Code	Ultimate Parent	Intermediate Subsidiary	Terminal Subsidiary
Greece	GR	0	0	17
Ireland	IE	2	135	111
Luxembourg	LU	0	1,200	81
Netherlands	NL	0	2,409	196
Panama	PA	1	1	19
Philippines	PH	0	0	22
Switzerland	CH	1	588	79
Taiwan	TW	0	0	49
United Kingdom	GB	0	5,459	811
United States	US	112	13,835	3,834
Total		116	28,673	9,050

The ownership data of Exhibit 21 show that the 116 ultimate parents own and operate 37,723 subsidiaries in 145 countries. Among these subsidiaries, I find 9,050 terminal subsidiaries and construct the same number of ownership chains. There are 28,673 intermediate subsidiaries along these ownership chains.

Table 1 shows the number of ultimate parents, intermediate subsidiaries, and terminal subsidiaries incorporated in selected countries. Four ultimate parents are incorporated in countries other than the United States while the rest are incorporated in the United States. The United Kingdom hosts the largest number of intermediate and terminal subsidiaries outside the United States. However, Luxembourg, the Netherlands, and Switzerland host disproportionately more intermediate subsidiaries than the other countries. In contrast, Taiwan, the Philippines, and Greece host no intermediate subsidiaries.

To examine the relationship between tax treaty networks and multinational ownership structures, I focus on ownership chains with ultimate parents and terminal subsidiaries incorporated in two distinct countries. There are 5,278 of such ownership chains.

For each ownership chain, the cross-border length, denoted by $LENGTH$, is defined as the number of subsidiaries owned by a foreign entity in the chain. For each ownership chain, the existence of a foreign intermediate subsidiary,

Table 2. Number of ownership chains by $HOLDCO$ and by $LENGTH$

$HOLDCO$	Number	Percent		$LENGTH$	Number	Percent
0	2,449	46.4%		1	2,449	46.4%
1	2,829	53.6%		2	1,294	24.5%
				3	755	14.3%
				4	390	7.4%
				5	169	3.2%
				6	117	2.2%
				7	71	1.4%
				8	26	0.5%
				9	7	0.1%
Total	5,278	100.0%		Total	5,278	100.0%

denoted by $HOLDCO$, is specified as an indicator variable. Table 2 shows the number of ownership chains by $HOLDCO$ and by $LENGTH$.

There are 2,449 ownership chains with $LENGTH$ equal to one. Because these ownership chains cross a national border only once, they include no foreign intermediate subsidiaries, and thus, $HOLDCO = 0$.

There are 2,829 ownership chains with $LENGTH$ greater than one. Because these ownership chains cross a national border at least twice, they include some foreign intermediate subsidiaries, and thus, $HOLDCO = 1$.

Some ownership chains exhibit long and complex structures. There are 780 ownership chains (about 14.78 percent) with $LENGTH$ greater than three. Each of these ownership chains includes at least three foreign intermediate subsidiaries from an ultimate parent to a terminal subsidiary. The longest ownership chains have the cross-border length of nine.

To construct data on tax treaty networks, I use the information on tax treaties and national tax laws from Deloitte International Tax Source and PwC Worldwide Tax Summaries.[11] For each ownership chain with home country i and source country j, I use $TREATY_{ij}$, WHT_{ji}, $DIRECT_{ij}$, and $TSHOP_{ij}$ as treaty-related independent variables.

$TREATY_{ij}$ is an indicator variable for the existence of a bilateral tax treaty in force between countries i and j.

WHT_{ji} is the withholding tax rate on dividends paid from an entity in country j to an entity in country i. If there is a tax treaty between countries

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[11]Accessed at www.dits.deloitte.com and taxsummaries.pwc.com

i and j, WHT_{ji} is defined as the minimum of the rates specified by the tax treaty and by the national tax law of country j. If there is no tax treaty, WHT_{ji} is defined as the withholding tax rate on dividends specified by the national tax law of country j. The WHT rate is in percentage.

$DIRECT_{ij}$ is an indicator variable for the existence of a tax-minimizing direct route from country i to country j. $TSHOP_{ij}$ is the treaty shopping rate among routes from i to j, defined as the difference between the foreign tax rates of the direct route and a tax-minimizing route. The treaty shopping rate is in percentage points. Hong (2017) presents computation algorithms and results on these treaty network variables for pairs of 70 countries.

CIT_j is the corporate income tax rate in country j. The CIT rate is in percentage and based on the information from Deloitte International Tax Source and PwC Worldwide Tax Summaries.

