Doctor of Philosophy

The International Tax System in the Digitalized Economy Studied from the Viewpoints of Network Science and Policy Processes

ネットワーク科学及び政策決定過程の観点から見たデジタル経済における国際課税制度

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Contents

List of Tables

List of Figures

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Abbreviations

AEOI	Automatic Exchange of Information
ALP	Arm's Length Principle
BEAT	Base Erosion and Anti-Abuse Tax
BEPS	Base Erosion and Profit Shifting
BFS	Breadth-First Search
BIAC	Business and Industry Advisory Committee
CbC MCAA	Multilateral Competent Authority Agreement on the exchange of Country-by-Country Reports
CbCR	Country-by-Country Reporting
CFA	Committee on Fiscal Affairs
CFC	Controlled Foreign Corporation
CIT	Corporate Income Tax
CTP	Centre for Tax Policy and Administration
DAC	Development Assistance Committee
DAG	Development Assistance Group
DIDS	Double Irish and Dutch Sandwich
EC	European Commission
EEC	European Economic Community
EOCSOC	UN Economic and Social Council
EOIR	Exchange of Information on Request
EU	European Union
FDI	Foreign Direct Investment
FHTP	Forum on Harmful Tax Practices
GDP	Gross Domestic Product
GILTY	Global Intangible Low Taxed Income Rules
GloBE	Global Anti-Base Erosion Measures
GRD	Global Relations and Development division
GRP	Global Relation Program in Taxation
GSAIS	Graduate School of Advanced Integrated Studies in Human Survivability
GSCC	Giant Strongly Connected Component
GWCC	Giant Weakly Connected Component
ICT	International Cooperation and Tax Administration division
IF	Inclusive Framework on BEPS
IFA	International Fiscal Association
IMF	International Monetary Fund
IP	Intellectual Property
IT	Information Technology
JITSIC	Joint International Taskforce on Shared Intelligence and Collaboration Network
LN	League of Nations
LOB	Limitation-on-Benefits

MLI	Multilateral Convention to Implement Tax Treaty Related Measures to Prevent Base Erosion and Profit Shifting
MOTN	Multilayer Ownership Tax Network
NGO	Non-governmental Organization
OECD	Organisation for Economic and Co-operation and Development
OEEC	Organisation for European Economic Co-operation
PBR	Project-Based Research
PPT	Principal Purpose Test
R&D	Research and Development
SDG	Sustainable Development Goal
SPE	Special Purpose Entity
TE	Tendrils
TFDE	Task Force on the Digital Economy
TFTD	Task Force on Tax and Development
TIEA	Tax Information Exchange Agreements
TiVA	Trade-in Value-Added
TIWB	Tax Inspectors without Borders
TPS	Tax Policy and Statistics division
TTP	tax Treaty, Transfer Pricing, and financial transactions division
TUAC	Trade Union Advisory Committee
UN	United Nations
UNCTAD	UN Conference on Trade and Development
VAT	Value-Added Tax
WP	Working Parties
WTN	Withholding Tax Network
WTO	World Trade Organization

Summary

Legal systems are difficult to cross borders, while economic activities are easy to cross them. The asymmetry between the legal systems and the economic activities causes problems in various policy areas like the international tax system. The system has been designed unilaterally due to fiscal autonomy, although applied to cross-border economic activities. As a result, the system has arbitrage used for international tax avoidance, and the States annually lose no less than 500 billion USD tax revenue.

This study examines international tax avoidance as a problematic phenomenon brought by the asymmetry between globalized economic activities and localized legal systems. It tries to answer the desirable international tax system under the tension between globalization and sovereignty. Chapter 2 reviews the literature and marshals the arguments related to international tax avoidance. From Chapter 3 to Chapter 5, we shed light on international tax avoidance quantitatively, using a network science perspective. Chapter 6 considers the possible policy that prevents taxpayers from abusing the international tax system, based on the findings from Chapter 3 to Chapter 5. Chapter 7 and Chapter 8 examine policy processes and social implementation related to international taxation, focusing on international organization and blockchain technology.

Chapter 2 reviews the literature concerning international tax avoidance, focusing on the three phenomena that this study explores by data analysis. The first phenomenon is treaty shopping, a well-known way to avoid tax by using the arbitrage inherent in the decentralized international tax system. The second phenomenon is the cross-border investments diverted through some specific countries due to tax reasons. The third phenomenon is the corporate structures that enable multinationals to take full advantage of the arbitrage in the international tax system.

Chapter 3 clarifies how the international tax system is vulnerable to treaty shopping, a way to avoid withholding taxation by exploiting arbitrage in the system. We construct a network representing withholding tax rates among 165 jurisdictions. We then quantitatively weigh the risk of a jurisdiction's being used for treaty shopping and investigate how the risk spreads to the entire system, using the network science approach. The result implies that it is quite challenging to prevent tax avoidance in the international tax system developed unilaterally and bilaterally. Multilateral rules or agreements are likely to be necessary for the effective prevention of tax avoidance.

Chapter 4 seeks to identify firms that play an important role in multinational tax planning by focusing on the equity investments that consist of multinational corporate structures. We make a

model that identifies key affiliates to multinational tax strategies, based on investigations that disclosed how multinationals have attempted to minimize their tax payments through their corporate structures. The effectiveness of the model is confirmed by the comparison between the result and the existing investigations. The result suggests that consideration of corporate structure helps tax administration narrow the potential candidates highly involved in multinational tax planning.

Chapter 5 attempts to detect what firms through which cross-border investments are routed to get a clue to the measure that effectively prevents taxpayers from exploring the arbitrage. We consider both the concentration of cross-border investments and the possibility of exploiting tax treaty benefits by constructing a multilayer network and defining a multilayer centrality. The result presents the specific sectors located in specific states that are likely to be utilized for diverted cross-border investments. The rules targeting those sectors may be effective for regulating the inappropriate use of tax treaty benefits.

Chapter 6 examines the policy implications for international tax policies that the above three data analyses carry. It argues that States need to check their positions when the international tax system is grasped as a network to know how much they are exposed to international tax avoidance risk. Besides, they might need to consider relinquishing part of discretion to protect their fiscal autonomy to prevent the vulnerability in a part of the international tax system from depriving of an essential part of discretion in fiscal policy. Next, it assesses the current major countermeasures against treaty shopping. It states the countermeasures have room for further improvement on the criterion for determining whether the income comes from genuine business activities. Lastly, it asserts that the tax administration may be able to effectively discourage multinationals from having a hand in aggressive tax planning by grasping multinational corporate structures.

Chapter 7 examines the policy processes related to international taxation, focusing on the role of the international organization. The Organisation for Economic Co-operation and Development (OECD) has played a central role in discussing international taxation rules since World War II. It has recently launched the Base Erosion and Profit Shifting project with G20 so that the international community deals with international tax avoidance. This chapter explains an overseas internship conducted at the Centre for Tax Policy and Administration of the OECD. We then investigate how the OECD involves emerging and developing countries and formulates international tax rules in the 21st century, taking the BEPS project as an example.

Chapter 8 discusses the social implementation of solutions for international tax avoidance. In the first half of this chapter, we describe the process and contents of a student workshop about the role of the OECD in the international tax arena. In the second half of this chapter, we consider applications of blockchain technology to the international tax system to effectively prevent international avoidance.

Chapter 1

Introduction

National economies are continuously becoming more globalized on the back of advances in technology. Transportation, communication, and information technologies (IT) enable business operations to be conducted across borders at low costs. Moreover, various barriers to trade and cross-border investment have been eliminated through the efforts of institutions such as governments and international organizations. The commercial environment has encouraged businesses to expand overseas and fragment their production and value chains across the world. As a result, world trade volume increased by almost four times between 1980 and 2007 [1], and global foreign direct investment (FDI) flows also increased by more than three times between 1995 and 2011 [2]. The tremendous increase in cross-border economic activities has contributed to the enrichment of our collective welfare.[1] Between 1990 and 2015, global gross domestic product (GDP) per capita increased by more than 70% [4], and over one billion people around the globe were able to ascend out of extreme poverty conditions [5].

However, unlike economic activities, legal systems remain confined within their borders. This is because each sovereign state has exclusive governmental authority over its territory in accordance with the state sovereignty principle. Correspondingly, no state can enforce legislation outside of its territory.[2] The principle of state sovereignty that underpins the contemporary state system derives from the Peace of Westphalia that European states concluded in 1648 as a reconciliation of the Thirty Years War. It was agreed in this doctrine that sovereignty would serve as the basis for maintaining peace on the continent. States outside of Europe also accepted the idea of sovereignty as the foundation of a world political system. Consequently, the idea has been incorporated as a core principle of international law, and it has been acknowledged that a state only has the right to exercise legal control in its own territory, which makes legal systems local in a trend of globalization.

It is difficult for legal systems to cross borders, whereas economic activities make them easy to cross. This asymmetry between legal system frameworks and economic processes creates problems in various policy areas. International double taxation is a typical example of this in the arena of international tax.

[1] Note that there is controversy regarding the contributions of economic globalization [3].

[2] Some legal scholars claim that states are given a wider degree of discretion concerning legislative jurisdiction than the enforcement thereof [6].

Under decentralized international taxation, where each state designs its taxation unilaterally, more than one state could tax the same taxpayer's same income when a transaction involves more than one state [7]. A state imposes taxation on an income on the basis of that taxpayer residing in the state, while another state imposes taxation on that same income with the reasoning that the income derives from its jurisdiction. In this case, the taxing power of one state conflicts with that of another for the same international transaction, as each state levies its tax in accordance with its own logic. This conflict is a serious issue because it essentially results in the unfair treatment of taxpayers whose businesses are internationally-focused. The same amount of income should be subject to the same amount of tax, regardless of the nature of the transactions from which it comes. Moreover, the conflict of taxing power among states could distort taxpayers' decision-making with respect to the destinations of their investments. If international transactions are taxed more heavily than domestic ones, it would not be surprising if taxpayers were incentivized to avoid international transactions and choose valueless domestic ones in light of their projected tax obligations [8]. This situation could lead not only to a slowing of the development of the world economy but also to disruption to effective resource allocation [9].

As trade with neighbor states increased, states began to recognize international double taxation as a threat to their national welfare. In order to resolve this issue, Prussia, which was part of what is currently Germany and Austria, concluded the world's first tax treaty in 1899. Subsequently, states attempted to solve the issue created by the conflict of taxing powers bilaterally. Each state concluded a tax treaty with its counterparts through bilateral negotiations and prevented its taxing power from crashing with the other. While the world was becoming increasingly globalized in the period from the 1880s to 1920s [10], the League of Nations presented guidelines for smooth bilateral negotiations to conclude tax treaties. This institution recommended that states follow economic allegiance, which was an objective devised by four distinguished economists, and to allocate their taxing power accordingly [11]. In order to retain fiscal autonomy as much as possible, states have clung to the unilateral design of their taxation and sought to overcome the taxing power conflict via bilateral negotiations based on the aforementioned guidelines.

Policymakers in the international tax arena considered that although the approach of unilateral design and bilateral negotiation could not be said to work perfectly, it also did not work so badly. They believed that it was realistic, because every state wanted to retain its fiscal autonomy. It seemed impossible to adjust taxing power on a global level, because the viewpoints and objectives of each state differed from those of the others. However, the media and non-governmental organizations (NGOs) have demonstrated that the approach had not worked as well as had been claimed in recent years. In the twenty-first century, the international tax system can be said not to have the problem of international double taxation, but of international tax avoidance [12]. Although states have made efforts to adjust taxing power among themselves, less income from international transactions has been properly taxed due to exploitation of the incoherence among different taxation regimes. As a result, states annually lose tax revenue that amounts

to at least 500 billion USD by a conservative estimate [13].

International tax avoidance could be classified into two types: double non-taxation and the abuse of tax benefit [14]. Double non-taxation refers to a situation in which income is not taxed by any state [15]. States conclude bilateral tax treaties and refrain from exercising their taxing power to avoid double taxation. Taxpayers cleverly manipulate transactions that involve more than two states and do not satisfy the taxing conditions, taking advantage of the restrictions of taxing power [16]. Moreover, taxpayers could avoid taxation by improperly enjoying tax benefits in a way that legislation does not intend. The most important feature of international tax avoidance is legitimacy. Unlike tax evasion, it essentially does not violate the tax law of any state [17]. Transactions that form parts of international tax avoidance schemes do not on first inspection appear to be against tax rules (at least in a certain form), but they bring about tremendous tax-saving effects when integrated with each other and functioning as one scheme.

One well-known example of this is a scheme called 'double Irish with a Dutch sandwich' (DIDS) [18], which is mainly utilized by US-based multinationals, such as Apple [19], Google [20], Microsoft, Twitter [21], Adobe, Pfizer, and Johnson & Johnson. This process enables multinationals to shift their profits, especially those derived from intellectual property (IP), to low-tax areas generally known as tax havens, not subject to taxation by any other state. As Figure 1.1 shows, a stylized image of DIDS consists of five components. Two affiliates are located in Ireland (the first and second Irish affiliates) and one is located in the Netherlands (the Dutch affiliate), and those play a key role in the DIDS arrangement. Its stages are as follows: (1) Initially, a multinational company transfers its IP from the affiliate that developed it to the first Irish affiliate. (2) Then, they let the first Irish affiliate manage it from a low-tax area. (3) The first Irish affiliate licenses the right to the IP to the second one via the Dutch affiliate. (4) The second Irish affiliate then uses the IP right and sells the products or services to customers around the world. (5) The first Irish affiliate treats both the second Irish and the Dutch affiliates as its branches in order to bypass US federal income taxation. Multinationals store their profits in low-tax areas through a combination of these five components.

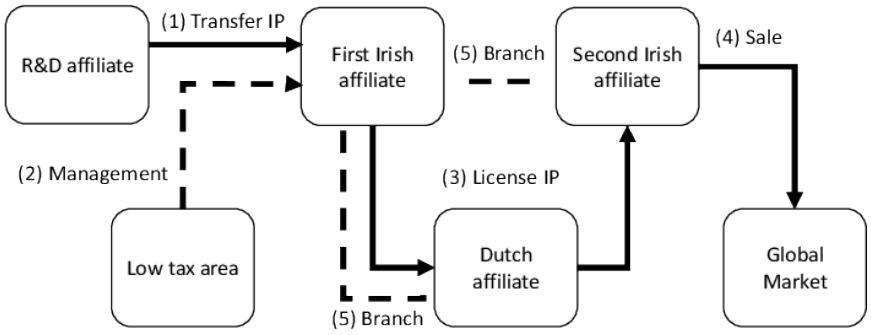


Figure 1.1: **Stylized image of a double Irish and Dutch sandwich.**

In fact, international tax policymakers recognized that the international system could present oppor-

tunities for tax avoidance before the media and NGOs disclosed multinational tax-avoiding behaviors. Some governments conducted a joint campaign to address the issue, but this came to a standstill not only because it could not arouse public interest but also because it faced constant countervailing pressure and bitter resistance [22]. The financial crisis of 2008, however, completely changed the situation and provided substantial momentum to the movement to tackle international tax avoidance. The media and NGOs revealed in succession that various multinationals paid almost no tax, despite their huge profits [23]. Multinationals such as Amazon and Starbucks, for instance, paid less tax in a state than a local sausage stall and café [24]. These facts sparked public outrage in a context in which people were already suffering from the recession resulting from the financial crisis. Nevertheless, some European Union (EU) member states even planned to raise their value-added tax (VAT) to enhance financial resources and ease fiscal pressures due to an EU directive. The directive commanded its member states to keep their fiscal deficits to less than 3% of their GDPs and to limit national debt issuance to less than 60% of their GDPs. The strong public protests made politicians in various states cognizant of international tax avoidance as an urgent matter to be dealt with.

International tax avoidance threatens developing countries more seriously than do developed countries. Developing countries have already suffered from insufficient tax revenue for the scale of their economies due to a lack of tax collection capacity [25]. Many developing countries do not reach as much as 20% except some Asian and Latin American countries, whereas most developed countries earn more than 30% tax on their GDP. It is less than 15% for more than half of sub-Saharan African countries [26]. International tax avoidance makes the problem more serious. In particular, low-income countries in sub-Saharan Africa, Latin America, the Caribbean, and South Asia have lost much of their tax revenues due to international tax avoidance [13]. Many developing countries do not have effective policies to prevent international tax avoidance, so that developing countries are more vulnerable to international tax avoidance than developed countries [27].

Mainly in developing countries, about 800 million people worldwide still cannot enjoy food, safe drinking water, and clean sanitation. In order to provide public services required to solve poverty, such as health, education, and social security, each developing country needs funding equivalent to 4% of their GDP [28]. Recently, it is expected that developing countries procure such funds from their tax revenue from the viewpoint of sustainable financial resources [29], although such funding has mostly relied on aid from developed countries so far. The United Nations (UN) set it as the Sustainable Development Goals (SDGs) 17.1 to develop the taxing capabilities of developing countries [30]. Solving international tax avoidance is essential for the international community to overcome poverty.

In order to unravel how multinationals exploited arbitrage in the international tax system, governments investigated those engaged in multinational tax planning. In June 2012, governments jointly declared the importance of dealing with international tax avoidance at the G20 summit held in Los Cabos, Mexico. In order to reorganize the international tax system that had lost fairness and trust, the Organisation for

Economic and Co-operation and Development (OECD) launched the Base Erosion and Profit Shifting (BEPS) project. In November 2012, the G20 welcomed the work of the OECD on the BEPS project at a meeting of national finance ministers held in Mexico City. Since February 2013, when the OECD issued a report on the BEPS [31], the international tax arena has made efforts to address the issue.

The present study sought a desirable approach to taxation that balances the tension between globalization and sovereignty to derive suggestions as to how governments deal with globalized economic activities under the sovereign state system. Fields, such as international political economy and global governance, have similarly addressed the relationship between globalized markets and states with different values. However, they do not seem to tackle international taxation, unlike trade or environmental issues [32]. This study discusses international tax avoidance as a problematic phenomenon brought about by the asymmetry between globalized economic activities and localized legal systems. Using a network science perspective, we shed light on the phenomenon from three perspectives: the international tax system, diverted cross-border investments, and multinational corporate structures. On the basis of our findings, it is considered that a way in which administration could prevent taxpayers from using arbitrage in the international tax system and what tax system would be necessary to make taxation fair and trustworthy under the state sovereignty principle, with each state having exclusive taxing power for its territory. It is needed now to craft an effective policy toward international tax avoidance for developing countries to earn adequate tax revenues. We also believe that our findings and discussion provide interesting clues by which similar problems caused by asymmetries or arbitrage in a variety of areas could be resolved.

Two analytical features make this work distinct from previous literature on international taxation: the adoption of a network science approach and the use of microdata. Utilizing firm-level data, we study international tax avoidance from a network science perspective. Network science is a field that first emerged in the 1990s [33]. Against the background of offering accurate network information in various fields, it has succeeded in illuminating complex issues because it can numerically capture the interactions among components being analyzed by treating any system as a network (or graph) made up of nodes and links [34]. It has revealed interesting results that had hitherto not been found in a broad realm from sociology to physics, that is to say, networks follow the same principle, although the networks come from different fields [35, 36]. In order to gain a good understanding of something complex, we must understand both the behaviors of the components and their interactions. However, the literature on the international tax system tends to focus on the components of the international tax system, such as states' taxation or tax treaties, and does not pay enough attention to the interactions among these facets. The system now works as one complex network underpinning economic globalization, although its components have been individually designed. We therefore analyze it by reference to network science measures, which provide better understanding. In addition, most of the empirical literature on international taxation used country-level data due to data limitation issues. We make the most of firm-level data that has recently

been made available to precisely examine firms' cross-border economic activities.

Chapter 2 describes three phenomena that we deal with in this chapter. These are all related to international tax avoidance. The first concerns the vulnerability inherent to the international tax system. As its components were erected unilaterally or bilaterally, the system naturally generates arbitrage among them. As a simple but typical example, we take treaty shopping from various approaches to exploit the arbitrage, such as transfer pricing and thin capitalization. The second phenomenon concerns multinational corporate structures. In order to take full advantage of the arbitrage in the international tax system, multinationals are said to internationally make their structures complex and unnatural. We explain how these structures enable them to minimize their tax payments, using a simplified model. The last approach is to divert cross-border investments. Some states have recently attracted abnormal levels of investment from other states, given the size of their economies. We illustrate how tax considerations are likely to be behind this. From Section 3 to Section 5, we investigate these phenomena from a network science perspective.

Chapter 3 evaluates the international tax system, which consists of two subsets: taxation that states design unilaterally and tax treaties that states have been concluded bilaterally [14]. The arbitrage among taxation and tax treaties must exist as long as they are built up by unilateral and bilateral approaches. As international transactions across multiple states increase, the arbitrage progressively causes double non-taxation as well as international double taxation. As the purpose of this chapter is to investigate tax avoidance, we focus on treaty shopping, which is known as the means to avoid withholding taxation through the exploitation of tax treaty benefits. Treaty shopping receives significant attention from policymakers in the international tax arena as an abuse of tax benefits, because it is known to seriously diminish tax revenues, especially for developing countries. We construct a withholding tax network that represents the withholding tax rates among 165 states to measure the national income effects that combinations of multiple taxations have on cross-border transactions. In order to clarify how the international tax system is vulnerable to tax avoidance, especially via treaty shopping, we quantitatively weigh the risk of a state being used for this purpose, drawing on load centrality. We also demonstrate that the risk will spread to other states in the international tax system through community detection. The result suggests that it is fairly difficult to unilaterally and bilaterally develop the international tax system and to prevent tax-avoiding behaviors at the same time. We argue that it becomes inevitable for a state to assess how much it is actually exposed to the risk of tax-avoiding behaviors in the international tax system, and that multilateral rules or agreements are ultimately necessary to prevent tax avoidance.

Chapter 4 takes a closer look at multinational tax planning from the viewpoint of corporate structures. Corporate structures can become complicated not only because production processes are fragmented around the world but also because tax payments can be minimized [37]. However, much previous literature has only considered subsidiaries and did not pay attention to the corporate structures within which subsidiaries operated. In addition, they drew on financial information such as profits and total

assets for their analysis, but that information was usually not provided, especially about the affiliates important for multinational tax planning. The picture presented by them likely reflected highly limited aspects of multinational tax behavior. Therefore, we try to identify the firms that play an important role in multinational tax planning through consideration of equity investment relations in multinational corporate structures. Our approach is superior to previous ones, because it potentially targets the firms that are important in the context of multinational tax planning. A database contains their investment relations related to these important firms much better than the financial information [38]. In order to identify key affiliates for the tax strategy, we develop a model that is based on investigations that disclose how multinationals attempted to minimize their tax payments through their corporate structures. We confirm the effectiveness of our model through comparisons with the investigations and with the results of the third section. The firms identified by our model suggest that consideration of the corporate structure greatly aids tax administration in narrowing the candidates for suspicious affiliates regarding multinational tax planning activities.

Chapter 5 explores diverted cross-border investments. Corporations indirectly invest in true destinations through third states in order to derive tax benefits in a way that these states do not necessarily intend [39]. The overall size of such indirect investments is unclear because of the current methodologies for measuring international investments. Macroeconomic statistics such as FDI assume that international investments are made directly to destinations. Therefore, investments routed through several states are counted multiple times. In this way, the detoured investments are reflected as inflation in FDI statistics. We attempt to detect where firms' investments are routed to gain insight into suitable anti-avoidance measures to effectively prevent taxpayers from experiencing the benefits of taxation in an improper way. For the detection of detoured FDI due to tax considerations, we consider both the concentration of cross-border investments and the possibility of exploiting tax treaty benefits. We shed light on the features of the firms that function as a tunnel of routed FDI by constructing a multilayer network and defining multilayer centrality. We present sectors and states that are likely to be utilized for the exploitation of tax treaty benefits and argue that rules should be developed for those sectors that would be effective in regulating inappropriate use of tax treaty benefits.

Chapter 6 examines the implications for rules and administration that our analyses carry. First, we consider the state sovereign principle in the century when economies became truly globalized. We argue that states need to check their own positions in the international tax system and to relinquish part of their discretion in order to protect their fiscal autonomy. Otherwise, states would lose more discretion in fiscal policy because the vulnerability in part of the international tax system can spread to its entirety as a result, which Chapter 3 suggests. We then assess the current major countermeasures against treaty shopping, which is a typical international tax avoidance technique. The result of Chapter 5 implies that the current major countermeasures have scope for further improvement of the criteria for determining whether income derives from genuine business activities. Lastly, we discuss the possibility

that tax administration effectively entails inspections that discourage multinationals from having a hand in aggressive tax planning. According to the results reported in Chapter 4, an understanding of corporate structures might be useful for making inspections more efficient.

Chapter 7 discusses policy processes related to international taxation. The OECD has played a central role in formulating international tax rules since the end of the Second World War (WWII). The author carried out an overseas internship at the Center for Tax Policy and Administration (CTP) of the OECD to understand the OECD's work in the international tax arena. In the first half of this chapter, we seek to sketch how the OECD, which is sometimes called as the biggest think tank in the world, deal with global issues by research through describe projects the author were engaged in during the internship. Based on experience in the internship, we study how the OECD involves the member and non-member countries and furthers the process of developing to international standards, taking the BEPS project, which intends to reform the international tax system, as an example.

Chapter 8 mentions our Project-Based Research (PBR), which is part of the curriculum of the Graduate School of Integrated Studies in Human Survivability (GSAIS). It consists of two parts: a student workshop and a consideration of the application of blockchain technology. Initially, we invited the OECD economist and organized a student workshop concerning international taxation in cooperation with students. In the workshop, it was discussed how international organizations facilitate collective policies and what taxation should be in the 21st century. We then consider the potential of blockchain technology to the international tax system. As international tax avoidance is created due to advances in technology, we examine the use of technology as possible solutions against international tax avoidance under cooperation with experts of Ripple Inc.

Chapter 2

Literature review of international tax avoidance

This chapter deals with three phenomena, as the study of international tax avoidance herein is based on a network perspective, citing previous studies. The first phenomenon is the vulnerability inherent to the current international tax system. Naturally, it has arbitrage, as the system's components are erected unilaterally or bilaterally. This section discusses how arbitrage makes the system vulnerable to international tax avoidance, taking treaty shopping as an example. The second phenomenon is multinational complex corporate structures. It is said that multinationals make their structures unnaturally complicated in order to take full advantage of the system's elements favorable to arbitrage. This section also describes how such complex structures enable them to minimize their tax payments, which is illustrated using a stylized example. The third phenomenon considered is diverted cross-border investments. Some countries attract an abnormal amount of foreign investments, given the size of their economies. This section outlines how tax considerations are often behind this.

Vulnerability inherent to the international tax system

Economic globalization has great influences on multinational business activities and international taxation. The activities of multinationals cross more borders and become more complex. Accordingly, the number of tax treaties regulating conflicts of each jurisdiction's[1] right of taxation increases from 1,200 in 1975 to 3,200 today worldwide. Now each jurisdiction's tax laws and treaties overlap and function as a single legal system [40] or network.

However, such a system bears a severe problem. When tax laws and treaties of multiple jurisdictions overlap, the differences among them create opportunities for unexpected reductions in the tax burden because each jurisdiction often legislates their laws and treaties individually and without consideration of the overlapping. These unexpected reductions, which is commonly called international tax avoidance, are one of the side effects of economic globalization.

The international tax system is composed of domestic tax rules and bilateral tax treaties. It has

[1]The meaning of jurisdiction is almost the same as that of country and region.

always had arbitrage between its components, because these are unilaterally and bilaterally set out under the state sovereignty principle. The problem is that arbitrage brings about results that states do not intend, such as the potential for international double taxation and international tax avoidance. In particular, tax avoidance threatens the fairness of taxation and harms tax revenue, which is a financial resource that is essential for providing public services.

Withholding tax and tax treaty Companies are subject to various forms of taxation in the process of conducting cross-border transactions, most importantly withholding tax as well as corporate tax. If the recipient (an individual or a firm) of such payment resides in other countries, the payment is, in principle, subject to the withholding tax of the country where the payer resides. This is because international custom gives each jurisdiction the primary right to tax income that arises in or is derived from that jurisdiction [7]. Therefore, each jurisdiction imposes a corporate tax on business income arising in its jurisdiction and imposes withholding tax on dividends, interest, and royalties derived from its jurisdiction and paid to other jurisdictions. Even if dividends, interest, and royalties are paid to companies in the same corporate group, withholding tax is imposed as long as the group company is in another jurisdiction.

These withholding tax rates are often lower than usual when dividends, interest, and royalties are paid to jurisdictions that conclude a tax treaty. This is because many tax treaties have provisions to reduce the withholding tax rate or exempt the company from paying the tax altogether. This reduction or exemption benefit is generally called tax treaty benefit. The purpose of offering a tax treaty benefit is to encourage economic activities between the two contracting jurisdictions, so the reduction or exemption is applied only to dividends, interest, and royalties paid to the other contracting state.

Treaty shopping The withholding tax rates differ depending on the conclusion and contents of tax treaties between payers' jurisdictions and those of recipients, which creates arbitrage opportunities in the international tax system [41]. Some taxpayers attempt to exploit this arbitrage that makes the difference of withholding tax rates among jurisdictions in order to minimize their withholding tax payments. The scheme that is often used to avoid withholding taxation is called treaty shopping, which is a typical example of international tax avoidance [42].[2]

Figure 2.1 illustrates a stylized example of treaty shopping. It is assumed, hypothetically, that three jurisdictions are in the international tax system: A, B, and C. The tax rule of jurisdiction A stipulates that its withholding tax rate is 25%, whereas that of jurisdiction C stipulates that its withholding tax rate is 5%. Suppose that a payment is made from jurisdiction A, where the payer resides, to jurisdiction C, where the recipient resides. In this case, the payment should be subject to a 25% withholding tax, in accordance with jurisdictions A's tax rule. Treaty shopping, however, attempts to make the payment through the third jurisdiction C to minimize the 25% withholding tax. If the payment were made through

[2]Treaty shopping is sometimes called treaty abuse [43] or improper use of tax treaties [44].

jurisdiction C, it would be subject to only a 5% withholding tax in total. No withholding tax would be imposed on payments from jurisdiction A to C because they concluded a tax treaty that offers the withholding tax exemptions. The tax rule of jurisdiction C imposes a 5% withholding tax on the payment made from jurisdiction C to B. In this way, jurisdiction A loses the opportunity to tax the income that arises from them.

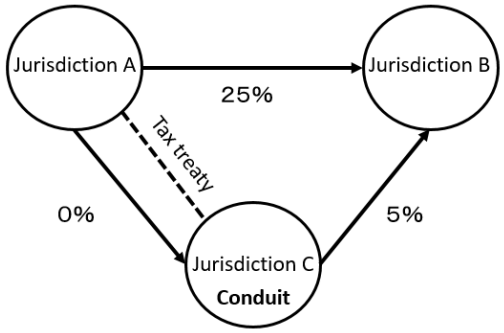


Figure 2.1: **Stylized example of the international tax system.** The circles indicate jurisdictions A, B, and C. The rates over the arrows indicate the withholding tax imposed on the payments. The dotted line indicates a tax treaty that offers a withholding tax exemption.

Governments see treaty shopping as a serious problem because it defeats these two purposes, which they try to accomplish by withholding tax. They provide substantial economic activities with tax benefits, but the indirect payments are usually lacking in real economic activities in third jurisdictions. If taxpayers still enjoy the benefits of treaty shopping, governments will fail to achieve their policy goals, in addition to incurring losses in their tax revenues. Moreover, treaty shopping could facilitate attempts to avoid taxation, because it provides taxpayers with the opportunity to shift their profits to low-tax jurisdictions free of any tax payment.

As in the tax treaty between jurisdiction A and C in Figure 2.1, bilateral tax treaties usually offer withholding tax reductions or exemptions with payments between their contracting jurisdictions. In order to promote economic activities between them, they are willing to give up part of the tax revenue they anticipate from the economic activities. In contrast, jurisdictions avoid concluding tax treaties with some other jurisdictions to protect their tax revenues. By imposing a full withholding tax, they attempt to prevent taxpayers from shifting income generated within their boundaries to low-tax jurisdictions, known as so-called tax havens. Therefore, the prevention of treaty shopping is an important policy issue in the arena of international tax.

For companies engaged in treaty shopping, this is just one of the ways to avoid tax. However, for source jurisdictions, this is one of the ways in which their rights to impose taxation are eroded by third jurisdictions, which are sometimes called conduit jurisdictions. It is source jurisdictions that originally have the right to impose taxation since the dividends, interest, and royalties are income derived from their jurisdiction. Nevertheless, it is the third jurisdictions that impose their tax on these incomes. In this way,

it has been found that using a particular bilateral tax treaty erodes the tax sources of jurisdictions that did not conclude the bilateral tax treaty. In other words, vulnerabilities in one jurisdiction's tax treaty potentially erode other jurisdictions' tax bases. This is why treaty shopping is regarded as a form of tax base erosion and is viewed as a problem in the area of international taxation. In fact, many developing countries have reported huge losses in their tax revenue as a result of treaty shopping due to insufficient countermeasure against treaty shopping [27].

Previous studies A few previous studies on treaty shopping have incorporated the method of network science. One of the earliest studies in the literature applied the idea of the shortest path problem to treaty shopping [45]. They used the Dijkstra algorithm to find the shortest paths between nodes [46] in order to calculate the tax rates resulting from treaty shopping. It was then suggested to use betweenness centrality that measures how often a node appears on the shortest paths [47] for the investigation of treaty shopping [48]. Later, withholding tax on dividends has attracted the attention of researchers. Relationships between treaty shopping and the withholding tax rates on dividends are examined [49]. It is also examined how the difference in the withholding tax rates on dividends affects the amount of bilateral FDI [50, 51].

However, other passive incomes, such as interest and royalties, are not investigated, although they are as important as dividends. In particular, cross-border royalties payments cannot be overlooked in studying treaty shopping because businesses become more digitalized in nature. Moreover, the international tax system is not analyzed from the viewpoint of relationships among jurisdictions, even though it has been noted that hub-and-spoke structures in the system might facilitate tax-avoiding behaviors [52]. By dealing with treaty shopping as the shortest path problem, we attempt to further uncover vulnerabilities inherent to the system.

Multinational corporate structures

Multinationals have been recognized as important players in the globalized world. They earn profits in various jurisdictions by conducting business worldwide. Tax rates are often high in the markets where they sell their products and services. In order to minimize global tax payments, some of them utilize the capacity to operate affiliates around the world. Not for business, but for tax purposes, they establish and manage affiliates in foreign jurisdictions to shift their profits from high-tax jurisdictions to low-tax ones.

In particular, it attracts much attention of policymakers that affiliates classified as intermediate companies nowadays [37]. Multinationals establish and utilize them for various fair reasons, such as improving management efficiency and eliminating legal risks [53]. However, the presence of intermediate companies makes multinational corporate structures complicated, which may result in facilitating the circumvention of various regulations, including minimization of tax payments.

Intermediate company Some jurisdictions offer tax benefits to taxpayers who satisfy certain requirements required by their tax treaties or rules. In order to meet these requirements, multinationals often establish intermediate companies even if they have no reasonable business purpose [54]. For instance, they are used for conducting treaty shopping, which is a technique to minimize withholding tax payments.

These intermediate companies established for tax purposes are roughly classified into two types: holding and conduit companies. Those classified as the former are usually established in low-tax jurisdictions and function as destinations of profits other affiliates earn in various jurisdictions. These companies manage transferred profits until affiliates in other jurisdictions need funds for their business operations.

However, many jurisdictions impose withholding tax on profits that attempt to be transferred to low-tax zones. In order to avoid these impositions, multinationals establish another affiliate called a conduit company in a third jurisdiction that is neither a high-tax jurisdiction nor a low-tax one, that is, suitable for treaty shopping. Conduit companies function as tunnels that tie affiliates in other jurisdictions to holding companies in low-tax ones. Multinationals transfer their profits to low-tax jurisdictions through a conduit company without paying much withholding taxes. In this way, multinationals make their profits subjected to the lowest taxation rates to multiply them as much as possible.

Figure 2.2 illustrates an example of part of a multinational corporate structure that includes holding and conduit companies to show how profits pass to the former from the latter. The rectangles refer to multinational affiliates. It is assumed that a multinational has a local affiliate in a given jurisdiction to sell local customers its products and services. In order to avoid the jurisdiction's high tax rate eating into its profits, the multinational establishes a holding company in a low-tax jurisdiction and a conduit company in a jurisdiction suitable for treaty shopping. The dashed arrows in the figure refer to capital flows or equity investments. The affiliates situated at the arrowheads invest in the affiliates at the start of the dotted arrows, with the normal arrows referring to profit flows. The profit flows in the opposite direction of the capital flows, because multinationals usually shift their profits to holding companies as internal payments, such as dividends.

It is now becoming apparent that multinationals use this combination of holding and conduit companies for income associated with intangible assets, such as IPs, which provide a considerable amount of profit for multinationals. However, the problem for multinationals is that Research and Development (R&D) activities to create new IPs are usually conducted at high-tax-rate jurisdictions, where it is easier to access those higher levels of educational attainment than the rest of the world. In order to minimize tax on income derived from IPs, multinationals transfer the rights to use them from the affiliate located in high-tax-rate jurisdictions that developed them to a holding firm located in a low-tax-rate jurisdiction and let the latter manage them [55]. Specifically, such a holding firm is often called an IP holding firm and established in a jurisdiction that offers preferential tax treatment on income derived from intangible assets. In this way, multinationals benefit from both high-tax-rate and low-tax-rate jurisdictions. They

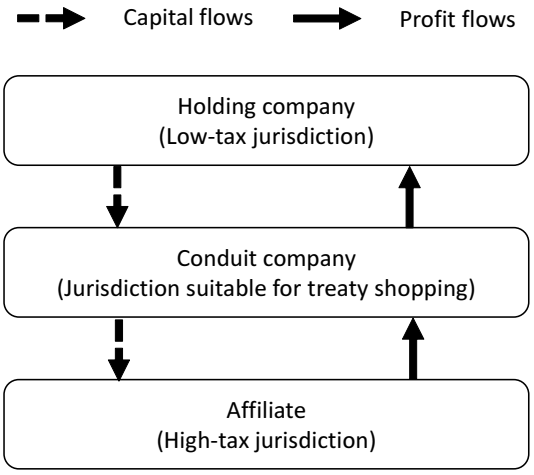


Figure 2.2: **Stylized example of part of a multinational corporate structure with a holding company and a conduit company.** The rectangles refer to multinational affiliates, the dashed arrows to capital flows, and the arrows to profit flows.

could reduce taxable income in high-tax rate jurisdictions by deducting the expense R&D activities as well as let profit generated from IPs subject to preferential tax treatment provided by low-tax-rate jurisdictions.

We illustrate this structure, taking a multinational that produces sporting goods as an example. It is assumed that it has local affiliates, an IP holding firm, and a conduit firm in its group. The local affiliates conduct marketing or sales activities in various jurisdictions. The IP holding firm is located in a jurisdiction that subjects IP income to special tax treatment, and the conduit firm is located in a jurisdiction suitable for treaty shopping. In order to minimize the local affiliates' tax payments, the multinational attempts to shift the local affiliates' profits to the IP holding firm in the form of a licensing fee. In order to make this possible, the multinational transfers the trademark right to the IP holding firm, which then licenses the local affiliates to use the trademark. However, the jurisdictions where the local affiliates are located might impose the withholding tax on licensing fees if they directly pay these to the IP holding firm. In order to avoid the withholding tax, the IP holding firm first licenses the conduit firm, which then sublicenses the local affiliates. Therefore, the local affiliates pay the IP holding firm license fees through the conduit firm, which allows the multinational to shift its profits to the jurisdiction with generous tax practices, with minimum withholding tax payments levied.

Previous studies In recent years, some empirical studies on international taxation have used ownership information because of the exponential growth of firm-level data. However, most of them use the information only for the purpose of determining which firm is a multinational affiliate, and do not consider how multinational corporate structures are overall. To the best of our knowledge, a limited number of studies considered ownership relations among multinational affiliates, however, they only analyzed affiliates whose headquarters were located in specific countries, such as the US [56] and

Germany [57]. There seemed to be few analyses carried out on global trends.

On the other hand, ownership relationships have nationally and globally been investigated by researchers of network science, as the development of economic data has reached an exponential growth in recent years. Initially, ownership relationships in the US and Italian stock markets were analyzed from an aspect of topology [58]. Those among European firms were then examined from the viewpoint of geographical space [59]. It is examined how control and wealth were structured and concentrated across countries [60]. Lately, it is suggested that network science is an effective way to assess the architecture and structure of multinational corporate structures, which is ownership relationships within multinationals [61, 62].

It has recently been proved that such comprehending ownership relationships in the real world, including multinationals, help us understand economic growth and incomes more clearly [63]. For instance, understanding the complexity of the ownership hierarchies of large bank holding companies assist in reaching a resolution is required when a company goes bankrupt [64]. Investigation of ownership relations at the jurisdiction-level is also applied to the analysis of offshore financial centers in the context of international taxation [65].

On the basis of these research trends, investigate complicated multinational corporate ownership structures is meaningful to considering effective countermeasures against international tax avoidance.

Diverted cross-border investments

As globalization has provided greater mobility to financial resources, some countries have started to receive an unusual amount of FDI, given the GDP that reflects their real domestic economic activities. Table 2.1 compares the top 10 jurisdictions of FDI receipt between 1995 and 2015. The column of FDI shows the amount of investment that a jurisdiction received in a year, and the column of the Ratio shows its ratio to GDP. It is evident that the 20 years have significantly increased not only the amounts of FDI stock but also the ratios. In 1995, Hong Kong, for example, received 228 billion USD, which was equivalent to 157% of its GDP. However, in 2015, they received 1591 billion USD, which was equivalent to 514% of its GDP. The progress of globalization has enabled these countries to receive about five times the value of the goods and services produced within their borders.

It is noted that diverted cross-border investments create a situation in which some jurisdictions have received tremendous levels of FDI for their GDP. The investments are purposely detoured through a third jurisdiction in order to exploit the difference of tax rules among jurisdictions [39]. FDI statistics, however, measure cross-border investments bilaterally under the assumption that international investments are made directly at their ultimate destinations. One indirect international investment is, therefore, counted as a separate investment every time it crosses a border. This is why several jurisdictions seem to have received a significant amount of FDI in the statistics. Although international investments are often made through third countries, current statistics on FDI are in bilateral units, which cannot capture the diversion

Table 2.1: Transition of the top 10 FDI recipients (in millions of USD)

1995			2015		
Jurisdiction	FDI	Ratio	Jurisdiction	FDI	Ratio
US	1005	13%	US	5731	31%
Germany	313	12%	Hong Kong	1591	514%
France	233	15%	UK	1530	52%
Hong Kong	228	157%	Netherlands	1399	183%
UK	200	15%	China	1220	11%
Canada	123	20%	Singapore	1092	354%
Belgium & Luxembourg	113	36%	Switzerland	890	131%
Australia	111	30%	Ireland	890	305%
Netherlands	111	24%	Canada	806	52%
Spain	106	17%	Germany	1000	23%

Source: The data on FDI is drawn from [66] and the GDP from [67].

of FDI perpetuated by multinationals.

In order to delineate genuine FDI from actual investors to ultimate destinations, international organizations now recommend that countries acknowledge two types of FDI: FDI that includes all investments, as previously, and that which excludes the investments via special purpose entities (SPEs) [68, 69]. The detours are so large in the global economy that they are difficult to be ignored by the international community [70]. A SPE is a legal entity that provides little employment and lacks a physical presence. If ever more countries accept these recommendations, the statistics could get close to representing the true picture of FDI. However, this is not enough for illuminating the relationship between indirect payments and tax considerations. Firstly, macroeconomic data used by such analyses contain many noises and biases in nature. Secondly, enjoying tax benefits does not necessarily require that cross-border investments pass through SPEs. Taxpayers could instead derive tax treaty benefits by detouring their investments through other types of legal entities. If indirect investments are simply regarded as the investments paid through SPEs, diverted investments affected by tax considerations will also be underestimated.

Previous studies There have been only a few previous studies on detoured international investments. They are investigated by taking into account both ownership relations among firms and the withholding tax rates [57, 71]. However, their targets are only specific countries, namely, Germany and the Netherlands. Studies that deal with them globally only focuses on the withholding tax rates [72] or ownership relations among firms [65]. There are no studies to analyze them worldwide that take both ownership relations among firms and the withholding tax rates. In addition, there are no studies to investigate them from the viewpoint of sectors, except transfer pricing, which is another method of international tax avoidance [73].

To take into account both ownership relations among firms and the withholding tax rate is necessary

for analyzing detoured cross-border investments motivated by tax purposes treaty shopping. In addition, a study that unveils which jurisdiction and which sector is a crucial enabler to avoid taxation globally is essential for considering effective countermeasures against opportunities for international tax avoidance created by detoured cross-border investments.

Chapter 3

International tax system that creates tax avoidance opportunities

Jurisdictions have unilaterally designed their legal rules in accordance with their own policy objectives and backgrounds. Until now, policymakers merely needed to examine whether their own legal rules were fit for the purposes for which they were originally intended. However, one jurisdiction's legal rules became combined with other jurisdictions' rules, as economic globalization progressed. This works as a component of the international legal system rather than as a single separate rule. Several legal systems exact a legal effect on a single international transaction across several jurisdictions.

In the age of globalization, policymakers must consider interactions with other jurisdictions' rules when assessing their own legal frameworks. However, analyzing a given jurisdiction's legal rules does not facilitate understanding of how the international legal system behaves as a whole. In the case of international taxation, an individual analysis cannot illuminate the inconsistencies of tax rules among different jurisdictions. The inconsistency presents a major risk to a jurisdiction's rules, because it could be used as an opportunity for aggressive tax planning. The lack of comprehensive analysis could in turn result in making both a jurisdiction's tax rules and the international tax system vulnerable to international tax avoidance.

This study focuses on opportunities for treaty shopping, which is a type of international tax avoidance on cross-border transactions that the international tax system brings [74]. The purpose is to examine how vulnerable to treaty shopping the international tax system actually is. We analyze what outcome is brought about when a country's taxation is interconnected with others by means of network science that enables us to numerically analyze complex systems such as the international tax system, and try to unveil hub-and-spoke structures that are hidden in the system and create opportunities for treaty shopping [52].

3.1 A numerical method for analyzing the international tax system

We analyze the withholding tax rates stipulated in the tax rules and treaties of 165 jurisdictions to grasp the vulnerabilities to treaty shopping that the current international tax system embodies. First, we estimate what jurisdictions are likely to be used as a hub for treaty shopping in the system by calculating

centrality. Then, through community detection, we examine what jurisdictions are spokes of those hubs and clarify how opportunities for treaty shopping in specific jurisdictions spread to the entire system.

The problems arising from arbitrage can be seen in various policy areas [75], and treaty shopping is an example of this in the context of international taxation. The simplest arbitrage is represented as a triad or triangular relationship in a graph or network [76]. Network researchers sometimes refer to such a relationship as a 'forbidden triangle' and have carefully analyzed it, because it makes networks unstable [77]. In international taxation, taxpayers exploit arbitrage inherent to the international tax system as an opportunity for tax avoidance.

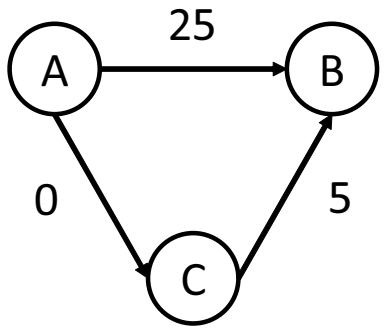


Figure 3.1: **Example of the international tax system represented as a network.** The nodes depicted as circles indicate jurisdictions A, B, and C. The distances depicted as the numbers on the arrows indicate the withholding tax rates between jurisdictions.

Figure 3.1 represents the international tax system of Figure 2.1 as a network. Jurisdictions A, B, and C are represented as the nodes depicted as circles, and the withholding tax rates depicted as the numbers on the arrows between jurisdictions are represented as distances between these. When going from node A to B, the route through node C is shorter than the direct route in terms of distance. Treaty shopping can, in this way, be regarded as the shortest path problem in graph theory or network science.

Withholding Tax Network

We take treaty shopping as an example of the legal effects brought about by the combination of several jurisdictions' rules. In order to capture the withholding tax reductions created by treaty shopping, we produced a graph $G_\beta = (N_\beta, L_\beta, W_\beta)$ to depict the withholding tax network (WTN), which represents the withholding tax rates for dividends, interest, and royalties paid among 165 jurisdictions on which we finally got the data from [78]. The graph comprises three components: the set of nodes N_β, the set of links L_β, and the set of the links' weight W_β. A node represents a jurisdiction, whereas a link connects a payer's jurisdiction and to a recipient's jurisdiction and is weighted with the withholding tax rate. Any two nodes are connected in both directions, because the withholding tax rate differs depending on the jurisdictions of a payer and recipient even though between the same two jurisdictions. In total, the WTN has 165 nodes; $165 \times 164 \times 2 = 54,120$ links.

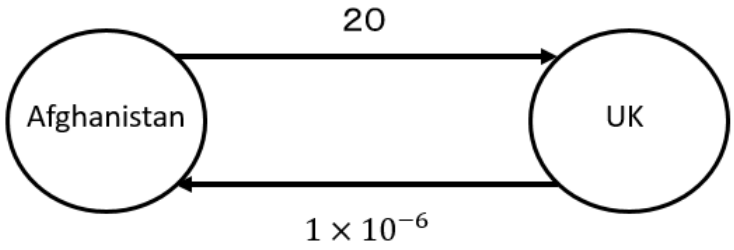


Figure 3.2: **Example of Afghanistan and the United Kingdom in the WTN.** The distances are depicted as the numbers on the arrows.

When tax rates are 0%, 1×10^{-6}, which is small enough not to affect the validity of our analysis, compared with other tax rates, is given as weight so that paths including many links whose tax rates 0% were not counted as shortage paths. Figure 3.2 shows an example of Afghanistan and the United Kingdom. Afghanistan imposes a 20% withholding tax on dividends paid to the UK, so that The link (depicted as an arrow) from Afghanistan to the UK has 20 as a distance. On the other hand, the UK imposes a 0% withholding tax on dividends paid to Afghanistan, so that the link from the UK to Afghanistan has 1×10^{-6}.

With respect to the withholding tax rate on dividends, many tax treaties apply different tax rates depending on the percentage of holdings. Generally, the higher the shareholding ratio, the lower the tax rate. The interest in this study is in the tax burden that arises when the profit is transferred within a corporate group. This is because international tax avoidance by multinationals is often done through the transfer of their profits between group companies. Therefore, assuming that the dividend was generated by a 100% wholly-owned subsidiary, the lowest tax rate are applied. Regarding interest, some jurisdictions have applied different tax rates for non-bank deposits and bank deposits. For the same reason, it is assumed that the tax rate for the non-bank deposit is applied.

Some tax treaties have other requirements for granting withholding tax exemptions or reductions, apart from the shareholding ratio mentioned above. We consider that all requirements are met in this case. Moreover, the applied withholding tax rate is not always clear because the wording in a given tax treaty and the relationship between domestic tax laws and tax treaties are not always clear. In these cases, the lowest tax rate among the possible withholding tax rates is applied. On the other hand, although some jurisdictions do not impose withholding tax according to their domestic tax laws, their tax treaties determine the withholding tax rate. Since the primary purpose of tax treaties is usually to avoid international double taxation, it is considered that withholding tax is not imposed, but only in this case, we assume that the tax rate stipulated in tax treaties is to be applied.

It is also necessary to consider corporate taxes in the third jurisdiction when calculating the strict amount of tax. This is especially true in the case of dividends. However, corporate taxes in the third jurisdiction are not considered in this study because only a few jurisdictions impose a corporate tax on

dividend income today[1] [79].

Centrality

We calculated load centrality [80] for the WTN to grasp which jurisdictions are likely to be used for treaty shopping from the viewpoint of withholding tax rates. The centrality was originally designed to calculate how much data processing capacity each passing point requires for the efficient movement of data packets in a network, such as the Internet. We used this centrality as an index that measures how much the shortest path between any pair of nodes through another node.

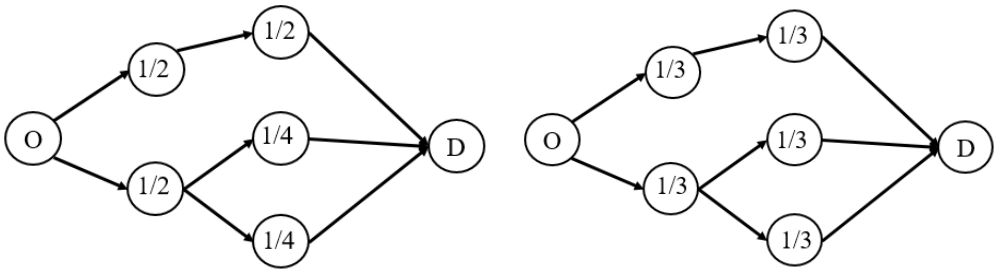
The higher node's centrality is, the more the node is on the shortest paths. In the WTN, where withholding tax rates are expressed as a distance, the shortest paths can be interpreted as a path that is likely to be used for treaty shopping. If a dividend or royalty were paid through that jurisdiction depicted as a node with a high centrality, withholding tax payments would be likely to be mitigated.

Load centrality is calculated in the following manner: It is assumed that one unit is sent from node s to node d along the shortest path. $l(k)$ represents the total amount of the unit that passed through node k after one unit was sent between all pairs of nodes. Although the unit was originally represented as a packet of data, we see it as the amount of dividends, interest, and royalties in this study. Load centrality of node j is given by:

$$lc_j = \sum_{s \neq d} w_{s,d}(i) \tag{3.1}$$

where $w_{s,d}(i)$ is the sum of the units that pass through node j when one unit is sent between all pairs of the nodes. The higher load centrality a given node has, the more shortage paths are via the node.

When there were several shortest paths, the unit was divided equally at the fork of the shortest paths, so that load centrality differs from betweenness centrality when a graph has multiple shortest paths [81], even though the former is sometimes thought to be similar to the latter [47]. As Figure 3.3 illustrates, the latter divides a unit equally by the number of shortest paths.



(a) Load centrality. (b) Betweenness centrality.

Figure 3.3: **Difference in the treatment of multiple shortest paths between load and betweenness centrality.** O indicates origin and D destination.

[1]Many countries have introduced participation exemptions. For instance, Japan exempts corporate tax for 95% of dividend income.

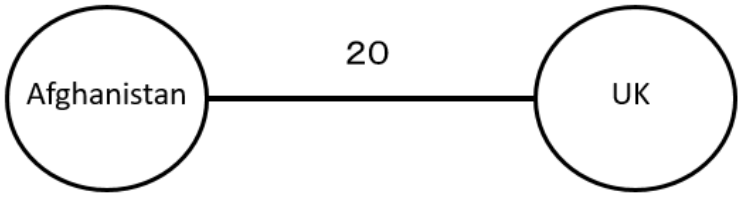


Figure 3.4: **Example of Afghanistan and the United Kingdom in an undirected graph of the WTN.** The weight is 20 because the higher tax rate between them is 20%.

Community

We attempt to identify communities within the WTN to understand the range of influences the opportunity for treaty shopping exerts on the international tax network. Community herein refers to a subgraph whose nodes are densely connected by links in accordance with a concept used in network science.

If a jurisdiction with a high load centrality is within a detected community, it can be understood that all jurisdictions in the community are probably exposed to the risk of treaty shopping through the jurisdiction with high centrality. This is because it is better to use a jurisdiction with a high centrality that belongs to the same community than that of other communities so that taxpayers effectively mitigate their withhold tax payments.

Detecting communities from the WTN unveils how the vulnerability to treaty shopping could spread within the international tax system. We take three steps for community detection. For the first step, the WTN that was originally represented as a directed graph is transformed into an undirected one, because the algorithms for community detection are essentially only applicable to undirected graphs. When a withholding tax rate between two jurisdictions differs, the higher withholding tax rate is put on links in an undirected graph of the WTN. This because we assume that the higher withholding tax rate is suitable for measuring the extension of opportunity for treaty shopping.

Figure 3.4 shows an example of Afghanistan and the UK. As Figure 3.2 illustrates, Afghanistan imposes a 20% withholding tax on dividends paid for British taxpayers, whereas the UK imposes no withholding tax on ones paid for Afghan taxpayers. Therefore, 20 is put on the link between Afghanistan and the UK as a weight in the undirected graph of the WTN for dividends.

As a second step, we remove the links according to a given threshold. Otherwise, the undirected graph is too dense to be split into several communities. We search for the best threshold for community detection, from every 5% in the range of 30-0%, namely, 30%, 25%, 20%, 15%, 10%, 5%, and 0%. No threshold is set to higher than 35% because few jurisdictions impose a withholding tax higher than 35%. For instance, there is no link between Afghanistan and the UK when the threshold is set to 15%, 10%, 5%, or 0%. Finally, communities whose modularities are highest among all threshold values are chosen. This is because the higher the modularities are, the more meaningful their communities are.

The modularity Q is an oft-used index when a result of community detection is analyzed [82]. It

notes how well a graph is divided into subgraphs, in which nodes are densely connected by links. The modularity Q for a graph with N nodes and M links is calculated as follows:

$$Q = \frac{1}{2M} \sum_{s,d}^{N} \left(a_{sd} - \frac{k_s k_d}{2M} \right) \delta[C(i), C(j)] \tag{3.2}$$

where a_{ij} represents the number of links between node i and node j, and $\frac{k_i k_j}{2M}$ represents the expected number of links for a randomly-wired graph. $C(i)$ is a subgraph of node i, and $C(j)$ is a subgraph of node j. If a $C(i)$ is the same subgraph as $C(j)$, $\delta[C(s), C(d)]$ is 1; otherwise, it is 0.

Modularity is normalized so that the maximum value is 1. Therefore, it can be said that there is a strong community structure in the network as it moves closer to 1, but from an empirical point of view, if it is larger than about 0.3, it is often considered that the network has a community structure.

As the last step, we use the Louvain algorithm [83], which is known for its accuracy and improved scalability [33], to differentiate communities within the WTN. The algorithm detects subgraphs from a graph by maximizing modularity.

The algorithm initially assigns each node to a different community. Then, for each node, it evaluates the increase in modularity if its adjacent node j is placed in $C(i)$. Lastly, the node that underpins the largest increase among the adjacent nodes is placed in $C(i)$. This procedure is then repeated until an adjacent node that increases in modularity cannot be found.

The increase in modularity brought about by placing an adjacent node j in $C(i)$ is calculated by:

$$\Delta Q = \left[\frac{\sum_{in} + 2k_{j,in}}{2M} - \left(\frac{\sum_{tot} + k_j}{2M} \right)^2 \right] - \left[\frac{\sum_{in}}{2M} - \left(\frac{\sum_{tot}}{2M} \right)^2 - \left(\frac{k_j}{2M} \right)^2 \right] \tag{3.3}$$

where $\sum_{in}$ represents the number of links in $C(i)$, $\sum_{tot}$ represents the number of links of all nodes in $C(i)$, k_j represents the number of links of node j, $k_{j,in}$ represents the number of links from node j to the nodes in $C(i)$, and M represents the number of all of the links in the graph.

3.2 Results of analyzing the international tax system

The numerical method mentioned above is applied for the international tax system that is consisted of 165 jurisdictions' taxation. First, we show the result of centrality and mention which jurisdictions are thought to be potential hubs for treaty shopping in the system. Then, we illustrate the result of community detection and point out what jurisdictions are in a hub and spoke relationship with these hubs. Lastly, we discuss differences in centralities and communities between jurisdictions that are often used for treaty shopping and those not.

Centrality

We calculated load centrality lc_j for 165 jurisdictions. Table 3.1 shows rankings and jurisdictions whose centralities were higher than 0.05 about dividends, interest, and royalties without any threshold. As the

listed jurisdictions are favorable for treaty shopping in terms of withholding tax rates, it can be said that these jurisdictions have high risks of being used for treaty shopping. It is also notable that the top jurisdictions differed markedly depending on dividends, interest, and royalties, and the centrality of interest is much lower than those of others.

We compare jurisdictions with high centralities with those that international tax experts empirically know are used for treaty shopping to check whether our method that uses load centrality contributes to the identification of jurisdiction used for treaty shopping. The listed jurisdictions include the Netherlands, Cyprus, and Switzerland, which are widely known among experts [84]. This shows that our method is capable of effectively identifying jurisdictions used for treaty shopping.

Community

As for taxpayers to use a jurisdiction with a high centrality, we conclude that jurisdictions in a community are exposed to the risk of treaty shopping if a jurisdiction with a high centrality belongs to the community. In other words, the vulnerability to treaty shopping could spread in the scope of a community.

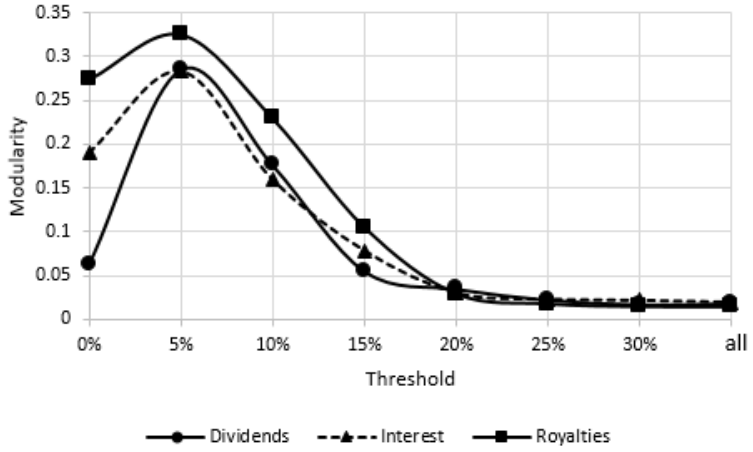


Figure 3.5: **Changes in the modularity Q of the WTN's undirected graph according to the thresholds.** These are set to every 5% in the range of 30-0%. All refers to no threshold.

For community detection, we need to transform the WTN to an undirected graph and set thresholds. Finally, we decided to set a threshold of 5%, which made the modularity Q the highest. Figure 3.5 shows changes in modularity of the undirected graphs of the WTN according to the thresholds. When a threshold is 5%, all graphs recorded the highest modularity, which is 0.2853738 for dividends, 0.283715 for interest, and 0.325377 for royalties. Therefore, we detected community as for the undirected graphs of the WTN in which links whose distances were more than five were removed.

Correlation coefficients of load centrality are calculated between the WTNs with and without thresholds to check that the result of the centralities is not affected too much by providing the thresholds. As Table 3.2 shows, all coefficients are around 0.9. Therefore, it can be said that providing the thresholds does not influence the results of the centralities so much.

Table 3.1: Ranking of the load centrality in the WTN

Rank	Jurisdiction	Centrality	Jurisdiction	Centrality	Jurisdiction	Centrality
1	UK	0.070639	UAE	0.041796	UAE	0.079455
2	UAE	0.058244	Switzerland	0.039489	Switzerland	0.079043
3	Kuwait	0.044943	Germany	0.035639	France	0.05139
4	Netherlands	0.027664	France	0.033565	Hungary	0.048268
5	Cyprus	0.024464	UK	0.032811	Mauritius	0.047201
6	Hong Kong	0.0239	Hungary	0.025905	Sweden	0.045731
7	Singapore	0.0228	Canada	0.024145	Netherlands	0.042169
8	Switzerland	0.022725	Netherlands	0.023775	Norway	0.037786
9	Mauritius	0.022512	Sweden	0.023619	Cyprus	0.034533
10	Spain	0.02209	Luxembourg	0.022488	Ireland	0.029864
11	Luxembourg	0.020043	Kuwait	0.019532	Luxembourg	0.029044
12	Lucia	0.018178	Norway	0.016801	Senegal	0.029034
13	Bahrain	0.018153	Ireland	0.016736	UK	0.024726
14	Malaysia	0.018115	Czech	0.016253	Malta	0.02437
15	Qatar	0.017946	US	0.014057	Gabon	0.024012
16	Ireland	0.017523	Estonia	0.013082	US	0.019653
17	Estonia	0.016039	Malta	0.011142	Spain	0.018766
18	Malta	0.015731	Austria	0.01061	Bahrain	0.018091
19	US	0.01268	South Africa	0.010495	Latvia	0.01757
20	South Africa	0.011743	Cyprus	0.009644	Germany	0.016731
21	Mexico	0.010967	Russia	0.009492	Macau	0.01241
22	Oman	0.010475	Bahrain	0.009354	Canada	0.012097
23	Denmark	0.010308	Latvia	0.009251	Monaco	0.01029
24	Hungary	0.010111	Italy	0.008287	South Korea	0.009735
25	Belgium	0.009487	Belarus	0.006977	South Africa	0.009731
26	France	0.009139	Mauritius	0.006841	Japan	0.008836
27	Lithuania	0.007719	Oman	0.006553	Denmark	0.007992
28	Georgia	0.007616	Ukraine	0.006507	Italy	0.007951
29	Bulgaria	0.006243	Bulgaria	0.006357	Guernsey	0.007783
30	Colombia	0.006188	Israel	0.006243	Estonia	0.007717
31	Zambia	0.006114	Algeria	0.006228	Slovak	0.006905
32	Tunisia	0.006075	Japan	0.006183	Austria	0.006784
33	Germany	0.005091	Seychelles	0.006154	Zambia	0.006121
34			Portugal	0.006108	Libya	0.005969
35			Zambia	0.006101	Liechtenstein	0.005768
36			Cameroon	0.006067	Belgium	0.005208
37			Denmark	0.005954	Russia	0.005146

Table 3.2: Correlation coefficients of load centralities between the WTNs with and without thresholds

	Dividends	Interest	Royalties
Threshold	Coefficient	Coefficient	Coefficient
30%	0.964963813	0.951327102	0.944070249
25%	0.964979316	0.951316117	0.943941746
20%	0.96515412	0.951212308	0.943555807
15%	0.963629098	0.950376936	0.936168543
10%	0.965430042	0.937609801	0.93951127
5%	0.959738913	0.912283135	0.911668238
0%	0.925707564	0.920637142	0.880016323

Table 3.3: Communities in the WTN for dividends when the threshold is set to 5%

Community 1 (61)		Community 2 (48)	Community 3 (19)
UK	Estonia	Cyprus	UAE
Kuwait	Malta	Hong Kong	Singapore
Netherlands	US	Saint Lucia	Malaysia
Switzerland	South Africa	Bahrain	Qatar
Spain	Mexico	Mauritius	
Luxembourg	Denmark	Oman	
Ireland	Hungary		

For dividends, we identified a total of four communities. The largest community (Community 1) has 61 jurisdictions, including the United Kingdom, Kuwait, the Netherlands, Switzerland, and Spain. The second-largest community (Community 2) has 48 jurisdictions, and includes Cyprus, Hong Kong, and Mauritius. The third-largest community (Community 3) has 19 jurisdictions, and includes countries such as the United Arab Emirates and Singapore. The smallest community (Community 4) has three jurisdictions. The remaining 34 jurisdictions do not belong to any communities. Table 3.3 shows the communities to which jurisdictions whose centrality is higher than 0.01 in the WTN belong.

Moreover, we examine how thresholds change the rankings of the load centrality for dividends to take a closer look at the effect of thresholds on the results. Figure 3.6 shows the top three jurisdictions and Cyprus as an example. The rankings of the top three jurisdictions in the WTN, namely the UK, United Arab Emirates, and Kuwait, were not affected much by the thresholds. This indicates that the change in the threshold values did not significantly influence the rankings of the load centrality for dividends. However, a few jurisdictions were indeed fluctuating. For instance, Cyprus fell sharply after a threshold of 30%.

For interest, four communities were detected in total. Table 3.4 shows the communities to which jurisdictions whose centrality is higher than 0.01 in the WTN belong. The largest community (Community 1) has 55 jurisdictions, including Switzerland, Germany, and France. The second-largest community (Community 2) has 48 jurisdictions, and includes Hungary, the Netherlands, and Sweden. The third-

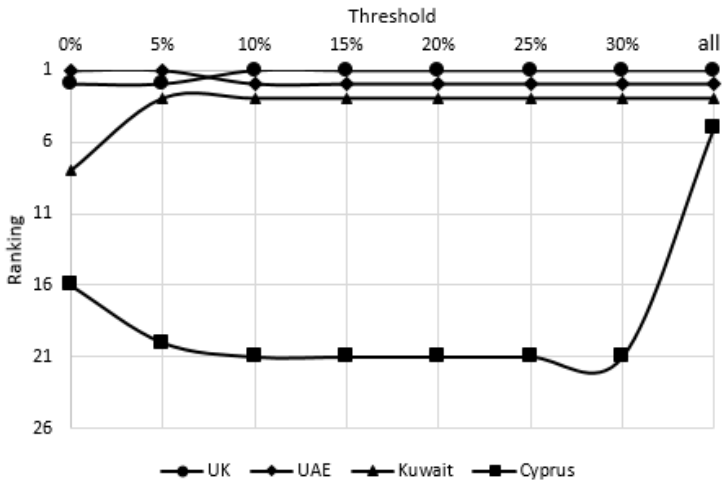


Figure 3.6: **Change in the rankings of the top 3 jurisdictions and Cyprus according to thresholds in the case of dividends.** The thresholds are set to every 5% in the range of 30-0%. All refers to no threshold.

Table 3.4: Communities in the WTN for interest when the threshold is set to 5%

Community 1 (55)		Community 2 (48)	Community 3 (13)
Switzerland	Czech	Hungary	UAE
Germany	Russia	Netherlands	
France	Austria	Sweden	
Kuwait	Malta	Canada	
UK		Luxembourg	
Ireland		Norway	
US		Estonia	

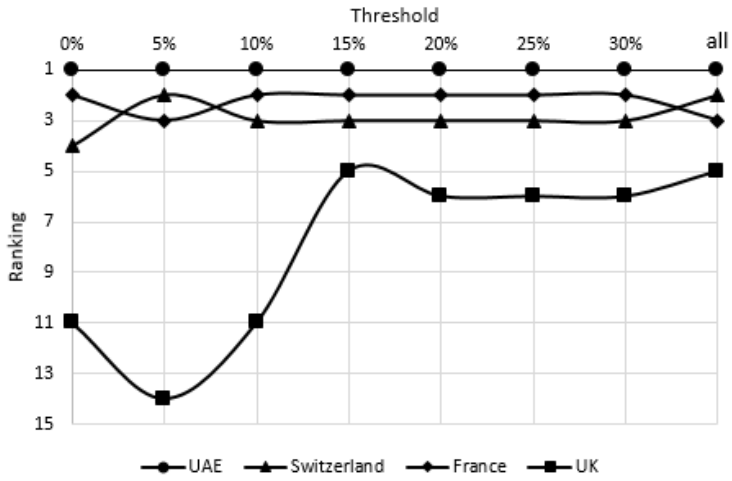


Figure 3.7: **Change in the rankings of the top 3 jurisdictions and Cyprus according to thresholds in the case of interest.** The thresholds are set to every 5% in the range of 30-0%. All refers to no threshold.

Table 3.5: Communities in the WTN for royalties when the threshold is set to 5%

Community 1 (41)	Community 2 (33)	Community 3 (35)	Community 4 (9)	Community5 (4)
Switzerland	France	Senegal	UAE	Gabon
Hungary	Sweden	Cyprus	Mauritius	
Netherlands	Norway	Bahrain		
Ireland	Luxembourg	Macau		
Malta	US	Monaco		
Spain	Latvia			
Germany	UK			
Canada				

largest community (Community 3) has 13 jurisdictions, and features the UAE. The smallest community (Community 4) has two jurisdictions. The remaining 47 jurisdictions do not belong to any community. Many European countries belong to Community 1 or 2. This may be because the EU has issued an Interest Directive (2003/49/EC), which exempts companies from paying withholding tax on interest paid within the EU member jurisdictions, to help create a single market.

We also examine how thresholds change the rankings of the load centrality for interest, as we do for dividends. Figure 3.7 shows the top three jurisdictions and the UK as an example. The rankings of the top three jurisdictions in the WTN, namely the UAE, France, and Switzerland, were not affected much by the thresholds. This indicates that the change in the threshold values did not significantly influence the rankings of the load centrality for interest. However, a few jurisdictions were indeed fluctuating. For instance, the UK fell sharply after a threshold of 10%.

For royalties, we identified five communities in total. Table 3.5 shows the communities to which jurisdictions whose centrality is higher than 0.01 in the WTN belong. The largest of these (Community 1) has 41 jurisdictions, and includes Switzerland, Hungary, the Netherlands, and Ireland. The second-

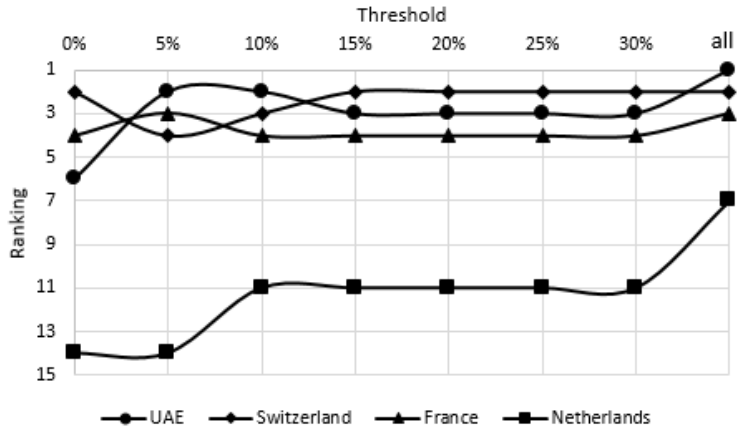


Figure 3.8: **Change in the rankings of the top 3 jurisdictions and Cyprus according to thresholds in the case of royalties.** The thresholds are set to every 5% in the range of 30-0%. All refers to no threshold.

largest (Community 2) has 35 jurisdictions, and includes countries such as Cyprus. The third-largest (Community 3) has 33 jurisdictions, and includes France and Sweden. The fourth-largest (Community 4) has nine jurisdictions, and features countries such as the UAE and Mauritius. The smallest community (Community 5) has four jurisdictions. The remaining 43 jurisdictions do not belong to any community. Many European countries belong to Community 1 or 2. This may be because the EU has issued a Royalty Directive (2003/49/EC), which exempts companies from paying withholding tax on royalties paid within the EU member countries.

The effects of thresholds on rankings of the load centrality for royalties are examined, as those are done for both dividends and interest. Figure 3.8 shows the top three jurisdictions and the UK as an example. The rankings of the top three jurisdictions in the WTN, namely the UAE, Switzerland, and France, were not affected much by the thresholds. This indicates that the change in the threshold values did not significantly influence the rankings of the load centrality for interest. However, a few jurisdictions were indeed fluctuating. For instance, the Netherlands fell sharply after a threshold of 30% and 10%.

Relationship between centrality and community

Load centrality can quantitatively uncover which jurisdiction is suitable for minimizing withholding tax payments. However, the question remains whether jurisdictions that have high load centrality but are not for their tax advantages well-known are used for treaty shopping. In order to further clarify the point, we compare our results with other indicators for dividends and royalties.

For dividends, we used the indicator proposed by [85], which refers to the ratio of the sum of inbound and outbound FDI stocks to GDP. The jurisdictions whose ratios exceed two times their GDPs are considered investment hubs, which are likely to be being used for treaty shopping, although FDI reflects real economic activities as well as treaty shopping. We calculated it for 146 jurisdictions, of which we were able to obtain data among 165 jurisdictions for which the centrality was calculated. The

data for 2015 comes from [67, 86, 87].[2]

Table 3.6: Load centrality lc_j and community of jurisdictions with high indicators

Jurisdiction	lc_j	Community	Indicator	Jurisdiction	lc_j	Community	Indicator
UK	7.87	1	164%	Cayman	0.64	2	18176%
UAE	6.59	3	32%	Luxembourg	2.65	1	8060%
Kuwait	5.22	1	8%	Curaçao	0.73	2	2410%
Netherlands	3.44	1	669%	Bahamas	0.64	2	743%
Cyprus	3.11	2	1429%	Malta	2.21	2	675%
Hong Kong	3.05	2	136%	Ireland	2.39	1	636%
Singapore	2.94	3	190%	Liechtenstein	1.01	2	452%
Switzerland	2.93	1	240%	Belgium	1.56	1	264%
Mauritius	2.91	2	305%				
Spain	2.86	1	70%				

Note: - means that we could not calculate the ratio due to a lack of data.

The ratios of 15 jurisdictions exceed 200%, whereas the world average is 64%. The left side of Table 3.6 shows 10 jurisdictions that feature the highest load centrality lc_j. The right side shows eight jurisdictions that are included in the 15 jurisdictions, but which are not listed in the left side. The column of lc_j refers to the centrality of each jurisdiction. Community column refers to the community to which each jurisdiction belongs.

Overall, the larger a community is, the more jurisdictions with high indicators it possesses. However, seven jurisdictions with high indicators belong to community 2 that comprises only 48 jurisdictions, whereas five jurisdictions with high indicators belong to community 1 that consists of 61 jurisdictions. This could be because its seven jurisdictions include areas that are known as tax havens rather than jurisdictions used for treaty shopping purposes, such as the Cayman Islands, Curaçao, and the Bahamas.

For royalties, we used the indicator introduced by [88], which refers to the ratio of the receipt of royalties in a jurisdiction to R&D expenditures therein. Exceeding 50% of the average ratio is generally thought to suggest the existence of tax avoidance related to intangible assets, although the royalty receipt could be generated from the IPs that resulted from R&D expenditures in prior years, strictly speaking. Due to data availability, we calculated this for 77 jurisdictions among the 165 jurisdictions for which the centrality was determined. For 2015, we used data from [69, 89].

The ratios of 11 jurisdictions exceed 50%, whereas the average ratio of 77 jurisdictions is 35%. The left side of Table 3.7 shows ten jurisdictions that feature the highest load centrality lc_j. The right side shows six jurisdictions that are included in the 11 jurisdictions, but which are not listed on the left side. The column of lc_j refers to the centrality of each jurisdiction. Community column refers to the community to which each jurisdiction belongs.

We found that many jurisdictions with high indicators were in community 1, rather than in community 2 or 3, even though those communities had similar sizes. The reason for this might be the different

[2]We used the inward and outward FDI stock from and to OECD member countries as the FDI indicator.

Table 3.7: Load centrality lc_j and community of jurisdictions with high indicators

Jurisdiction	lc_j	Community	Indicator	Jurisdiction	lc_j	Community	Indicator
UAE	6.62	4	-	Malta	2.44	1	629%
Switzerland	6.58	1	76%	Luxembourg	2.80	2	247%
France	4.49	3	28%	Singapore	0.66	1	129%
Hungary	4.25	1	92%	Guatemala	0	-	89%
Mauritius	4.17	4	-	El Salvador	0	-	88%
Sweden	4.06	3	54%	Iceland	0.61	1	61%
Netherlands	3.79	1	247%				
Norway	3.46	3	7%				
Cyprus	3.21	2	-				
Ireland	2.86	1	236%				

Note: - means that we could not calculate the ratio due to a lack of data.

jurisdictions that each community has. The top jurisdictions in terms of R&D expenditure, such as the US, China, and Japan, belong to communities 2 or 3, except Germany. Taxpayers have perhaps less motivation to establish their affiliates in the jurisdiction of the same community for treaty shopping because the withholding tax rate will not be high, even if these receive royalties directly from jurisdictions of the same community.

3.3 Summary

Due to economic globalization, each jurisdiction's tax laws and treaties have been forced to work as a single network. However, the jurisdictions have not made their laws and treaties under the assumption that the laws and treaties function as an element of one network, so unexpected results have been brought. We thought that the results are exactly international tax avoidance. In order to contribute to providing the solution to international tax avoidance, we tried to investigate which part of the network is vulnerable. Specifically, focusing on treaty shopping, which is one of international tax avoidance schemes, we attempted to identify which jurisdiction is likely to be used for treaty shopping from the viewpoint of tax rates and reveal the relationships between jurisdictions used for treaty shopping and the others.

For this purpose, based on withholding tax rates imposed on dividends, interest, and royalties, we produced the Withholding Tax Network expressed as graphs. The load centrality of each jurisdiction was then computed, and communities were detected by setting a given threshold and the Louvain algorithm. As a result, we were able to identify jurisdictions used for treaty shopping from the viewpoint of the withholding tax rates because our results matched with the jurisdictions known to be used for treaty shopping. The community structures were founded at a 5% threshold, and all jurisdictions can be divided into four or five communities.

Therefore, it can be said that the standardized load centrality LC_j can quantitatively uncover which jurisdiction is suitable for minimizing withholding tax payments. The ten jurisdictions with the highest

standardized load centrality LC_j surely include some jurisdictions well-known for their tax advantages. On the other hand, the question remains whether jurisdictions that have high standardized load centrality but are not for their tax advantages well-known are used for treaty shopping.

Chapter 4

Multinational corporate structures motivated by tax avoidance

It is necessary to shed empirical light on multinational tax planning to gain a better understanding of international tax avoidance. However, this is often difficult to examine with data alone, because no multinationals take a positive attitude towards the release of information relating to their tax planning. Researchers have traditionally sought to overcome this difficulty through financial statements and statutory corporate tax rates [90]. They assumed that capital and labor inputs were a proxy for 'true' income, any part of which had not shifted by tax planning yet [91]. A multinational tax behavior was then examined by observing how sensitive income affiliates reported in their financial statements was to difference in the tax rate among jurisdictions where they were located.

This approach is now ascendant among researchers engaged in empirical analyses of international taxation, but it has limitations in its scope of investigations. This is because it requires financial information, but it is usually difficult to obtain the financial statements of affiliates that play an important role in tax planning activities. Multinational corporations usually disclose financial information consolidated at the multinational group level. As researchers are only able to analyze the range of information disclosed, they are likely to underestimate the extent of multinational tax avoidance. In fact, the UK Parliament [92] and US Congress [93] consider some affiliates of multinational corporations to play a role in tax planning, but it seems impossible to acquire their financial statements.

Unlike previous studies, herein we focus on the multinational corporate structure motivated by tax planning because these days, policymakers pay more attention to the structures in their debates on international taxation [39]. It is noted that some multinationals purposely make their structures complicated through cross-border investments in order to take full advantage of the fiscal benefits [94]. We attempt to detect the affiliates likely to play an important role in multinational tax minimization strategies through the use of ownership (or equity investments) information. This is because the ownership information related to multinational affiliates is much easier to acquire than their financial statements [38].

The structure of this chapter is as follows: In the method section, we mention the databases that are

used to build the Global Ownership Network (GON). Then, we propose and explain the model to identify the key companies that are at high risk in international profit shifting. In the Results section, we describe the structure of the GON and features of key companies described in our model. In the Summary section, we explain our analysis briefly and outline important results and their implications.

4.1 A method for analyzing multinational corporate structures

We propose herein a model that contributes to the identification of affiliates that play an important role in multinational tax planning. Unlike the approach that previous empirical studies adopted, it utilizes ownership information among firms and considers the positions in corporate structures that multinational affiliates take when identifying those that raise suspicions. The analysis is carried out in three steps. First, we construct a network that represents ownership information among firms around the world. Next, we develop a model and confirm the validity of its identification. Lastly, we apply the model to the largest multinationals in the world.

Global Ownership Network

We produce a directed graph $G_\gamma = \left(N_\gamma, L_\gamma\right)$ as the GON that represents ownership relations among firms around the world, including multinational corporate structures. This graph comprises two sections: the set of nodes N_γ and the set of links L_γ. Each node refers to a firm, whereas each link refers to an ownership relationship among firms. The links are directed, going from a shareholder firm to an owned one. In total, the GON includes 59,581,452 firms and individuals across 215 jurisdictions.

Note that we consider more than 10% equity investments as the links in the GON, because the affiliates used for tax strategy should be engaged in investment management rather than portfolio investment. In general, a natural or legal person with an equity stake of more than 10% in a firm is thought to have the ability to affect that firm's management decisions. In fact, macroeconomic statistics incorporate investments that exceed a 10% shareholding ratio into direct investments [68, 95].

Orbis database We construct the GON based on the ownership information obtained from Orbis [96], which is one of the most comprehensive and widely used firm-level databases. The database contains information of each firm, such as geographical positions, the standard industrial classification (SIC), ownership structures, and financial information, as it is reported to the Ministry of Commerce of each jurisdiction. However, the recording rates of firms' information vary greatly from jurisdiction to jurisdiction, and this also depends on the size of firms. Small firms are less likely to be included because of their lack of accuracy [97]. Moreover, firms located in low-income jurisdictions are less likely to be included [98]. Lack of financial data in certain no-corporate-tax jurisdictions is a serious issue, but this can be mitigated by the ownership relations, although all ownership relationships still are not included in the database. It is difficult to evaluate the magnitude and importance of the missing ownership

relationships due to a general lack of data on actual ownership relations. However, an important number of ownership relations in no-corporate tax jurisdictions are identified among multinationals listed in the Fortune Global 500 [99]. Although the database suffers from potential biases, it has been widely used for empirical tax analyses because it is considered the most comprehensive commercially available company-level global database at present [90, 100].

Fortune Global 500 The focus of this analysis is on multinationals listed in the Fortune Global 500 [101], which are compiled and published by Fortune magazine. The list includes the most 500 largest companies that sell worldwide based on their total revenues. It can be said that listed multinationals are representatives of huge multinationals because they sold products worth 30 trillion USD and hired 67.7 million people worldwide as of 2017.

Previous studies on intermediate companies have been limited to multinationals in the US [56] and Germany [57]. However, we are not focusing on the locations of multinational headquarters but on their sizes in our study. This is because large multinationals are likely to shift their profits to other jurisdictions. As these companies generate large profits, they often have greater incentives to minimize their tax obligations. As its background, the retention of suitable advisory services is costly, and such entities have many opportunities to exploit tax benefits or mismatches due to their global operations. In fact, complex ownership structures tend to be more common in larger multinationals than other types of firms [37]. Therefore, we target 480 multinationals with the largest sales in the world listed in the Fortune Global 500 and have the records of their headquarters in the Orbis database.

Figure 4.1 shows sectors of multinationals that are subject to our analysis according to the Orbis database, which classifies sectors in accordance with [102]. Many multinationals listed in the Fortune Global 500 operate in the manufacturing or finance, and insurance sectors.

Figure 4.2 represents the locations of headquarters of multinationals based on the analysis of the corporate tax rate of each jurisdiction on the world map. Almost half of them have their headquarters in the US, China, and Japan that have relatively high statutory corporate tax rates. It is suggested that the locations of multinational headquarters have nothing to do with the height of the statutory corporate tax rate.