$CORRUPT_j$ is an index of perceived corruption in country j. To define $CORRUPT_j$, I use the Corruption Perceptions Index (CPI) from Transparency International.[12] Originally, according to the CPI, each country receives a score out of 100 with a higher score meaning a lower level of perceived corruption. For example, Denmark receives 91 and Angola receives 15. The CPI 2015 data include 168 countries. I convert the CPI for country j, denoted by CPI_j, to $CORRUPT_j$ by setting $CORRUPT_j = 10 - CPI_j/10$. Thus, $CORRUPT_j$ is a score out of 10 and increasing in the level of perceived corruption. For example, if country j is Denmark, $CORRUPT_j = 0.9$. If country j is Angola, $CORRUPT_j = 8.5$.

Table 3 provides descriptive statistics.

Before proceeding to regression results, it is worthwhile to examine patterns in the data. Table 4 provides descriptive statistics for the dependent variables, $HOLDCO$ and $LENGTH$, conditional on the existence of a tax-minimizing direct route.

For 1,104 ownership chains between home and source countries with no tax-minimizing direct routes, the average cross-border length is about 2.543,

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[12]Accessed at www.transparency.org/cpi2015

Table 3. Descriptive statistics

Variable	Description	Obs	Mean	SD	Min	Max
$HOLDCO$	1 if there is a foreign intermediate subsidiary in each chain	5,278	0.536	0.499	0	1
$LENGTH$	number of subsidiaries owned by a foreign entity in each chain	5,278	2.118	1.453	1	9
$TREATY_{ij}$	1 if there is a tax treaty between i and j	5,278	0.771	0.420	0	1
WHT_{ji}	withholding tax rate on dividends paid from j to i	5,278	3.253	4.999	0	30
$DIRECT_{ij}$	1 if there is a tax-minimizing direct route from i to j	4,966	0.778	0.416	0	1
$TSHOP_{ij}$	difference between the foreign tax rates of the direct route and a tax-minimizing route	4,966	1.327	2.825	0	14
CIT_j	corporate income tax rate in country j	5,278	21.401	8.805	0	39
$CORRUPT_j$	$10 - CPI_j/10$ with CPI_j = Corruption Perceptions Index for country j	4,811	3.584	2.052	0.900	8.500

Table 4. $HOLDCO$ and $LENGTH$ conditional on $DIRECT_{ij}$

Variable	Conditional on	Obs	Mean	SD
$HOLDCO$	$DIRECT_{ij} = 0$	1,104	0.677	0.468
	$DIRECT_{ij} = 1$	3,862	0.497	0.500
$LENGTH$	$DIRECT_{ij} = 0$	1,104	2.543	1.630
	$DIRECT_{ij} = 1$	3,862	2.010	1.395

and the proportion of ownership chains with foreign intermediate subsidiaries is about 0.677.

For 3,862 ownership chains between home and source countries with tax-minimizing direct routes, the average cross-border length is about 2.010, and the proportion of ownership chains with foreign intermediate subsidiaries is about 0.497.

Therefore, for ownership chains between home and source countries with tax-minimizing direct routes, the average cross-border length is shorter by 0.533 than that for ownership chains between home and source countries with no tax-minimizing direct routes. Moreover, the proportion of ownership chains with foreign intermediate subsidiaries is smaller by 0.180.

In the Appendix, Table A.1 shows both the Pearson and Spearman correlations between the variables. Pearson coefficients are shown above the diagonal and Spearman coefficients are shown below the diagonal.

The use of a foreign intermediate subsidiary in an ownership chain is positively correlated with the withholding tax rate on dividends, negatively correlated with the existence of a tax-minimizing direct route, and positively correlated with the treaty shopping rate.

The cross-border length of an ownership chain is positively correlated with the withholding tax rate on dividends, negatively correlated with the existence of a tax-minimizing direct route, and positively correlated with the treaty shopping rate.

5 Results

Now I present regression results in Table 5. Each column corresponds to the regression equation with the same number.

Columns (1) to (3) show results for logistic models with $HOLDCO$ as the dependent variable. The independent variables of interest are $TREATY_{ij}$ and WHT_{ji} in column (1), $DIRECT_{ij}$ in column (2), and $TSHOP_{ij}$ in column (3). Due to the strong (negative) correlations noted in Table A.1, I do not use $DIRECT_{ij}$ and $TSHOP_{ij}$ together as independent variables.