Model

In complex multinational corporate structures, some affiliates play an important role in achieving tax advantages at the multinational group level. We call such affiliates key companies and present a model for their identification. We define holding and conduit company centralities. Then, the model hierarchically calculates the centralities of every affiliate in a multinational corporate structure and detects key companies according to the following functions: holding, conduit, and holding&conduit companies [103].

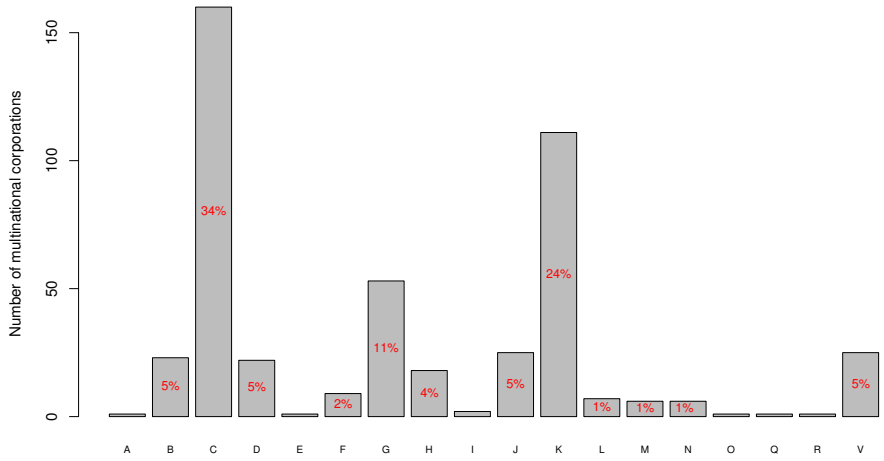


Figure 4.1: **Sectors of headquarters of multinationals that is subject to this analysis.** A is Agriculture, Forestry, and Fishing. B is Mining and Quarrying. C is Manufacturing. D is Electricity, Gas, steam, and Air conditioning supply. E is Water supply, Sewerage, Waste management, and Remediation activities. F is Construction. G is Wholesale and Retail trade, and Repair of motor vehicles and motorcycles. H is Transportation and Storage. I is Accommodation and Food service activities. J is Information and Communication. K is Financial and Insurance activities. L is Real estate activities. M is Professional, Scientific, and Technical activities. N is Administrative and Support service activities. O is Public administration and Defense, and Compulsory social security. Q is Human health and Social work activities. R is Arts, Entertainment, and Recreation. V is no information in the dataset.

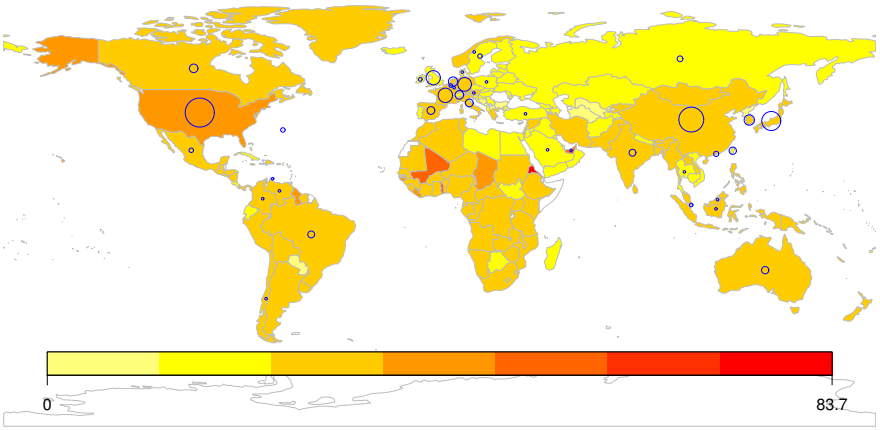


Figure 4.2: **Geographical distribution of headquarters of multinationals that is subject to this analysis and statutory corporate tax rate.** The size of the circles represents the number of headquarters of multinationals that is subject to this analysis and the depth of the color indicates the statutory corporate tax rate, by the jurisdiction.

The classification of the key companies is based on definitions in the literature that pertains to the role of intermediate companies in multinational corporate structures [57]. In this study, a holding company is assumed to be located in a different jurisdiction from its ultimate parent company [104] and to have shares in a large number of affiliates. On the other hand, a conduit company is assumed to be located in a different jurisdiction from both its ultimate parent and holding companies and to intervene between a

holding company and other affiliates. A holding and conduit company has features of both holding and conduit companies.

The holding and conduit company centralities are developed based on sink and conduit centralities proposed in a previous study, which identified jurisdictions used for tax purposes from a network perspective [65]. The sink and conduit centralities necessitate that the information is written in financial statements, and can only be used for a jurisdictional-level analysis. We change these centralities to the holding and conduit company centralities, so that they only require the ownership information and can be applied to a firm-level analysis. The holding company centrality helps the model in identifying the affiliates that function as holding companies, whereas the conduit company centrality helps it identify the affiliates that function as conduit companies.

This study applies our model to complex multinational corporate structures, which usually have several layers like Figure 4.4. In accordance with the layers, our model hierarchically calculates the holding and conduit company centralities per affiliate. The idea of the hierarchical calculation is derived from the findings from investigations and analyses of aggressive multinational tax planning. In order to better understand multinational tax minimization, the UK Parliament [92] and US Congress [93] investigated several well-known multinationals as a case study. It was noted that these multinationals exploited tax benefits through the hierarchy of corporate structures [105]. Our model takes into consideration the hierarchy through the hierarchical calculation of the holding and conduit company centralities.

Key company This analysis categorizes multinational affiliates that are likely to be used for international profit shifting into holding, conduit, and holding&conduit companies and call them key companies. Holding companies attract and park large capital for mitigating corporate tax, whereas conduit companies allow multinationals to route their capital from other affiliates, especially, located in high-tax-rate jurisdictions, to holding companies without withholding tax payments in accordance with previous studies [106, 107].

From the viewpoint of multinational corporate structures, we consider that key companies should satisfy the following two conditions. First, in the realm of international taxation, holding companies are classified into three, depending on their locations: home country, host country, and a third country [57]. The third country is located in a different jurisdiction from its headquarters and one of its underlying affiliates, is thought to be a key company because this type is likely to be used for international profit shifting. We call this condition the condition of the third country type. Next, from the viewpoints of affiliates' positions in multinational corporate structures, we assume that holding companies make a hierarchical relationship with conduit companies [94, 105, 108]. In other words, holding companies are often tied with conduit companies by ownership links in the GON.

Holding company centrality In order to detect an affiliate that functions as a holding company, we define a holding company centrality that measures the number of ownership relationships involving an affiliate. Herein, it is assumed that a is an affiliate of a multinational group M. First, we calculate the difference between the total number of links to a and the total number of links from it. Next, we divide the difference of this by the total number of links in the GON. Finally, the result is divided by the total number of links in the multinational group. The latter fraction is a normalization function that considers the economic scale of a compared with other affiliates. The holding company centrality of an affiliate a is given by:

$$H_a = \frac{\sum k_a^{in} - \sum k_a^{out}}{\sum_{b \in M} k_b^{in}} \cdot \frac{\sum_{b \in M} \left(k_b^{in} + k_b^{out} \right)}{k_a^{in} + k_a^{out}} \tag{4.1}$$

where k_a^{in} is the in-degree of a, and k_a^{out} is the out-degree of a. $\sum_{b \in M} k_b^{out}$ is the number of links in M. $k_a^{in} + k_a^{out}$ refers to the sum of in- and out-degrees of a, whereas $\sum_{b \in M} k_b^{in} + k_b^{out}$ refers to the sum of in- and our-degrees of all of the affiliates of M. Herein, the in-degree of an affiliate is proxy for the amount of capital flowing into the affiliate, and its out-degree the amount of capital flowing out of it. The sum of its in-and out-degrees is assumed to represent its economic scale. Although it is better to use capital or labor factors as indicators of the economic scale of an affiliate, we only make use of ownership information for the purpose of this study; the information we were able to acquire has limitations.

Holding company centrality supposes that the difference between the amount of foreign capital flowing into an affiliate and those flowing out of the affiliate is proportional to its economic scale. When the difference is not proportional, holding company centrality becomes large and suggests that the affiliate is likely to function as a holding within a multinational corporate structure. In this analysis, we suppose that an affiliate with its holding company centrality exceeding 0 has the possibility of identification as a holding company.

Conduit company centrality In order to detect an affiliate that functions as a conduit company, we define a conduit company centrality that measures the proportion of capital routed to holding companies through an affiliate. First, we divide the total number of links to holding companies through a multinational affiliate a by the total number of links in the GON. The latter fraction is a normalization function that considers the economic scale of a compared with other affiliates. The conduit company centrality of an affiliate a is given by:

$$T_a = \frac{k_a^{in}}{\sum_{b \in M} \left(k_b^{in} \cdot k_b^{out} \right)} \cdot \frac{\sum_{b \in M} \left(k_b^{in} + k_b^{out} \right)}{k_a^{in} + k_a^{out}} \tag{4.2}$$

where the in-degree of an affiliate is a proxy for the amount of capital that passes through the affiliate and flows into holding companies. The sum of its in- and out-degrees is assumed to represent its economic scale. Although it is better to use capital or labor factors, we only made use of the ownership information for the same reason as the holding company centrality.

Conduit company centrality supposes that the amount of capital that passes through an affiliate flows to holding companies is proportional to its economic scale. When the amount was not proportional, conduit company centrality becomes large and suggests that the affiliate is likely to function as a conduit within a multinational corporate structure. In this analysis, we suppose that an affiliate with its conduit company centrality exceeding zero has the possibility of identification as a conduit.

Hierarchical calculation Our model is applied to every multinational corporate structure. It hierarchically calculates the holding and conduit company centralities per affiliate from the first layer of a structure to consider its position in a corporate structure. The hierarchical calculation follows two steps. Our model calculates the holding company centrality of each affiliate situated in the first layer for the first step. If the holding company centrality of an affiliate exceeds zero, our model will classify it as a candidate for a holding company. As a second step, our model moves to the second layer and calculates the conduit company centrality. The centrality is calculated of each affiliate linked with the candidate situated in the one above, the first layer. If the conduit company centrality of an affiliate exceeds zero, our model will identify it as the conduit company. It will also identify the candidate as the holding company. If the model identifies an affiliate as both holding and conduit companies, it will be classified as a holding and conduit company. Our model iteratively performs these two steps to the last layer. Figure 4.3 indicates the algorithms in which holding and conduit company centralities are calculated.

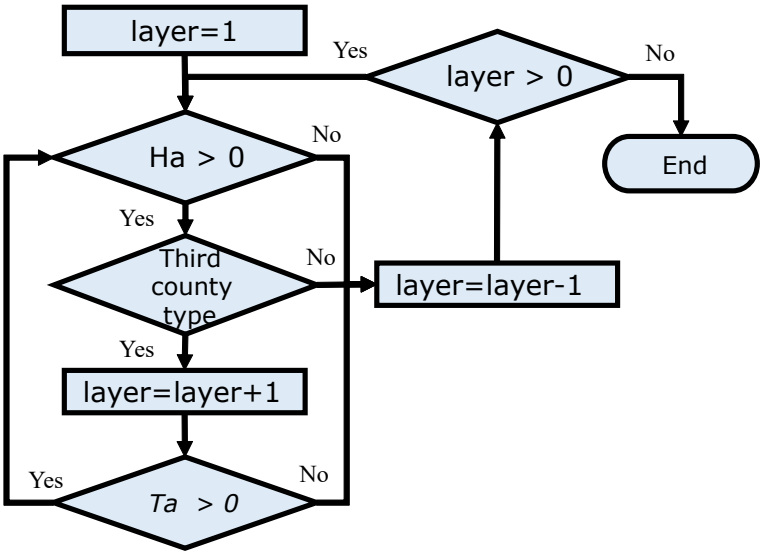


Figure 4.3: **Flow chart of our model.** First of all, holding company centrality H_a is calculated for affiliates in the first ownership layer. Of it exceeds 0, conduit company centrality T_a is calculated for affiliates held by the affiliate with holding company centrality H_a exceeding 0.

Taking a multinational corporate structure that Figure 4.4 illustrates as an example, we explain the aforementioned hierarchical calculation comprising two steps. Note that all of the affiliates are located in different jurisdictions. Initially, the model calculates the holding company centralities of a and g in

the first layer. As H_a exceeds zero, our model classifies a as a candidate for the holding company. It then moves to the second layer. It calculates the conduit company centralities of b, c, and d that are linked with a. As T_b exceeds zero, it classifies b as a conduit company. It also classifies a as a holding company because a holds b identified as a conduit company. It repeats these two steps from the second layer. It calculates the holding company centrality of b in the second layer. As H_b exceeds zero, it classifies b as a candidate for the holding company. It then moves to the third layer. It calculates the conduit company centralities of e and f that are linked with b. As T_e exceeds zero, it classifies e as a conduit company. It also identifies b as a holding company because b holds e identified as a conduit company. As b is true for both holding and conduit companies, it is classified as a holding&conduit company.

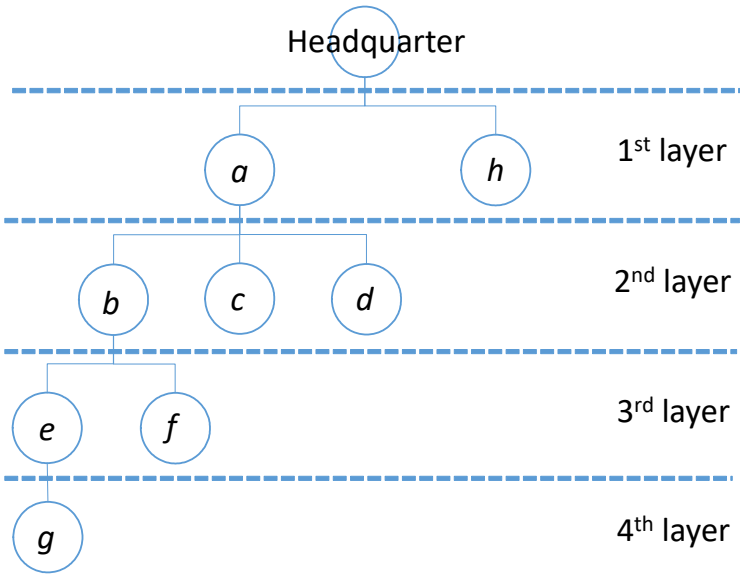


Figure 4.4: **Stylized example of the corporate structure of a multinational group.** The circles indicate its headquarters and affiliates, the lines the ownership links in the GON, the labels names of the affiliates, and the dotted lines the layers of the corporate structure.

4.2 Results for multinational corporate structures

In preparation for this study, we examined the structure of the GON that we constructed and found that it had a scale-free nature, hierarchy, and a small degree of assortativity. We then assessed the validity of our model. We compared the affiliates that the model identified with those that previous investigations found suspicious. As a result, we can confirm a certain degree of validity, although it depends on sectors. Finally, we applied our model to the largest multinationals around the world and analyzed the key companies that our model identified in terms of geographical locations and positions within the GON. It was found that the ownership information can greatly reduce the candidates for affiliates that might play an important role in tax strategies, and with the key companies concentrating on a specific component of the GON.

As preparation for a detailed examination of tax matters, we analyzed the GON's structural properties and observed the characteristics of ownership relationships among firms from the viewpoint of fundamental network statistics, including degree, degree distributions, clustering coefficient, and degree correlation. The average nodal in- and out-degree of the GON were found to be $\langle k_{in} \rangle = \langle k_{out} \rangle = 0.718$. The average degree below 1.0 suggests that many firms do not accept investments from other firms, but only from individuals.

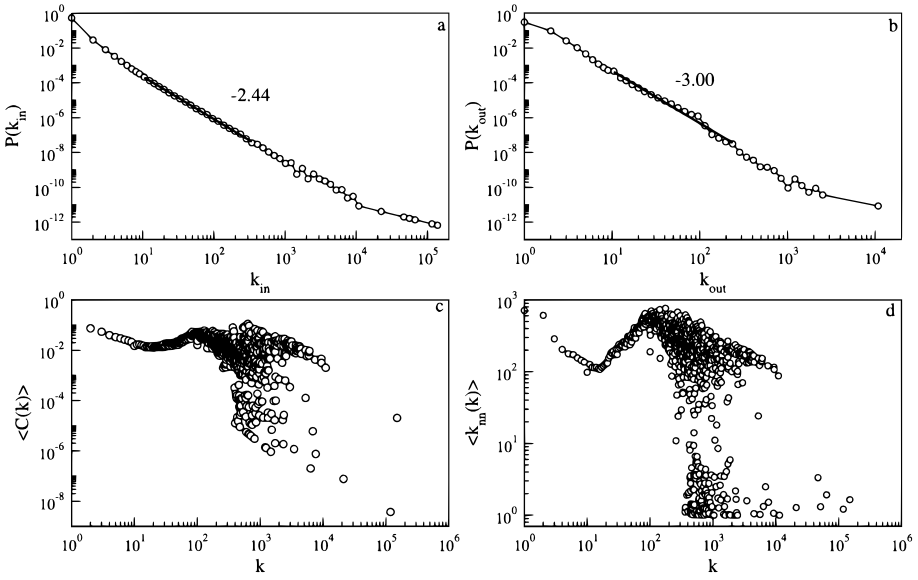


Figure 4.5: **Structural properties of the GON.** Probability density distributions P for nodal (a) in-degree k_{in} and (b) out-degree k_{out}. The solid lines indicate the best power law fit to the data. (c) The average clustering coefficient $\langle C(k) \rangle$ is plotted with the total degree k. (d) The variation in the average nearest neighbor degree $\langle k_{nn}(k) \rangle$ is shown as a function of the nodal degree k.

We could apprehend the nature of the GON through its probability density distributions of nodal in- and out- degrees on a double logarithmic scale (Figure 4.5 a, b). Both of the distributions feature a significant straight portion of the intermediate values of the degrees, which indicates a power-law decay of the degree distribution with $P(k_{in/out}) \sim k_{in/out}^{-\gamma_{in/out}}$. The slope of the distributions yields the values of the exponents $\gamma_{in} = 2.44$, and $\gamma_{out} = 3.00$ and characterizes the scale-free nature of the network. It can be said that a few firms function as hubs in the network, which affects decision-making processes at many of these.

The local clustering coefficient $C(k)$ measures the degree of cliqueness among the neighbors around a node and the three-point correlation. This can be interpreted as potentially indicating that the adjacent nodes of a node are linked to one another [109]. The higher this value, the higher the likelihood of connecting each of the adjacent nodes around a primary node. The extent of clustering can be expressed as the average of the local clustering coefficient $C(k)$. As Figure 4.5c shows, the average clustering coefficient of the GON $\langle C(k) \rangle$ decreases as k increases, which is also observed in many other real-world

networks and implies that the GON is a hierarchical structure [110].

The nodal degree-degree correlation $k_{nn}(k)$ measures the average degree of the nearest neighbor [111]. As Figure 4.5 d shows, the $k_{nn}(k)$ of the GON has an unusual shape with a low $k < 200$. From here, it progressively decreases until $k < 20$, indicating that it is disassortative in nature, which means that high-degree nodes tend to link to low-degree nodes and low-degree nodes tend to link to high-degree ones. However, it also increases until $k < 200$, indicating an assortative nature, which means high-degree nodes tend to connect to high-degree nodes and low-degree nodes tend to connect to low-degree ones. It then decreases again with very high k values, possibly due to structural disassortativity. Scale-free networks are found to be unable to sustain assortativity for high k values unless they are allowed multi-links [112].

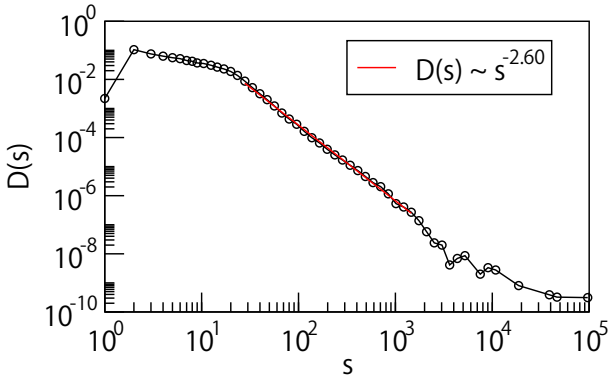


Figure 4.6: **The probability density distributions $D(s)$ of community sizes s for the GON.** The red line indicates the best power law fit to the data

Community detection is conducted on the GON using the Infomap method (Rosvall and Bergstrom 2008). This detects 363,991 communities with wide variation in their sizes s, where the size is measured by the total number of nodes within the community. Figure 4.6 is the probability density distribution $D(s)$ of the sizes of the communities. On the double logarithmic scale, the distribution has a considerably long straight portion reflecting a power-law behavior of the form $D(s) \sim s^{-2.60}$.

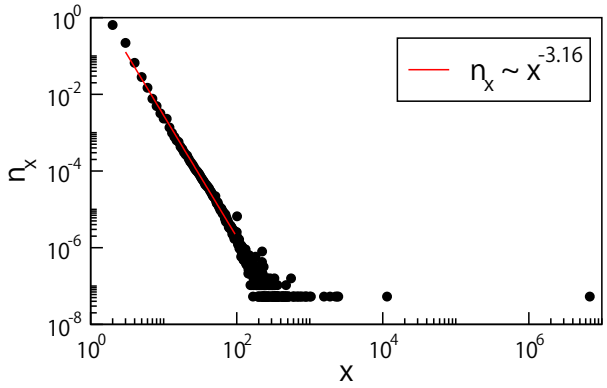


Figure 4.7: **Distribution n_x of the component sizes x in the GON.** The red line indicates the best power law fit to the data

We study the connected components when the network is viewed as an undirected network. The largest connected component of the network is known as the giant weakly connected component (GWCC). As can be seen from Figure 4.7, the network consists of a very large GWCC with $N = 6,827,299$ nodes and $L = 8,367,999$ links, which is 11.459% of the GON. The small components with size $x < 100$ can be fitted with a power-law decay of form $n_x \sim x^{-3.16}$. In the later part of our study, we investigate the GWCC of the network.

We also consider the GON's largest connected component, namely the Giant Weakly Connected Component (GWCC), which accounts for 11.46% of the GON and has 6,827,299 nodes and 8,367,999 links. The bow-tie structure is borrowed from the GWCC. The definitions of the different regions of the bow-tie structure are given as follows:

- The Giant Strongly Connected Component (GSCC): The largest region where any two nodes are reachable through directed paths.
- IN component: The nodes from which GSCC is reachable through directed paths.
- OUT component: The nodes that are reachable from the GSCC through directed paths.
- Tendrils (TE): The rest of the nodes in the GWCC.

Table 4.1: Bow-tie structure: Sizes of different components.

Component	Companies	Ratio (%)
GSCC	2239	0.033
IN	1,161,655	17.015
OUT	15,514	0.227
TE	5,647,891	82.725
Total	6,827,299	100

Note: "Ratio" refers to the ratio of the number of companies to the total number of companies in GWCC.

The number of companies in each component is shown in Table 4.1. Unlike other networks that can be identified in the real world (see, e.g., [113]), its shape is highly asymmetrical; the GSCC, which is the largest region in which any two nodes can be reached through links, only accounts for 0.03% of the total GWCC. The OUT component, which comprises the nodes reachable from the GSCC through links, accounts for a very small portion of 0.23%, whereas the IN component, which constructs the nodes reachable to the GSCC through links, accounts for 17.02%. Most of the nodes (82.73%) belong to the TE, which are the nodes that are not linked to the GSCC.

Table 4.2 the distribution of the shortest distance from nodes on the IN component to nodes on the GSCC and the shortest distance from nodes on the GSCC to nodes on the OUT component. Nearly 80% of the nodes on the IN component had a distance of 2-3 to the GSCC, and 80% of the nodes on the OUT

Table 4.2: The distribution of the shortest distance from nodes in the IN component to those in the GSCC and from nodes in the GSCC to those in the OUT component

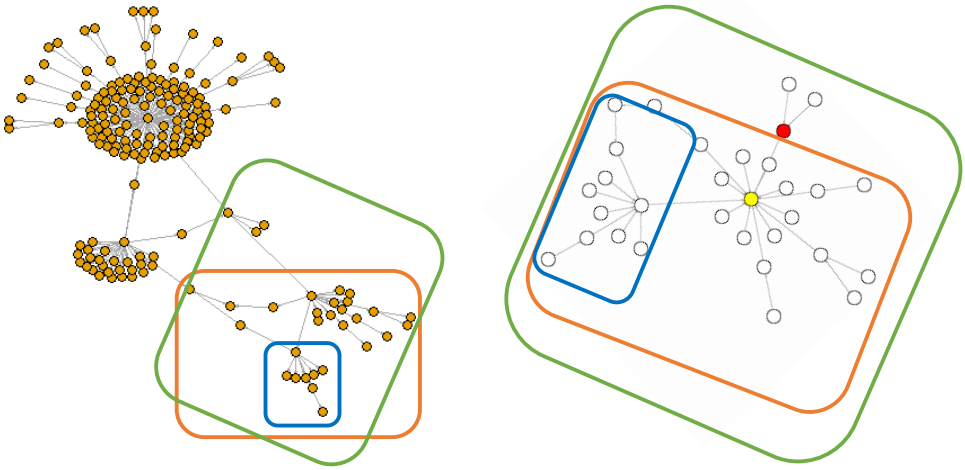
	IN to GSCC		OUT to GSCC	
Distance	Companies	Ratio	Companies	Ratio
1	98,342	8%	7405	48%
2	564,328	49%	5131	33%
3	296,760	26%	1897	12%
4	123,753	11%	712	5%
5	46,106	4%	269	2%
6	18,258	2%	54	0%
7	7883	1%	37	0%
8	3226	0%	4	0%
9	1563	0%	2	0%
10	705	0%	3	0%
11	319	0%	-	0%
12	183	0%	-	0%
13	65	0%	-	0%
14	37	0%	-	0%
15	33	0%	-	0%
16	34	0%	-	0%
17	13	0%	-	0%
18	16	0%	-	0%
19	23	0%	-	0%
20	8	0%	-	0%
Total	1,161,655	100%	15, 514	100%

component had a distance of 1-2 from the GSCC. The distances from the IN component to the GSCC are longer than those from the GSCC to the OUT component. The shape of the bow-tie structure is different from those shown in other networks [114, 115, 116].

Validity

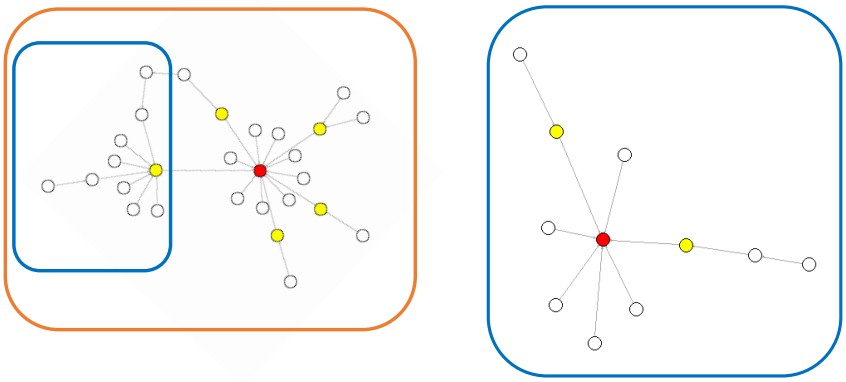
In order to assess our model's validity, we test it for five multinationals, namely: Amazon, Apple, Google, Microsoft, and Starbucks. It was clarified through investigations by the UK Parliament [92] and US Congress [93] which affiliates would be likely to play an important role in tax planning for these five multinationals. We compare the affiliates that our model identified as the key companies with those the investigations held to be suspicious.

Taking Google as an example, we describe how our algorithm identifies key companies by showing an important part of the result. Figure 4.8 (a) shows 190 affiliates that are directly or indirectly tied with Google LLC, which is the headquarter of Google, by the substantial ownership links. We herein consider Google LLC as the headquarter of Google because the Orbis database 2015 does not include the information of Alphabet Inc, which was established in 2015. Holding and conduit company centralities are calculated for the 190 affiliates, following the hierarchical identification algorithm. In Figure 4.8



(a) Google affiliates

(b) First layer



(c) Second layer

(d) Third Layer

Figure 4.8: **Example in which our model is applied to Google.** (a) shows all Google's affiliates. (b)-(d) show the result of calculation in the first-third layers, respectively. An affiliate whose holding company centrality exceeds 0 is painted in red and an affiliate whose conduit company centrality exceeds 0 is painted in yellow. Green, orange, and blue rectangles show the first-third layer, respectively.

(b), we show that the first layer is indicated by a green rectangle; one affiliate whose holding company centrality exceeds zero is painted in red, and one affiliate whose conduit company centrality exceeds zero is painted in yellow. Therefore, one affiliate painted in red is identified as a holding.

Figure 4.8 (c) shows the result of the calculation in the second layer; this is indicated by an orange rectangle. One affiliate whose holding company centrality exceeds zero is painted in red because, and five affiliates whose conduit company centralities exceed zero are painted in yellow. The one affiliate painted in red in the second layer is identified as a holding&conduit company because its conduit company centrality exceeds zero in the first layer as well as its holding company centrality exceeds zero in the second layer. On the other hand, in the second layer, only one affiliate is identified as a conduit because four affiliates do not satisfy the conditions of the third country type, even though their conduit company centralities exceed zero.

Figure 4.8 (d) shows the result of the calculation in the third layer indicated by a blue rectangle. One affiliate whose holding company centrality exceeds zero is painted in red, and two companies whose conduit company centralities exceed zero are painted in yellow. The one affiliate painted in red in the third layer is identified as a holding & conduit because its conduit company centrality exceeds zero in the second layer as well as its holding company centrality exceeds zero in the third layer. On the other hand, no affiliate is identified as a conduit in the third layer because no company satisfies the conditions of the third country type, even though their conduit company centralities exceed zero. The hierarchical identification algorithm works in this way regarding Google.

Table 4.3: Number of key companies detected for five multinationals

Multinationals	Affiliates	Holding	Holding&Conduit	Conduit	Reported
Amazon	312	2	0	2	25%
Apple	152	1	1	0	50%
Google	190	3	2	0	20%
Microsoft	266	8	1	1	20%
Starbucks	274	1	1	0	100%

Table 4.3 summarizes the percentage of the five multinationals for the application of our model and their affiliates, which play an important role in international tax avoidance. The column of Affiliates displays the number of affiliates in a multinational group; the columns of Holding, Holding&Conduit, and Conduit contain the number of affiliates detected as key companies; finally, the Reported column portrays the ratio of key companies to affiliates that the previous investigations considered suspicious. The ratio varies from 20-100%, depending on the multinationals in question. In particular, the ratios are relatively low for multinationals whose businesses are digital in nature, possibly because they can conduct foreign operations with smaller physical presences. It can be said that the model has a certain validity because the affiliates it identified as key companies include affiliates that played important roles in tax planning activities.

Identified affiliates

We apply our model to the largest multinationals listed in the Fortune Global 500 [101]. Generally, the larger multinationals face a high risk in international profit shifting.

In this study, we assume that affiliates of a given multinational are firms that are directly or indirectly linked to the multinational parent company. In order to delineate the corporate structures, we employ the breadth-first search (BFS) algorithm, which identifies all of the nodes that are directly or indirectly linked to a particular node. First, the parent companies of the largest targeted multinationals are manually identified. Then, the BFS algorithm identifies firms, starting from those parent companies. The corporate structures we extracted from the GON in this way feature 361,166 firms in total.

Figure 4.9 shows the geographic distribution of the affiliates. About 30% of the affiliates are located

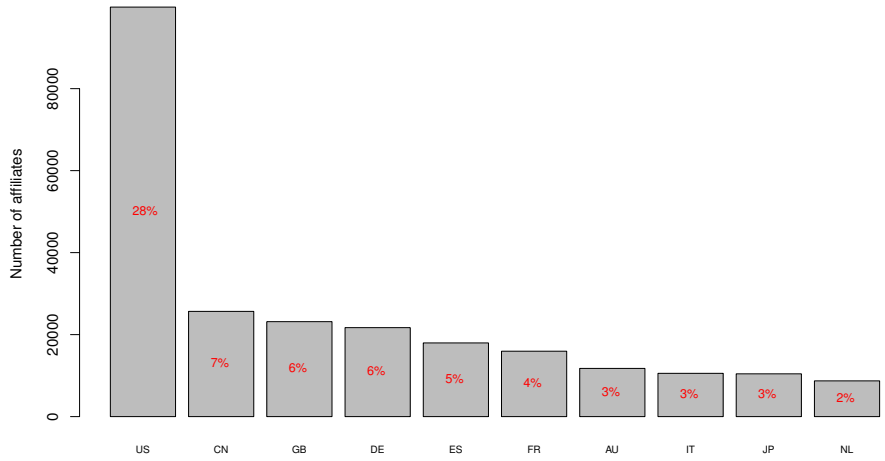


Figure 4.9: **Top 10 Jurisdictions where affiliates of multinationals listed in the Fortune 500 are located.** The top 10 jurisdictions of affiliates of multinationals subject to this analysis. The horizontal axis indicates the locations, the vertical axis indicates the number of the affiliates, and the labels indicate the percentage accounting for the total number of the affiliates. CN is mainland China; GB is the UK; DE is Germany; ES is Spain; FR is France; AU is Austria; IT is Italy; JP is Japan; and NL is the Netherlands.

in the US, and most of the other affiliates are located in Europe and East Asia. This might be because many headquarters of multinationals that are subject to this analysis are located in those jurisdictions that have large markets. We also point out that the bias included in the dataset might cause the locations of the affiliates to concentrate on certain areas, that are the US, Europe, and East Asia.

Our model is applied to corporate structures to detect affiliates with a relatively higher risk of international tax avoidance. Our model ultimately identified 3316 affiliates as holding companies, 1596 affiliates as holding and conduit companies, and 1311 affiliates as conduit companies. We observed that a limited number of affiliates were involved in aggressive tax planning activities. The identified firms are listed in the Appendix, pertaining to the top multinationals in the US, China, and Europe.[1]

Geographical and network topological distributions

Firstly, we identify the distributions of the detected firms from a geographical perspective. The left bar plots of Figure 4.10 show the top five jurisdictions according to the categories. As the first bar plot indicates, the US, China (CN), Japan (JP), Germany (DE), and France (FR) are the top five locations for the headquarters. These jurisdictions are also at the top in terms of GDP. On the other hand, we found that the locations of the key companies tended to be jurisdictions that offer various generous tax benefits to multinationals [53]. The second bar plot shows that the Netherlands, US, UK, Germany, and Spain are notable locations for holding companies to be situated. The third bar plot shows that the US, UK, Netherlands, Germany, and Spain are notable locations for holding&conduit companies. The fourth bar plot shows the Netherlands, Hong Kong, UK, British Virgin Islands, and Germany. The US and Netherlands are remarkable in all of the categories for key companies. Hong Kong and the British

[1]Note that it is not our intention to claim that the listed affiliates are surely involved in tax planning.

Virgin Islands are within the top ranks as the locations of conduit companies, which could imply that multinationals tend to establish key companies in low layers that are distant from their headquarters to slip through the tax administration of a jurisdiction where a parent company is located. Overall, many key companies are found to be located in Europe, probably because the database used in this study more intensively covers European firms than the rest of the world [97].

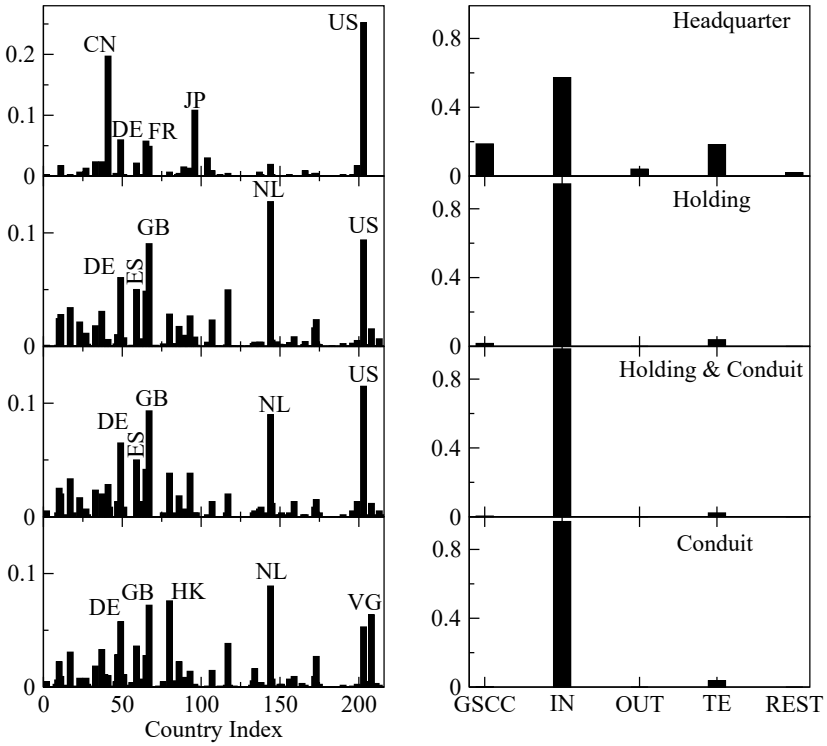


Figure 4.10: **Distribution of the headquarters and the key companies of the multinationals.** The left bar plots show the geographical distributions, whereas the right bar plots the distributions in the bow-tie structure of the GWCC of the GON. The REST stands for the component except the GWCC.

We then uncovered the distributions of the detected firms in terms of network topology to observe the features of international tax avoidance from a network perspective. The right bar plots of Figure 4.10 show the distributions of the headquarters and key companies in the bow-tie structure of the GWCC of the GON. Interestingly, many headquarters of large multinationals listed in the Fortune 500 were in the GSCS, even though the bow-tie structure only accounts for 11.4% of the total GON. Moreover, it can be noted that their key companies are mostly located within the IN component of the bow-tie structure, although the IN component only accounted for 1.95% of the entire GON. Key companies concentrated on a tiny part of the GON.

Key companies and treaty shopping

We examine the relationship between the number of the key companies and favorableness for treaty shopping in detail because the major incentives for establishing key companies are to avoid the withholding

tax imposed on the profits of multinationals. As an indicator of favorableness for treaty shopping, we use the load centrality of the WTN that represents the withholding tax rates that each jurisdiction imposes on dividends [74]. The higher this centrality for jurisdiction is, the more the jurisdiction is favorable for treaty shopping.

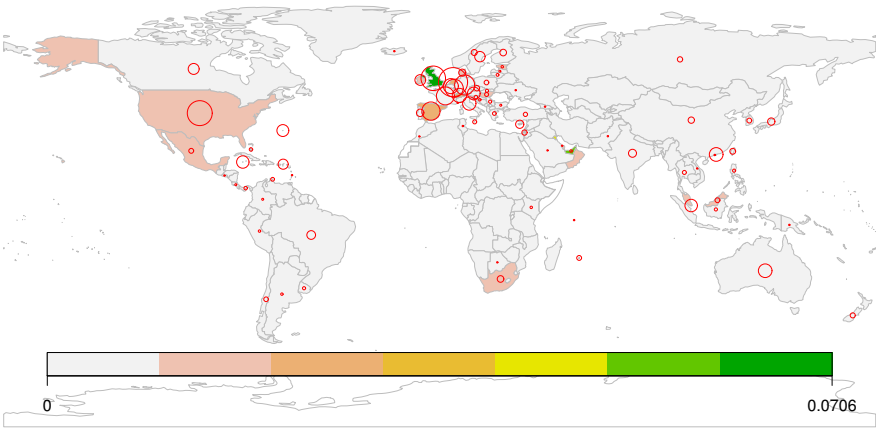


Figure 4.11: **Locations of affiliates identified as holdings and jurisdictions favorable for treaty shopping.** The size of the circles indicates the number of holding companies and the depth of the color indicates how favorable for treaty shopping jurisdictions are.

In Figures 4.11-4.13, the size of the circles shows the geographic distributions of the key companies used for treaty shopping. The depth of the color shows the load centrality, which represents favorableness for treaty shopping. The more favorable for treaty shopping a jurisdiction is, the darker its color is. These figures suggest a certain relationship between the number of the key companies and favorableness for treaty shopping.

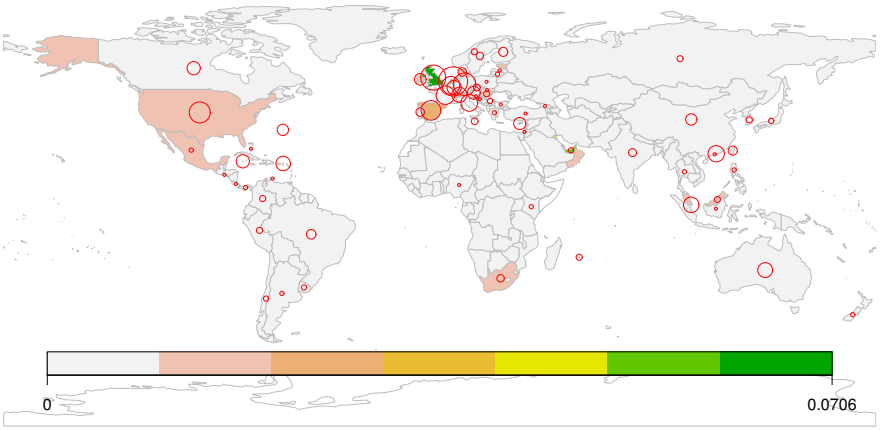


Figure 4.12: **Locations of affiliates identified as holding and conduits and jurisdictions favorable for treaty shopping.** The size of the circles indicates the number of holding and conduit companies and the depth of the color indicates how favorable for treaty shopping jurisdictions are.

In order to statistically examine the tendency for key companies to be located in tax-preferable jurisdictions, we perform regression analyses on the number of detected key companies in a jurisdiction

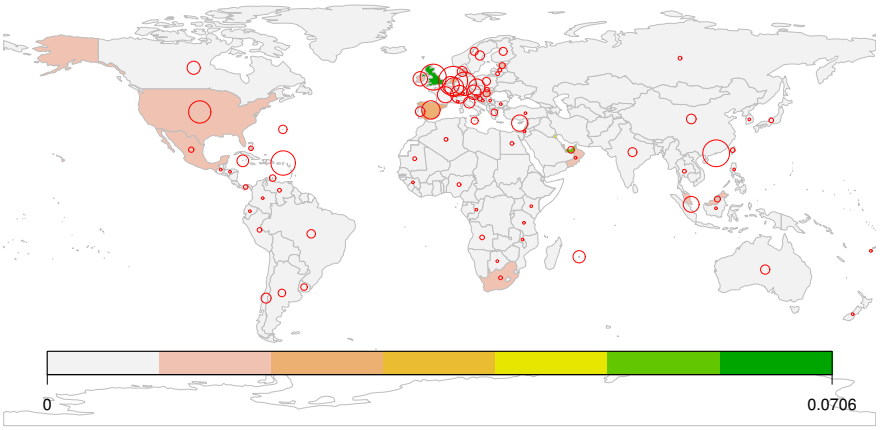
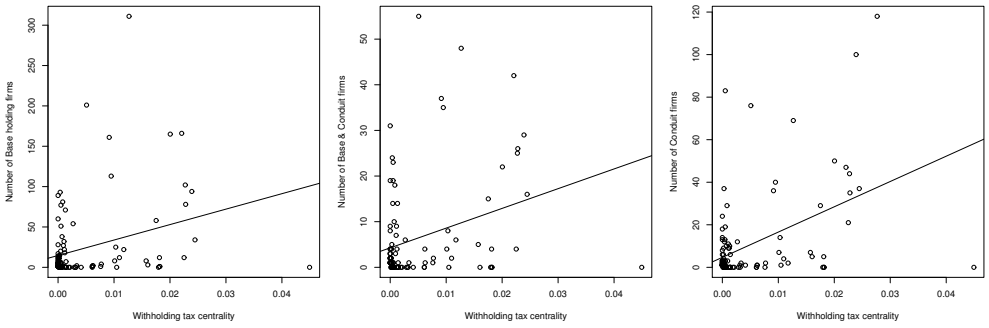


Figure 4.13: **Locations of affiliates identified as conduits and jurisdictions favorable for treaty shopping.** The size of the circles indicates the number of "conduit" companies and the depth of the color indicates how favorable for treaty shopping jurisdictions are.

and the load centrality that concerns the withholding tax rates imposed on dividends lc_j (see Chapter 3). Figure 4.14 shows the results of the regression analyses. The straight lines refer to the regression lines, the horizontal axis represents the number of key companies, and the vertical axis is lc_j.