Column (1) is a benchmark motivated by Dyreng et al. (2015). The withholding tax rate on dividends is positively and significantly related to the use of a foreign intermediate subsidiary, as expected. Moving WHT_{ji} from 0 percent (the 25th percentile of the WHT_{ji} distribution) to 5 percent (75th percentile) is estimated to increase the probability of using a foreign intermediate subsidiary by 2.9 percent. However, there is no significant relationship between the existence of a tax treaty and the use of a foreign intermediate subsidiary. It also turns out that the corporate income tax rate in the source country (where the terminal subsidiary is incorporated) is negatively and significantly related to the use of a foreign intermediate subsidiary. Moreover, the corruption level in the source country is positively and significantly related to the use of a foreign intermediate subsidiary. These results are consistent with those of Dyreng et al. (2015).

In column (2), as expected, the existence of a tax-minimizing direct route is negatively and significantly related to the use of a foreign intermediate subsidiary. The existence of a tax-minimizing direct route (i.e., moving $DIRECT_{ij}$ from 0 to 1) is estimated to decrease the probability of using a foreign intermediate subsidiary by 15.3 percent.

In column (3), as expected, the treaty shopping rate is positively and significantly related to the use of a foreign intermediate subsidiary. Moving $TSHOP_{ij}$ from 0 to 5 percentage points is estimated to increase the probability of using a foreign intermediate subsidiary by 10.1 percent.

Columns (4) to (6) show results for OLS models with $LENGTH$ as the dependent variable. The independent variables of interest are $TREATY_{ij}$ and WHT_{ji} in column (4), $DIRECT_{ij}$ in column (5), and $TSHOP_{ij}$ in column (6).

While WHT_{ji} in (4), $DIRECT_{ij}$ in (5), and $TSHOP_{ij}$ in (6) exhibit the relationship with $LENGTH$ similar to that with $HOLDCO$ in the significance and the sign of the estimated coefficients, $TREATY_{ij}$ in (4) shows an unexpected result. It turns out that the existence of a tax treaty is positively and significantly related to the cross-border length of an ownership

chain. For ownership chains between home and source countries with tax treaties, the cross-border length is longer by 0.158 than that for ownership chains between home and source countries with no tax treaties.

In contrast, as column (5) shows, the existence of a tax-minimizing direct route is negatively and significantly related to the cross-border length of an ownership chain. For ownership chains between home and source countries with tax-minimizing direct routes, the cross-border length is shorter by 0.487 than that for ownership chains between home and source countries with no tax-minimizing direct routes.

In column (6), the treaty shopping rate is positively and significantly related to the cross-border length of an ownership chain. Moving $TSHOP_{ij}$ from 0 to 5 percentage points can increase the cross-border length of an ownership chain by 0.300.

Next I present regression results with parent dummies in Table 6. For the independent variables of interest, the significance and the sign of the estimated coefficients remain the same as in the previous table.

In column (1), the withholding tax rate on dividends is positively and significantly related to the use of a foreign intermediate subsidiary. There is no significant relationship between the existence of a tax treaty and the use of a foreign intermediate subsidiary. However, in column (2), the existence of a tax-minimizing direct route is negatively and significantly related to the use of a foreign intermediate subsidiary. In column (3), the treaty shopping rate is positively and significantly related to the use of a foreign intermediate subsidiary.

In column (4), the existence of a tax treaty and the withholding tax rate on dividends are positively and significantly related to the cross-border length of an ownership chain. In column (5), the existence of a tax-minimizing direct route is negatively and significantly related to the cross-border length of an ownership chain. In column (6), the treaty shopping rate is positively and significantly related to the cross-border length of an ownership chain.

Probably, the most notable change in Table 6 is that including parent

Table 5. Regression results

	(1) Logit HOLDCO	(2) Logit HOLDCO	(3) Logit HOLDCO	(4) OLS LENGTH	(5) OLS LENGTH	(6) OLS LENGTH
$TREATY_{ij}$	0.123			0.158***		
	(0.084)			(0.059)		
WHT_{ji}	0.023***			0.021***		
	(0.007)			(0.005)		
$DIRECT_{ij}$		-0.641***			-0.487***	
		(0.075)			(0.057)	
$TSHOP_{ij}$			0.083***			0.060***
			(0.011)			(0.008)
CIT_j	-0.021***	-0.015***	-0.018***	-0.008**	-0.003	-0.005
	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
$CORRUPT_j$	0.071***	0.053***	0.064***	0.024*	0.012	0.022*
	(0.019)	(0.017)	(0.017)	(0.014)	(0.013)	(0.013)
Parent Dummy	No	No	No	No	No	No
Constant	0.251*	0.861***	0.270**	2.057***	2.563***	2.121***
	(0.132)	(0.126)	(0.110)	(0.097)	(0.093)	(0.084)
Observations	4,811	4,642	4,642	4,811	4,642	4,642
(Pseudo) R^2	0.008	0.017	0.014	0.008	0.021	0.016

Table 6. Regression results with parent dummies

	(1) Logit HOLDCO	(2) Logit HOLDCO	(3) Logit HOLDCO	(4) OLS LENGTH	(5) OLS LENGTH	(6) OLS LENGTH
$TREATY_{ij}$	0.118			0.118**		
	(0.106)			(0.051)		
WHT_{ji}	0.024***			0.013***		
	(0.008)			(0.004)		
$DIRECT_{ij}$		-0.557***			-0.275***	
		(0.095)			(0.043)	
$TSHOP_{ij}$			0.071***			0.035***
			(0.013)			(0.006)
CIT_j	-0.023***	-0.016**	-0.019***	-0.011***	-0.007**	-0.008***
	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)
$CORRUPT_j$	0.106***	0.079***	0.091***	0.050***	0.039***	0.044***
	(0.023)	(0.022)	(0.021)	(0.011)	(0.010)	(0.010)
Parent Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.367	0.847***	0.362	1.089***	2.072***	1.040***
	(0.293)	(0.288)	(0.278)	(0.081)	(0.057)	(0.040)
Observations	4,567	4,396	4,396	4,811	4,642	4,642
(Pseudo) R^2	0.234	0.242	0.241	0.455	0.461	0.459

Note: Robust standard errors in parentheses; * significant at 10%; ** at 5%; *** at 1%

dummies boosts R^2 in all models. This implies that certain unobserved characteristics of ultimate parent firms, specified by parent dummies, can help explain the patterns in ownership chains to terminal subsidiaries.

In the Appendix, Table A.2 shows regression results for probit and Poisson models with parent dummies. For the independent variables of interest, the significance and the sign of the estimated coefficients remain unchanged as before.

6 Conclusion

Multinational corporations often organize indirect ownership chains with intermediate subsidiaries, such as foreign equity holding companies, in countries with low taxes and favorable tax treaties. In this paper I examine the relationship between multinational ownership chains and tax treaty networks by constructing data on ownership chains of multinational corporations and by combining the ownership data with two treaty network variables from a treaty network analysis (Hong, 2017).

The first treaty network variable $DIRECT_{ij}$, indicating the existence of a tax-minimizing direct route from country i to country j, is negatively related to the use of a foreign intermediate subsidiary and the cross-border length of an ownership chain. The existence of a tax-minimizing direct route is estimated to decrease the probability of using a foreign intermediate subsidiary by 15.3 percent, and to decrease the cross-border length by 0.487.
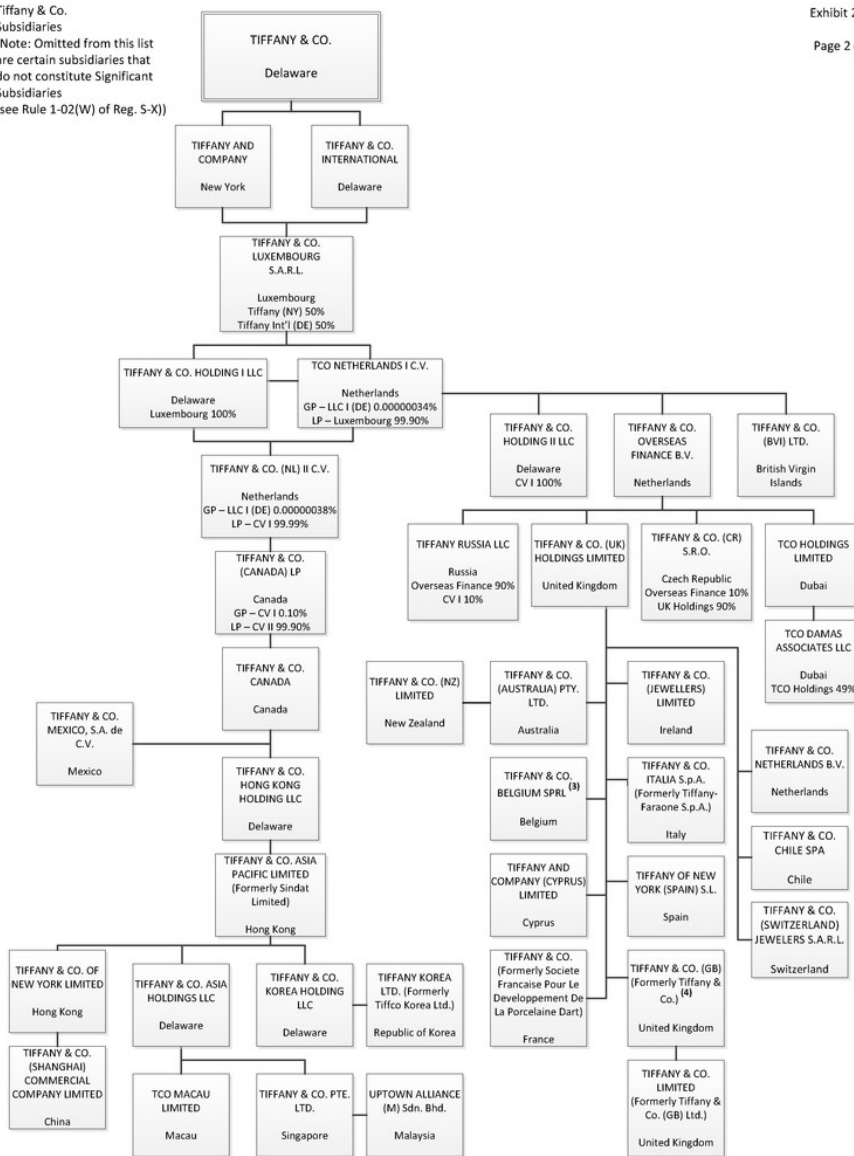
The second treaty network variable $TSHOP_{ij}$, assessing the difference between the foreign tax rates of the direct route and a tax-minimizing route from i to j, is positively related to the use of a foreign intermediate subsidiary and the cross-border length of an ownership chain. Moving $TSHOP_{ij}$ from 0 to 5 percentage points is estimated to increase the probability of using a foreign intermediate subsidiary by 10.1 percent, and to increase the cross-border length by 0.300.