(a) Holding (b) Holding & Conduit (c) Conduit

Figure 4.14: **Regression analysis between the number of the key companies and the load centrality concerning withholding tax rates** lc_j**.**The vertical axis indicates a number of key companies in a jurisdiction, whereas the horizontal axis the load centrality of that jurisdiction.

Regarding holding companies, an obtained regression equation is $y = 14.671 + 1914.126x$, and the adjusted R-squared is 0.0888. The t-value of the intercept is 2.856; its p-value is 0.005154; this is significant at 1%. The t-value of the load centrality is 3.395; its p-value was 0.000964; this is significant at 0.1%. Regarding holding&conduit companies, a regression equation is $y = 4.267 + 432.241x$ is obtained, and the adjusted R-squared is 0.08672. The t-value of the intercept is 3.475; its p-value is 0.000751; it is significant at 0.1%. The t-value of the load centrality is 3.283; its p-value is 0.001406; this is significant at 1%. Regarding conduit companies, $y = 4.678 + 1188.987x$ is obtained as a regression equation, and the adjusted R-squared is 0.2073. The t-value of the intercept is 2.365; its p-value is 0.0197; this is significant at 10%. The t-value of the load centrality is 5.551; its p-value is 1.9×10^{-7};

this is significant at 0.1%.

For all types of key companies, we found that the correlations were statistically-significant at below 1%. The locations of the key companies clearly correlate with the possibilities for the locations to be used for treaty shopping. It is found that treaty shopping has a greater influence on the number of holding and conduit companies because their coefficient of withholding tax centrality is high. It is also worthy of attention that the withholding tax centrality can explain the number of conduit companies by about 20%.

Direct shareholders and subsidiaries of key companies

The establishment of intermediate companies or the key companies leads to a diversion of FDI. We analyze how key companies divert cross-border investment flows. Tables 4.4-4.6 show direct shareholders and subsidiaries of key companies in the top three jurisdictions, respectively, for holding, holding&conduit, and conduit. The column of Subsidiary shows locations of affiliates of which key companies directly hold shares. The column of Shareholder shows locations of affiliates that directly hold shares of key companies.

Table 4.4: Direct shareholders and subsidiaries identified as holdings

the Netherlands				the United States				the United Kingdom			
Subsidiary		Shareholder		Subsidiary		Shareholder		Subsidiary		Shareholder	
IE	9%	US	35%	CA	18%	GB	14%	US	15%	US	34%
US	8%	GB	11%	GB	13%	CA	12%	ZA	5%	n.a.	16%
n.a.	7%	FR	10%	IE	5%	JP	12%	IN	5%	FR	7%
DE	7%	DE	6%	JP	4%	DE	10%	NL	4%	CH	4%
FR	6%	CH	4%	MX	4%	FR	8%	IE	3%	DE	4%

Note: IE is Ireland; DE is Germany; FR is France; GB is the UK; CH is Switzerland; CA is Canada; JP is Japan; MX is Mexico; ZA is South Africa; IN is India; NL is the Netherlands; and n.a. is no information.

Table 4.4 indicates holding companies located in the Netherlands, US, and UK, which are the top three jurisdictions in terms of the number of identified holding companies. The major investments through the Netherlands are made among Western jurisdictions, such as Ireland and Germany. The investments through holding companies located in the US are often related to Canada and Mexico, which are geographically close to the US, as well as Japan. The investments through the UK tend to be made by the Commonwealth jurisdictions, such as South Africa and India.

Table 4.5 provides details of holding&conduit companies located in the US, UK, and Netherlands, which are the top three jurisdictions in terms of the number of holding&conduit companies. The investments through the US include many investments related to China, which is an East Asian jurisdiction. The investments through the UK consist of many investments from the Bermuda Islands and the British Virgin Islands, which are British overseas territories and known as so-called tax havens. In addition,

Table 4.5: Direct shareholders and subsidiaries identified as holding&conduit

the United States				the United Kingdom				the Netherlands			
Subsidiary		Shareholder		Subsidiary		Shareholder		Subsidiary		Shareholder	
CA	20%	GB	15%	ZA	31%	US	29%	UA	17%	US	19%
CN	13%	FR	15%	AU	9%	n.a.	27%	BE	9%	GB	14%
LU	9%	CH	11%	LU	7%	ZA	12%	GB	6%	PL	8%
GB	9%	DE	11%	BR	5%	FR	5%	NG	5%	FR	7%
HK	5%	CA	7%	VG	5%	BM	4%	n.a.	4%	DE	7%

Note: CA is Canada; CN is mainland China; LU is Luxembourg; GB is the UK; HK is Hong Kong; FR is France; CH is Switzerland; DE is Germany; ZA is South Africa; AU is Austria; BR is Brazil; VG is the British Virgin Islands; BM is the Bermuda Islands; UA is the UAE; BE is Belgium; NG is Nigeria; PL is Poland; and n.a. is no information.

holding&conduit companies located in the UK make much investment in South Africa. It is noteworthy that South Africa occupies a high proportion of both columns of Subsidiary and Shareholder. The Investments in South Africa from South Africa via the UK suggest the existence of round-tripping [117]. The holding and conduit companies located in the Netherlands make much investment in the UAE due to oil companies.

Table 4.6: Direct shareholders and subsidiaries identified as conduit

the Netherlands				Hong Kong				the United Kingdom			
Subsidiary		Shareholder		Subsidiary		Shareholder		Subsidiary		Shareholder	
DE	13%	ES	14%	CN	60%	KY	24%	ES	28%	NL	12%
GB	10%	GB	14%	VG	11%	BM	13%	IE	10%	DE	10%
PL	7%	US	13%	TW	6%	VG	11%	ID	8%	IE	9%
BE	7%	DE	11%	NL	4%	FR	6%	DE	7%	US	7%
ES	7%	CH	8%	BM	2%	CN	5%	NL	6%	AU	7%

Note: DE is Germany; GB is the UK; PL is Poland; BE is Belgium; ES is Spain; CH is Switzerland; CN is mainland China; VG is the British Virgin Islands; TW is Taiwan; NL is the Netherlands; BM is the Bermuda Islands; FR is France; IE is Ireland; ID is Indonesia; and AU is Austria.

Table 4.6 shows the results of conduit companies located in the Netherlands, Hong Kong, and the UK, which are the top three jurisdictions in terms of the number of conduit companies. The investments through conduit companies located in the Netherlands are mainly related to Western jurisdictions. The investments through Hong Kong are mainly made in mainland China and Taiwan. In addition, the interesting point is that both columns Shareholder and Subsidiary have the Cayman Islands, the British Virgin Islands, and the Bermuda Islands, which are British Overseas Territories known to be used as tax havens. Many investments through conduit companies located in the UK are related to Indonesia and Australia.

As a general trend, the key companies are close to the geographical jurisdictions of the headquarters. In addition to the trend, not a few investments through the US are related to East Asian jurisdictions such as Japan and China. The investments through the UK or former leasehold land Hong Kong are mainly made in the Commonwealth and the British overseas territories. It is notable that affiliates located in so-called tax havens are found to have connections with holding&conduit or conduit companies. This implies affiliates related to tax havens are the lower ownership layer in the ownership structures.

Locations of headquarters and key companies

Finally, we analyze whether the locations of key companies differ depending on those of headquarters. Table 4.7 shows the top five locations of headquarters of multinationals that have key companies for each type. For instance, 27% of affiliates identified as holding are held by US-based multinationals, and they have the most holding companies than multinationals based in other jurisdictions.

Table 4.7: Top five locations of headquarters of multinationals that holds key companies

Holding		Holding&Conduit		Conduit	
US	27%	US	30%	US	27%
GB	13%	GB	19%	GB	16%
JP	11%	CN	9%	CN	13%
DE	11%	DE	8%	DE	10%
CN	8%	JP	7%	JP	8%

Note: GB is the UK; JP is Japan; DE is Germany; and CN is mainland China.

For any types of key companies, US-based multinationals own the most. This fact might suggest that US-based multinationals are more aggressive in terms of tax planning than those based in other jurisdictions. However, it should also be noticed that US-based multinationals are most among multinationals that are subject to this analysis. In contrast, UK-based multinationals in own many key companies, given the number of multinationals that are subject to this analysis. It might suggest that UK-based multinationals tend to have more affiliates that can play an important role in international profit shifting than multinationals based in other jurisdictions.

We further look into a relationship between locations of headquarters and key companies. Tables 4.8-4.10 summarize the locations of key companies held by multinationals based in the top three jurisdictions listed in Table 6. For instance, Table 7 shows holding companies held by multinationals in the three jurisdictions, which are in the top three in the column of holding company in Table 4.7: the US, UK, and Japan. It shows holding companies are mainly located in Western jurisdictions for any multinationals in the top three jurisdictions except that Japan-based multinationals also own many holding companies in Singapore.

Table 4.9 shows holding&conduit companies are often located in Western jurisdictions for multi-

Table 4.8: Top five locations of holding companies held by multinationals based in the top three jurisdictions listed in Table 4.7

the United States		the United Kingdom		Japan	
GB	15%	NL	15%	US	22%
NL	13%	US	12%	GB	13%
DE	9%	ES	7%	NL	12%
LU	8%	LU	7%	DE	6%
FR	5%	DE	6%	SG	5%

Note: GB is the UK; NL is the Netherlands; DE is Germany; LU is Luxembourg; FR is France; ES is Spain; and SG is Singapore.

Table 4.9: Top five locations of holding&conduit companies held by multinationals based in the top three jurisdictions listed in Table 4.7

the United States		the United Kingdom		China	
NL	12%	GB	11%	HK	12%
US	12%	NL	9%	CN	9%
GB	9%	DE	9%	VG	9%
DE	7%	US	8%	KY	8%
ES	7%	ES	6%	US	8%

Note: NL is the Netherlands; GB is the UK; DE is Germany; ES is Spain; HK is Hong Kong; CN is mainland China; VG is the British Virgin Islands; and KY is the Cayman Islands.

nationals based in the US and UK. However, those for China-based multinationals tend to be located in British overseas territories, such as the Cayman Islands, the British Virgin Islands, and the Bermuda Islands. This tendency is also true for conduit companies (Table 4.10).

In addition, it is noteworthy that many holding&conduit and conduit companies are located in jurisdictions of their headquarters. For instance, 12% of holding&conduit companies held by US-based multinationals are located in the US, 11% of those held by UK-based multinationals are located in the UK, and 9% of those held by China-based multinationals are located in mainland China (Table 4.9).

Similar tendencies can be found for conduit companies. 8% of conduit companies held by the US-based multinationals are located in the US, 17% of conduit companies held by the UK-based multinationals are located in the UK, and 29% of conduit companies held by China-based multinationals are located in mainland China (Table 4.10). These results might suggest multinationals often perform round-tripping [117] by using affiliates located at the lower layer within their corporate structures.

4.3 Summary

In the global economy, the existence of intermediate companies held by multinationals is becoming a policy issue because they are often used for shifting profits to low-tax jurisdictions. The purpose of this

Table 4.10: Top five locations of conduit companies held by multinationals based in the top three jurisdictions listed in Table 4.7

the United States		the United Kingdom		China	
GB	17%	GB	17%	CN	29%
ES	14%	IE	10%	HK	24%
DE	9%	US	10%	VG	9%
US	8%	ES	9%	KY	6%
RU	6%	DE	6%	BM	6%

GB is the UK; ES is Spain; DE is Germany; RU is Russia; IE is Ireland; CN is mainland China; HK is Hong Kong; VG is the British Virgin Islands; KY is the Cayman Islands; and the BM is the Bermuda Islands.

chapter is to identify such intermediate companies, which we call key companies in this chapter, in order to clarify the actual situation of multinational tax planning.

For the analysis, the GON was constructed using the information in the Orbis database to consider multinational corporate structures. We proposed a model that focuses on the position affiliates occupy in a multinational corporate structure, rather than using financial information as used by previous studies. The validity of our model is confirmed by a comparison between affiliates that our model identified as the key companies and those previous investigations held to be suspicious.

After analyzing the basic features of the GON, our model is applied to multinationals listed in the Fortune Global 500 since large multinationals have a higher risk of international profit shifting. Our study shows that ownership information might be useful for reducing the candidates for the affiliates suspected of involvement in tax planning activities. Our model was able to identify 6223 affiliates as key companies, which accounts for about 1.7% of a total of 361,166 affiliates, only by the use of ownership information. These results suggest that the ownership information has the potential to help tax authorities estimate the risk of international tax avoidance that each multinational affiliate has.

From the geographical viewpoint, it was found that many identified key companies exist in jurisdictions such as the Netherlands and the UK. We also found that there is a relationship between locations of key companies and favorableness for treaty shopping, which is a scheme for tax planning. From the topological viewpoint, it was found that such identified companies concentrated in the IN component of the bow-tie structure, which suggests that tax administration may discourage tax avoidance behaviors only by checking a limited number of multinational affiliates.

It is clear that there is a difference in the investment routes depending on the location of key companies. For example, the investments related to East Asian jurisdictions often pass through the key companies located in the US, and the investments related to the Commonwealth tend to pass through the key companies located in the UK. It was also revealed that UK-based multinationals held a relatively large number of key companies, and China-based multinationals tended to hold many conduit companies

in British overseas territories. It is suggested that key companies not only receive a strong influence from the withholding tax rate but also strongly reflect the historical, economic, and political relationships of their locations. The key companies are a microcosm of such various relationships.

The future work should focus on network properties of the ownership structures in more detail and cooperative analysis in the cross-section to better understand the GON.

Chapter 5

Diverted cross-border investments analyzed on the basis of tax avoidance behaviors

In the present time, a significant amount of FDI is invested in some jurisdictions, given the size of their real economies. This is asserted to be behind investments that are routed through third jurisdictions. Tax considerations are one of the main reasons for such behaviors [39]. Macroeconomic statistics on FDI, however, bilaterally measure investments without the expectation of detoured investments. One indirect investment is counted multiple times per two jurisdictions, and some jurisdictions appear to attract immense amounts of FDI on the basis of the statistics.

A few studies in the literature have sought to separate diverted investments from FDI statistics in an effort to highlight genuine investments that actual investors make in ultimate recipients. One approach is to utilize the correlation between FDI and GDP [118]. Another is the application of probabilistic theory making use of Markov chains [119]. These methods are common, in that they implicitly assume that all investments are genuine, apart from those involved in SPEs, and use macro-level (jurisdiction-level) statistics for separation purposes.

In this study, we propose a different approach to the analysis of diverted cross-border investments to that in previous studies [120]. It is not enough in the context of international tax policy to equate detoured cross-border investments with investments involved in SPEs. Firms can enjoy tax benefits by diverting their investments through legal entities, apart from SPEs. In order to shed light on the cross-border investments driven by tax avoidance behaviors, we focus on investment flows and withholding tax ratios rather than SPEs. In addition, we use firm-level equity ownership data as a proxy for these investment flows, which enables us to unveil the features of firms used as transit points for the investments.

5.1 A method for exploring diverted cross-border investments

We aim to highlight the firms that function as transit points of cross-border investments, which tax planning diverts. This study refers to these firms as transit firms and clarifies their features. This subsection explains its method in the following three steps. First, we construct the multilayer ownership-tax network (MOTN) composed of an ownership network and WTN (see Chapter 3) in order to consider

cross-border investment flows and the withholding tax ratios. Firm-level equity ownership data is reflected in the ownership network. Second, we assume the tax-related motivation behind why the cross-border investments were diverted in the first place. Third, we define the multilayer centrality that evaluates the size of cross-border investment and the possibility of it being a vehicle for the enjoyment of tax treaty benefits. Finally, the multilayer centrality is applied to the MOTN in accordance with our assumptions about diverted cross-border investments. The result of the centrality indicates the sectors and locations in which transit firms concentrate.

Multilayer Ownership Tax Network

We construct a multilayer network $M = (g, l)$ as the MOTN. A multilayer network is one that has several graphs as its layers [121]. Figure 5.1 shows an image of the MOTN, which consists of two components: a set of weighted directed graphs $g \in G_\alpha, G_\beta$ and a set of interlayer connections $l \in E_{\alpha\beta}$. The first layer is an ownership network G_α that reflects cross-border investment relationships, and the second layer is the WTN G_β that reflects the withholding tax ratios among jurisdictions (see Chapter 3). $l \in E_{\alpha\beta}$ connects the nodes of G_α and that of G_β.

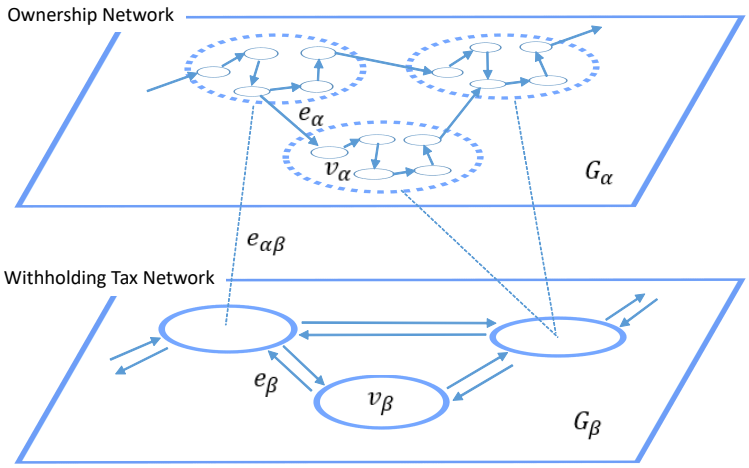


Figure 5.1: **Image of the multilayer ownership tax network.** G_α represents the ownership network where V_α is a node representing a firm and e_α is an equity investment from a firm to another firm. G_β represents the WTN for dividends where v_β is a jurisdiction and e_β is the a withholding tax rate imposed on dividends sent from a jurisdiction to another jurisdiction. $e_{\alpha\beta}$ stands the interlayer connections between G_α and G_β and tied with a company and the jurisdiction where the company is.

$G_\alpha = (N_\alpha, L_\alpha)$ is a graph into which we aggregate the nodes and the links of the GON at the jurisdiction-sectoral level. The graph consists of two parts: a set of nodes N_γ and a set of links L_γ. Each node refers to a pair of jurisdictions and sectors, like manufacturing in Japan. The classification of sectors follows the statistical classification of economic activities in the European community [102]. Each link refers to an equity ownership relationship.

Note that our analysis contains a certain bias due to data availability. The database is based on

the information that each firm reported to a local chamber of commerce. However, the criteria that require firms to submit financial statements are different depending on the jurisdictions. Therefore, the availability of data varies greatly among jurisdictions. Kosovo, for instance, covers 99.1%, whereas Seychelles cover only 0.1%. In particular, it is noted that there is not much coverage of the information on small firms [97] and those located in jurisdictions with high financial secrecy.

Tax purposes of diverting cross-border investments

This study assumes that the primary tax purpose of diverting cross-border investments is to shift profit to firms in low-tax jurisdictions with minimum withholding tax payments, as per [65]. Such firms usually receive profit from those which operate in other jurisdictions and function as a pool to cut down on the tax expenses of entire groups of multinationals. This study refers to members of these as pool firms. If profit is directly moved to such firms, it is usually subject to a full withholding tax. In order to hinder tax avoidance behavior, jurisdictions usually do not conclude tax treaties with low-tax jurisdictions where pool firms may be located. Multinationals establish the firms in third jurisdictions to establish routes where profit can be shifted without being subject to withholding taxes. This study also assumes that profit is transferred to pool firms via investment flows, corresponding to other studies in the literature, such as [49]. Multinationals often distribute their profits to affiliates in other jurisdictions as dividends, although they may sometimes distribute them as royalties and interest. It is, therefore, assumed that multinationals move their profits over links in the ownership network G_α.

Income attributable to shareholders

The firm-level data that we used to calculate the sink centrality herein is the Orbis database [96], which is the same data that we use for the GON G_γ. It includes firm-level information such as operating revenues, shareholding ratios, and the sectors involved. However, it does not incorporate information on the amount of equity capital or dividends paid to shareholders. Instead of such information, the centrality considers the amount of profit calculated by multiplying an operating income by a shareholding ratio moving over links. This study names it the amount of income attributable to shareholders. It is hypothetically assumed that there are two firms: A and B. A has a 60% equity of B, whose operating income is three million USD. In this case, 180 million USD flows from B to A as income attributable to its shareholders. The amount of income attributable to shareholders is defined as follows [61]:

$$v_{n_{i+1}} = p_k \prod_{i=1}^{l-1} w_{n_i n_{i+1}} \tag{5.1}$$

where p_k is an operating income of a firm k located at the end of chains in the GON, which is data on ownership relations are not compiled to the jurisdiction-sectoral level, and $w_{n_i n_{i+1}}$ is the shareholding ratio from a shareholder firm n_{i+1} to an owned firm n_i. The amount $v_{n_{i+1}}$ flows into a firm n_{i+1}, and the amount $v_{n_{i+2}}$ flows out of a firm n_{i+1}.

Calculation of multilayer centrality

We identify which sectors pool firms tend to be involved in and which jurisdictions they often locate themselves in, prior to calculating the multilayer centrality. The result indicates the firms for which multilayer centrality is calculated. This is because the transit firms that the centrality tries to clarify are supposed to be directly linked with the pool firms, according to this study's assumptions on the ownership network G_α.

The multilayer centrality is calculated based on the values of the multilayer outward/inward centralities. The calculation of the multilayer outward/inward centralities necessitates the values of the conduit outward/inward centralities and the WTN's load centrality l_j (see Chapter 3). Therefore, we explain the conduit outward/inward centralities and the multilayer outward/inward centralities first to define the multilayer centrality.

Sink centrality Figure 5.2 illustrates the concept of a sink. We supposed that a jurisdiction × sector pair functioning as a "sink" has much more value compared with its economic scale.

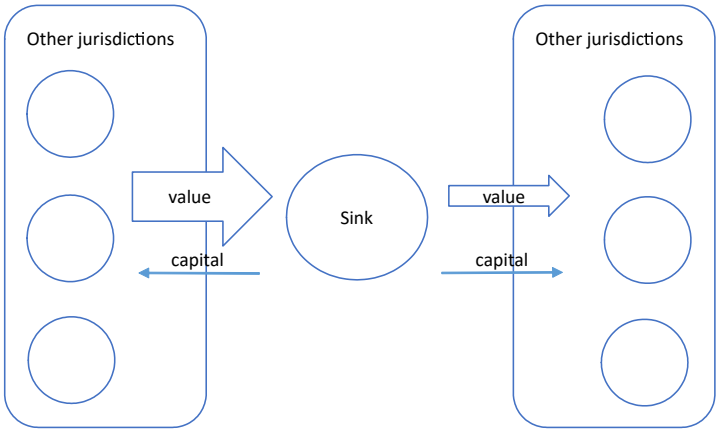


Figure 5.2: **Sink concept**: more amount as income attributable to shareholders flows into a sector in a jurisdictions functioning as a sink, whereas less amount leaves the sector in the jurisdiction.

The sink centrality value is calculated for each sector and jurisdiction. Sectors and jurisdictions with high sink centralities will tend to attract concentrations of pool firms. The sink centrality compares the amount of cross-border investment with real economic activities, in accordance with [65]. The basic idea is similar to the ratio of FDI to GDP proposed by other studies in the literature, such as [85] (see Chapter 3.2). The sink centrality utilizes firm-level equity ownership data instead of jurisdiction-level FDI.

The sink centrality is computed as follows. Initially, it takes the difference between the income attributable to shareholders that flows into and out of the firms involved in sector s in jurisdiction j into account. The difference is regarded as the amount of income attributable to shareholders that is pooled by the firms. It then calculates the proportion of the difference to the total income attributable

to shareholders in the ownership network G_α. Lastly, it compares this to the proportion of jurisdiction j's GDP to global GDP. [1] Although it is better to use sector-level GDP when precisely calculating the sink centrality, we used jurisdiction-level GDP, because GDP delineated to the jurisdiction level is not available for most jurisdictions. The sink centrality of sector s in jurisdiction j is given by:

$$sc_{sj} = \frac{V_{sj}^{in} - V_{sj}^{out}}{V^{total}} \cdot \frac{GDP^{total}}{GDP_j} \tag{5.2}$$

where V_{js}^{in} is the income attributable to shareholders that flows to the firms involved in sector s in jurisdiction j, whereas V_{sj}^{out} is the income attributable to shareholders that flows out of the firms involved in s in jurisdiction j. V^{total} is the total income attributable to shareholders in the ownership network G_α, GDP_j is the GDP of jurisdiction j, and GDP_{total} is the total GDP of 215 jurisdictions. The sink centrality becomes high when the income attributable to shareholders pooled in node js is much for the jurisdiction j's real economic activities. In order to easily distinguish the sectors and locations with extraordinarily high sink centralities, we standardize the sink centrality sc_{sj} so that both its average value and standard deviation are 1.0. The standardized sink centrality of sector s in jurisdiction j is then given by:

$$SC_{sj} = \frac{sc_{sj} - \overline{sc_{sj}}}{\sigma_{sc_{sj}}} + 1.0 \tag{5.3}$$

where $\overline{sc_{sj}}$ is the average of the sink centrality and $\sigma_{sc_{sj}}$ the standard deviation of the sink centrality. We consider that the firms involved in sector s in jurisdiction j tend to function as pool firms if the standardized sink centrality exceeds a given value.

In order to distinguish the transit firms used for tax purposes, this study analyzes both investment flows and withholding tax rates. We propose the multilayer centrality that incorporates the amount of income attributable to shareholders and the extent to which jurisdictions are favorable for tax treaty benefits [120].

Conduit centrality A conduit is like a tunnel through which value enters or leaves a sink. We consider that much more value entering the sink or leaving the sink passes through jurisdiction × sector pairs functioning as a conduit compared with its economic scale. Because the conduit plays a key role in treaty shopping, we analyze the location and sectors of firms functioning as conduits. For the analysis, we define a conduit centrality c_{js} of jurisdiction j × sector s that consists of conduit outward centrality c_{js}^{out} and conduit inward centrality c_{js}^{in}. Figure 5.3 shows the concept of a conduit. The conduit outward centrality c_{js}^{out} measures the value entering the sink through firms whose location is j and sector is s, while the conduit inward centrality c_{js}^{out} measures the value leaving the sink through firms whose location is j and sector is s.

[1] GDP data comes from [122, 123] for every country except the following countries. Data is obtained through [124] for Cayman Islands, San Marino, Syria, Anguilla, Curaçao, the British Virgin Islands, the Democratic People's Republic of Korea, French Polynesia, New Caledonia, Sint Maarten, and Somalia. Data is acquired through [125] for Taiwan and Gibraltar. Data from [126] is used for the Reunion). The same holds true for the conduit outward/inward centralities explained later.

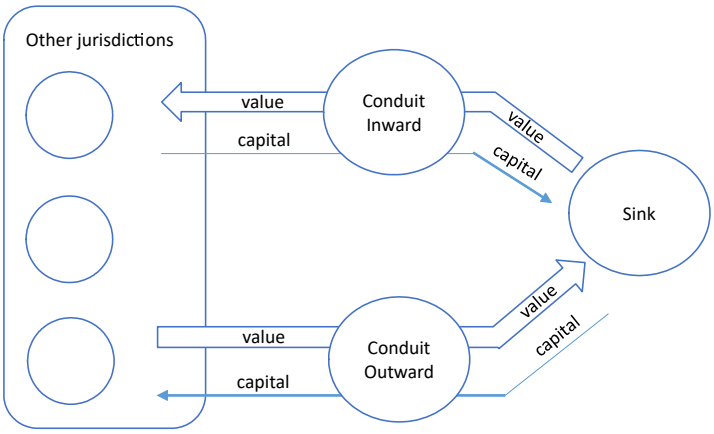


Figure 5.3: **Conduit concept**: the amount of income attributable to shareholders flows into sink through conduit outward and leaves sink through conduit inward.

The conduit outward/inward centralities measure the profit that flows into/out of pool firms across links of the ownership network G_α. The conduit outward/inward centralities correspond to the ideas of [65], which compare the volume of cross-border investments with real economic activities. The conduit outward centrality is computed as follows. Initially, it estimates the amount of income attributable to shareholders that flows into pool firms through firms located in third jurisdictions. It then calculates the proportion of the amount to the total income attributable to shareholders in the ownership network G_α. At last, it compares this to the proportion of jurisdiction j's GDP to global GDP. It is better to use the industry-level GDP, but we use the jurisdiction-level GDP due to the limitation of the available data. The conduit outward centrality of sector s in jurisdiction j is given by

$$cc_{sj}^{out} = \frac{V_{sj}^{sink,out}}{V^{total}} \cdot \frac{GDP^{total}}{GDP_j} \tag{5.4}$$

where $V_{sj}^{sink,out}$ is income attributable to shareholders that flows into pool firms identified by SC_{sj} through firms engaged in sector s in jurisdiction j. The conduit outward centrality cc_{sj}^{out} gets high when the income attributable to shareholders is much for the jurisdiction j's real economic activities. In order to easily distinguish the sectors and locations with extraordinarily high conduit outward centralities, we standardize the conduit outward centrality so that both its average value and standard deviation are 1.0. The standardized conduit outward centrality of sector s in jurisdiction j is given by:

$$CC_{sj}^{out} = \frac{cc_{sj}^{out} - \overline{cc_{sj}^{out}}}{\sigma_{cc_{sj}^{out}}} + 1.0 \tag{5.5}$$

where $\overline{cc_{sj}^{out}}$ is the average of the conduit outward centrality cc_{sj}^{out} and $\sigma_{cc_{sj}^{out}}$ is the standard deviation of the conduit outward centrality cc_{sj}^{out}.

As in the conduit outward centrality cc_{sj}^{out}, the conduit inward centrality of sector s in jurisdiction j

is given by:

$$cc_{sj}^{in} = \frac{V_{sj}^{sink,in}}{V^{total}} \cdot \frac{GDP^{total}}{GDP_j} \tag{5.6}$$

where $V_{sj}^{sink,in}$ is income attributable to shareholders that flows out of pool firms identified by the standardized sink centrality through firms engaged in sector s in jurisdiction j. The conduit inward centrality cc_{sj}^{in} increases when the income attributable to shareholders is much for jurisdiction j's GDP. For the same reason as the conduit outward centrality cc_{sj}^{out}, the conduit inward centrality cc_{sj}^{in} is also standardized so that both its average value and standard deviation are 1.0. The standardized conduit inward centrality of sector s in jurisdiction j is given by:

$$CC_{sj}^{in} = \frac{cc_{sj}^{in} - \overline{cc_{sj}^{in}}}{\sigma_{cc_{sj}^{in}}} + 1.0 \tag{5.7}$$

where $\overline{cc_{sj}^{in}}$ is the average of the conduit inward centrality cc_{sj}^{in} and $\sigma_{cc_{sj}^{in}}$ is the standard deviation of the conduit inward centrality cc_{sj}^{in}.

Standardized load centrality In order to easily grasp how excessive load centrality lc_j (see Chapter 3) is, we standardize it so that both its average value and standard deviation amount to 1.0:

$$LC_j = \frac{lc_j - \overline{lc_j}}{\sigma_{lc_j}} + 1.0 \tag{5.8}$$

where $\overline{lc_j}$ is the average of the load centrality and σ_{lc_j} is the standard deviation of the load centrality. The standardization enables us to assume a jurisdiction with its standardized load centrality of more than 1.0, which potentially carries a greater risk of treaty shopping than the average.

Multilayer outward/inward centralities The multilayer outward centrality MC_{sj}^{out} represents the weighted geometric average of the standardized conduit outward centrality CC_{sj}^{out} and the standardized load centrality LC_j. This incorporates the standardized conduit outward centrality CC_{sj}^{out} in order to evaluate the cross-border investments that flow into pool firms. It also incorporates the standardized load centrality LC_j in order to distinguish investments for tax purposes from those for other purposes. LC_j considers the extent to which jurisdictions are favorable for tax treaty benefits (see Chapter 3). The multilayer outward centrality of sector s in jurisdiction j is given by:

$$MC_{sj}^{out} = \sqrt[\alpha+\beta]{\left(CC_{sj}^{out}\right)^{\alpha} \times \left(LC_j\right)^{\beta}} \qquad (\alpha + \beta = 1) \tag{5.9}$$

where α and β is the ratio for considering cross-border investment flows and the favorability of tax treaty benefits for the calculation of the weighted geometric average. If α is set to 0.6 and β to 0.4, the multilayer outward centrality will consider cross-border investment flows over withholding tax rates.

As in the multilayer outward centrality MC_{sj}^{out}, the multilayer inward centrality MC_{sj}^{in} is the weighted geometric average of the standardized conduit inward centrality CC_{sj}^{in} and the standardized load centrality

LC_j. This incorporates the standardized conduit inward centrality CC_{sj}^{in} in order to evaluate the cross-border investments that flow out of pool firms. The multilayer inward centrality MC_{sj}^{in} incorporates the standardized load centrality LC_j in order to distinguish investments for tax purposes from those for other purposes. The multilayer inward centrality MC_{sj}^{in} of sector s in jurisdiction j is given by:

$$MC_{sj}^{in} = \sqrt[\alpha+\beta]{\left(CC_{sj}^{in}\right)^{\alpha} \times \left(LC_j\right)^{\beta}} \qquad (\alpha + \beta = 1) \tag{5.10}$$

Multilayer centrality We ultimately calculate the multilayer centrality, which is defined as the Euclidean distance between the multilayer outward and inward centralities. The sectors and jurisdictions with high multilayer centralities indicate that transit firms concentrate on these. The multilayer centrality of sector s in jurisdiction j is given by:

$$MC_{sj} = \sqrt{\left(MC_{sj}^{out}\right)^2 + \left(MC_{sj}^{in}\right)^2}/\sqrt{2} \tag{5.11}$$

where MC_{sj}^{out} is the multilayer outward centrality and MC_{sj}^{in} is the multilayer inward centrality.

In order to identify the pairs used for treaty shopping, the standardized multilayer centrality MC_{sj} considers the withholding tax rates (i.e., the standardized load centrality LC_j) in addition to the amount of income attributable to shareholders (i.e., the standardized conduit centrality CC_{sj}). It is necessary to decide how much income attributable to shareholders and the withholding tax rates are considered into the calculation of the standardized multilayer centrality MC_{sj}. The parameters α and β in Eq. 5.9 and Eq.5.10 determine the extent where the withholding tax rates are taken into account, compared to income attributable to shareholders.

As α and β indicates, it is important how large β is compared to α rather than how much the respective values of α and β are. In our analysis, α is set to 1.0 to be easy to understand how much the standardized load centrality LC_j (i.e., the withholding tax rates) is considered for the calculation of the multilayer centrality MC_{sj}, compared to the standardized conduit centrality CC_{sj}. This is because the ranking of each pair is the same if the ratio of α and β is the same. For instance, a combination of α = 1.0 and β = 0.5 differs from that of α = 2.0 and β = 1.0 in terms of values of α and β, but the ranking of the former is the same as that of the latter. Therefore, we see the ranking of each pair obtained by fixing α to 1.0 and changing β.

5.2 Results of exploring diverted cross-border investments

Initially, we present which pairs are identified as sinks for the calculation of the standardized multilayer centrality MC_{sj}. We then explain how to set the values of α and β that this study utilizes. Lastly, we show the top pairs in the centrality as the sectors and jurisdictions that are likely to be used for the tunnels of cross-border investments.

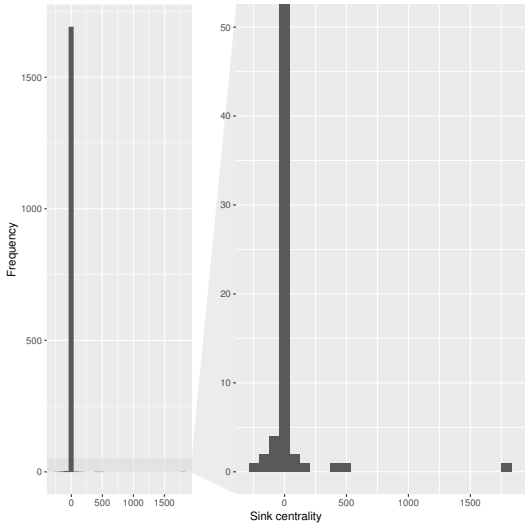


Figure 5.4: **Frequency distribution of sink centrality SC_{sj}.** The sink centrality of most pairs is less than 1.0. The width of the bins is 81.5.

Sink centrality

For the identification of sinks, we calculated the standardized sink centrality SC_{sj} for 1704 pairs whose data could be obtained. The maximum value of the sink centrality was 1784.38, and the minimum value of that was -251.82. The value of sink centrality is wide, but most of the value of the sink centrality is concentrated in parts. Figure 5.4 shows its frequency distribution. The sink centrality of 1,598 pairs (about 93.8% of the total pairs) is 1.0 or less. We can suppose that the pairs whose standardized sink centrality SC_{sj} is high are unique and likely to function as a sink.

Table 5.1: Sectors in jurisdictions identified as sinks

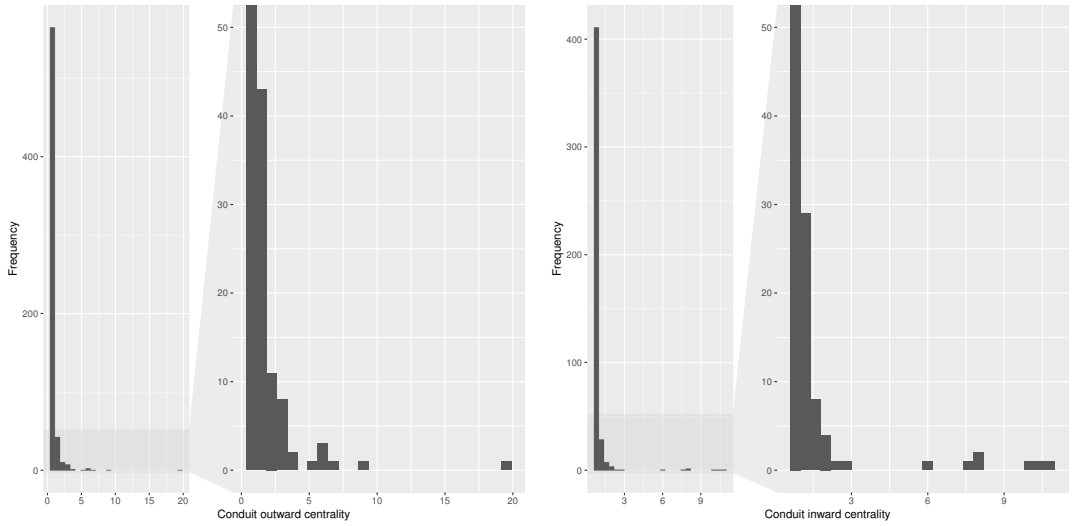
Jurisdiction	Sector	SC_{sj}	Jurisdiction	Sector	SC_{sj}
Malta	Finance&Insurance	1784.4	Luxembourg	Pro. activities, etc.	511.9
Luxembourg	Admin. service, etc.	369.7	Bermuda	Construction	134.6
Bermuda	Finance&Insurance	87.8	British Virgin	Manufacturing	57.0
Cayman	Finance&Insurance	39.8	Curaçao	Finance&Insurance	34.5
France	Finance&Insurance	34.1	Marshall	Transportation, etc.	30.4
Sweden	Finance&Insurance	28.0	British Virgin	Wholesale, etc.	23.1
Cyprus	Finance&Insurance	19.6	Spain	Finance&Insurance	19.0
Curaçao	Wholesale, etc.	16.4	UK	Mining&Quarrying	16.2
Portugal	Finance&Insurance	15.5	Norway	Finance&Insurance	14.3
Belgium	Finance&Insurance	13.1	UK	Finance&Insurance	13.0
Austria	Pro. activities, etc.	12.7	Iceland	Finance&Insurance	12.7
South Africa	Manufacturing	10.9	Singapore	Other service, etc.	10.5
UK	Pro. activities, etc.	10.3			

The 25 pairs shown in Table 5.1 were identified as sinks on the grounds that their standardized sink centrality SC_{sj} is higher than 10.0. Nine sectors are represented among the pairs with the highest sink centrality. The financial and insurance activities (Finance&Insurance) account for more than half of this

list, and the professional, scientific, and technical activities (Pro. activities, etc.) account for about 1/8 of this list, which show that much more income remained in these sectors than the real economic activity, represented as the GDP. Finally, we regarded the 25 pairs accounting for about 1.5% of all pairs as sinks.

Conduit centrality

The standardized conduit outward centrality CC^{out}_{sj} was calculated for 636 pairs, and the standardized conduit inward centrality CC^{in}_{sj} was calculated for 461 pairs. Finally, we obtained 389 pairs having both standardized conduit outward centralities CC^{out}_{sj} and standardized conduit inward centralities CC^{in}_{sj}. The maximum value of the standardized conduit outward centrality CC^{out}_{sj} was 19.37, and the minimum value was 0.78. The maximum value of the standardized conduit inward centrality CC^{in}_{sj} is 10.79, and the minimum value is 0.81. Even though the differences between their maximum value and their minimum value are not small, both centralities were distributed in certain parts.



(a) Standardized conduit outward centrality CC^{out}_{sj} (b) Standardized conduit inward centrality CC^{in}_{sj}

Figure 5.5: **Frequency distribution of the standardized conduit outward/inward centralities.** Most of the centralities are less than 1.0. The width of the bins is 1.1.

Figure 5.5 shows frequency distributions of the standardized conduit outward centrality CC^{out}_{sj} and the standardized conduit inward centrality CC^{in}_{sj}, respectively. It was 608 pairs, accounting for 95.6% of the total pairs, that have standardized conduits outward centrality CC^{out}_{sj} less than 1.0. Similarly, it was 449 pairs, accounting for 97.4% of the total pairs, that have standardized conduit inward centrality CC^{in}_{sj} less than 1.0. We can suppose that the pairs whose standardized conduit centrality CC_{sj} is high are unique and likely to function as conduits.

Table 5.2 shows 15 pairs of sectors and jurisdictions whose standardized conduit centrality CC_{sj} is over 2.0. Seven sectors across 13 jurisdictions are represented among the 15 pairs. Most of the 13 jurisdictions are developed countries, and there are no small island jurisdictions except Bermuda. Wholesale and retail trade and repair of motor vehicles and motorcycles (Wholesale, etc.) represents more

Table 5.2: Pairs of sector and jurisdiction whose standardized conduit centrality CC_{sj} is over 2.0

Jurisdiction	Sector	CC_{sj}^{out}	CC_{sj}^{in}	CC_{sj}
Netherlands	Finance&Insurance	19.37	6.13	14.36
Luxembourg	Wholesale, etc.	6.18	10.79	8.79
Bermuda	Mining&Quarrying	1.33	9.49	7.48
Luxembourg	Finance&Insurance	6.55	8.08	7.36
Sweden	Electricit, etc.	9.03	0.91	6.41
Austria	Wholesale, etc.	3.21	7.87	6.01
Bermuda	Wholesale, etc.	4.12	7.42	6.00
Portugal	Pro. activities etc.	6.35	1.24	4.57
Malaysia	Manufacturing	5.62	1.03	4.04
Switzerland	Wholesale, etc.	3.85	0.93	2.80
Germany	Manufacturing	3.08	2.19	2.46
UK	Admin. services, etc.	1.86	2.94	2.46
France	Pro. activities, etc.	3.23	1.05	2.40
Ireland	Finance&Insurance	3.12	1.18	2.36
Austria	Mining&Quarrying	3.08	0.84	2.26
Austria	Manufacturing	2.53	1.61	2.12
Portugal	Information, etc.	2.16	1.94	2.05

than 1/4 of this list, and Finance&Insurance represents about 1/5 of this list, showing that considerable value, either from or toward sinks, passes through firms in these sectors.

Load centrality

We calculated the standardized load centrality LC_j for 165 jurisdictions to find which jurisdictions are likely to be used for treaty shopping. The standardized load centrality LC_j considers all withholding tax liabilities imposed on dividends made between 165 jurisdictions (27,060 pairs in total). The maximum value of the standardized load centrality LC_j was 7.87, and the minimum value was 0.59. The value of the standardized load centrality LC_j is wide, but most of the value of the standardized load centrality LC_j is concentrated in parts.

Figure 5.6 shows its relative frequency distribution. The standardized load centrality LC_j of 147 jurisdictions (about 89.0% of 165 jurisdictions) is 1.0 or less, and the jurisdictions with high standardized load centralities LC_j are limited. We can suppose that the jurisdictions whose standardized load centrality LC_j is high are likely to be used for treaty shopping.

Table 5.3 shows jurisdictions whose standardized load centrality LC_j is in the top 15. It is confirmed that focusing on withholding tax rates imposed on dividends and evaluating jurisdictions by the load centralities lc_j is meaningful to the analysis of treaty shopping because the list contains jurisdictions that multinationals usually use for treaty shopping [74, 84]. The 15 jurisdictions are scattered around Europe, the Middle East, East Asia, Africa, and America. European jurisdictions especially have high standardized load centrality LC_j because the withholding tax imposed on dividends made between EU member states is exempted by the European Union directive (Directive 90/435/EC).

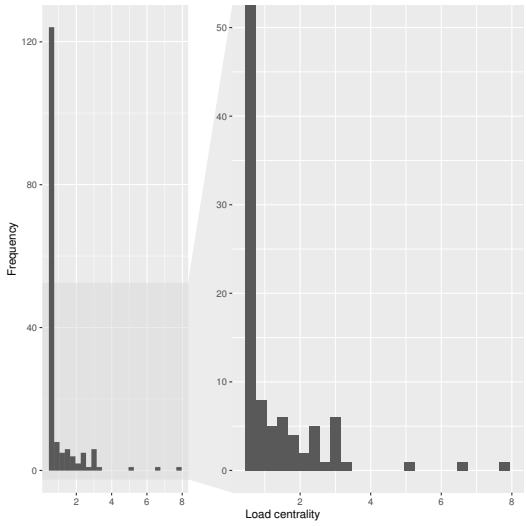


Figure 5.6: **Distribution of standardized load centrality LC_j.** Most of the centralities are below 1.0.

Table 5.3: Jurisdictions whose standardized load centralities LC_j are in the top 15

Jurisdiction	LC_j	Jurisdiction	LC_j	Jurisdiction	LC_j
UK	7.87	Singapore	2.94	Saint Lucia	2.46
UAE	6.59	Switzerland	2.93	Bahrain	2.46
Kuwait	5.22	Mauritius	2.91	Malaysia	2.45
Netherlands	3.44	Spain	2.86	Ireland	2.39
Cyprus	3.11	Luxembourg	2.65	Estonia	2.24
Hong Kong	3.05	Qatar	2.44	Malta	2.21

Multilayer centrality

The standardized multilayer centrality MC_{sj} is able to be calculated regarding 389 pairs having both results of the standardized conduit centrality CC_{sj} and the standardized load centrality LC_j. It is necessary for the calculation of the multilayer standardized centrality MC_{sj} to be set to the values of α and β because its values depend on α and β. Initially, we see the result without consideration of the withholding tax rates and one with equal consideration of the withholding tax rate and income attributable to shareholders.

Table 5.4 shows the result of the standardized multilayer centrality MC_{sj} without consideration of the withholding tax rates, which means β is set to 0.0. The listed pairs include jurisdictions such as Germany and France, which are not usually thought to be the jurisdictions used for treaty shopping [84]. Other reasons except treaty shopping possibly make much value pass through such jurisdictions. This shows it is necessary to consider the withholding tax rates as well as the value intensity for the identification of the pairs used for treaty shopping.

Table 5.5 shows the result of the standardized multilayer centrality MC_{sj}, considering the withholding tax rate and the value intensity equally, which means β is set to 1.0. Many listed pairs are in the UK, and even Public administration&Defence, etc., which it is hard to think that be used for treaty shopping,

Table 5.4: Sector in jurisdictions whose standardized multilayer centrality MC_{sj} are in the top 5% when β is set to 0.0

Jurisdiction	Sector	MC_{sj}^{out}	MC_{sj}^{in}	MC_{sj}
Netherlands	Finance&Insurance	19.37	6.13	14.36
Luxembourg	Wholesale, etc.	6.18	10.79	8.79
Bermuda	Mining&Quarrying	1.33	10.49	7.48
Luxembourg	Finance&Insurance	6.55	8.08	7.36
Sweden	Electricity, etc.	9.03	0.91	6.41
Austria	Wholesale, etc.	3.21	7.87	6.01
Bermuda	Wholesale, etc.	4.12	7.42	6.00
Portugal	Pro. activities etc.	6.35	1.24	4.57
Malaysia	Manufacturing	5.62	1.03	4.04
Switzerland	Wholesale, etc.	3.85	0.93	2.80
Germany	Manufacturing	3.08	2.19	2.67
UK	Admin. service	1.86	2.94	2.46
France	Pro. activities, etc.	3.23	1.05	2.40
Ireland	Finance&Insurance	3.12	1.18	2.36
Sweden	Manufacturing	2.84	1.59	2.30
Austria	Mining&Quarrying	3.08	0.84	2.26
Austria	Manufacturing	2.53	1.61	2.12
Portugal	Information,	2.16	1.94	2.05
Ireland	Pro. activities, etc.	2.41	1.43	1.98

Table 5.5: Sectors in jurisdictions whose standardized multilayer centrality MC_{sj} are in the top 5% when β is set to 1.0

Jurisdiction	Sector	MC_{sj}^{out}	MC_{sj}^{in}	MC_{sj}
Netherlands	Finance&Insurance	8.16	4.59	6.62
Luxembourg	Wholesale, etc.	4.05	5.35	4.74
Luxembourg	Finance&Insurance	4.17	4.63	4416
UK	Admin, etc.	3.83	4.81	4.35
UK	Manufacturing	3.43	3.48	3.46
Malaysia	Manufacturing	3.71	1.59	2.86
UK	Information, etc.	2.70	2.74	2.72
UK	Electricity, etc.	2.67	2.72	2.69
UK	Wholesale, etc.	2.59	2.72	2.65
Switzerland	Wholesale, etc.	3.36	1.65	2.64
UK	Construction	2.52	2.65	2.59
UK	Transportation&Storage	2.53	2.62	2.57
UK	Water supply, etc.	2.50	2.60	2.55
UK	Other service	2.49	2.60	2.55
UK	Real estate activities	2.53	2.55	2.54
UK	Arts&Entertainment&Reflection	3.18	0.89	2.33
UK	Public administration&Defence, etc.	1.90	2.63	2.29
UK	Human health etc.	1.01	3.19	2.37
UK	Accommodation	2.77	1.62	2.27

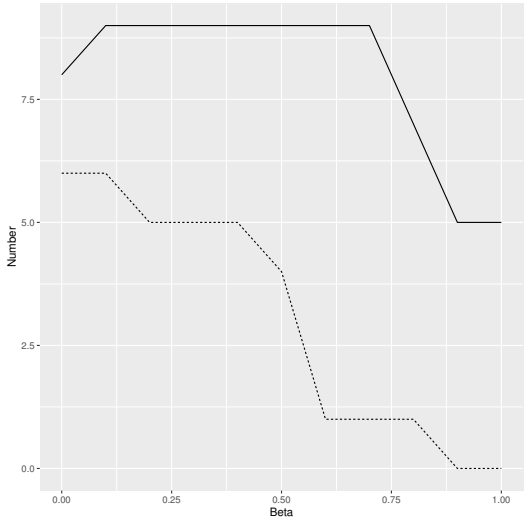


Figure 5.7: **Changes in the rankings of sectors in jurisdictions according to β.** The solid line indicates the number of the jurisdictions known for treaty shopping and the dotted line indicates the number of the jurisdictions not famous for treaty shopping when α is fixed to 1.0 and β changes from 0.0 to 1.0.

is listed. As the withholding tax is imposed on all industries by the same rate and the standardized load centrality LC_j is also the same. If such a standardized load centrality LC_j (i.e., the tax advantage) is taken into the calculation of the standardized multilayer centrality MC_{sj} too much, its calculation result will consist of various industries in the same jurisdictions. In Table 5.5, various industries in the UK. The cause of the result might be not to make the difference of sectors into account.

In order to look for the appropriate values, we consider the rankings of pairs in the multilayer centrality while fixing α to 1.0 and changing β in the range of 0.0 to 1.0. We then compare jurisdictions of the top 5% of pairs in the multilayer centrality with jurisdictions that are well-known for treaty shopping activities [84]. This is because we believe that the desirable result of the multilayer centrality includes jurisdictions known to be used for treaty shopping much in high rank and those not thought to be used for treaty shopping less in high rank.

Figure 5.7 shows how the result of the standardized multilayer centrality MC_{sj} change by fixing α to 1.0 and changing β from 0.0 to 1.0. The solid line indicates the number of jurisdictions known to be used for treaty shopping, while the dotted line indicates the number of jurisdictions not thought to be used for treaty shopping. When β is set to 0.6, the result in the top 5% has nine jurisdictions known to be used for treaty shopping and one jurisdiction not thought to be used for treaty shopping.

The result obtained by setting α to 1.0 and β to 0.6 has jurisdictions known to be used for treaty shopping much and those not thought to be used for treaty shopping less, compared to results created when α and β are set to other values. Therefore, we conclude that it is appropriate to set α to 1.0 and β to 0.6, which leads to a desirable and plausible result.

Table 5.6 shows the top 5% of pairs when the standardized multilayer centrality MC_{sj} considers the income flow at $\alpha = 0.4$ and the withholding tax rate at $\beta = 0.6$. It includes eight sectors across ten

Table 5.6: Sectors in jurisdictions identified as conduits

Jurisdiction	Sector	MC_{sj}	Jurisdiction	Sector	MC_{sj}
Netherlands	Finance&Insurance	8.0	Luxembourg	Wholesale, etc.	5.5
Luxembourg	Finance&Insurance	5.0	UK	Admin. services	3.8
Malaysia	Manufacturing	3.1	Bermuda	Mining&Quarrying	2.8
UK	Manufacturing	2.8	Sweden	Electricity, etc.	2.72
Bermuda	Wholesale, etc.	2.7	Switzerland	Wholesale, etc.	2.7
Austria	Wholesale, etc.	2.6	Ireland	Finance&Insurance	2.3
Singapore	Wholesale, etc.	2.2	Singapore	Manufacturing	2.1
Ireland	Pro. activities, etc.	2.1	UK	Information, etc.	2.1
UK	Electricity, etc.	2.1	UK	Wholesale, etc.	2.0
UK	Construction	2.0			

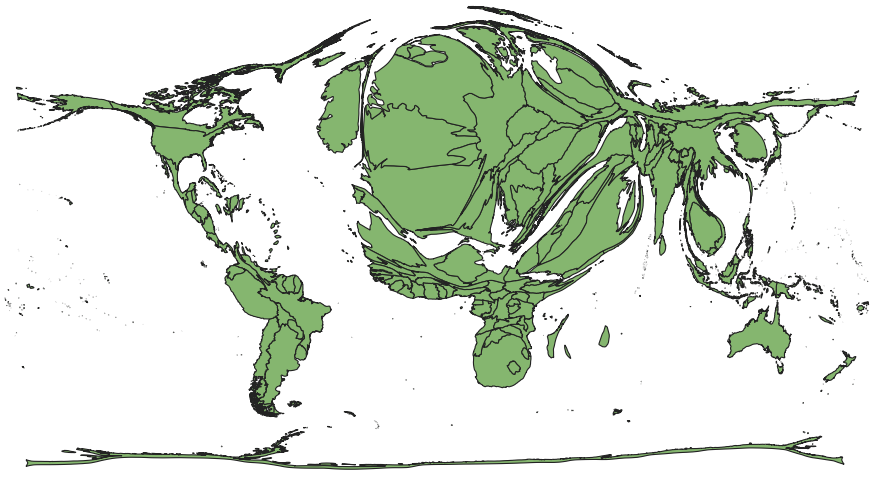
jurisdictions. Compared with other sectors, Finance&Insurance and Wholesale, etc., have exceptional features, which implies that these sectors have a higher potential for exploitation via treaty shopping. It is possible that treaty shopping can be prevented by making new tax rules focusing on these sectors. In addition, no Middle East Asian jurisdictions are ranked highly in the standardized multilayer centrality MC_{sj}, although their standardized load centralities LC_j are ranked highly (see Table 5.3). Other regulations of the jurisdictions imposed may cause the results.

At present, the mainstream countermeasures against treaty shopping involve introducing a limitation on benefits or a principal purpose test into tax treaties. The limitation on benefits clause limits firms that can receive the withholding tax reduction or exemption by certain criteria. On the other hand, the principal purpose test deprives firms whose main purpose is to enjoy the reduction or exemption of withholding tax liabilities. Developing countries prefer the principal purpose test because they are easy to enforce compared with the limitation on benefits, whose application criteria are complicated. On the other hand, the business community is concerned with the principal purpose test because the test is unclear as to the main purpose and tends to prefer the limitation on benefits whose application criteria are clearer.

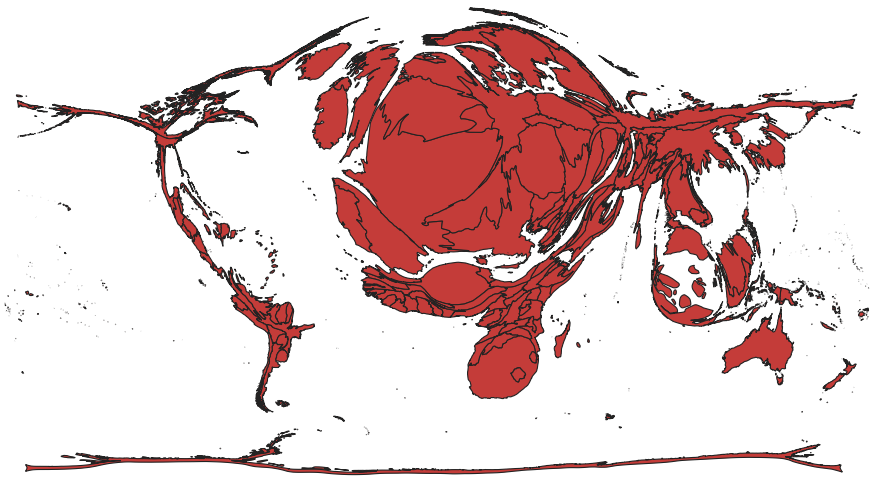
Our analysis shows that some sectors, such as Manufacturing, Wholesale, etc., and Pro. activities etc., are likely to be used for treaty shopping. We think that countermeasures to focus on such sectors are effective for preventing treaty shopping as Controlled Foreign Company rules of some jurisdictions, which is a countermeasure against another scheme of international tax avoidance, already focused on sectors. The introduction of rules focusing on some sectors may not only prevent treaty shopping effectively but also reduce the complexity of application criteria developing countries are concerned with and improve taxpayer predictability.

The size of each jurisdiction in Figure 5.8 indicates the size of the standardized multilayer centrality MC_{sj} regarding Finance&Insurance and Wholesale, etc., respectively. It should be noted that jurisdictions with high standardized multilayer centrality MC_{sj} are limited. Figure 5.8 (a) indicates

the standardized multilayer centrality MC_{sj} of Finance&Insurance and shows that the centrality of the Netherlands, Luxembourg, and other financial centers such as the UK, Bahrain, Hong Kong, and Mauritius is high. Figure 5.8 (b) indicates the standardized multilayer centrality MC_{sj} of Wholesale, etc., and shows that the centrality of the jurisdictions of Europe and South East Asia is high. We suggest that the new clauses focusing on certain sectors are introduced to tax treaties already concluded with jurisdictions having high standardized multilayer centrality MC_{sj}.



(a) Finance & Insurance



(b) Wholesale, etc.

Figure 5.8: **Cartogram of standardized multilayer centrality MC_{sj}.** The size of each jurisdiction indicates the degree of the standardized multilayer centrality MC_{sj}.

Developing countries conclude tax treaties with developed countries to increase investment from developed countries. With the globalization of the economy, the number of tax treaties has increased, and about 1,000 tax treaties are related to developing countries among about 4,000 tax treaties in the world. It should be noted that tax treaties not only increase foreign direct investment from developed

countries, but also increase the possibility of treaty shopping and the loss of their own tax sources.

5.3 Summary

It is noted that conducting international tax avoidance leads to diverted cross-border investments, which results in the inflation of macroeconomic statistics on cross-border investments, such as FDI, because these statistics measure them at the bilateral level.

A few previous studies sought to separate diverted cross-border investments from FDI statistics. They use macro-level (jurisdiction-level) statistics and divide them into one for genuine business purposes and other purposes, such as mitigation of tax payments, under the assumption that all investments are made for genuine business purposes, apart from those involved in SPEs. However, it is not enough in the context of international tax policy to equate detoured cross-border investments with investments involved in SPEs because firms can enjoy tax benefits by diverting their investments through legal entities except SPEs.

In order to design effective countermeasures against international tax avoidance, we have sought to extract cross-border investment diverted due to tax purposes and unveil features, such as locations and sectors, of firms involved in these investments. We constructed the multilayer ownership-tax network and proposed the multilayer centrality, which enables us to consider both cross-border investments and withholding taxation. It is expected to grasp precisely the locations and sectors of firms involved in diverted cross-border investments for tax purposes.

The results of our analysis suggest that firms involved in diverted cross-border investments for tax planning may concentrate on firms in the sectors of Finance&Insurance and Wholesale, etc. It suggests that governments should introduce a clause focusing on specific sectors in their tax treaty, especially with jurisdictions with high multilayer centrality, in order to prevent treaty shopping. Such countermeasures to international tax avoidance may not be too complicated for local administration to apply in the real world. They also could contribute to increasing the predictability of taxpayers.

A further quantitative study of treaty shopping is needed that takes not only withholding tax but also corporate tax into consideration. Such findings would contribute to our understanding of the effects of treaty shopping toward each jurisdiction's tax revenue.

Chapter 6

Policy Implications

We examine the implications for international tax policies that our analyses carry. First, we consider the sovereign state system in the age when the economies are getting globalized. We argue that countries might need to relinquish a part of discretion as well as check their own positions in the international tax system in order to protect fiscal autonomy. Otherwise, states would lose more discretion in fiscal policy because the vulnerability in a part of the international tax system spreads to the entirety as a result of analyzing the international tax system implies. We then assess the current major countermeasures against treaty shopping, which is a typical international tax avoidance technique. Considering the result of analyzing diverted cross-border investments, we assert that the current major countermeasures have room for further improvement on the criterion for determining whether income comes from genuine business activities. Lastly, we discuss the possibility that tax authorities effectively carry out inspections that discourage multinationals from having a hand in aggressive tax planning. An understanding of corporate structures might be useful for making inspections more efficient, according to the results for multinational corporate structures.

International tax system Under the current international tax system, the taxation of international transactions has been determined by the interaction among the domestic tax rules of the states from which the transactions are conducted. This is because the state sovereign principle provides countries with exclusive taxing power within their territories. As each state unilaterally designs its domestic tax rules, this naturally results in international transactions that can have the undesirable effect of being subject to double taxation. Several countries claim the same income under their taxation rights. In order to avoid this effect, various states have concluded tax treaties through bilateral negotiations that aim to adjust their taxing power. The international tax system has been built up in this way, with domestic tax rules and bilateral treaties serving as its components.

However, it was recently revealed that the bilateral approach had reached the limit of taxing power adjustment in a world where transactions can easily cross multiple jurisdictional boundaries. Some multinationals skillfully design their transactions to exploit the gaps or arbitrage in domestic tax rules and bilateral treaties, and successfully avoid taxation in any country. In Chapter 3, we looked into how

vulnerable the international tax system is to arbitrage, taking treaty shopping as an exemplary method of tax avoidance. We then constructed the WTN and calculated load centrality, which enabled us to numerically grasp which country or region was likely to be used for treaty shopping. Our analysis implies that a state's domestic tax rules and bilateral treaties are potentially affected by changes in other states' domestic tax rules and bilateral treaties. The interactions between its own taxation framework and that of others could create unexpected opportunities for international tax avoidance. It is, therefore, recommended that policymakers in each state continually monitor interactions, as well as examine their own taxation practices. It is necessary to develop tools that help policymakers quickly and easily estimate the risk of international tax avoidance, although it is not easy to determine where arbitrage occurs in the international tax system, due to it being made up of a large number of domestic tax rules and bilateral treaties. Network science might therefore be a useful perspective for the development of these tools given its ability to quantitatively analyze complex systems.

The assessment of interactions with other taxation is in particular required for developing countries, which are said to be significantly fiscally damaged by treaty shopping. Indeed, many developing countries are eager to conclude tax treaties with developed countries in the hope that firms from the developed countries will make more investments in their jurisdictions, as can be seen from the recent increase in the number of tax treaties. There are about 4000 in the world, and those with developing country contracting states account for about 25% of the total. However, tax treaties can also provide another country for international tax avoidance schemes, as was mentioned above. It is noted that the conclusion of tax treaties could raise the possibility of treaty shopping and lead to the loss of tax sources for the contracting states [85]. Therefore, developing countries must assess the effects that new tax treaties are likely to have on them when they decide to conclude them.

Moreover, such vulnerabilities make the entire system vulnerable, as if arbitrage exists in any part of the international tax system, it is likely to be exploited. Community detection from the WTN implies that the harmful effects of treaty shopping are not retained in countries with arbitrage, but often spread to other countries in the system. In order to protect the entire international tax system from vulnerabilities, it is necessary to eliminate arbitrage that makes it possible for some countries to be used to take advantage of the system's design for tax avoidance purposes. However, the system inevitably entails arbitrage that can be used for multinational tax strategies, as long as the components of the international tax system are unilaterally and bilaterally established. The multilateral approach is, therefore, necessary to prevent arbitrage from damaging the system. Policymakers in the international tax arena must work on the multilateral agreements that fill in the gaps that are harmful to a wide range of countries within the system.

It has been asserted that multilateralism is unrealistic in the context of international taxation, because states are subject to different legal and economic circumstances [127]. In seeking not to surrender any degree of fiscal autonomy, states have also not been welcoming of any international rules that lead to the

restriction of a free hand for designing their own domestic tax rules or negotiating bilateral tax treaties. However, they should note that too strong a claim for fiscal autonomy incurs the loss of fiscal autonomy, which is proof that multinationals exploit arbitrage that the pursuit of their own national interests or sovereignty creates. We believe that fiscally autonomy fundamentally entails the right for a state to decide on public service provision within its borders. As each state has different legal and economic conditions, each state should decide on the quantity and quality of public services it favors.[1] However, international tax avoidance can gradually deprive states of public service autonomy by damaging their tax bases, which are the most important financial resources for public service provisions. Taking these factors into account, it may not be a bad choice to somewhat bind a free hand on taxation power and ensure that the more important value of fiscal autonomy is enshrined.

The multilateral approach may seem like "cartels" in the arena of international tax, but it does not mean that the international community should eliminate tax competition. We believe that tax competition does not always bring negative effects, considering market mechanisms and administrative costs [129]. However, unrestricted competition doubtless results in undesirable results. Fair competition always requires a level playing field on which each player can equitably compete. It could be desirable that the international community agrees with the regulation of certain types of taxation that harm other countries' autonomy for public service provisions as a rule in tax policy. This would help countries as participants in the world market compete with each other in a sound way in terms of their tax policies.

In this context, the project that the OECD started around 1996 to address harmful tax practices [130] should be further evaluated. The report that the OECD published in 1998 as a result of the project's findings highlighted the factors that could make countries' taxation practices harmful. Because it also attempted to develop a blacklist of so-called tax havens, it has been frustrated by the oppositional movements [22]. Despite the deadlock, the spirit of the project has been taken up in the forum on harmful tax practices (FHTP). The FHTP has reviewed global preferential regimes since 1998, and its work has also been incorporated in the BEPS project as Action 5 [131]. The international community requires the support of these efforts to continually clarify the characteristics of harmful tax practices. This might therefore be an important milestone on the road towards stated rules for taxation policies that are multilaterally agreed upon. In fact, the international community is seeking to agree on multilateral rules, such as the global anti-base erosion mechanism proposed by the OECD [132].

Countermeasures against treaty shopping The international community also recognizes the necessity of multilateral approaches to tackling the issue of international tax avoidance. Even though a jurisdiction may unilaterally reduce the opportunity for international tax avoidance provided by its policies, the jurisdiction remains exposed to opportunities in other jurisdictions that make up part of the international tax system. In order to remove all such opportunities that exist in the system, the BEPS project formulated

[1]The level of public service provision substantially differs, even among OECD countries, which have the world's richest economies. For instance, in 2018, France spent 55.9% of its GDP on its expenditures, whereas Ireland spent 25.5% [128].

the Multilateral Convention to Implement Tax Treaty Related Measures to Prevent Base Erosion and Profit Shifting (MLI) as a multilateral instrument [133]. The MLI includes all countermeasures against international tax avoidance, which the project requests that its participating countries implement. It is epoch-making that jurisdictions revise their tax treaties without individual bilateral negotiations, and the opportunity for international tax avoidance is expected to be dispensed with among the jurisdictions that join the MLI.[2]

The MLI contains countermeasures against treaty shopping. The first of these is stated clearly in the title and preamble of tax treaties, noting that the purpose of such a treaty is not to create an opportunity for international tax avoidance. The second countermeasure is to introduce prevention of abuse clauses, such as the limitation-on-benefits (LOB) provision and the principal purpose test (PPT) [135]. In order to prevent treaty shopping, the LOB provision determines whether a taxpayer is qualified for the receipt of tax benefits, whereas the PPT examines the main purpose of a transaction within the framework of a tax treaty and determines whether tax benefits should be granted. The jurisdictions that participated in the BEPS project could choose from three options: the PPT, both a detailed LOB provision and an anti-conduit provision, or both a simplified LOB provision as well as the PPT [136].

The LOB provision and PPT have both good points and bad ones. The good point of the LOB is that the criterion for granting tax benefits is both concrete and objective. It minimizes the broad discretion of tax administrators and enhances the taxpayers' predictability. However, it also tends to be a complicated criterion, and it is often difficult to quickly deal with new treaty shopping schemes. On the other hand, the PPT is superior at points where the criterion for denying tax benefits is simple and can be applied to new schemes that are not predicted when the PPT is first introduced. However, this could reduce taxpayers' predictability, because the criterion is not written in a comprehensive manner and does not specify which transactions are denied tax benefits. Up until now, the PPT seems to be preferred, especially by governments of developing countries. As its criterion is simple and inclusive, it is easy for such countries to implement it and use it to deal with various treaty shopping schemes. The business community is, on the contrary, concerned with the "abuse" of the PPT by tax authorities. If tax benefits are easily denied, even to legitimate economic activities, commercial entities could not conduct business in foreign countries within a stable environment.

We believe that more concrete and objective criteria are generally better as anti-avoidance measures, although it is difficult to predict all potential schemes for treaty shopping in advance. This is because a wide range of discretion by tax authorities could be problematic, not only in terms of taxpayers' predictability but also its enforcement. Overly general and inclusive criteria could make some tax administrators hesitant to deny tax benefits, even to transactions that were seemingly inappropriate, because taxpayers might take their applications to court and cases concerning tax matters usually incur much time and high costs. We believe that the burdens that clear anti-avoidance rules bring to tax

[2]As of 2020, 95 jurisdictions joined the MLI, and three expressed interest in it [134].

authorities are lighter than those that vague rules would introduce in the long term.

Assuming all of the above, what criteria should be established as countermeasures against treaty shopping? The comparison between the LOB provision and PPT serves to remind us of an interesting point. Although the LOB provision and PPT may seem to deal with treaty shopping in contrasting ways, both share a common understanding that tax benefits should be granted on the basis of operations with business justification. The LOB provision features an active trade or business test, and the PPT does not intend to abolish tax benefits afforded by genuine business activities. In fact, this attitude is the same as the controlled foreign corporation (CFC) rule,[3] although the schemes that the CFC rule targets differ from those that the LOB provision and PPT do. The CFC rule makes whether an economic activity is genuine a fundamental criterion for triggering taxation. The CFC rule differs, however, from the LOB provision and PPT at the point where the criterion is elaborately expressed as an economic substance test. The CFC rule has more concrete and objective stipulations concerning genuine business activities than the LOB provision and PPT [135].

We therefore think that it may be better for countermeasures against treaty shopping to have stipulations related to genuine economic activity, as elaborated in the CFC rule. Our analysis of cross-border investments in Chapter 5 implies that the finance and insurance sectors and the wholesale and retail trade etc. sectors are probably extensively involved in the exploitation of tax benefits. It might be effective to regulate treaty shopping by presenting concrete and objective criteria for these sectors. The CFC rule, in fact, specifies several business activities that are lacking in positive economic rationality. If countermeasures against treaty shopping have more elaborated active trade or business tests such as the CFC rule, taxpayers could develop their foreign operations without the fear of sudden tax burdens and tax authorities also could avoid the risk of dealing with unnecessary court actions.

Tax administration Tax administrations have played an important role in adequately imposing and collecting tax revenues. However, they face many challenges that arise from the asymmetry between local legal systems and global economic activities. It is difficult for tax administrations to acquire information related to international transactions. Due to enforcement legislation, these administrators are not allowed to cross borders for the acquisition of information. Their access to information is limited to the extent that multinational affiliates in their jurisdictions possess it, even though multinational tax planning usually involves their affiliates in other countries. The asymmetrical information between taxpayers and administrations makes it more difficult to prevent inappropriate tax behaviors such as international tax avoidance. The fact that tax authorities usually do not have enough human and financial resources further exacerbates the situation. It is not easy to effectively assess taxpayers in a situation where the number of firms, including multinational affiliates, is steadily increasing. There is a growing need for tax authorities to carry out tax inspections with limited resources.

[3] [137] details the CFC rule in Japan.

Tax authorities and the international community have made efforts to eliminate information asymmetries. They have built a legal framework structure for the exchange of information with foreign tax authorities in order to overcome the obstacle of enforcement legislation. The tax authorities have negotiated with their foreign counterparts to include the exchange of information clauses in tax treaties or to conclude tax information exchange agreements (TIEA). The international community, moreover, established the convention on mutual administrative assistance in tax matters with 137 jurisdictions as of 2020 [138]. In this way, tax authorities gain access to information on transactions that involved foreign countries. However, there is still a limit on the extent to which tax authorities grasp the overall picture of multinational tax planning, because the information is essentially exchanged bilaterally within these frameworks.

It is noticeable that the BEPS project seeks to enhance the environment for the exchange of information. The project requests participating nations to implement the Country-by-Country reporting (CbCR) standard [139]. This standard provides that large multinationals must prepare CbCR and submit it to local tax authorities. It has the potential to illuminate multinational tax planning because it contains data on multinational global operations, such as profits, taxes paid, economic activities, and multinational organizational structure. The OECD's analysis of anonymized and aggregated CbCR statistics has already revealed interesting insights into multinational activities [140]. The CbCR data that tax authorities of a country individually collect can then be exchanged with foreign counterparts, in accordance with the Multilateral Competent Authority Agreement on the exchange of Country-by-Country reports (CbC MCAA). It is expected that the CbCR standard helps tax authorities properly and effectively weigh the risk of international tax avoidance.

The BEPS project also recommends that participating nations adopt mandatory disclosure rules. In order to enhance tax compliance and evaluate the risk of aggressive tax planning, the rules request taxpayers or promoters, such as tax lawyers and accountants, to disclose their tax planning arrangements to tax authorities [141]. It is suggested that the schemes that tax authorities of a country collect be shared with those of foreign countries via the Joint International Taskforce on Shared Intelligence and Collaboration network (JITSIC), which 42 tax administrative bodies joined as of 2020. Because schemes progress and change by the day, for appropriate and effective tax inspections, it is desirable that tax administrators understand new schemes for aggressive tax planning strategies in a timely manner. It seems that the rule has not yet been introduced into a wide range of jurisdictions because of strong opposition, although the EU has already introduced the rules by Council Directive (EU) 2018/822. The problem is that multinationals have expressed little interest in disclosing information on their tax strategies. They are also afraid that it would be a heavy burden to prepare the documents submitted to tax administrations. A further mutual understanding between taxpayers and tax authorities is required, so that the information asymmetry is resolved.

As well as the legal framework intended to enable the exchange of information, it is also important

that tax authorities with limited resources effectively make the best use of information received from other jurisdictions. The analysis of multinational corporate structures in Chapter 4 provides a clue for resolving the issue concerning how tax authorities should more effectively investigate taxpayers involved in cross-border economic activities. The results suggest that an understanding of corporate structures could greatly help tax administrations narrow down the multinational affiliates suspected of international tax avoidance. Our model successfully identifies the key affiliates that played an important role in multinational tax planning through equity investment information to a certain extent, whereas many empirical studies concerning international taxation have sought to illuminate the tendency towards international tax avoidance through a comparison of financial information with tax rates. In order to protect the trust that the public has in taxation processes, tax authorities should be expected to utilize information obtained from the CbCR standard [142] to observe mandatory disclosure rules to understand the overall picture of potentially manipulative tax planning practices by multinationals.

Chapter 7

Policy processes

Legal systems are difficult to cross borders, while economic activities are easy to cross them [143, 144]. The asymmetry between the legal systems and the economic activities causes problems in various policy areas like the international tax system [145, 146]. The system has been designed unilaterally due to fiscal autonomy, although applied to cross-border economic activities. As a result, the system has arbitrage used for international tax avoidance, and states annually lose no less than 500 billion USD tax revenue. In order to overwhelm this issue, the international community commits itself to establishing international rules that encourage worldwide taxpayers to pay tax adequately in each jurisdiction. As an international organization, the OECD has played a central role in such a multilateral effort.

In order to understand the OECD's work in the international tax arena more, the author carried out an overseas internship of the GSAIS) at the CTP, the OECD's directorate dealing with tax issues, for six months since April 2019. The OECD has been an essential international organization in the international tax arena since the end of WWII. The author joined the division of Tax Policy and Statistics (TPS) and engaged mainly in three projects. The first project evaluated the effectiveness of countermeasures against international tax avoidance. The second project investigated multinational business activities from the viewpoint of taxation. The third project estimated tax revenues under the so-called digital taxation. Through the OECD's work, the author studied how research approaches contribute to solving global issues practically and understood how the OECD facilitated the formulation of international tax rules.

The construction of this chapter is as follows. Section 7.1 describes our overseas internship. In Section 7.2, the international tax policy procedure in the OECD, an international organization, is explored on the basis of experience in the internship. Section 7.3 summarizes this chapter.

7.1 Overseas internship

The GSAIS provides an overseas internship as its curriculum in order to enrich practical research that considers issues when solutions derived from academic research are implemented in real society [147]. Our overseas internship was conducted in the CTP, a directorate of the OECD, for six months since April 2019, supported financially by Japan Public-Private Partnership Student Study Abroad Program. Since

the end of WWII, the CTP has played a central role in making international rules in the international tax arena. The author was assigned to the TPS, which is a division of the CTP and provides tax policy analysis and recommendations to governments by an interdisciplinary team consisting of economists, statisticians, policy analysts, and lawyers [148].

Our overseas internship was conducted mainly for the following two purposes. The first purpose is to study how research approaches contribute to solving global issues. The OECD is the best destination for our overseas internship because it is both an international organization consisting of 37 member countries and a research institution with 2500 expertise. The second purpose is to explore policymaking procedures in an international organization. Considering the implementation of any solutions deduced from academic research into the real international community, it is necessary to understand current processes on which international rules are shaped and agreed upon by governments. We analyzed how rules are established in international taxation, which is a policy area with conflicting national interests most and without enough attention from researchers.

The duties during our internship were mainly related to the BEPS projects and the taxation of the digital economy. For instance, we attempted to improve the measurement of BEPS by using new data that governments have started to collect from multinationals due to the project. Along with this, we tried to numerically evaluate how effective a solution recommended by the project is in terms of regulating tax avoidance behaviors. Tax revenues estimation was also carried out for discussions about the taxation of the digital economy.

The BEPS project that deals with the global issue of international tax avoidance has proposed several ways to make multinational business activities more transparent in terms of tax payment. Its representative example is Country-by-Country Reporting (CbCR). The final report of the project Action 13 advises governments to require headquarters or affiliates of large multinationals in their jurisdictions local to report their global operations to local administration, if their annual worldwide revenue is more than 750 million EURO.

Governments aggregate their CbCR data at the jurisdiction-level and voluntarily provide it to the OECD in order to improve BEPS data analysis [149]. The data is now made public on the OECD Stat [150]. Ahead of its release, its preliminary analysis was conducted during our internship. For instance, its data reveals multinational contributions to corporate tax revenues, as Figure 7.1 shows. The blue part indicates corporate tax revenues from domestic multinationals, while the orange part indicates those from foreign multinationals. Ireland, known as a country being used for international tax avoidance, got corporate tax revenue mainly from foreign multinationals. In contrast, the US, known as a country being suffered from international tax avoidance, got corporate tax revenue mainly from domestic multinationals. It reveals more clearly that countries might have different national interests in international taxation.

The discrepancy between business activities was also investigated. As mentioned in Chapter 2, it is noted that multinationals locate their business activities around the world for mitigating their global tax

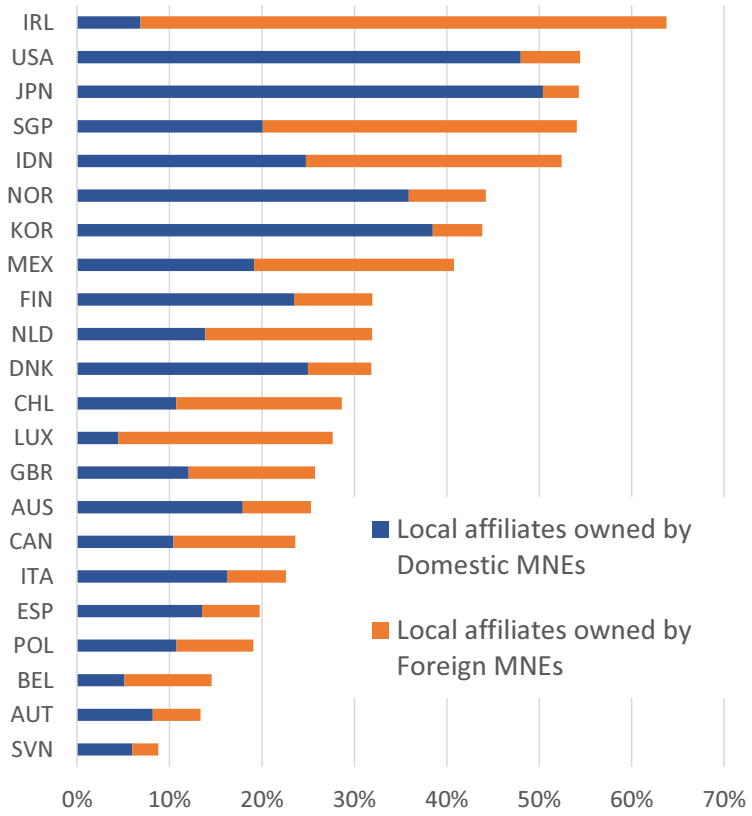


Figure 7.1: **Multinational contributions to corporate tax revenue revealed from CbCR.**
Note: IRL refers to Ireland, USA refers to the United States of America, JPN refers to Japan, SGP refers to Singapore, IDN refers to Indonesia, NOR refers to Norway, KOR refers to Korean, MEX refers to Mexico, FIN refers to Finland, NLD refers to the Netherlands, DNK refers to Denmark, CHL refers to Chili, LUX refers to Luxembourg, GBR refers to the United Kingdom, AUS refers to Australia, CAN refers to Canada, ITA refers to Italia, ESP refers to Spain, POL refers to Poland, BEL refers to Belgium, AUT refers to Austria, and SVN refers to Slovenia.

payments as well as genuine business purposes. For instance, multinationals of which business models are based on intangible assets, such as IP, often attempt to conduct their R&D activities in high-tax rate jurisdictions and locate their holding IP activities in low-tax rate jurisdictions. R&D activities tend to be carried out at high-tax rate jurisdictions partly because tax rates are usually high in jurisdictions where it is easy to access people who get higher education. However, the main reason is to deduct the expense for their R&D activities from taxable income earned at high-tax rate jurisdictions as much as possible.

It is not a problem for multinationals to deduct the expense for their R&D activities at high-tax rate jurisdictions if intangible assets created from these R&D activities are managed in the same jurisdictions. However, multinationals often transfer these assets to affiliates established in low-tax-rate jurisdictions so that considerable profits brought by these assets avoid being subjective to high tax rates.

We sought to reveal these multinational tax planning statistically, using data on CbCR about the number of business activities conducted by multinational affiliates in each jurisdiction. Figure 7.2 arranges countries in descending order of differences in the numbers of R&D and IP holding activities.

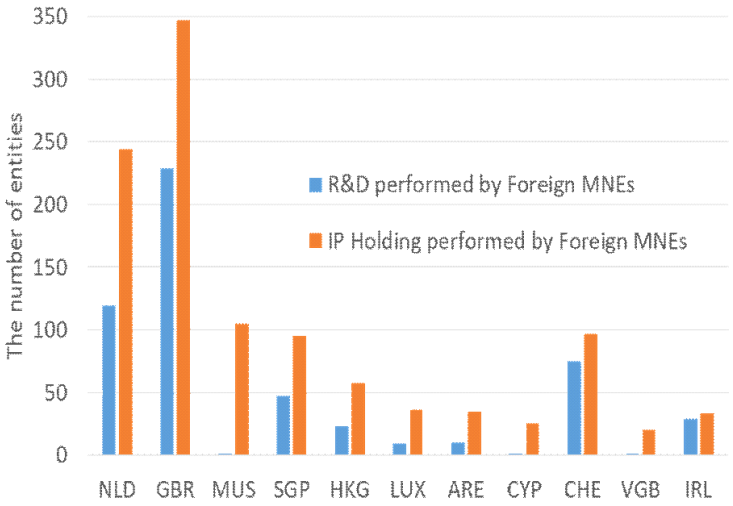


Figure 7.2: **Misalignment between R&D and IP holding activities conducted by foreign affiliates of multinationals subject to CbCR.**

The blue bar indicates the number of R&D performed by foreign multinationals, while the orange bar indicates the number of IP holding performed by foreign multinationals. It shows that the number of IP holding activities tends to be more than the number of R&D activities in countries that are said to provide tax benefits to IPs.