Appendix

Figure A.1. Exhibit 21 of Tiffany & Co. in 2016

Table A.1. Correlations

	$HOLDCO$	$LENGTH$	$TREATY_{ij}$	WHT_{ji}	$DIRECT_{ij}$	$TSHOP_{ij}$	CIT_j	$CORRUPT_j$
$HOLDCO$	-	0.716***	0.061***	0.081***	-0.145***	0.131***	0.047***	0.063***
$LENGTH$	0.913***	-	0.073***	0.082***	-0.151***	0.129***	0.050***	0.039***
$TREATY_{ij}$	0.011	0.026*	-	-0.012	-0.132***	0.089***	0.316***	-0.277***
WHT_{ji}	0.081***	0.092***	0.004	-	-0.678***	0.721***	0.229***	0.467***
$DIRECT_{ij}$	-0.143***	-0.153***	-0.062***	-0.725***	-	-0.879***	-0.099***	-0.234***
$TSHOP_{ij}$	0.140***	0.150***	0.049***	0.743***	-0.989***	-	0.107***	0.198***
CIT_j	-0.014	-0.014	-0.058***	0.070***	-0.038***	0.051***	-	0.447***
$CORRUPT_j$	0.064***	0.055***	-0.204***	0.352***	-0.242***	0.259***	0.503***	-

Note: Pearson coefficients above the diagonal; Spearman below; * significant at 10%; ** at 5%; *** at 1%

Table A.2. Regression results for probit and Poisson models

	(1) Probit *HOLDCO*	(2) Probit *HOLDCO*	(3) Probit *HOLDCO*	(4) Poisson *LENGTH*	(5) Poisson *LENGTH*	(6) Poisson *LENGTH*
$TREATY_{ij}$	0.069			0.054**		
	(0.062)			(0.024)		
WHT_{ji}	0.014***			0.006***		
	(0.005)			(0.002)		
$DIRECT_{ij}$		-0.333***			-0.117***	
		(0.054)			(0.017)	
$TSHOP_{ij}$			0.043***			0.015***
			(0.008)			(0.002)
CIT_j	-0.014***	-0.010**	-0.011***	-0.005***	-0.003**	-0.004***
	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
$CORRUPT_j$	0.064***	0.048***	0.055***	0.023***	0.019***	0.021***
	(0.013)	(0.013)	(0.013)	(0.005)	(0.005)	(0.004)
Parent Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.219	0.498***	0.209	0.625***	0.749***	0.645***
	(0.175)	(0.170)	(0.166)	(0.066)	(0.063)	(0.062)
Observations	4,567	4,396	4,396	4,811	4,642	4,642
Pseudo R^2	0.234	0.242	0.241	0.122	0.125	0.125

Note: Robust standard errors in parentheses; * significant at 10%; ** at 5%; *** at 1%

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