Although this preliminary analysis has revealed many aspects of BEPS, note that this data has some limitations. It covers a limited part of international taxation because it is not an obligation for governments to submit their CbCR to the OECD. In addition, it does not necessarily include clear evidence of BEPS because it is aggregated data by country and includes data about multinationals that aggressively avoid taxation and not. A future study should look for a way to overcome those limitations.

We also attempted to evaluate a countermeasure against tax avoidance behaviors proposed by the BEPS project. For instance, the project has recommended governments ratify the Multilateral Convention to Implement Tax Treaty Related Measures to Prevent Base Erosion And Profit Shifting (MLI) [151] to regulate treaty shopping behaviors. We quantitatively measure how effective this multilateral treaty closes opportunities for treaty shopping with researchers of a Dutch think tank [49]. The estimation revealed how much average avoided tax rate is lowered and changes in each jurisdiction's relative favorability for treaty shopping.

Moreover, we tried to look for ways to calculate residual profits by using available data in order to estimate tax revenues brought by a proposal about the taxation of the digital economy. In the on-going discussion about its taxation, residual profits are thought to be profits derived from intangible assets, and one of the main topics is how these profits should be divided among governments. The OECD has sought to have governments reach a consensus by providing the estimated amount of these profits to governments and let them understand the impact of its taxation. Currently, it estimates annual worldwide residual profits at 510 billion USD [152].

7.2 International policy procedure among OECD countries

International organizations have recommended various policies to national governments to resolve global policy issues and improve the quality of people's lives. They analyze policy issues scientifically, look for reasonable solutions, and design policies that governments can implement practically. In order to make their proposed solutions more effective, they also try to formulate international rules that prompt national governments to follow best practices. However, it is not easy to take into account various countries' opinions, achieve consensus agreements, and promote initiatives, especially when countries do not necessarily share values and policy goals. Even when governments do agree on broad policy goals, they often disagree on the practical details of implementation.

In today's world, industrialized countries are gradually losing economic power, and emerging and developing countries are steadily gaining power as the world economy becomes more globalized. The proportion of global GDP represented by emerging and developing countries was 40% in 2000, increased to 49% in 2010, and will reach 57% in 2030 [153]. In order to address global issues, it is crucial to involve these countries in international policymaking and create shared values that countries of various backgrounds can embrace.

This section discusses how the OECD contributes to formulating international standards as developing countries are gaining power within the international community. Firstly, we review how the OECD became an international organization composed of industrialized countries, and describe the features that distinguish it from other international organizations. Secondly, we explain the OECD's general procedures for making policy recommendations and setting international standards. Thirdly, it is discussed how the OECD generally relates to non-member countries. Lastly, it is explored how the OECD involves the member and non-member countries and furthers the process of developing to international standards, taking the BEPS project, which intends to reform the international tax system, as an example.

The Organisation for Economic and Co-operation and Development

The OECD was established in 1961 in accordance with the Convention on the OECD; its headquarters is in Paris, France. It deals with a broad range of policy areas from macroeconomy to society, unlike other international organizations that deal with specific policy areas, such as the International Monetary Fund (IMF) for exchange policy and the World Trade Organization (WTO) for trade policy. It also lacks the UN's mandate to maintain world peace and security or to facilitate global cooperation. As of 2020, the OECD had only 37 member countries [154], about one-fifth of the 193 countries participating in the UN. The OECD countries are characterized by a strong commitment to democracy and reliance on market mechanisms. The OECD is supported financially by contributions from member countries, which vary in size depending on each members' economic scale. In 2019, the budget amounted to about 386 million euros [155], which is 14% of the UN budget, 40% of the IMF budget, and 230% of the WTO budget. About 2,500 staff work at the OECD Secretariat; this number is 5% of the UN, almost the same

as the IMF's staff size, and more than four times that of the WTO. The OECD's work usually appears in publications rather than in the conclusion of treaties or agreements. It publishes as many as 250 titles annually.

Along with many of the characteristics of an international organization, the OECD also bears some characteristics of a European organization, derived from its historical background. It was initially established in 1948, shortly after the end of WWII, as the Organisation for European Economic Co-operation (OEEC). In 1947, US Secretary of State George Marshall stated, in a speech at Harvard University, that the US government was ready to support European countries in restoring their war-damaged economies. He also urged European countries to take the initiative in clarifying what aid was needed for their recovery and in preparing a mechanism that would make US aid effective. The subsequent aid program from the US to European countries would become known as the European Recovery Program or the Marshall Plan. As part of its response to the US offer, European nations decided to create the OEEC, the primary initial purpose of which was to discuss and decide on the most effective distribution of US aid. The OECD, as a reconstitution of the original OEEC, continues to consist primarily of European countries. Also, the European Commission (EC) or its predecessor, the European Economic Community (EEC), has been heavily involved in the organisation's work from the beginning.

During the 1950s, European countries smoothly rebuilt their economies and regained economic strength. Meanwhile, the US government gradually came to recognize the need for a forum to coordinate economic policy and collaborate with European countries on foreign aid policy. The US external foreign trade balance was getting worse, and colonies in Asia and Africa were successively becoming independent. In 1960, the Development Assistance Group (DAG) was set up as an institution to coordinate foreign aid policy in the OEEC. In 1961, the OEEC was reorganized into the OECD so that the US and Canada could function as full participants alongside the OEEC member countries. These two countries had been associate members of the OEEC. At the same time, the DAG was reorganized as the Development Assistance Committee (DAC), a subordinate body of the OECD. In 1964, Japan joined the OECD as the first member that had not been involved with the OEEC. The OECD began to become more international in scope by including non-European countries.

The OECD is characterized by a wide breadth of policy involvement. It was initially established to deal with economic growth, development, and trade (according to Article 2 of the Convention on the OECD), but it now covers all policy areas except military security, including topics as diverse as agriculture, corruption, technology, and energy. The OECD is frequently called a think tank for governments. It provides its member countries with information and knowledge by analyzing various policy issues to help governments implement better policies so that people can lead better lives. As it deals with a broad range of policy areas, it can examine issues from multidisciplinary viewpoints. For example, it horizontally considers aging-related issues from medical service and public finance to employment

and education. This makes it more valuable to governments facing complicated, interconnected policy challenges.

The OECD is also distinguished from other international organizations by its ability to anticipate emerging future policy issues ahead of others. It analyzes newly significant topics and provides its findings to member countries to guide policy discussions. The OECD's work often leads to the establishment of international standards, partly because its analysis facilitates the development of common understandings that sometimes spread even to non-member countries before the issues have surfaced in other global forums. For example, governments are currently eager to discuss digital taxation. Initial conversations on this topic took place at an international conference on e-commerce that the OECD held in 1998. At this conference, member countries and other related international organizations discussed various aspects of e-commerce, such as privacy, technology, and consumer protection. The resulting agreement concerning international taxation was announced as the Ottawa taxation framework. Current discussions are based on this framework.

International policymaking processes facilitated by the OECD

As Figure 7.3 illustrates, the OECD consists of three parts: a council, committees, and a secretariat [156]. The interactions among them enable the OECD's work to progress. The council is the lead entity and the OECD's decision-making body. It includes representation from each member country and the EC. As for council meetings, the ministerial-level meeting is held once a year, and meetings of permanent representatives occur twice a month. At the ministerial-level meeting, the representatives discuss the challenges that the member countries face and prioritize them for OECD consideration. They also discuss the topics to be on the agenda at upcoming G7 summit meetings, in which the major industrialized countries participate. On the other hand, the meetings of permanent representatives discuss decisions that would affect the member countries and make policy recommendations. The General Secretariat of the OECD serves as a chairperson in council meetings and provides strong leadership when the member countries do not have a common view.

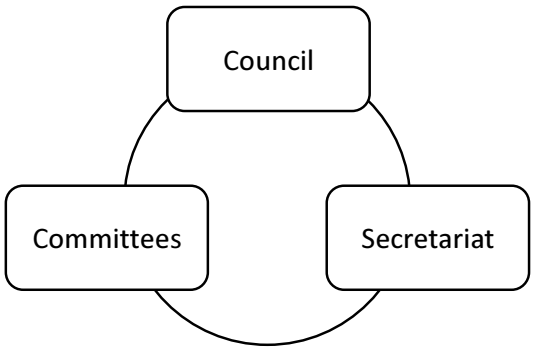


Figure 7.3: **Organizational structure of the OECD.**
Source: [156]

The committees cover every major policy area, such as economy, trade, science, employment,

education, and finance. Counting expert and working groups, there are more than 300 committees overall. Committee-level meetings discuss policy issues, develop and advance proposals, and review progress. Although official representatives are the main participants, other people often participate. In all, the OECD sessions attract about 40,000 participants a year from academia, non-governmental organizations (NGOs), and other stakeholders. These people also contribute to the OECD's work by examining proposals and asking the OECD's secretariat to look into particular issues. The committees thus become places where the OECD collaborates with various stakeholders, playing an essential role in making the OECD's work effective.

The secretariat carries out the work delegated to it by the council, following the priorities that the council set. Figure 7.4 illustrates its organizational structure. Along with four special bodies, such as the Development Centre, and four special entities, such as the Financial Action Task Force, it has twelve departments that cover a broad range of policy areas, such as the Development Co-operation Directorate. The Secretary-General, elected by the member countries, leads the 3,300 staff, most of whom work at the OECD headquarters, and who enable the secretariat to collaborate smoothly with the member countries' representatives. The staff includes economists, lawyers, scientists, government officials, and former politicians. Their main work is to support the committees. As experts, they are actively involved in the examination and discussion of policy issues help with such tasks as document preparation and translation. They analyze the issues that the member countries face, prepare discussion drafts for the committees, compose reports, and assemble the views of member countries.

Figure 7.5 illustrates the typical process by which international policies are shaped within the OECD [156]. It comprises five steps: direction from countries; data collection and analysis; discussion and consultation; standard setting and policy guidance; and implementation support, peer reviews, and multilateral surveillance. Through this process, the OECD encourages countries to agree on global goals and standards. The process usually begins with member countries raising issues. New investigations are launched when several member countries raise a concern or present a policy topic that has not previously been examined. Contrarily, the secretariat sometimes identifies issues that the OECD should deal with.

In response to direction from these sources, the secretariat initiates data collection and analysis. Good data are essential for the OECD's work because they make analysis and recommendations evidence-based and objective. The organisation has attempted to resolve various politically challenging issues that could arouse opposition from some countries by conducting scientific research. They usually collect data published by governments, other organizations, and private companies. If data needed for their analyses are not available, they will ask governments to submit data or send staff to help them collect data. They also obtain data by developing new statistical methods. An exemplary example of this is the Trade-in Value-Added (TiVA) [158], which decomposes international trade statistics to a value-added level. Also, they often design indicators to evaluate each country's policy achievement. Indicators help governments and the OECD find better policies around the world and identify what makes the policies better. These

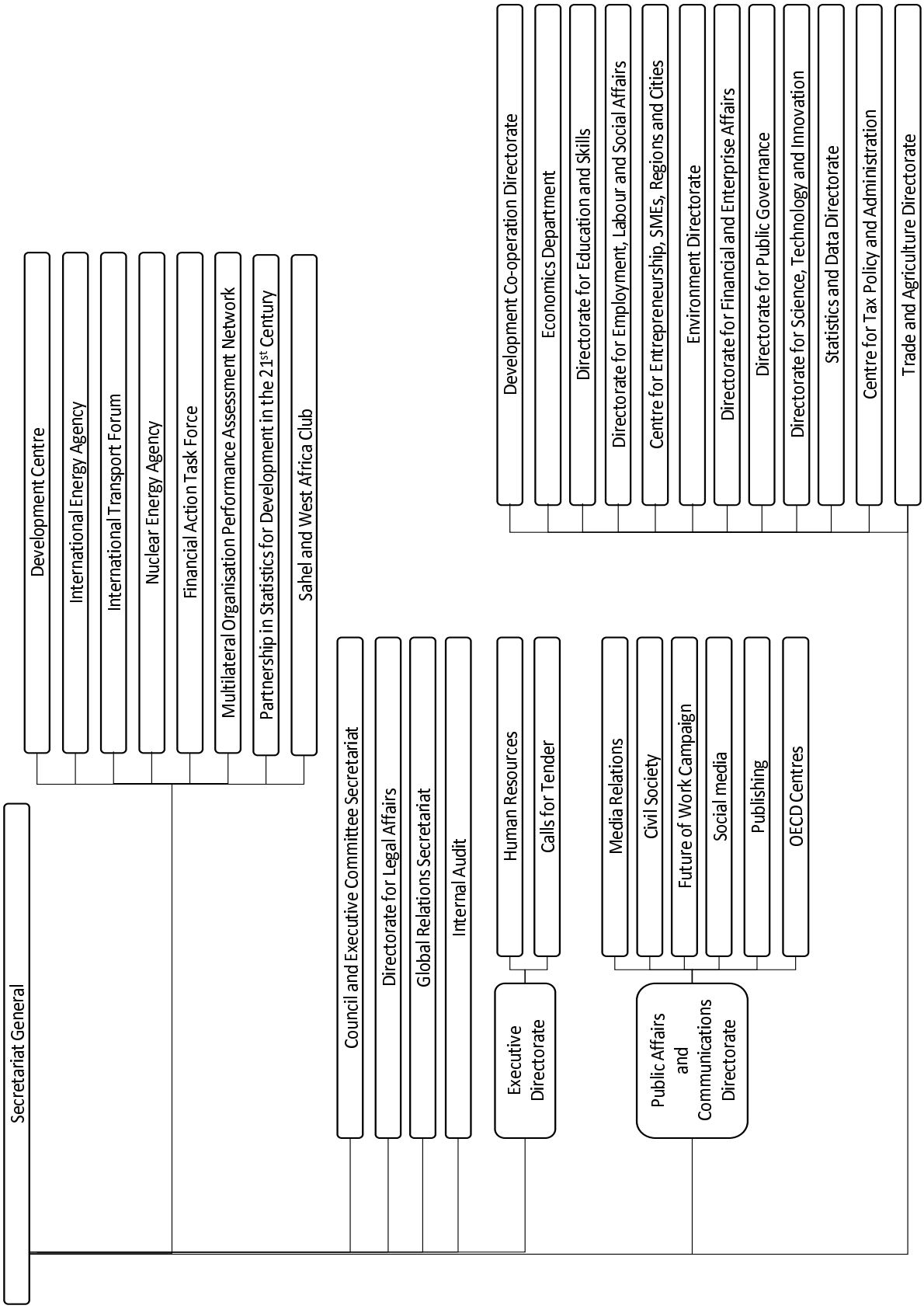


Figure 7.4: **Organizational structure of the OECD secretariat.**
Source: [157]

Figure 7.5: **International policy process at the OECD.**
Source: [156]

data are collected primarily for the OECD work, but most of them are released on their website [159] so that citizens, researchers, and NGOs utilize them.

In the committees, representatives from member countries give the secretariat feedback on analyses conducted by the secretariat. They then discuss policy issues on the basis of findings from such analyses and facilitate peer learning by sharing their experience with others. Multi-stakeholders, such as academia, NGOs, and private sectors, are often invited to the committees in order to take various viewpoints into their discussions. In this way, a common understanding of a policy issue is gradually established among the member countries. The committees are an essential engine of the OECD work.

Discussions held in the committees ultimately evolve into international agreements or policy guidance if the OECD member countries can achieve a consensus. Consensus herein means that there is no strong opposition from any representatives. All of the member countries participate in discussions on an equal footing. The OECD rarely takes voting to obtain agreements, and none of them have the right of veto. This system enables member countries without enormous economic powers to affect decision-making. Moreover, the agreements and guidance adopted by the OECD usually feature no legal binding force. That is why some scholars distinguish them from international laws and call them soft law.

Once an agreement or policy guidance is adopted, the secretariat then supports its implementation. Such support is offered even to non-member countries because it is beneficial for the facilitation of global economic integration if non-member countries also introduce the standards and guidance developed by the OECD. The system for making the standards and guidance effective on global policy issues involves peer review and multilateral surveillance. The OECD encourages countries to monitor each other voluntarily in order to check whether member countries are appropriately following adopted standards and guidance. Peer review or multilateral surveillance is usually carried out in the following way. First, the secretariat schedules a screening session. Before the session, the government receiving the screening submits relevant materials concerning its policy to the secretariat. During the session, the representative of a government explains the policy to other countries. The countries designated in advance as questioners ask questions regarding the policy, based on the materials and the explanation presented. Finally, the secretariat integrates the results of the session into a report, which clarifies what aspects of the country's performance merit favorable recognition and what should be corrected, as well as what new policies are recommended. These peer reviews make the OECD standards and guidance, which otherwise have no binding force, influential within the international community.

Taking the area of taxation as an example, we can see how international taxation standards have been shaped through the OECD's history. Directorates in the OECD primarily help member states to improve their policies and administrations. However, the CTP differs from other directorates in that it has played a central role in discussions on international taxation rules ever since WWII. Taxation is a policy area closely connected with national interests. The CTP's activity offers insights into the process of international policy development.

Taxation policy work within the OECD progresses through close interaction between the relevant committees and the secretariat. The Committee on Fiscal Affairs (CFA) is the committee responsible for tax matters, whereas the CTP is responsible on the secretariat's side. As the upper part of Figure 7.6 illustrates, the committee comprises ten working parties, forums, or task forces that deal with different aspects of international taxation. The lower part of Figure 7.6 shows the CTP's five divisions that also deal with the different aspects of taxation. The divisions of the CTP are paired with the working parties, forums, and task forces of the CFA. For example, the Tax Policy and Statistics division (TPS), which is in charge of tax statistics, economic analysis, tax policy advice, and consumption taxes [148], is paired with working party 2 (WP 2) on tax policy analysis and tax statistics and working party 9 (WP 9) on consumption taxes.

Within the CTP, the Tax Treaty, Transfer Pricing, and Financial Transactions division (TTP), staffed by lawyers and member countries' public officers, mainly drafts international standards and policy guidelines. The TPS, whose staff are economists, statisticians, lawyers, and policy analysts, mainly conducts data collection and analysis, collaborating with other related directorates such as the economics department. While analyzing issues and drafting documents, the secretariat holds workshops and invites opinions from scholars and stakeholders. The results of analyses and draft documents are presented in the meetings of the working parties, forums, or task forces. In the meetings, the member countries' representatives express opinions about the results and drafts, share their experiences with other countries and the secretariat, and discuss related policy issues. In order to enable these meetings to run smoothly, the secretariat sometimes sets up an executive committee, composed of a limited number of representatives, and discusses meeting agendas in advance. After the meeting, the secretariat drafts a summary of the proceedings and asks the representatives for comments. Based on the comments received, the secretariat modifies the summary and distributes it to the representatives.

The secretariat sometimes has joint working sessions to coordinate the discussions held by different working parties, forums, and task forces. In this way, the CFA can build consensus among the member countries and send proposals to the council. After the proposals are adopted as international standards or policy guidelines, the International Cooperation and Tax administration division (ICT) helps countries implement the standards and guidelines and monitors whether countries are meeting the agreed-upon structures appropriately by means of peer review.

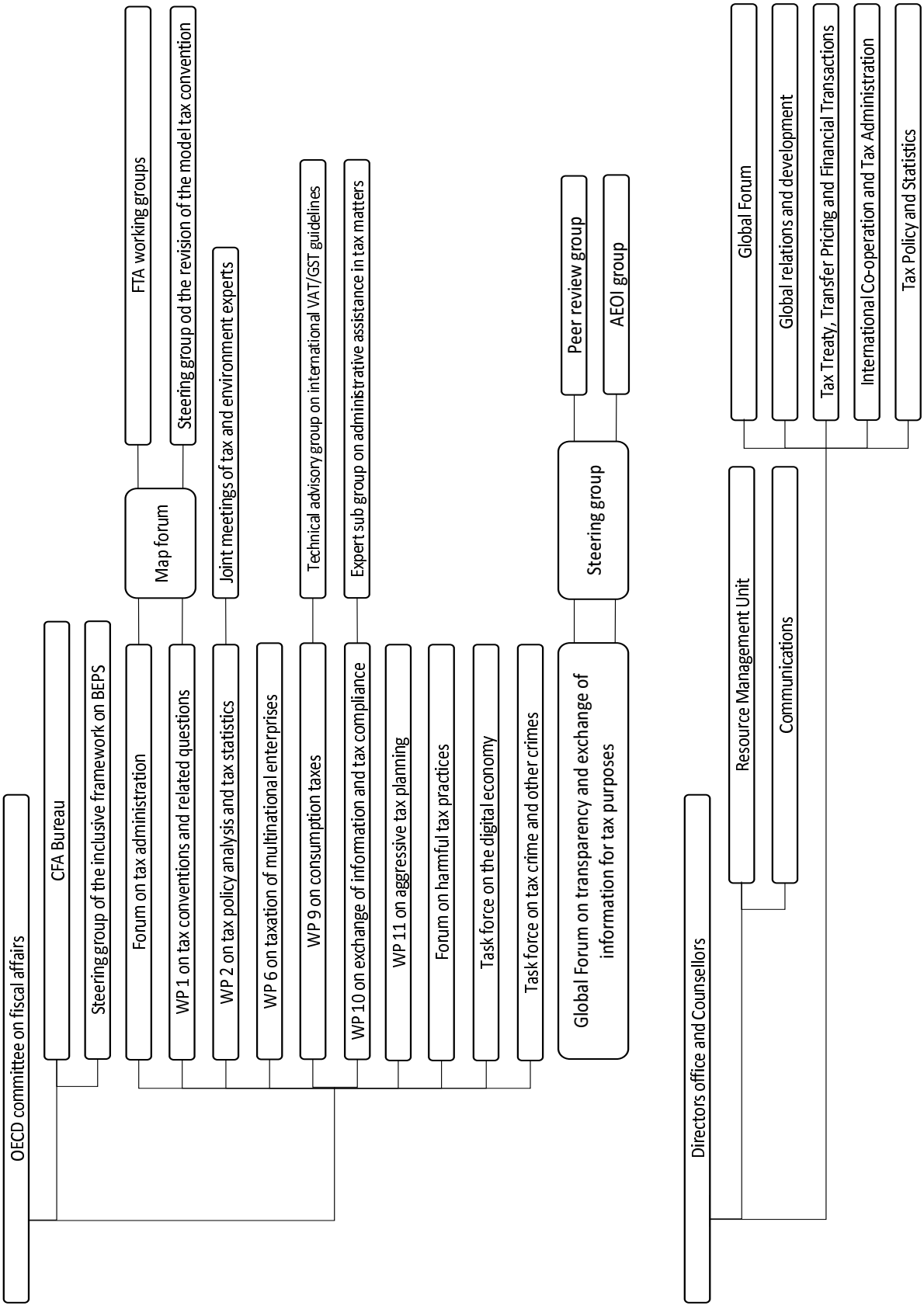


Figure 7.6: **Organizational charts of the CFA and the CTP.**

The OECD's work is not aimed only at industrialized member countries. In order to contribute to the expansion of economies in developing countries, the OECD is also active in development assistance as its second mission. In order to enhance the efficiency and effectiveness of development assistance, the DAC has been set up as the OECD committee where donor countries discuss all issues related to aid to developing countries [160]. The committee encourages donor countries to coordinate their foreign assistance policies and to consider what cooperation is possible toward achieving shared development goals. In addition, donor countries mutually examine and compare their assistance policies to evaluate whether the policies are truly helping recipient countries. By releasing reports on foreign aid policy and implementation (e.g., [161] reviews development assistance by Irish governments), the committee has inspired donor countries to improve their policies. Moreover, the committee has taken a leading role in the development assistance arena by presenting the international community's perspective on the future direction of assistance policy [162].

In addition to these indirect interactions with non-member countries through discussing and coordinating donor countries' assistance policies, the OECD is involved with non-member countries more directly through its outreach activities to developing countries and the participation of developing countries as observers. In terms of outreach activities, the organisation implements technical assistance in a wide range of policy areas, providing non-member countries with seminars and materials. Moreover, it sends staff to non-member countries on request to investigate the policy issues at hand, examine existing policies, and make policy recommendations.

In the case of tax issues, the OECD assists developing countries in tax administration through the CTP, which is a directorate of the secretariat. The CTP has several divisions that are deeply involved in developing countries. The Global Relations and Development division (GRD) has launched programs that help developing countries implement international tax standards [163]. One representative program is called Tax Inspectors Without Borders (TIWB). In order to enhance developing countries' tax audit abilities, the OECD sends tax experts from developed countries as part of a collaboration with the UN Conference on Trade and Development (UNCTAD) (see [164], which is an annual report of the program). It also offers developing countries opportunities to acquire knowledge concerning international taxation, such as the Global Relation Program in taxation (GRP). In addition, the TPS sends tax policy analysts to assess a country's tax system and make recommendations at the request of non-member countries (e.g., [165] provides tax policy advice for Kazakhstan).

The other type of assistance involves participation by non-member countries in the discussions held in the OECD. If the council approves a non-member country's request to participate, the country can join the committees as an observer, even though it does not have equal status with OECD members. The non-member countries are usually permitted to participate in the committees if they have already been significant players in specific policy areas. For instance, the OECD works closely with Brazil, China,

India, Indonesia, and South Africa, all of which are major emerging economies. They take part in the organisation's work, discussions, and surveys as critical partners. Involving non-member countries in the OECD's work contributes to the smooth integration of the world economy [162]. The communication between non-member and member countries through the OECD helps member countries to understand non-member countries better and encourages the latter group to accept international rules and perform as responsible players in the world economy.

One example of such collaboration in tax policy and administration is the global forum on transparency and exchange of information for tax purposes [166]. This forum discusses the standards used to monitor the application of Exchange of Information on Request (EOIR) and Automatic Exchange of Information (AEOI), which are legal frameworks for exchanging tax information among jurisdictions. Its membership characterizes the forum. It welcomes non-member jurisdictions as well as the OECD member countries. As of September 2020, 161 jurisdictions were involved in the forum. As the upper part of Figure 7.6 indicates, the forum is separated from the CFA. As in this instance, the OECD sometimes creates a new committee separate from existing committees.

Case study: the BEPS project

In order to reform international tax rules, the OECD has recently worked with both member and non-member countries in the BEPS project. Taking this project as a case study, we will explore how the OECD involves non-member countries and produces international rules.

The OECD, composed of major industrial economies, took over the role formerly occupied by the League of Nations (LN) and has led discussions on the setting of international tax rules since WWII. The member countries deliberate on international tax matters and agree on specific common standards, which are then propagated at the international standards through a model treaty and commentary. Consistent with the economic theory that the world welfare is maximized by maximizing resource allocation efficiency, the treaty and commentary prioritize investing countries' taxation rights and restrict recipient countries' taxation rights. The treaty and commentary as the international standards have taken investing countries' taxation rights well than those of recipient countries. This means that The treaty and commentary are naturally advantageous to industrialized countries, which are usually the source of foreign investment, and disadvantageous to developing countries, which are usually the recipients of foreign investment.

Despite such an OECD model treaty and commentary, developing countries have voluntarily accepted them as an international standard. This is partly because the OECD member countries have a tremendous political and economic influence on the international community. The primary reason is that developing countries have sacrificed part of their tax revenue to attract more foreign investment from industrialized countries. They have restricted their taxation rights on income generated within their boundaries as an incentive to foreign investors. Foreign investment is essential for nations that depend on it to develop

their industrial infrastructures.

However, developing countries' position toward the OECD model treaty and commentary has gradually changed, as the world economy is globalizing and the aid volume from industrialized countries has declined. They have begun to focus more on tax revenue than on foreign investment, although the latter remains crucial. Developing countries want to foster their development without financial assistance from industrialized countries by utilizing tax revenues as their development source. This tendency is especially apparent in large emerging economies, such as Brazil, China, India, and South Africa. They have sought to modify international standards, so that recipient countries are given more taxation rights. In response to the emerging economies, the UN has begun to regard work on international tax matters as a necessary activity. In 2004, the UN Economic and Social Council (ECOSOC) also upgraded an ad hoc group to the status of a committee [167]. In 2013, the UN presented a model treaty, which took into account the recipient countries' taxation rights [168]. Furthermore, the fiscal affairs department of IMF, which comprises 189 countries as of 2020, also has a strong interest in international taxation.

Under such circumstances, it is inevitable that the OECD should involve developing countries in its work on international taxation, in order to maintain its influence in the international tax arena and continue to function as the primary platform for the development of international taxation rules. There was a time where it was considered that UN would replace the OECD's position as the leading forum on international taxation, because the BRICS,[1] which was the primary economic engine after the 2008 financial crisis, preferred the former to the latter [169]. However, the OECD has continued to take the initiative in international taxation up to now. The decisive factor was the acquisition of political support from the G20, in which emerging countries also participate. In June 2012, the G20 Leaders requested the OECD to address tax avoidance issues in Los Cabos, Mexico. As a result of this request, the OECD launched the BEPS project. In November 2012, the project was welcomed at the G20 Finance Ministers and Central Bank Governors Meeting held in Mexico City, Mexico. In September 2013, the G20 declared full support for the project at its Leaders' summit held at Saint Petersburg, Russia, in response to a report that the OECD submitted to the G20 Leaders [170]. These events led to the first discussion of international tax rules involving developing countries, which further strengthened the OECD's position in the international tax arena.

When drafting international standards on a policy issue, the OECD respects previous related work and discussions among the member countries. In Action 5 of the BEPS project, it has taken over the work of the Forum on Harmful Tax Practices (FHTP), which is a subordinate body of the CFA [171]. Along with this, the OECD refers to model practices adopted by particular countries as a way of responding to a policy issue. For instance, in Action 4 of the BEPS project, recommendations are based on existing German rules [172]. Moreover, a similar approach can be seen in the discussions regarding digital tax that have been a successor to the BEPS project's Action 1. The OECD has also proposed Global

[1]The bloc is composed of emerging economies Brazil, Russia, India, China, and South Africa.

Anti-Base Erosion (GloBE) measures as Pillar II [173], which appear to have been modeled on rules that the US government has adopted to counter BEPS behaviors, namely Global Intangible Low Taxed Income rules (GILTI) and Base Erosion and Anti-abuse Tax (BEAT) [174].

In the process of determining appropriate international standards, the OECD seeks input from researchers and private stakeholders. The OECD explains the drafts at workshops that invite expert opinions and the IFA, a global research community for international taxation. Likewise, the OECD actively interacts with the Business and Industry Advisory Committee (BIAC), an international business network representing more than seven million companies worldwide, and the Trade Union Advisory Committee (TUAC), an international entity representing the labor movement [175].

In the BEPS project, the OECD published 23 discussion drafts containing more than 12,000 pages of text and held 11 public consultations to receive opinions from as wide a range of people as possible [176]. The OECD seems to consider those opinions seriously, since the final reports differ from the discussion drafts at many points. Moreover, the discussions with academia sometimes affect the proposals significantly. For example, although the OECD had stuck to the Arm's Length Principle (ALP)[2] for a long time, it seems to have changed its attitude recently, introducing the idea of the residual profit allocation by income[3] to make international tax rules adapted to digitalized business models [177]. This idea probably originated with a proposal by Professor Reuven Avi-Yonah, an international taxation scholar who has pointed out the limitations of the ALP for the 21st-century context [178].

It is also noteworthy that the BEPS project includes a BEPS data analysis that facilitates fact-based discussions as Action 11. Through this analysis, countries could understand the magnitude of BEPS issues and monitor the effectiveness of countermeasures [149]. In 2015, the OECD revealed that governments worldwide were likely to lose total Corporate Income Tax (CIT) revenue of 100 billion to 240 billion USD every year [99]. As a result, governments and civil society have come to recognize the significance of BEPS issues and begun to cooperate in tackling them.

In order to expand the analysis and improve its quality, the OECD has put much effort into collecting related data on both member and non-member jurisdictions. It created a mechanism under which governments voluntarily offer aggregated data in CbCR. According to the BEPS project's Action 13, large multinationals have to submit CbCR, including their global business operations, to local tax administrations [179]. The OECD also launched a global revenue statistics tax database in 2018 [180] and a corporate tax statistics database in 2019 [181]. These databases are now the most comprehensive of their type in the world.

Additionally, the OECD has also designed indicators that help to identify BEPS behaviors. In its final report, six indicators are proposed based on the academic literature [99], although some governments

[2]Multinationals sometimes manipulate prices in transactions between their affiliates in order to allocate more profits to affiliates located in low-tax jurisdictions. In order to prevent such behavior, the arm's length principle requires multinationals to establish the prices as if the transactions were carried out between unrelated entities.

[3]The idea of the residual profit allocation by income focuses on residual profits rather than transaction prices. It allocates residual profits generated from multinational global operations to market countries.

have disagreed with their use. The OECD has also developed statistical methodologies, an example of which is the model used to calculate effective tax rates that accurately reflect investment incentives by considering depreciation and other deductions or allowances [182]. Another example is the analysis of the aggregated CbCR data, which revealed large multinationals from various viewpoints, such as contributions to CIT revenues, the size of key financial variables, and business activity allocations [183]. In order to provide meaningful insights to governments and civil society, the OECD staff actively communicates with academic researchers and other organizations, such as the IMF, through workshops. The analysis of treaty shopping is a good example of this [49].

The OECD has adopted a consensus method in the BEPS project, as it does in other projects. However, it was predicted that the project would face extreme difficulty in reaching agreements among participating countries, because international tax rules directly influence national fiscal interests. It would be even more challenging to secure a consensus encompassing developing countries, which do not necessarily share the values of the OECD member countries. Even if the OECD presented international tax rules, they would be ineffective as countermeasures against tax avoidance if some jurisdictions did not follow the rules. In order to overcome this difficulty, the OECD sought to balance international regulation and national autonomy by classifying recommendations into four categories: minimum standards, reinforced international standards, common approaches, and best practices. Participating countries must commit to implementing the recommendations classified as minimum standards in order to make the recommendations effective. However, they can decide whether to implement the recommendations classified into the other categories in accordance with their national autonomy.

In the BEPS project, the OECD utilized existing bodies and mechanisms as much as possible. According to the nature of the BEPS issues, the technical work was allocated to the CFA's existing working parties (WPs) (see the upper part of Figure 7.6). Countries and stakeholders participated in discussions at each WP. The project's legal aspects were covered mainly by WPs 1 and 6, although the issues related to harmful tax practices (Action 5) were handled by the FHTP and those related to mandatory disclosure rules (Action 12) were covered by WP 11. The project's data analysis was delegated to WP 2. Only two bodies were newly created for the project: the Task Force on the Digital Economy (TFDE), which worked on digital taxation (Action 1), and an ad hoc, non-permanent group, which worked on the multilateral instrument (Action 15) [184]. Non-member countries' opinions gave their input by joining the CFA. The CFA started with the OECD member countries plus eight non-member G20 countries and eventually expanded to 60 countries [176]. In this way, non-member countries have worked on an equal footing with member countries within all subordinate bodies on deliberations related to the project. In response to the G20's request, the OECD researched the impact of the BEPS in low-income countries [185] and obtained opinions from developing countries that did not participate in the CFA, through the UN and from various other bodies, such as the Task Force on Tax and Development (TFTD), the OECD GR Programme, and the Global Forum on Transparency and Exchange of Information for Tax

Purposes [171].

Again as in other OECD projects, a peer review system has been introduced into the BEPS project. In order to continuously develop the rules established in the BEPS project and monitor the rules' implementation, the OECD and the G20 established an Inclusive Framework on BEPS (IF) in 2016 [186]. The IF started with 82 jurisdictions and now works with 137 jurisdictions [187], of which more than 80% are non-member countries, as well as international organizations such as the IMF, the UN, and the World Bank. Under the IF, jurisdictions mutually review the implementation of minimum standards and discuss digital taxation, which was the focus of the BEPS project's Action 1.

Although more time will be needed to evaluate the BEPS project comprehensively, it has successfully involved emerging and developing countries and maintained the OECD's position as the leading forum on international taxation. In fact, the BRICS, which rarely mentions the OECD's work, endorsed it in the Ufa Declaration and has cooperated in implementing the BEPS action plans.

We see three reasons why the OECD can have a strong influence on establishing international tax standards in addition to political support from the G20. First, the standards they present to the international community are practically reasonable. The standards are drafted by the CTP, which has more than 400 expert staff and has accumulated much experience in coordinating various opinions. Through meetings and public consultation, the CTP staff reflect the perspectives of various policymakers, researchers, and stakeholders in their drafts. Second, the OECD pursues consensus among the participating countries when creating international standards. The discussions involved in a consensus encourage countries to commit themselves to supporting and implementing the decisions ultimately reached. Although a consensus method can often risk a breakdown in negotiations, the OECD puts great effort into keeping the discussions fact-based and arriving at objective solutions. Third, the OECD has a system to assist countries in implementing the standards effectively. Especially for countries with the limited administrative capacity to implement the rules, the OECD offers beneficial e-learning programs, training workshops, and implementation toolkits, in cooperation with other international organizations.

7.3 Summary

The author carried out an overseas internship of GSAIS at the CTP, one of the OECD directorates, for six months since April 2019 in order to deeply understand the role the OECD has played in tackling international tax avoidance. Through the internship, the author was engaged in three projects: evaluation of countermeasures against treaty shopping, analysis of CbCR, and tax revenue estimation under digital tax proposals. These projects allowed the author to learn how research approaches contribute to solving global issues practically and explore the policymaking procedure in the OECD.

On the basis of experience in the overseas internship, it is examined how the OECD currently makes policy recommendations and international rules. Firstly, we examined the OECD historically and considered what makes its work different from that of other international organizations. The OECD was

initially established for European countries, although it is an international organization for industrialized countries. The primary goal was to help European countries recover quickly from the massive damage inflicted during WWI by effectively implementing the Marshall Plan. After the recovery plan came full circle, the OECD has strengthened its role in coordinating industrialized countries' various policies by accepting non-European countries as members, such as the U.S., Canada, and Japan.

The OECD has been recognized as a reliable international organization with authority. It holds this status not only because it includes all major industrialized countries, but also because the OECD's work is distinguished for its multidisciplinary and pioneering research. No other international organization can analyze a wide range of issues beyond a specific policy area as the OECD does. It is also a leader in identifying and examining newly emerging issues. These strengths have made it the world's largest think tank for governments.

Secondly, we described the general procedure of making policy recommendations and international rules within the OECD. The OECD consists of three parts: a council, committees, and a secretariat. Its work takes place through the organic coordination of these three components of the organisation. The OECD encourages its member countries to participate in discussions and express their opinions mutually. When recommending policies, it seeks to achieve a consensus among its member countries. Unlike other international organizations, it usually makes its recommendations effective not through legal binding force but by peer influence and review among member countries. We concretely explained how these procedures occur, taking tax issues as an example. Along with this, the OECD does not include only member countries in its discussion. We explained that it engages non-member countries by coordinating foreign assistance policies, carrying out outreach activities, and welcoming non-member countries as observers of the committees.

Finally, we carefully explored how the OECD has formulated international taxation rules. Taking the BEPS project, which aims to reform international tax rules, as an example, we examined how the OECD has maintained its position as a forum on international taxation. The most significant factor is that the OECD successfully gained support from the G20, in which the world's largest emerging countries participate, and involved non-member countries in the project. Other factors have also strengthened the OECD's position. The outcomes of the deliberations are practically useful because its staff members work to incorporate the viewpoints of various experts and stakeholders. The consensus method gives all participating countries a sense of ownership and responsibility for the project. Jurisdictions are encouraged to implement the outcomes with various forms of support from the OECD and other international organizations. All these factors have helped the OECD-brokered agreements to gain wide recognition as international standards and preserved the OECD's status as a forum for discussing international taxation.

Chapter 8

Social implementation

We study a global issue of international tax avoidance as a problematic phenomenon brought by the asymmetry between globalized economic activities and localized legal systems. The purpose of this study is to seek a desirable international tax system under tensions between globalization and sovereignty. From Chapter 3 to Chapter 5, we examine phenomena arising from international tax avoidance through the approach of academic research. We also carried out an overseas internship at the CTP of the OECD, which is the field where policymakers and experts around the world discuss international tax rules and explore policy processes in which international tax rules are established.

In this section, we discuss the social implementation of solutions for international tax avoidance. Through Project-Based Research (PBR), we consider how the outcome of academic research on international tax avoidance is led to the social implementation of its solutions. Our PBR consists of two parts: a student workshop and applications of blockchain technology. For the workshop, we organized a student workshop in order to understand the OECD's work for adapting the current international tax system to global and digital business models. We invited an economist of the OECD as a special lecturer to the workshop. The lecturer was a supervisor during the overseas internship and took charge of economic analyses of the BEPS project and the so-called digital taxation discussed by the international community under the facilitation of the OECD and G20. By holding the workshop, we discussed how the international community overwhelms obstacles to collective policies and what taxation should be in the 21st century with its participants.

For applications of blockchain technology, we consider the possibility of solving international tax avoidance by applying blockchain technology to the international tax system. In the international tax arena, most experts and policymakers currently attempt to solve this issue by revising or creating international tax rules. To design new international tax rules would be effective for preventing taxpayers from improper tax-avoiding behaviors. However, it is challenging that countries with various backgrounds reach unified international agreements. Although advances in technology bring about international tax avoidance to the international tax system [188], at the same time, new technology might be useful for the effective prevention of international tax avoidance. Under the cooperation of experts of Ripple

Inc., a leading company of blockchain technology, we investigate existing patents related to blockchain technology and research the potential of blockchain technology for hampering international tax avoidance.

In Section 8.1, we explain the preparation and contents of the student workshop. Section 5 explores the importance of tax information for appropriate taxation and investigates the possibility that blockchain technology is applied to the international tax system for the purpose of solving international tax avoidance.

8.1 Workshop on BEPS and digital taxation

As part of our PBR, we invited the OECD economist in charge of international tax policymaking and organized the student workshop regarding international taxation with other students. The purpose of the workshop is to understand the role of the OECD as an international organization and the international community's trend regarding the BEPS project and the ongoing discussion on the so-called digital taxation.

Preparation for the workshop

In January, we asked Dr. Tibor Hanappi, who works for the OECD as an economist and was a supervisor of the author during the overseas internship (see Chapter 7), the possibility of giving a lecture in the workshop. As he kindly accommodated our request, we planned to have the workshop inviting him as a lecturer. As a result of discussing the date and time of the workshop between him and us, it was decided that it would be held from 6:15 p.m. to 7:45 p.m. on June 22nd, 2020. The start time was set after 6 p.m. so that students interested in its topic could join it as much as possible because university lectures finished at 6 p.m. The end time was set to 7:45 p.m. as a result of considering that there was a large time difference between France, where the lecturer was, and Japan, where most participants were supposed to be. Its venue was planned to be Higashi-ichijyo-kan [189] of Kyoto University. We originally plan that only the lecturer was going to participate in it online because he would be in France. However, the university prohibited all face-to-face events from being held on campus, responding to the spread of COVID-19 in Japan. Therefore, it was decided that the workshop was going to be held online by using Zoom [190], a virtual conference service.

We presented our PBR plan that includes the workshop to the GSAIS faculty members at the Presentation and Examination for PBR plans held on April 3rd, 2020. After receiving a letter that noticed that the GSAIS international committee approved his plan, we began full-scale preparation. We looked for the students who helped to have the workshop, and three students, Ms. Bandal Apurwa Rajendra, Mr. Botong Gao, and Mr. Myasoedov Fedor, kindly accommodated our request. We discussed the structure of the workshop to encourage participants to participate in the workshop actively. As a result, the workshop was decided to consist of two parts: the lecture given by Dr. Hanappi and a group discussion among participants.

We also discussed how the workshop would be enjoyable even to the students who did not major

in taxation because we supposed that most participants were probably not familiar with taxation. The three students were very suitable for considering this matter because their majors were different from each other. We thought that it might be great that the lecture dealt with a general issue rather than some specific issues, although the workshop was concerning international taxation. One of the options under their consideration was how the OECD approached global issues as an international organization. We thought it might evoke participants' interests because their research topics were usually related to global issues, even though they did not major in taxation. We told the lecturer our thought and sounded him about his lecture topic by email. As he agreed with us, it was decided that he would talk about how the OECD tackled so-called international tax avoidance and digital taxation and how the OECD's research contributes to those discussions.

In May, we found that the workshop fell on the training session that the AISIMAS Impact Center Kyoto (AISIMAS), the group established by some GSAIS students and graduates, organized for service learning in Laos. We had a chance to participate in AISIMAS's internal meeting to ask them about the possibility of changing the date of their training session and collaborating with them for the workshop. As a result, AISIMAS agreed on the change of the date and accommodated our request. It was then decided that AISIMAS members considered the topic of the group discussion, the second half of the workshop, with the three students and the author.

We had several online meetings to discuss a topic of the group discussion with the three students and AISIMAS members from the following two points. The first point was the connection between the special lecture and the group discussion. If a topic of group discussion were irrelevant to the special lecture, the workshop would lose unity. The second point was whether a group discussion topic was easy to be discussed by all participants. We thought a more general discussion topic would be great so that even participants who were not well informed about taxation could actively join a group discussion.

Finally, "what should be taxed" was decided as a topic of the group discussion, considering the content of the special lecture. In the first half of the workshop, the lecturer was going to pick up on the so-called digital taxation that the international community discussed to correct the imbalance with traditional business models. However, taxation was still controversial among countries and private companies. On the basis of this fact, we decided to discuss what kind of tax was willingly accepted by people because we ought the acceptance of the public was an essential element when governments designed new taxation.

It was also decided that the group discussion would proceed by the following two steps. First, the participants would be assigned to small groups. Each small group would have one facilitator, who would help the participants discuss the topic. The three students and two AISIMAS members, who were Ms. Satsuki Shioyama and Ms. Ayaka Watanabe, were decided to serve as the facilitators.

Contents of the workshop

Based on the consideration mentioned above, the program was decided to be as follows. We announced the workshop by making a poster and sending emails. As a result, it got about 40 participants from inside and outside the university.

- [Session 1] Special lecture
  Title: Multilateralism in Global Tax Policy: the Role of the OECD
  Lecturer: Dr. Tibor Hanappi

- [Session 2] Group discussion
  Topic: What should be taxed?
  Facilitator: Ms. Ayaka Watanabe, Ms. Bandal Apurwa Rajendra, Mr. Gao Botong, Mr. Myasoedov Fedor, Ms. Satsuki Shioyama

Session 1: Special lecture The lecturer was a leading expert in an ongoing discussion on digital tax in the OECD. He works as an economist for CTP that deals with international tax rules. He also was a supervisor during the author's overseas internship. Based on our request to speak about the role of the OECD as an international organization plays in a policy area of international taxation, he gave a special lecture under the title, "Multilateralism in Global Tax Policy: the Role of the OECD."

In his lecture, he mentioned that international organizations' role was not limited to providing the international community with a place to discuss. Especially when a country's interest conflicts, providing objective and neutral analyses of policy issues was important for encouraging the international community to reach a consensus. He took a digital tax, one of the OECD's projects that attracted worldwide tax policymakers' attention, as an example, introduced the OECD's economic analyses, and showed the timetable for an international agreement that the OECD and the international community agreed. He said that the OECD, as an international organization, had built the base for discussions and facilitated international discussions by sharing its objective and neutral analyses and making efficient timetables with the international community countries.

Session 2: Group discussion The group discussion topic was "what should be taxed?" so that even the persons who were not familiar with taxation could enjoy the discussion. The participants were assigned to five small groups and discussed it with other participants. The group discussion was initially planned to be proceeded face-to-face by putting sticky notes on a big paper. However, it had to be held online because all face-to-face meetings were prohibited on campus due to COVID-19. Although there was a certain limitation, an online service called Miro [191] was used in the workshop to get close to the environment of face-to-face group discussion as much as possible. The service provided each small

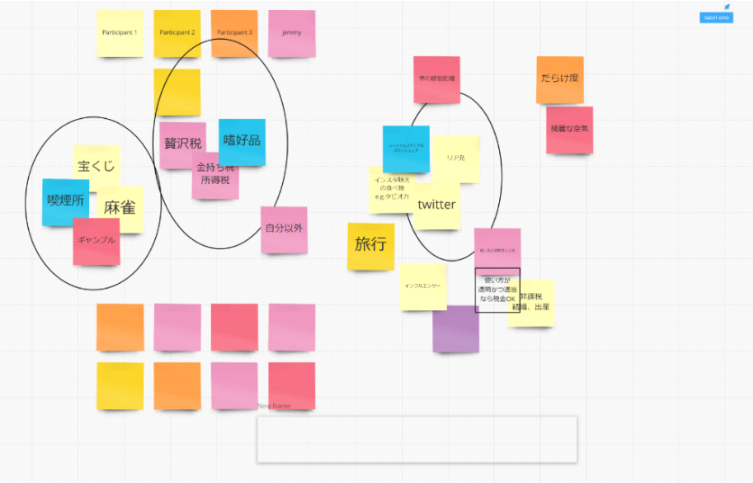


Figure 8.1: **Miro's discussion board used by a small team for the group discussion.**

group with a discussion board that allows the participants to put sticky notes on a virtual big paper. Figure 8.1 is the discussion board used by a small team for the group discussion.

After discussions in each small group, each group's representative shared their discussion with other small groups' participants. The lecturer then gave comments as a tax expert. Most of the discussions held in small groups were that governments should impose a tax on something negatively impacting society. One small team raised environmental tax as a measure against global warming, and others proposed a "bachelor tax" under consideration of an aging society with fewer children. The common idea was that tax could perform as a sanction and that governments can lead people to "desirable" behaviors by taxation. The lecture's comment on those discussions was that tax should be neutral in any behaviors. In other words, it is not desirable that tax distorts taxpayers' behaviors from the viewpoint of efficient resource allocation.

Although it was challenging that the participants discussed an unfamiliar topic of taxation in front of computers, the group discussion smoothly proceeded because five facilitators effectively demonstrated their leadership. Interestingly, the discussions in each small group and the lecturer's comment showed two conflicting aspects in policymaking. Theoretically, taxation should be neutral, but practically taxation needs to be "unneutral." It is always difficult how society should compromise between them [220]. As a whole, it was good that the participants had a chance to think about what role tax should play in society through the group discussion.

8.2 Blockchain technology application

International tax avoidance is a global issue that the international tax arena faces. As a solution to the issue, the student workshop took up the BEPS project and the so-called digital tax. The common idea between the project and the tax is to solve issues by amending or formulating international tax rules. On the contrary, correctly grasping tax information is another promising idea for a prevention measure.

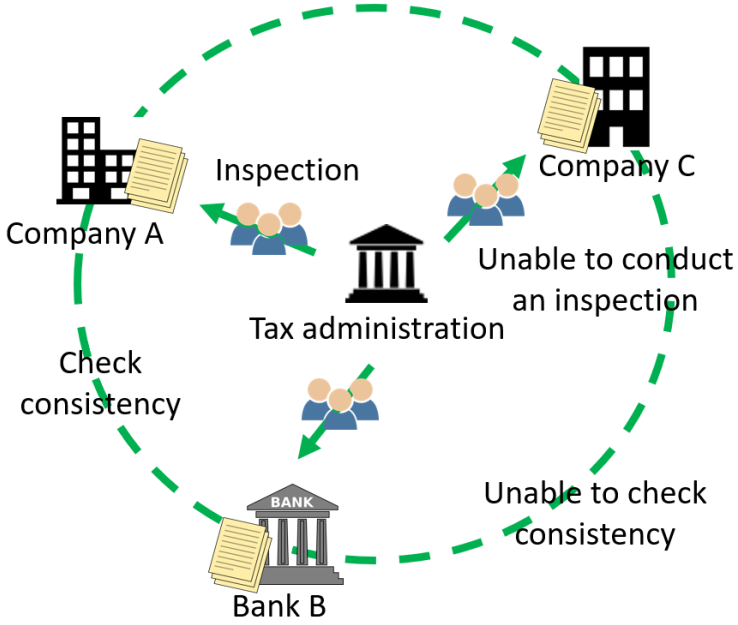


Figure 8.2: **Tax information encourages tax administrators to impose taxes appropriately.**

As part of his PBR, he has considered the potential of applying blockchain technology to a grasp of tax information under the cooperation from the experts of Ripple Inc., a leading company of blockchain technology.

Tax information

It is necessary for imposing and collecting a tax appropriately that tax administration grasps enough and accurate tax information about taxpayers and their transactions [192]. Taxpayers and tax administration have spent time and incurred costs to secure the accuracy of the information written on tax returns. Taxpayers need to leave their business activities on an enormous amount of tax documents and keep them securely for a long time under legal obligation. In addition, some new international tax rules have recently required more tax documents for the administration to measure the risk of tax avoidance. Tax returns that they submit to the administration are based on those tax documents.

The administration usually acquires the tax information through those tax returns. It regularly carries out tax inspections of taxpayers to confirm whether taxpayers correctly record the tax information on their tax returns. If the tax information acquired from the inspections of a taxpayer did not correspond with others' information, it would suspect the existence of improper tax behaviors. For instance, a seller's tax documents are compared with a buyer, as Figure 8.2 illustrates [193]. They are sometimes compared with the information on the bank accounts of the seller and the buyer. The incoincidence would possibly suggest wrongdoing.

Of course, the incoincidence is sometimes caused by the mistakes that taxpayers made when filing their tax documents. It seems that such cases are not a few, as required tax documents get complicated nowadays. However, the tax administration still needs to conduct tax inspections to find certain tax fraud

cases. Otherwise, taxpayers might be demotivated to declare their business income correctly, and honest taxpayers would not pay under the tax system.

Although tax inspections are an indispensable element for facilitating proper tax behaviors, they may risk taxpayers' rights like privacy. The administration searches tax documents and conducts interviews on tax information at their offices. It is an enormous burden to conduct inspections, even for the administration. The administration has to spend its limited human resources on looking for and examining paper-based tax documents. It sends some personnel from limited variable staff as tax inspections.

Moreover, globalization makes it hard to facilitate taxpayers' proper behaviors. Taxpayers conduct their business worldwide. However, the administration normally does not have any right to access tax information held by overseas taxpayers due to sovereignty. The administration is losing chances to notice improper taxpayers' behaviors because it cannot check the consistency of tax information between domestic and overseas taxpayers. Therefore, if a domestic taxpayer tries to carry out tax fraud in conspiracy with an overseas taxpayer or overseas affiliates, it is often difficult that the administration proves the existence of frauds or even notice it.

It had been recognized a serious issue in the international tax community that improper tax behaviors, such as tax evasion, international tax avoidance, and tax fraud, are facilitated by the fact that the tax administration cannot acquire the tax information outside its territory. The legal clause for the exchange of tax information can go back to the OECD model treaty drafted in 1963, and in 2000 the OECD listed the jurisdictions uncooperative with the exchange of tax information, such as the so-called tax havens [194]. The situation was greatly changed by Foreign Account Tax Compliance Act (FATCA) that the US government enacted in 2010. FATCA forces foreign financial institutions to report US citizens' financial account information to the Internal Revenue Service (IRS), the US tax administration. The enactment was triggered against the background of two banking scandals: the Liechtenstein Global Trust (LGT) scandal and the Union Bank of Swiss (UBS) scandal [195, 196]. The former is the scandal where an LGT employee provided the German tax administration with bank account information. The latter is the scandal where the US arrested a former UBS employee who helped US clients evade US tax through bank accounts. Following the US government, the international community made the legal framework and approved Common Reporting Standard (CRS) in 2014. Under the CRS, the tax administration automatically exchanges the information of financial account that a partner country's citizens have in its territory with the administration of the partner country [192].

The range of the information exchanged has expanded to the global operation of multinational enterprises. It gave rise to strong opposition from the citizens that multinationals had aggressively avoided their tax payments worldwide while the citizens were suffered from a worse fiscal balance due to the financial crisis in 2008. In order to strengthen the appropriate taxation on multinationals, the administration started to exchange CbCR with the administration involved in the multinationals

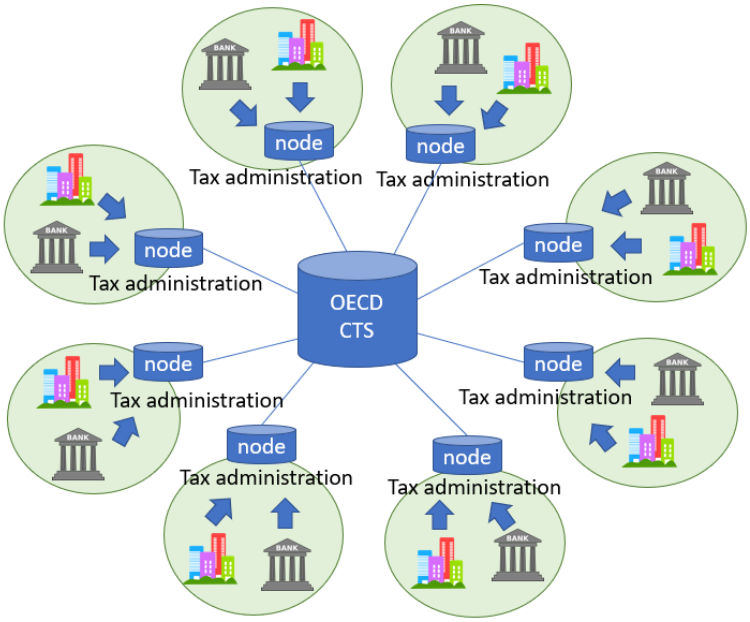


Figure 8.3: OECD Common Transmission System plays a hub of exchanging tax information.

from 2017. CbCR is part of the BEPS project's outcome and requires multinationals to submit their tax-related information to the local administration. It includes information on local operations of multinationals, such as the amount of revenue, the amount of tax paid, the number of employees, and business activities. Exchanging the CbCR helps the administration grasp an overall picture of multinational global complicated operations, especially among their affiliates.

As Figure 8.3 illustrates, the information is practically exchanged through the Common Transmission System (CTS), the Information Technology (IT) system for tax information the OECD launched in 2017 for the first time. The CTS checks whether the administration follows the international protocol and exchanges the information. These legal frameworks for exchanging information among the administration seem to overwhelm an issue of asymmetric information between taxpayers and the administration. However, it is noted out that some issues remain.

The most serious one is regarding the confidentiality of tax information [197]. The business community is especially worried about the improper use of tax information exchanged (see e.g., [198]). If the information exchanged is leaked to taxpayers' competitors in some ways, the taxpayers are harshly likely to be damaged because tax-related documents usually contain information sensitive to taxpayers' business strategies. Nevertheless, taxpayers' rights in the exchange of tax information are hardly protected by current international tax rules [199]. Practically, their rights are protected by a law court of countries involved. [200].

Another issue is who incurs the cost required for the exchange of tax information. It naturally takes the CTS costs to operate and maintain. In the case of automatic exchange of bank account information, the financial institutions are practically forced to bear expenses related to FATCA and CRS regime.

However, it is a question of whether it is reasonable to impose such expenses and administrative burden to press on private institutions to bear related expenses as well as collect tax information instead of tax administration.

There is also an issue for the tax administration side. It is that some developing countries are not allowed to connect the system because they have not prepared domestic systems enough to satisfy international security protocols [201]. If the situation continues where some countries cannot participate in the exchange system, the effectiveness of exchanging tax information in improper tax behaviors will be lost. Taxpayers with malice may use the countries without participation as a cover for improper tax behaviors like international tax avoidance.

Even though it has been recognized that tax information is essential for imposing a tax appropriately, it has recently been shed light only on the legal aspect. The international community has typically made an effort to allow the tax administration to legally access the information outside its territory to overwhelm a problem of the information asymmetric caused by globalization. It has not been paid enough attention to how taxpayers and the tax administration practically generate, keep, and transit the tax information [202], although it has been pointed out that the administration needs to complete arrangements for managing tax information[1]. It is necessary to utilize tax information effectively to consider the system for tax information.[2].

Blockchain technology application

Blockchain is the technology initially invented to create a cryptocurrency called Bitcoin [205]. It has attracted significant attention because it may change the way to exchange. Taking money as an example, banks have been necessary for sending money certainly and securely. However, blockchain can realize a certain and secure exchange without reliable intermediaries like banks. Because of the feature, cryptocurrencies using blockchain have also been created one after another. As a result, the trade volume of cryptocurrencies has increased so much that it is discussed how they should be counted into macroeconomic statistics [206].

Since blockchain does not need intermediaries, there is a great possibility of reducing the time and cost necessary for exchange [207]. For instance, international remittance has brought remitters many days and costs because multiple intermediaries are usually involved in it as intermediaries. However, blockchain technology enables them to send money directly to recipients at a low cost. The remittance will also not be interrupted by intermediaries' conditions, such as maintenance or system error. If a smart contract is incorporated into blockchain, the transactions are automatically checked and executed without humans' help.

Blockchain technology technically makes intermediaries unnecessary[3]. In the blockchain system,

[1] [203] is counted as one of the oldest Japanese literature that discusses issues related to tax information.
[2] [204] discusses elements that a system dealing with tax information needs to have.
[3] [208] gives a detailed explanation of blockchain technology.

its participants as nodes record transaction data, unlike the traditional system where some reliable intermediaries keep the data. The data held by participants is encrypted by the hash function and protected by an electronic signature so that anyone without a secret key cannot manipulate the data. The participants check whether a new transaction is consistent with previous transactions to prevent manipulation. If the participants recognize the consistency, the new transaction will be approved by a blockchain system. Therefore, if anyone intends to manipulate some transactions, they need to rewrite the participants' data. Otherwise, the manipulated data will be denied due to the lack of consensus among participants. However, manipulation is practically hard because rewriting the data takes an enormous time and cost. In this way, blockchain is powerful in the prevention of manipulating data.

Blockchain features can be utilized in other areas besides currency because the currency exchange is almost equivalent to the data exchange. Blockchain potentially helps the issues concerning managing, exchanging, sharing the data securely. In fact, the possibility of applying blockchain is considered in many areas, such as the so-called Internet of Things (IoT) and the sharing economy. Blockchain technology is also set up as a research area by the social innovation center established by Kyoto University [209]. It is hoped that blockchain technology contributes to solving global issues [210].

In this section, we consider blockchain applications that prevent improper tax behaviors, facilitate fair taxation, and liberate people from administrative burdens related to tax returns [211] as part of our PBR. We aim to clarify gaps between issues the current tax system faces and things achievable by blockchain technology. We review existing studies and patents, and discuss the applications with two experts of Ripple Inc., Ms. Yoshikawa Emi, a vice president of human resources, and Ms. Liz Chien, a vice president of global tax.

On the basis of existing studies and patents, we categorize blockchain applications into three groups: secure exchange of tax information, accurate record of tax information, and the prevention of diversion of funding to pay tax. We describe a representative example for each group and introduce related patents in the following. As an example of secure exchange of tax information, we consider utilizing blockchain technology for the exchange of tax information among tax authorities. An example of accurate records of tax information, we mention the Value-Added Tax invoice system using blockchain. Then, we pick up the payment VAT using a cryptocurrency to prevent diversion of the funds to pay tax.

Secure exchange of tax information

As mentioned above, the tax administration currently exchanges tax information through a central system called the CTS that the OECD launched. The CTS checks whether the information exchanged through itself follows the security protocol agreed by the international community. However, if the amount of data exchanged and the number of the administration connected to the network increase, the CTS as a central computer needs to increase the ability to process the data and take the security measure more.

There is the possibility of utilizing blockchain for exchanging tax information among the tax ad-

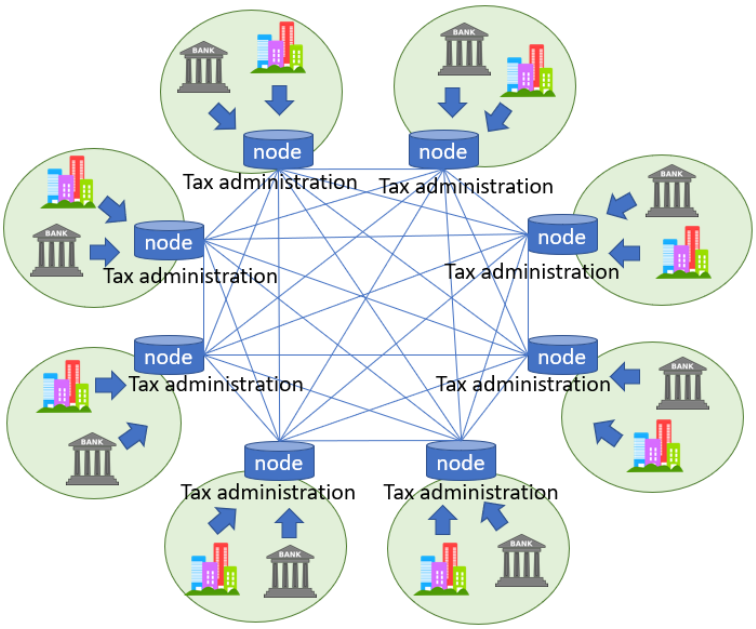


Figure 8.4: **A blockchain technology potentially enables tax administrators directly to exchange tax information with each other.**

ministration. As Figure 8.4 illustrates, the tax administration exchanges the tax information directly to another administration through blockchain. The required ability to process the data might be lower than the current system because an autonomous distributed system of blockchain distributes the processing to each tax administration's computers. The blockchain can check the security issues if the smart contract incorporated into the blockchain checks whether the information exchanged follows the international security protocol. The cost of maintaining the system of tax information exchange probably falls because it is not necessary to keep a central computer for the system. Also, blockchain is usually more resistant to data manipulation than the system located in a third party like international organizations.

The sensitive information is not limited to tax information. For example, genome information is also sensitive to privacy because a person's genome information reveals and predicts its health and may expose its family's genome information. It is also similar in the point where the information is expected to be shared among related parties. Genome information is essential for progressing research in various fields, such as biology and medicine. Therefore, the system is needed where the genome information sensitive for privacy is easily shared under high security.

The way to store and transfer genome information by multiple blockchains is proposed and registered as a patent [212]. The proposed system has five blockchains, and each blockchain has plural nodes. The user information blockchain has users' hash keys and personal information. The contract information between users is recorded on the electronic contract blockchain. The metadata blockchain has the genome information encrypted with public keys. The data transmission blockchain holds the genome information transmitted and the hash information on the users that carry out the transmissions. The data storage blockchain stores the genome information kept in the storage server.

Currently, there is virtually no protection for taxpayers about the exchange of information [197]. The only way to claim taxpayers' rights is to bring the tax administration involved before the court when taxpayers are concretely damaged from the exchange. However, if the tax administration uses blockchain technology when exchanging tax information with the foreign administration, a court can be checked later how the information is exchanged. Moreover, taxpayers' rights are automatically protected by embedding clauses to ensure proper procedures as a code [213].

Accurate record of tax information

The VAT system using blockchain technologies is thought to be the most prominent case of blockchain application. Many experts have proposed the idea of applying blockchain technology to VAT. The idea has already tried to be implemented in several countries, such as Thailand. The most advanced example might be the case of Shenzhen in China. In August 2018, Tencent provided the system called Tencent Blockchain as a Service (TBaaS) [214]. The system has been used by about 140 million people daily. So far, firms have usually been required to make and keep invoices to pay tax properly. The invoices have been printed on paper or saved as data on computers. However, companies input the information into the system, and it manages VAT invoices by utilizing blockchain technology.

The information on VAT needs to correspond among related parties, such as buyers, sellers, the tax administration, auditors, and banks, to ensure VAT is paid correctly. Humans have checked the correspondence because invoices have been issued paper-based. The system tries to make the information on accurate invoices shared among the related parties by connecting the systems held by related parties through blockchain. The blockchain is useful for unifying the data among related parties' systems. Suppose that the same invoice is submitted to multiple tax administrations. If it goes on, VAT may be deducted twice mistakenly. It is necessary to judge which submission should be accepted or denied. Blockchain technology enables the system to make appropriate judgments, even though the same invoice is inputted multiple times into the system. The mechanism is similar to the prevention of double payments in the case of cryptocurrencies using blockchain technology. Moreover, each related party can continue to use its system and share only the data necessary to be visible to other related parties.

The system takes on a public nature because it is connected to the tax administration. However, it is still likely to be profitable by connecting the system to companies' accounting systems. When an accounting system connects to the system, a connection fee can be taken from the company having the accounting system, and the fee can be used to operate the system. The connection makes it able to make a VAT return automatically at the same time when accountants input the information into their accounting systems. It might relieve people from administrative burdens related to VAT documentation [211]. Moreover, the system might help tax administrators to implement the proposal for the so-called digital taxation [215]. It is pointed out that the mechanism that ensures VAT payment is key to implementing digital taxation. However, what is the motivation for taxpayers to register transaction data on blockchain.

It increases that an affiliate transacts with another affiliate within the same multinational group, as the world economy is interconnected. However, such intercompany transactions are sometimes manipulated to minimize the entire multinational group's corporate tax payment. The transaction price is intentionally set so that more profit remains in low tax jurisdictions. This scheme to avoid tax is called transfer pricing. Many countries make transfer pricing rules as countermeasures against transfer pricing. The rules provide multinationals with the way to appropriately calculate intercompany transaction prices and require them to prepare the documentation that enables the tax administration to check the calculation later. However, it is not a small burden for multinationals to calculate the prices and prepare the related documents. It is also said that the rules make their predictability for tax payments unstable because the rules are not necessarily concise. The interpretations of the rules sometimes depend on the negotiations between the tax administration involved.

It is proposed that the blockchain is applied to transfer pricing procedures. It was registered as a patent in 2018. The idea is that the amount of corporate tax to pay is automatically calculated if multinational affiliates input the information on intercompany transactions into the blockchain in which transfer pricing rules are embedded. It relieves affiliates from the administrative burdens related to transfer pricing rules. This is because the amount of tax to pay is automatically calculated, and it gets unnecessary to keep the related documents safely. Moreover, it will be more convenient if the blockchain's access is given to the related parties. If a multinational headquarters' Chief Financial Officer (CFO) can access the blockchain, the headquarters can easily and timely grasp all intercompany transactions. It may bring more effective business operations to multinational groups. If the auditors of affiliates involved in the intercompany transactions are allowed to access the blockchain, accounting wrongdoing might be prevented beforehand. If the blockchain is visible to the tax administration related, it can accurately measure the transfer pricing risk. It may enhance the predictability of the calculation of tax payments. Overall, the unexpected risk related to intercompany transactions can decrease dramatically.

Prevention of diversion of funds to pay tax

Cryptocurrencies are the example of applying blockchain technology most in the world. In the international tax arena, they are often thought to be a threat to international efforts in combating improper tax behaviors. In fact, the cryptocurrency companies worth about 44 billion USD are in Switzerland, where tax rates are low and living standards high [216]. Above all, it is worried that cryptocurrencies may be abused for conducting international tax avoidance for the following two reasons [217]. First, there are no central organizations managing cryptocurrencies. The transactions involved in cryptocurrencies naturally tend to be omitted from withholding taxation. Second, cryptocurrency accounts are usually anonymous. It is not easy to grasp the information on anonymous transactions enough to lead to tax imposition.

However, there are also proposals to use cryptocurrencies for the prevention of improper tax behav-

iors. It has often been discussed to use cryptocurrencies for VAT imposed on cross-border economic activities. VAT is superior to other tax types because it has a mechanism where taxpayers mutually check VAT payment. However, the problem is that the mechanism does not function when transactions are across borders. It is also a problem that VAT calculation gets complicated. When something is export to another country, VAT needs to be refunded in an exporting country and be imposed in an importing country to make competitive conditions the same between import and home products in import countries.

VAT refund and imposition are done when products cross borders. However, the problems get serious when products do not need to pass customs. The EU is a typical example where there are no customs at borders in the community. It annually lost 8 billion EURO due to Missing Trader Intra-Community (MTIC). Exporters get VAT refunds from the administration of exporting countries, while importers do not pay VAT to the administration of importing countries. In addition, economic activities have recently been digitalized, and valuable products are not necessarily tangible. For example, digital service is usually exported to another country through the Internet. Because the service does not pass customs, it is challenging for the tax administration to accurately grasp those transactions and check whether VAT is paid correctly.

One proposal is that treasury issues cryptocurrency only used for VAT payment to facilitate proper VAT payment within a country [218]. The feature is that the cryptocurrency is converted to legal tender only by the treasury. Also, the cryptocurrency's transactions are recorded one by one. The cryptocurrency prevents such a situation that sellers sometimes do not pay VAT to the tax administration, although they receive money as VAT payment from buyers. Suppose buyers give sellers the cryptocurrency as VAT payments. In that case, sellers cannot divert VAT payment received from buyers to other purposes because the cryptocurrency is converted to a legal tender by the treasury.

The idea aims to enable travelers to apply VAT refunds for themselves by using blockchain [219]. The idea registered as a patent is a VAT refund method using a blockchain-based cryptocurrency. It aims to make VAT refund procedures at duty-free shops more efficient rather than prevent tax avoidance. Travelers from other countries can benefit from VAT refunds when making purchases at duty-free shops in airports and hotels. The VAT refunds virtually function as a discount for foreign travelers. It is expected to encourage them to make more consumption. However, the discount effect is usually mitigated because duty-free shops usually pay commission fees to refunding service providers. Duty-free shops usually ask refunding service providers to help their customers apply VAT refund to the tax administration because the procedures for getting VAT refund are complicated. The commission fees probably lower the discount effect. The idea aims to enable foreign travelers to apply VAT refunds for themselves by using blockchain.

8.3 Summary

We study a global issue of international tax avoidance to find solutions to problems arising from the asymmetry between national legal systems and global economic activities. We also conducted an overseas internship at the CTP of the OECD, where international tax rules have been formulated in order to understand policy processes of international tax rules. Based on these, we carried out a PBR to find a way to lead academic research to practical solutions for global issues. Our PBR consists of two parts: a student workshop and consideration of blockchain technology application.

As part of our PBR, we organized a student workshop regarding international taxation. The workshop consists of two sessions: a special lecture and a group discussion. For the special lecture, we invited an economist of the OECD as a lecturer. He was a supervisor during an overseas internship and was in charge of economic analyses of the BEPS project and the so-called digital taxation. The lecturer mentioned that international organizations play an essential role in encouraging the international community to achieve a consensus and formulate international standards. Especially when a country's interest conflicts, international organizations make efforts to provide objective and neutral analyses of policy issues.

For the group discussion, we discussed how international organizations facilitate collective policies and what taxation should be in the 21st century with participants under the cooperation of three students and AISIMAS. Although it is said that taxation has the ability to lead people to a certain behavior, the lecturer emphasized the importance of tax neutrality in the workshop. Through the discussion, participants and we recognized the difficulty of compromising between theory and practice as well as understanding the importance of taxation in society.

Although formulating new international tax rules were effective countermeasures against international tax avoidance, the workshop suggested that it was not always easy to achieve a consensus in the international community. For the other part of our PBR, we considered the use of technology rather than the formulation of international rules as an approach to possible solutions for international tax avoidance. As advances in technology bring about international tax avoidance, technology might be key to prevention against international tax avoidance. Under the cooperation of experts of Ripple Inc., a leading company of blockchain technology, we explored existing studies and patents related to blockchain technology and discussed how the gaps were filled.

For our investigation, it is considered that how blockchain technology potentially prevents improper tax behaviors. We review existing studies and patents, and discuss applications to the international tax system. In conclusion, blockchain technology is likely to solve problems that international taxation faces, but it is necessary to carefully consider the benefits and limitations that it would bring about. It surely facilitates proper taxation. However, it is likely to be sensitive to give domestic tax information to foreign tax administrators due to sovereignty. It is noted that the logic to justify the exchange or some incentives to encourage the exchange would be required [220].

Chapter 9

Conclusions

Economic activities are being increasingly conducted across borders, but the legal systems concerned with enforcing commercial and taxation laws cannot follow. Every state unilaterally designs its own taxation framework, and no state is permitted to enforce its legal system outside of its own territory. This is an inherent characteristic of the state sovereign principle that originated from the 1648 Treaty of Westphalia. Such an asymmetry between economic activities and legal systems, however, creates problems in various policy areas. International double taxation is a typical example in the case of cross-border taxation practices. More than one state can impose taxes on the same income earned from international transactions because several states' tax rules with different criteria come into effect regarding the transaction.

States have attempted to resolve the international double taxation issue, because it is harmful to national welfare. In pursuit of this goal, however, For its prevention, they have adjusted their taxing power through bilateral tax treaties and have traditionally preferred the bilateral approach to a multilateral approach when developing sovereign tax policy, as they wish to maintain the greatest degree of fiscal autonomy. In recent times, however, as economic globalization has progressed and international transactions have come to involve multiple states, it has been found that the bilateral approach does not work effectively. Multinational companies are able to avoid taxation of their global operations by exploiting arbitrage or gaps that bilateral measures could not address.

In this study, we analyzed international tax avoidance as a policy issue arising from the asymmetries between economic processes and legal systems in order to gain insight into desirable taxation in the era of economic globalization. In particular, we focused on three phenomena related to treaty shopping by means of a network analysis that enabled us to numerically analyze these. The first phenomenon is the vulnerability inherent to the current international tax system. The fact that the international tax system is designed unilaterally and bilaterally creates opportunities for taxpayers to exploit arbitrage of the withholding tax rates. The second phenomenon is multinational complex corporate structures. It is noted that multinationals establish intermediate companies that enabled them to make the most of arbitrage of the international tax system, resulting in such complicated corporate structures that tax administrators

are difficult to correctly weigh the risks of international tax avoidance. The third phenomenon is diverted cross-border investments. Some countries attract a tremendous amount of FDI from other countries as if they played the role of an international hub of cross-border investments, which is likely to be motivated by tax purposes.

Firstly, we evaluated the current international tax system, constructing a WTN that represented withholding tax rates therein. We zoomed into treaty shopping, which is one scheme of international tax avoidance and especially harsh for tax revenues of developing countries. By seeing it as the shortest path problem, we attempt to uncover the vulnerability of the system to international tax avoidance. The calculation of load centrality lc_j for 165 jurisdictions enabled us to quantitatively estimate the risk of a given jurisdiction being used for treaty shopping for the purpose of international tax avoidance. The validity of its results was proved by comparing jurisdictions with high centralities to those that are famous for treaty shopping. In addition, we sought to detect communities from the international tax system by applying the Louvain algorithm to an undirected graph of the WTN. Its results implied that the vulnerability to treaty shopping in part of the system could spread to the entire system. Moreover, a comparison of results between centralities and communities suggests that community structure may affect the ease of treaty shopping.

Secondly, we studied multinational corporate structures that reflect multinational tax planning considerations. It is noted that an intermediate company, which is called a key company in our study, plays an essential role in multinational tax planning. We attempted to identify such intermediate companies in order to clarify multinational tax planning and consider effective countermeasures against international tax avoidance. We analyzed large multinationals listed in the Fortune 500 because the larger a firm is, the higher the risk of international tax avoidance. On the basis of what is clarified by investigations of multinationals that are aggressively involved in tax planning, we developed a model to identify affiliates that are important to multinational tax planning within multinational corporate structures. Our model differs from those in previous studies in that it only makes use of equity investment relationships. We confirmed its validity through its application to multinationals that were also investigated by governments. It also was found that such identified affiliates concentrated in the IN component of the bow-tie structure on the GON, including 59,581,452 firms. The results indicate that ownership information is useful for narrowing down the number of suspicious affiliates and that those that play an important role in tax planning are in specific components of the GON. Moreover, it is clear that there is a difference in investment routes depending on the locations of key companies. It is suggested that key companies not only receive a strong influence of the withholding tax rates but also strongly reflect the historical, economic, and political relationships of locations of key companies.

Thirdly, we explored cross-border investments diverted by corporations. In order to understand how firms route cross-border investments for the purpose of tax minimization, we examined both equity investments among firms and withholding tax rates across 165 jurisdictions by constructing a multilayer

network of a MOTN, which consists of a layer that reflects ownership relationships among firms worldwide and that of the WTN. In the MOTN, nodes of a layer of the ownership relationships were connected to those in the WTN. We then defined a standardized multilayer centrality MC_{sj} that takes both layers into account, and applied this to the MOTN. Our study was distinct from previous studies because it shed light on detoured cross-border investment from the viewpoint of sectors for the first time. It used microdata to record firm information worldwide and considered both cross-border investments and the withholding tax rates by our multilayer centrality. The results suggest that finance and insurance sectors, as well as wholesale and retail trade sectors, are likely to be used to detour international investments.

Based on these analyses, we examined the implications for international tax policy based on findings from the aforementioned analyses. Considering the results of our analysis of the international tax system, we assert that the multilateral approach is necessary to prevent international tax avoidance because a vulnerability in a jurisdiction quickly spreads to others. International tax rules should be strengthened so that every jurisdiction continues to exert control of public services at the appropriate level provided by its boundaries. With respect to countermeasures against treaty shopping, we believe that the LOB provision and PPT should consider a firm's sector when determining whether or not it conducted genuine business activities. As our analysis of diverted cross-border investments suggests, the sectors most used for treaty shopping could be limited. We also propose that tax authorities utilize information, such as ownership information, that can be acquired through legal frameworks for exchanging information. Such information is likely to aid in the efficient execution of tax inspections.

In order to overwhelm a global issue of international tax avoidance, the international community commits itself to establishing international rules that encourage worldwide taxpayers to pay tax adequately in each jurisdiction. The OECD, as an international organization, has played a central role in such a multilateral effort. In order to understand the OECD's work in the international tax arena more, the author conducted an overseas internship in the CTP of the OECD for six months in 2019. This internship allowed us to engage in projects related to the BEPS project and the so-called digital taxation and directly touch on policymaking procedures in the OECD. We studied how research approaches contributed to the practical solving of global issues and how international tax policy was designed in the OECD. Based on experience in the internship, we explored how the OECD involves the member and non-member countries and furthers the process of developing to international standards, taking the BEPS project, which intends to reform the international tax system, as an example. It is very challenging to achieve agreements in the international community.

Finally, we held a student workshop and study applications of technology to the international tax system in order to consider the social implementation of solutions for international tax avoidance. We considered possible issues when the outcome of our academic research on international tax avoidance, which is from Chapter 3 to Chapter 5, is implemented into real society. For the workshop, we organized a student workshop that dealt with the role the OECD as an international organization played in the

international tax arena to understand the vivid policy process procedure for international taxation. The OECD economist, who was a supervisor during the overseas internship and took charge of economic analysis of the BEPS project and proposals of the so-called digital taxation, was invited as a lecturer. The workshop clarified that international organizations played essential roles in leading the international community to consensus and formulating international policymaking processes while implying that the difference in the national interests and way of thinking made it challenging to formulate new international rules. For applications of technology, we considered the possibility of using blockchain technology as a solution to international tax avoidance with experts of Ripple, Inc. This is because we believe the use of technology would also contribute to effective countermeasures against treaty shopping, although the international community mainly deals with formulating new international tax rules. We found that blockchain technology is likely to solve problems that international taxation faces, but it is carefully considered the benefits and limitations that it would bring about.

The future work should focus on network properties of multinational corporate structures in more detail and cooperative analysis in the cross-section to better understand the GON. In addition, a further quantitative study of treaty shopping is needed that takes not only withholding tax but also corporate tax into consideration. Such findings would contribute to our understanding of the effects of treaty shopping on each jurisdiction's tax revenue. Moreover, we continue to consider possible applications of blockchain technology to the international tax system, and study what is a desirable international tax system is on the basis of the actual situation of global supply chains.

Appendix A

Jurisdictions included in the WTN

Table A.1: Jurisdictions included in the WTN

Iceland	Kosovo	Palestinian Autonomous Region	Costa Rica
Ireland	Colombia	Hungary	Paraguay
Azerbaijan	Congo	Fiji	Russia
Afghanistan	Congo Democratic	Philippines	Panama
United State of America	Saudi Arabia	Finland	Luxembourg
United Arab Emirates	Santome Principe	Puerto Rico	Pakistan
Algeria	Zambia	Brazil	Croatia
Argentina	Gibraltar	France	Bahamas
Albania	Jersey	Bulgaria	Rwanda
Armenia	Jamaica	Brunei	Cayman Islands
Angola	Georgia	Vietnam	Papua New Guinea
United Kingdom	Singapore	Venezuela	Romania
Israel	Zimbabwe	Belarus	Lesotho
Italy	Switzerland	Peru	Cote d'Ivoire
Iraq	Sweden	Belgium	Bermuda Islands
India	Spain	Poland	Lebanon
Indonesia	Suriname	Botswana	Kuwait
British Virgin Islands	Sri Lanka	Bonnaire	
US Virgin Islands	Slovakia	Bolivia	
Uganda	Slovenia	Hong Kong	
Ukraine	Swaziland	Portugal	
Uzbekistan	Seychelles	Honduras	
Uruguay	Equatorial Guinea	Macau	
Ecuador	Senegal	Macedonia	
Egypt	Serbia	Madagascar	
Estonia	Saint Lucia	Malawi	
Ethiopia	French St. Martin	Mariana	
El Salvador	Dutch East Indies	Malta	
Australia	Saint Lucia	Malaysia	
Austrian	Thailand	Isle of Man	
Oman	Taiwan	South Africa	
Netherlands	Tanzania	South Sudan	
Ghana	Czech Republic	Myanmar	
Cape Verde	Chad	Mexico	
Guernsey	China (mainland)	Mauritius	
Guyana	Tunisia	Mauritania	
Kazakhstan	Chile	Mozambique	
Canada	Denmark	Monaco	
Gabon	Germany	Maldives	
Cameroon	Dominican	Moldova	
Korea	Trinidad and Tobago	Morocco	
Cambodia	Turkey	Mongolia	
Guinea	Nigeria	Montenegro	
Cyprus	Namibia	Jordan	
Curacao	Japan	Laos	
Greece	Nicaragua	Latvia	
Kyrgyzstan	New Zealand	Lithuania	
Guatemala	Norway	Libya	
Guam	Bahrain	Liechtenstein	

Appendix B

Availability of information recorded in the Orbis 2015 database

Table B.1: Availability of information about industry code and operating revenue for companies in the Orbis 2015 database

Jurisdiction	Coverage	Jurisdiction	Coverage	Jurisdiction	Coverage
Kosovo	99.1%	Sri Lanka	14.5%	Namibia	5.2%
Bosnia and Herzegowina	94.0%	Iran	14.4%	Lao	5.2%
Croatia	94.0%	Trinidad and Tobago	14.3%	Guinea	5.2%
France	94.0%	Belarus	14.2%	Uzbekistan	5.0%
Morocco	92.8%	Taiwan	14.0%	Hong Kong	4.9%
Republic of Korea	90.9%	Oman	13.4%	Madagascar	4.8%
Portugal	90.7%	Grenada	13.3%	Mauritius	4.6%
Hungary	90.5%	Zambia	13.1%	Tonga	4.5%
Italy	90.2%	United Kingdom	12.9%	Kyrgyzstan	4.5%
Sweden	90.1%	Nigeria	12.8%	Cambodia	4.4%
Czech Republic	87.9%	South Africa	12.5%	Mozambique	4.4%
Slovenia	87.3%	Cayman Islands	11.4%	Guinea-bissau	4.3%
Switzerland	83.9%	Syria	11.3%	Aruba	4.1%
Lithuania	83.8%	Paraguay	11.2%	Mali	4.1%
Slovakia	82.4%	Montenegro	11.2%	Barbados	4.0%
Greece	81.3%	Ireland	11.0%	Guyana	4.0%
Finland	76.8%	Cote d'Ivoire	10.7%	Niger	4.0%
Estonia	71.6%	Kenya	10.7%	Liechtenstein	3.9%
Malaysia	68.2%	Indonesia	10.7%	Mauritania	3.9%
Spain	67.7%	Peru	10.2%	Myanmar	3.8%
Iceland	67.5%	Turkey	10.1%	Haiti	3.8%
Thailand	66.5%	Sudan	10.1%	Dominican Republic	3.7%
Latvia	65.8%	Ghana	9.9%	Sint Maarten	3.7%
Moldova	62.7%	Malawi	9.7%	Saint Lucia	3.4%
Vietnam	57.1%	Rwanda	9.7%	Antigua and Barbuda	3.4%
Colombia	54.2%	Botswana	9.4%	San Marino	3.4%
Philippines	52.5%	Honduras	9.4%	Papua New Guinea	3.3%
Russia	51.7%	Azerbaijan	9.4%	Libya	3.0%
Serbia	51.5%	Uganda	9.3%	Andorra	2.7%
Bulgaria	51.0%	Guatemala	9.0%	Lebanon	2.6%
Romania	48.9%	Tunisia	8.7%	Bahrain	2.5%
United States of America	48.0%	Lesotho	8.3%	Marshall Islands	2.5%
China (mainland)	47.9%	South Sudan	8.3%	Bahamas	2.3%
Germany	45.2%	Chad	8.3%	Turkmenistan	2.3%
Malta	42.2%	Uruguay	8.2%	Panama	2.1%
Japan	42.0%	Israel	8.1%	Macau	1.8%
Bhutan	40.0%	Qatar	8.0%	Brunei	1.8%
Pakistan	38.5%	Tanzania	7.9%	Curaccao	1.7%
India	38.1%	Afghanistan	7.8%	Sao Tome and Principe	1.6%
Georgia	34.6%	El Salvador	7.7%	Cyprus	1.5%
Senegal	30.2%	Costa Rica	7.7%	Saint Kitts and Nevis	1.3%
Norway	29.3%	Denmark	7.6%	Maldives	1.3%
Australia	27.8%	Central African Republic	7.5%	Equatorial Guinea	1.2%
Bangladesh	27.1%	Venezuela	7.5%	Tajikistan	1.1%
Saudi Arabia	25.1%	Armenia	7.5%	Anguilla	1.0%

Belgium	24.8%	Zimbabwe	7.4%	Mongolia	1.0%
Argentina	24.1%	Macedonia	7.4%	Vanuatu	0.9%
Iraq	23.8%	Djibouti	7.3%	United Arab Emirates	0.8%
Egypt	22.5%	Dem. Rep. of Congo	7.3%	Liberia	0.7%
Mexico	22.4%	Cape Verde	6.9%	Samoa	0.7%
Jordan	22.0%	Monaco	6.8%	Gibraltar	0.5%
Ecuador	21.9%	Sierra Leone	6.7%	Virgin Islands (British)	0.5%
Austria	21.3%	Burkina Faso	6.5%	Dominica	0.4%
Algeria	21.2%	Suriname	6.4%	St. Vincent and The Grenadines	0.4%
Brazil	20.9%	Benin	6.4%	Albania	0.4%
Gambia	20.7%	Togo	6.4%	Belize	0.2%
Luxembourg	20.6%	Cuba	6.3%	Seychelles	0.1%
Bolivia	20.2%	Fiji	6.2%	Eritrea	0.0%
Bermuda	19.8%	Nicaragua	6.2%	Micronesia	0.0%
Canada	19.2%	Cameroon	5.9%	Kiribati	0.0%
Nepal	18.5%	Burundi	5.9%	Comoros	0.0%
Palestine	18.4%	Swaziland	5.9%	Dem. People's Rep. of Korea	0.0%
Angola	17.4%	Gabon	5.8%	Nauru	0.0%
Singapore	17.2%	Kazakhstan	5.8%	Palau	0.0%
Poland	17.0%	Ethiopia	5.5%	Solomon Islands	0.0%
Yemen	16.4%	Chile	5.4%	Somalia	0.0%
Jamaica	15.5%	New Zealand	5.3%	Timor-leste	0.0%
Kuwait	14.8%	Congo	5.3%	Tuvalu	0.0%
Ukraine	14.7%	Netherlands	5.3%		

Appendix C

Identified affiliates

As part of result of the analysis described in Section 4, Table A1, A2, and A3 show the top 10 US, Europe, China-based multinationals' affiliates that the model identified as a key company. In the column of the name, the name written in bold indicates a multinational group's name, and the number in parenthesis indicates the number of affiliates listed in the tables. The column of type indicates the categories of the key companies. The multinationals that ranked in the top 10 in 2015 but were not analyzed are written in the tables' notes.

Due to the limited number of pages, we only list the affiliates that fulfill the following three conditions. The first condition is that a holding company is not a listed company. If it is a listed company, we exclude itself and the conduit companies directly linked with it. A listed company seldom minimizes their tax payment for itself. The second condition is that a holding company is directly linked with more than one conduit company. A holding company with a conduit company usually has more risk of being used for tax purposes than a holding company without any conduit company. The third condition is that a holding company's jurisdiction is different from its conduit companies' jurisdictions. A holding company with a foreign conduit company is more suspected of involving an attempt to avoid tax payments than a holding company without any foreign conduit company.

The tables include more key companies regarding European-based multinationals than the US and China-based multinationals. This probably is because the database used for the analysis covers the companies located in Europe much well than the rest of the world. Note that we do not have any intention that the listed affiliates are surely involved in multinationals' tax strategies.

Table C.1: Identified affiliates of the top 10 US-based multinationals.

Affiliate	Type
Walmart (14)	
Walmart B.C. Holding 2 ULC	Holding & Conduit
Assedox SL	Conduit
Wal-Mart China Company Limited	Holding & Conduit
Wal-Mart (China) Investment Co., Ltd.	Conduit
Inversiones Internacionales D&S Ltda	Holding & Conduit
Inmobiliaria DYS Peru SAC	Conduit
South Pacific Trade Limited	Conduit
Walmart Chile Comercial S.A.	Holding & Conduit
Inversiones Hipermercados Ltda	Conduit
Inversiones Supermercados Ltda	Conduit
Walmart Chile Servicios Financieros Ltda	Holding & Conduit
Presto Telecomunicaciones S.A.	Conduit
Exxon Mobil (12)	
Esso Italiana S.R.L.	Holding & Conduit
Mobil Oil Hellas S.A.	Conduit
Mediterranea Iciom S.R.L.	Conduit
Mobil Oil Turk A S	Conduit
Exxonmobil Petroleum & Chemical	Holding
Esso Italiana S.R.L.	Conduit
Exxonmobil Benelux Holdings B.V.	Conduit
Infineum Holdings B.V.	Holding
Infineum International Limited	Conduit
Exxonmobil Benelux Holdings B.V.	Holding & Conduit
Exxonmobil Central Europe Holding GMBH	Conduit
Apple (4)	
Apple (UK) Limited	Holding
Apple Operations International	Conduit
Apple Retail Europe Holding	Holding
Apple Retail Italia S.R.L.	Conduit
McKesson (70)	
Celesio AG	Holding

Table C.1: Identified affiliates of the top 10 US-based multinationals.

Affiliate	Type
Admenta Beteiligungs GMBH	Conduit
Admenta Verwaltungs GMBH	Conduit
Aewige Aerztliche Wirtschaftsgesellschaft M.B.H.	Conduit
Apo-Holding Gesellschaft M.B.H.	Conduit
Hc-Beteiligungsgesellschaft MBH	Conduit
Herba Chemosan Apotheker-Ag	Conduit
Lloydspharma	Conduit
Pharma Partners	Conduit
Onco Prod Distribuidora De Produtos Hospitalares E Oncol Gicos S/A.	Conduit
Admenta Denmark APS	Conduit
Admenta France	Conduit
OCP Repartition	Conduit
28cvr Limited	Conduit
AAH Retail Pharmacy Limited	Conduit
AAH Twenty Four Limited	Conduit
Acme Drug CO. Limited	Conduit
Admenta Holdings Limited	Conduit
Admenta UK Limited	Conduit
Ayrshire Pharmaceuticals Limited	Conduit
Barclay Pharmaceuticals Limited	Conduit
Barley Chemists Holdings Limited	Conduit
Berkshire Medical Supplies Ltd.	Conduit
BIG Pharma Limited	Conduit
Bridport Medical Centre Services Limited	Conduit
Company Chemists Association Limited	Conduit
Cross And Herbert (Holdings) Limited	Conduit
Cross And Herbert Limited	Conduit
Foster & Plumpton Group Limited	Conduit
G K Chemists Limited	Conduit
George Staples (Stoke) Limited	Conduit
Greens Pharmaceutical (Holdings) Limited	Conduit
H.H.Thatcher Limited	Conduit
Houghton & Lappin Limited	Conduit
Hywel Davies (Caerphilly) Limited	Conduit
Independent Pharmacy Care Centres (2008) Limited	Conduit
Kingswood-Gk Limited	Conduit
Levelcrown Limited	Conduit
Linford Pharmacies Limited	Conduit
Lloyds Chemists Limited	Conduit
Lloyds Chemists Retail Limited	Conduit
Lloyds Pharmacy Limited	Conduit
Lloyds Retail Chemists Limited	Conduit
LPL One Limited	Conduit
Munro Pharmacy Limited	Conduit
Palemoda Limited	Conduit
Primelight Limited	Conduit
R.F.Foskett & Son Limited	Conduit
Scholes (Chemists) Limited	Conduit
Thurnby Rose Limited	Conduit
AAH Ireland	Conduit
Babbingore Limited	Conduit
Cahill May Roberts Group Limited	Conduit
Gerard Ryan Pharmacy (Clonmel) Limited	Conduit
Kairnbury	Conduit
Lloydspharmacy Ireland Limited	Conduit
P.C. Cahill And Company Limited	Conduit
Pharmacy O'Riada Holdings Limited	Conduit
Admenta Italia S.P.A.	Conduit
Comptoir Pharmaceutique M Diterr EN	Conduit
Brocacef Groep N.V.	Conduit
Blomsterdalen Apotek As	Conduit
Norsk Medisinaldepot As	Conduit
Vitus-Apoteket Torvbyen Fredrikstad As	Conduit
Kemofarmacija, Veletrgovina ZA Oskrbo Zdravstva, D.D.	Conduit
OCP	Holding & Conduit
PCB Nv/Sa	Conduit
Brugefi Invest	Conduit
Mckesson Information Solutions Holdings SARL	Holding
Mckesson UK Holdings Limited	Conduit

Table C.1: Identified affiliates of the top 10 US-based multinationals.

Affiliate	Type
UnitedHealth Group (7)	
Amil Assistencia Medica Internacional Ltda	Holding
LUS Adas, Sgps, S.A.	Conduit
Unitedhealthcare International I B.V.	Holding
Frontier Medex Limited	Conduit
Frontier Medex Limited	Holding
Exploration Logistics Canada Ltd	Conduit
Frontiermedex Canada Holdings Ltd	Conduit
Amazon.com (7)	
Abebooks INC	Holding
Abebooks Europe GMBH	Conduit
Amazon EU SARL	Holding
Amazon FR Holdings	Conduit
Lovefilm International Limited	Conduit
Push Button Holdings Limited	Conduit
Amazon Italia Customer Services S.R.L.	Conduit
AT&T (13)	
KPN Mobile Holding B.V.	Holding & Conduit
E-Plus Mobilfunk Geschaeftsfuehrungs GMBH	Conduit
KPN Mobile N.V.	Holding & Conduit
Base Company	Conduit
KPN Telecommerce B.V.	Holding & Conduit
SNT Deutschland AG	Conduit
Controladora De Servicios De Telecomunicaciones, S.A. De C.V.	Holding & Conduit
Telmex Solutions Telecomunica ES Ltda.	Conduit
Getronics International B.V.	Holding & Conduit
Tecnocom Telecomunicaciones Y Energia S.A.	Conduit
Getronics Holdings Emea B.V.	Holding & Conduit
DMN UK Limited	Conduit
Getronics (Holdings) Limited	Conduit
General Motors (69)	
Adam Opel AG	Holding & Conduit
General Motors Espa A SLU	Conduit
GM Automotive UK	Conduit
GM Holdings U.K. NO. 1 Limited	Conduit
Bank of Georgia Holdings PLC	Holding
JSC Liberty Consumer	Conduit
General Motors Automotive Holdings SL	Holding
General Motors Europe Limited	Conduit
GM Korea Company	Holding & Conduit
Chevrolet Italia S.P.A	Conduit
Chevrolet Nederland B.V.	Conduit
GMF Europe Holdco Limited	Holding
Gmac Lease B.V.	Conduit
General Motors Europe Holdings SLU	Holding & Conduit
Neovia Logistics Supply Chain Services GMBH	Conduit
General Motors France	Conduit
General Motors Italia S.R.L.	Conduit
Opel Norge As	Conduit
JSC Bank of Georgia	Holding & Conduit
Belarusky Narodny Bank Ojsc	Conduit
Prologis UK Holdings SA	Holding
Prologis Group Holdings Limited	Conduit
JSC Insurance Company Aldagy-Bci	Holding & Conduit
Partner Insurance Company Limited	Conduit
Xylem Analytics Germany GMBH	Holding
Aanderaa Data Instruments As	Conduit
Xylem Holdings SARL	Holding & Conduit
Xylem Denmark Holdings APS	Conduit
Xylem Service Italia S.R.L.	Conduit
Xylem IP Management SARL	Holding
Xylem Germany GMBH	Conduit
Xylem Industriebeteiligungen GMBH	Conduit
Xylem Water Solutions Polska SP. Z O.O.	Conduit
Xylem Luxembourg SARL	Holding & Conduit

Table C.1: Identified affiliates of the top 10 US-based multinationals.

Affiliate	Type
Xylem Water Holdings Limited	Conduit
Xylem Water Solutions Manufacturing AB	Holding
Xylem Water Solutions Holdings France SAS	Conduit
Valmy	Holding & Conduit
Adamar Hotels Netherlands B.V.	Conduit
Petroleum Geo-Services ASA	Holding
Petroleum Geo-Services (UK) Limited	Conduit
Seismic Exploration (Canada) Ltd	Conduit
Prologis B.V.	Holding
Prologis Czech Republic Management, S.R. O.	Conduit
Prologis Germany Management GMBH	Conduit
Prologis Spain Management SL	Conduit
Prologis Management Services II SAS	Conduit
Prologis Hungary Management Korl Tolt Feleloss GU T Rsas G	Conduit
Prologis Italy Management S.R.L.	Conduit
Prologis Poland Management SP. Z O.O.	Conduit
CGG Holding B.V.	Holding & Conduit
CGG Services (Australia) PTY Ltd	Conduit
CGG Data Services AG	Conduit
CGG Geoscience GMBH	Conduit
CGG Services (UK) Limited	Conduit
CGG Holding South Africa (Pty)Ltd	Conduit
Cggveritas Holding B.V.,	Holding & Conduit
Graal Tech S.R.L.	Conduit
Sercel Holding	Holding & Conduit
Sercel	Conduit
De Regt Marine Cables B.V.	Conduit
Veritas DGC Limited	Holding & Conduit
Veritas Caspian (Veritas Kaspian)	Conduit
ITT Industries Luxembourg S. .R.L.	Holding
ITT Germany Holdings GMBH	Conduit
Prologis European Holdings X SARL	Holding
Prologis Superholding II B.V.	Conduit
ITT Italy Holding S.R.L.	Holding & Conduit
Koni B.V.	Conduit

Note: The following list does not include the affiliates of Berkshire Hathaway and CVS Health, as we were not able to identify their parent companies in the database.

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Volkswagen (111)	
Bertrandt AG	Holding
Bertrandt France	Conduit
P G A SA	Holding & Conduit
PGA Nederland N.V.	Conduit
PGA Polska SP. Z O.O.	Conduit
SGL Carbon Holdings B.V.	Holding & Conduit
SGL Carbon Polska S.A.	Conduit
Porsche Financial Services GMBH	Holding
Porsche Financial Services Verwaltungsgesellschaft MBH	Conduit
Porsche Holding Gesellschaft M.B.H.	Holding & Conduit
Eurocar Deutschland Verwaltungs GMBH	Conduit
Pofin Financial Services Verwaltungs GMBH	Conduit
Scania AB	Holding & Conduit
Scania Romania SRL	Conduit
B. + V. Grundstuecks-Verwaltungs- Und Verwertungs- GMBH	Conduit
Donbas Skan Servis OOO	Conduit
Italscania S.P.A.	Conduit
Norsk Scania As	Conduit
Norsk Scania Eiendom As	Conduit
Scania (Great Britain) Limited	Conduit
Scania - RUS LLC	Conduit
Scania Australia Pty. Limited	Conduit
Scania Commercial Vehicles Renting SA	Conduit
Scania Czech Republic, S.R.O.	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Scania Danmark A/S	Conduit
Scania Danmark Ejendom APS	Conduit
Scania Deutschland Gesellschaft MIT Beschraenkter Haftung	Conduit
Scania Finance Belgium	Conduit
Scania Finance Deutschland GMBH	Conduit
Scania Finance Holding Great Britain Limited	Conduit
Scania Finance Nederland B.V.	Conduit
Scania Hispania Holding SL	Conduit
Scania Hispania SA	Conduit
Scania Holding France	Conduit
Scania Latin Am Rica Ltda.	Conduit
Scania Leasing	Conduit
Scania Schweiz AG	Conduit
Scania Service	Conduit
Scania Suomi OY	Conduit
Skaniya Ukraina PII OOO	Conduit
SRE Holding SARL	Conduit
SGL Technologies Beteiligung GMBH	Holding
Fortum Bytom S.A.	Conduit
Scania CV Deutschland Holding GMBH	Conduit
Scania Finance Polska SP. Z O.O.	Conduit
Scania Finance Schweiz AG	Conduit
Scania Oesterreich Holding GMBH	Conduit
SGL Kuempers Verwaltungs-Gmbh	Conduit
Seat SA	Holding & Conduit
Seat Deutschland GMBH	Conduit
Volkswagen Bank GMBH	Holding
Consorzio PER LA Tutela DEL Credito	Conduit
Volkswagen Bank Polska	Conduit
Volkswagen Financial Services AG	Holding
Collect Car B.V.	Conduit
Global Automotive Finance C.V.	Conduit
Inis International Insurance Service S. R.O., VE Zkratce Inis, S.R.O.	Conduit
VVS Verzekerings-Service N.V.	Conduit
Volkswagen International Finance NV	Holding & Conduit
Volkswagen Slovakia, A.S.	Conduit
KPI Polska SP. Z O.O.	Conduit
S Dert LJE BIL Invest Aktiebolag	Conduit
SGL Carbon Beteiligungs GMBH	Holding
SGL Carbon Holding SL	Conduit
SGL Carbon GMBH	Holding & Conduit
Fisipe-Fibras Sinteticas De Portugal SA	Conduit
Volkswagen Group France	Holding & Conduit
Volkswagen Group Real Estate GMBH & CO. KG	Conduit
Rheinmetall Man Military Vehicles GMBH	Holding
Rheinmetall Man Military Vehicles Nederland B.V.	Conduit
Rheinmetall Man Military Vehicles Oesterreich Holding Gesmbh	Conduit
Leaseplan Corporation NV	Holding
Elymus Holding Espa A SL	Conduit
Inula Holding UK Limited	Conduit
Iris Holding (Belgium)	Conduit
Lease Plan Fleet Management	Conduit
Lease Plan Italia S.P.A O Leaseplan Italia S.P.A.	Conduit
Lease Plan Portugal - COM Rcio E Aluguer De Autom Veis E Equipamentos, Unipessoal, LDA	Conduit
Leaseplan Australia Limited	Conduit
Leaseplan Fleet Management Polska SP. Z O.O.	Conduit
Leaseplan M Xico, S.A. De C.V.	Conduit
Leaseplan New Zealand Limited	Conduit
Leaseplan Oesterreich Fuhrparkmanagement GMBH	Conduit
Leaseplan UK Limited	Conduit
LPD Holding A S	Conduit
C&F International GMBH	Holding
Aceros Internacionales C&F International Iberica SL.	Conduit
Dogus Holding A S	Holding
Acropolis S.P.A.	Conduit
Azumi Limited	Conduit
D-Marine Investments Holding B.V.	Conduit
D-Marine Investments Holding Cooperatief U.A.	Conduit
Dogus Hoteli D.O.O.	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Dogus Marine Croatia D.O.O.	Conduit
Dogus Razvitak I Upravljanje D.O.O.	Conduit
Dream International B.V.	Conduit
Garanti Holding B.V.	Conduit
Lamda Flisvos Holding S.A.	Conduit
London Doors Restaurant Group Limited	Conduit
Robata Restaurants Limited	Conduit
The Tom Aikens Group Limited	Conduit
Turkiye Garanti Bankasi A.S.	Holding
G Netherlands B.V.	Conduit
Dogus Insaat VE Ticaret Anonim Sirketi	Holding
Dogush Inshaat Tidzharet Limitet Shirketi OOO	Conduit
Dogan Sirketler Grubu Holding A.S.	Holding
DHI Investment B.V.	Conduit
Hurriyet Invest B.V.	Conduit
Pronto Invest B.V.	Conduit
Pronto-Baikal Ltd	Conduit
TCM Adria D.O.O.	Conduit
Glencore (128)	
Asturiana De Zinc SA	Holding
Chemoil Energy Limited	Conduit
Kemoil Limited	Conduit
California Software CO Ltd	Conduit
Chemoil Europe B.V.	Conduit
Chemoil International Pte. Ltd.	Conduit
Oceanconnect Marine Pte. Ltd.	Conduit
Chemoil Logistics INC	Conduit
Finges Investment B.V.	Holding & Conduit
Glencore Polska SP. Z O.O.	Conduit
Optimum Coal Holdings Limited	Conduit
Glencore (Schweiz) AG	Holding & Conduit
Cumnock NO. 1 Colliery PTY Limited	Conduit
Enex Liddell PTY Limited	Conduit
Enex Togara PTY Limited	Conduit
GOH 128 115 140 PTY Limited	Conduit
Glencore AG	Holding & Conduit
Polymet Mining Corp	Conduit
Strategic Minerals PLC	Conduit
Topley Corporation	Conduit
Glencore International AG	Holding
Glencore Group Funding Limited	Conduit
Oleaginosa Moreno Hermanos S.A.C.I.F.I.A.	Conduit
Sucesion De Antonio Moreno S.A.	Conduit
Glencore Grain PTY Limited	Conduit
Glencore Investment PTY Limited	Conduit
Viterra Inc.	Conduit
Turais Investments Limited LLC	Conduit
Vrondi Holdings Limited	Conduit
Hotodo Hamburg Tankers GMBH	Conduit
Glencore UK Ltd.	Conduit
Glencore Grain UK Ltd.	Conduit
Piruto B.V.	Conduit
Glencore Protein Romania SRL	Conduit
ST Shipping And Transport Pte. Ltd.	Conduit
Glencore Asian Holdings Pte. Ltd.	Conduit
Carlisa Investments Corporation	Conduit
Kansuki Investments SPRL	Conduit
Katanga Mining Limited	Holding & Conduit
Katanga Mining Finance Limited	Conduit
KFL Limited	Conduit
Lonmin Public Limited Company	Holding
6529241 Canada INC	Conduit
Southern Platinum (Cayman Islands) Corp	Conduit
Recylex	Holding & Conduit
Harz-Metall GMBH	Conduit
Recylex GMBH	Conduit
Renaisco B.V.	Holding
Usti Oilseed Processing, S.R.O.	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Green Fuel Trade Management B.V.	Conduit
Romsiloz Cereale SRL	Conduit
Agro Niva OOO	Conduit
Artsizke Hlibopriymalne Pidpriemstvo OAO	Conduit
Barvinkove Agro ZAO	Conduit
Chotirbotske Hlibopriymalne Pidpriemstvo OAO	Conduit
Chudnivskiy Kombikormoviy Zavod OOO	Conduit
Kulevchanskiy Kombinat Hliboproduktiv OAO	Conduit
Luchanske 2 OOO	Conduit
Lyubashivskiy Elevator OAO	Conduit
Pomichnyanskiy Elevator OAO	Conduit
Publichne Aktsionerne Tovaristvo Baltske Hlibopriymalne Pidpriemstvo	Conduit
United Company Rusal PLC	Holding
Gershvin Investments Corp. Limited	Conduit
Eurallumina - Societa' PER Azioni	Conduit
Xstrata Copper	Holding
Xstrata Copper Canada	Conduit
Compa IA Minera Antapaccay SA	Conduit
Glencore Industries The Netherlands B.V.	Holding & Conduit
Kolos ZAO	Conduit
GHP 104 160 689 PTY Ltd	Holding & Conduit
Xstrata EL Pachon Limited	Conduit
Noranda Income Fund	Conduit
Compania Minera Lomas Bayas	Conduit
Xstrata Copper Chile S.A.	Conduit
Kabanga Holdings Ltd	Conduit
Noranda Antamina Sociedad Comercial De Responsabilidad Limitada	Conduit
Glencore Finance (Bermuda) Ltd.	Holding & Conduit
Mirabela Nickel Limited	Conduit
Katanga Mining Holdings Ltd	Holding & Conduit
Global Entreprises Corporate Limited	Conduit
London Australian & General Property Company Limited	Conduit
Mining And Metallurgical Company Norilsk Nickel	Holding & Conduit
Norilsk Nickel Holding SA	Conduit
Belfund Investments Limited	Conduit
Norilsk Nickel (Cyprus) Limited	Conduit
Norilsk Nickel Harjavalta OY	Conduit
Norimet Limited	Conduit
NN Metal Holding SA	Conduit
Straits Resources Limited	Holding & Conduit
7874987 Canada INC	Conduit
Closed Joint-Stock Company Gold-Mining Company Polus	Holding & Conduit
Jenington International INC	Conduit
Ojsc Inter RAO UES	Holding & Conduit
JSC Moldavskaya Gres	Conduit
Inter RAO Finance B.V.	Conduit
Sangtudinskaya Ges-1	Conduit
Spitzmar Limited (Spitzmar Limited)	Holding & Conduit
Imeretinskaya Riviera Limited Liability Company	Conduit
Viterra Europe Cooperatie U.A.	Holding
A.C.N. 137 191 023 PTY Ltd	Conduit
Viterra Ltd	Conduit
Straits Gold PTY Ltd	Holding & Conduit
Goldminco Corporation Limited	Conduit
Norilsk Nickel Holdings (Cyprus) Ltd	Holding & Conduit
Norilsk Nickel Australian Holdings B.V.	Conduit
AO Irkutskenergo	Holding & Conduit
Graciosa Holdings Limited	Conduit
Vukelich Limited	Conduit
Inter RAO Holding B.V.	Holding & Conduit
Inter RAO Turkey Enerji Holding A S	Conduit
Open Joint Stock Company Inter RAO - Electric Power Plants	Holding & Conduit
Nvgres Holding Limited	Conduit
RAO Nordic OY	Holding & Conduit
Inter RAO Lietuva AB	Conduit
Asia Energy B.V.	Conduit
Kuhmo Nickel Limited	Holding & Conduit
Vulcan Exploration B.V.	Conduit
All-Russian Association of Employers Russian Union of Industrialists And Businessmen	Holding & Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Viterra Operations Ltd	Conduit
Viterra Malt PTY Ltd	Conduit
Varomet Holdings Limited	Holding & Conduit
Magontec Xian CO Ltd.	Conduit
Magontec GMBH	Conduit
OAO Pktbkhimmash	Holding
PF	Conduit
Gfe-Mir Holdings AG	Holding & Conduit
Gfe-Mir GMBH	Conduit
Gfe-Mir Alloys And Minerals SA (PTY) Ltd	Conduit
Daimler (18)	
Daimler Financial Services AG	Holding
Mercedes-Benz Finansal Kiralama Turk A.S	Conduit
Daimler Vermoegens- Und Beteiligungsgesellschaft MBH	Holding
FKT Holding GMBH	Conduit
Mercedes-Benz Trucks Vostok Holding GMBH	Conduit
Evobus GMBH	Holding
Evobus Austria GMBH	Conduit
Evobus Ceska Republika, S.R.O.	Conduit
Mbtech Group GMBH & CO. Kgaa	Holding
Mbtech Muhendislik VE Danismanlik Ltd STI	Conduit
Mercedes-Benz Danmark A/S	Holding
Mercedes-Benz Sverige AB	Conduit
OAO Kamaz	Holding
Mikam Holdings Limited	Conduit
Torgovaya Kompaniya Kamaz	Conduit
Mikam Holdings Limited	Holding
FKT Holding GMBH	Conduit
Mercedes-Benz Trucks Vostok Holding GMBH	Conduit
EXOR Group (207)	
Almacantar SA	Holding
Almacantar Limited	Conduit
Almacantar (Marble Arch) Limited	Conduit
Almacantar Crossbow Holding Limited	Conduit
Antalis International	Holding
Antalis Austria GMBH	Conduit
GMS Distribuidora Grafica S.A.	Conduit
Inversiones Antalis Holding Ltda	Conduit
Antalis GMBH	Conduit
Antalis As	Conduit
Antalis Group (Holdings) Limited	Conduit
James Mcnaughton Group Limited	Conduit
Antalis Hungary Kft.	Conduit
Antalis Poland SP. Z O.O.	Conduit
Antalis Asia Pacific Pte. Ltd.	Conduit
Cushman & Wakefield France Holding SAS	Holding & Conduit
Cushman & Wakefield, S.R.O.	Conduit
Cushman & Wakefield International Real Estate Advisor Ltd. Cushman & Wakefield Ltd.	Conduit
Cushman & Wakefield Netherlands B.V.	Conduit
Cushman & Wakefield - Sociedade De Media O Imobili Ria, LDA	Conduit
Cushman & Wakefield Singapore Holdings Pte. Limited	Holding & Conduit
Cushman & Wakefield (Australia) PTY Ltd	Conduit
Exor SPA	Holding
New Holland Holdings Argentina S.A.	Conduit
CNH Industrial Argentina S.A.	Conduit
Fiat Group Automobiles Austria GMBH	Conduit
CNH Industrial Capital Australia Pty. Limited	Conduit
FCA Belgium	Conduit
Cushman & Wakefield Capital Holdings Asia	Conduit
Comau DO Brasil IND Stria E COM Rcio Ltda.	Conduit
Magneti Marelli Sistemas Automotivos IND Stria E COM Rcio Ltda.	Conduit
Magneti Marelli Cofap Fabricadora De PE As Ltda.	Conduit
Fiat DO Brasil S/A.	Conduit
Magneti Marelli DO Brasil IND Stria E COM Rcio S/A.	Conduit
Chrysler Receivables 1 INC	Conduit
Chrysler Receivables 2 INC	Conduit
Cushman & Wakefield FM Limited Partnership	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Cushman & Wakefield Canada Limited Partnership	Conduit
Cushman & Wakefield First Nova Scotia ULC	Conduit
New Carco Acquisition Holdings Canada Limited	Conduit
0914098 BC Unlimited LLC	Conduit
Cushman & Wakefield Ltd	Conduit
Fiat Group Automobiles Switzerland S.A.	Conduit
Fiat Chrysler Rimaco SA	Conduit
Chrysler Asia Pacific Investment CO. Ltd.	Conduit
Chrysler Deutschland GMBH	Conduit
Iveco Magirus Fire Fighting GMBH	Conduit
Magirus GMBH	Conduit
Magneti Marelli Iberica SA	Conduit
Italian Motor Village SL	Conduit
Automotive Lighting Rear Lamps France	Conduit
Iveco Participations	Conduit
Magneti Marelli France	Conduit
Cushman And Wakefield SAS	Conduit
Ufima	Conduit
Iveco Limited	Conduit
Cushman & Wakefield (U.K.) Services Ltd.	Conduit
Cushman & Wakefield Facilities Management Trading Limited	Conduit
Cushman & Wakefield (HK) Limited	Conduit
Cushman & Wakefield (China) Limited	Conduit
Chrysler (Hong Kong) Automotive Limited	Conduit
Cushman & Wakefield Investment Advisors K.K.	Conduit
Ferrari International SA	Conduit
Cushman & Wakefield Luxembourg Holdings SARL	Conduit
Ifil Investissements SA	Conduit
Fiat Finance And Trade Ltd	Conduit
Chrysler Mexico Holding S. De R.L. De C.V.	Conduit
Servicios Administrativos Corporativos Ipasa, S.A. De C.V.	Conduit
Chrysler Netherlands Holding Cooperatie U.A.	Conduit
Chrysler Mexico Investment Holdings Cooperatie U.A.	Conduit
Chrysler Netherlands Distribution B.V.	Conduit
Magneti Marelli Motherson India Holding B.V.	Conduit
Cushman & Wakefield Industrial Dutch Holdings B.V.	Conduit
Cushman & Wakefield Polska SP. Z O.O.	Conduit
Fiat Auto Poland S.A.	Conduit
Sadi Polska - Agencja Celna SP. Z O.O.	Conduit
Plastic Components And Modules Poland S.A.	Conduit
Fiat Group Automobiles Portugal, S.A.	Conduit
Cushman & Wakefield (S) PTE Limited	Conduit
Cushman & Wakefield Indonesia Holdings PTE Ltd	Conduit
Iveco France	Holding & Conduit
Iveco Czech Republic, A. S.	Conduit
Magneti Marelli S.P.A.	Holding & Conduit
Magneti Marelli Sistemas Electr Nicos M Xico, S.A. De C.V.	Conduit
Magneti Marelli Mako Elektrik Sanayi VE Ticaret Anonim Sirketi	Conduit
Sistemi Comandi Meccanici Otomotiv Sanayi VE Ticaret Anonim Sirketi	Conduit
Sequana	Holding
Map Merchant Holdings GMBH	Conduit
Guarro Casas, SA	Conduit
OY Map Merchant AB	Conduit
Antalis Group	Conduit
Antalis Holdings Limited	Conduit
Wiggins Teape Group Limited(The)	Conduit
Arjo Wiggins UK Holdings Limited	Conduit
Sequana Capital UK Limited	Conduit
Arjowiggins HKK 1 Limited	Conduit
Antalis As	Conduit
Afin Leasing AG	Holding & Conduit
Iveco Capital Leasing IFN S.A.	Conduit
Iveco Romania SRL	Conduit
CNH Industrial Asian Holding Limited	Holding & Conduit
New Holland Fiat (India) Pvt. Ltd.	Conduit
CNH Industrial Europe Holding SA	Holding & Conduit
CNH Industrial Baumaschinen GMBH	Conduit
New Holland Holding Limited	Conduit
Iveco Espa A SL	Holding & Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
SOC Charolaise De Participations	Conduit
Iveco FS Holdings Limited	Holding & Conduit
Afin Bulgaria EAD	Conduit
Transolver Service SA	Conduit
Iveco S.P.A.	Holding & Conduit
Saic Iveco Commercial Vehicle Investment Company Limited	Conduit
Cushman & Wakefield of Asia Limited	Holding & Conduit
Cushman & Wakefield Mauritius Holdings, Inc.	Conduit
Banca Leonardo SPA	Holding
Leonardo & CO	Conduit
Banque Leonardo SA	Conduit
FCA Bank SPA	Holding
FGA Bank Germany GMBH	Conduit
FC France SA	Conduit
FGA Capital Hellas S.A.	Conduit
FGA Leasing Polska SP. Z O.O.	Conduit
FCA Italy S.P.A., In Forma Estesa Fiat Chrysler Automobiles Italy S.P.A., E In Forma Abbreviata Fiat Group Automobiles S.P.A. E Fiat Auto S.P.A.	Holding & Conduit
Fiat Group Automobiles Germany AG	Conduit
Fiat Group Automobiles Spain SA	Conduit
Fiat France	Conduit
Fiat Group Automobiles UK Ltd	Conduit
Fiat Group Automobiles Maroc SA	Conduit
Fiat Automobili Srbija	Conduit
FER MAS OTO Ticaret A S	Conduit
Tofas T RK Otomobil Fabrikasi A.S.	Conduit
Comau S.P.A.	Holding & Conduit
Comau M Xico, S. De R.L. De C.V.	Conduit
Ferrari-Societa'Per Azioni Esercizio Fabbriche Automobili E Corse O Semplicemente: Ferrari S.P.A.	Holding & Conduit
Ferrari Financial Services AG	Conduit
Teksid S.P.A.	Holding & Conduit
Teksid Hierro De M Xico, S.A. De C.V.	Conduit
Automotive Lighting Reutlingen GMBH	Holding & Conduit
Automotive Lighting, S.R.O.	Conduit
Magneti Marelli Poland SP. Z O.O.	Conduit
C.F. Gomma S.R.L.	Holding
C.F. Gomma Deutschland GMBH C/O Stuettgen & Partner	Conduit
Sistemi Sospensioni S.P.A.	Holding
Magneti Marelli Promatcor Sistemi Sospensioni Mexicana, S. De R.L De C.V	Conduit
Arjowiggins	Holding
Arjo Wiggins Carbonless Papers Europe Limited	Conduit
Arjowiggins Sourcing Limited	Conduit
Arjowiggins Security	Holding
Bsecure Ltd	Conduit
Windward Prospects Limited	Holding & Conduit
Direct Nickel Limited	Conduit
G.B.L. Fiduciaria S.P.A.	Holding
Bluneven Limited	Conduit
Giansophi Limited	Conduit
Fiat Autom Veis Ltda.	Holding & Conduit
Fiat Auto Argentina S.A.	Conduit
Fiat Partecipazioni S.P.A.	Holding
Fiat U.K. Limited	Conduit
Zastava Kamioni	Conduit
Samvardhana Motherson International Limited	Holding
Samvardhana Motherson Finance Services Cyprus Limited	Conduit
KO Holding A.S.	Holding
Grundig Intermedia GMBH	Conduit
Beko France	Conduit
Beko PLC	Conduit
Beko Italy S.R.L.	Conduit
Yapi Kredi Bank Nederland N.V	Conduit
Yapi Kredi Holding B.V.	Conduit
Opet Trade B.V.	Conduit
Fiat Services S.P.A.	Holding
Fiat GMBH	Conduit
Fiat Iberica SA	Conduit
Servizi E Attivita' Doganali PER l'industria S.P.A., Piu' Brevemente Sadi S.P.A.	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Mssl (S) PTE Ltd	Holding & Conduit
Mssl Australia PTY Ltd	Conduit
Mssl Mauritius Holding Ltd.	Holding & Conduit
Global Environment Management (FZC)	Conduit
Samvardhana Motherson Global Holdings Limited	Conduit
Mssl Mideast FZE	Holding & Conduit
Mssl GMBH	Conduit
Samvardhana Motherson Reflectec Group Holdings Limited	Holding & Conduit
SMR Holding Australia PTY Limited	Conduit
SMR Automotive Australia PTY Limited	Conduit
SMR Automotive Mirrors Stuttgart GMBH	Conduit
SMR Automotive Mirror Systems Holding Deutschland GMBH	Conduit
SMR Automotive Systems Spain SAU	Conduit
SMR Automotive Mirror Technology Holding Hungary Korl Tolt Feleloss GU T Rsas G	Conduit
SMR Poongjeong Automotive Mirrors Korea Ltd.	Conduit
AR Elik A.S.	Holding
Gpl-Grundig Portuguesa - COM Rcio De Artigos Electr Nicos, LDA	Conduit
Yapi VE Kredi Bankasi A.S.	Holding
Yapikredi Bank Azerbaijan	Conduit
Samvardhana Motherson Automotive Systems Group B.V.	Holding
Samvardhana Motherson Peguform GMBH	Conduit
SMP Automotive Technology Iberica SL.	Conduit
Desa Enerji Elektrik Uretim A S	Holding
DYO Matbaa M Rekkepleri Sanayi VE Ticaret Anonim Sirketi	Conduit
Turkcell Iletisim Hizmetleri A.S.	Holding
Beltur Cooperatief U.A.	Conduit
SMP Deutschland GMBH	Holding
Changchun Peguform Automotive Plastics Technology Co., Ltd.	Conduit
Euroasia Telecommunications Holdings B.V.	Holding & Conduit
Tsifroviy Stilnikoviy Zvyazok Ukraini ZAO	Conduit
Ukurova Holding Anonim Sirketi	Holding
Borak SA	Conduit
Cukurova Finance International Limited	Conduit
Cukurova Investments N.V.	Holding & Conduit
Fintur Technologies B.V.	Conduit
Total (106)	
Atotech B.V.	Holding & Conduit
Atotech Deutschland GMBH	Conduit
Atotech CZ, A.S.	Conduit
ELF Aquitaine	Holding
Total Kenya Limited	Conduit
Total Marketing Middle East FZE	Conduit
Total South Africa (PTY) Ltd	Conduit
Totsa Total Oil Trading SA	Conduit
Situs Umwelt- Und Sicher- Heits GMBH	Conduit
Hutchinson	Holding & Conduit
Hutchinson DO Brasil S/A.	Conduit
Gasket International S.P.A	Conduit
Hutchinson Stop-Choc Vertriebs-Gmbh	Conduit
Joint Stock Company 'Novatek	Holding
Novatek Overseas AG	Conduit
Total E ET P Holdings	Holding & Conduit
Brass Holdings Company Ltd	Conduit
Total Dolphin Midstream Ltd	Conduit
Total E & P Canada Ltd	Conduit
Total Holding Dolphin Amont Ltd	Conduit
Total Yemen LNG Company Ltd	Conduit
Total Yemen LNG Company Ltd	Conduit
Total Energie Solaire Concentree	Holding
Total Abengoa Solar Emirates Investment Company B.V.	Conduit
Total Energy Ventures International	Holding
Sunfire GMBH	Conduit
Total Gaz Electricite Holdings France	Holding & Conduit
Total LNG Nigeria Ltd	Conduit
Total Holdings Europe	Holding & Conduit
Total E&P Norge As	Conduit
Total Holdings UK Limited	Conduit
Total Mineraloel Und Chemie GMBH	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
Norsea Pipeline Limited	Conduit
Total Mineraloel Und Chemie GMBH	Conduit
Total Lubrifiants	Holding & Conduit
Arteco	Conduit
Total Marketing Services	Holding & Conduit
Air Total International SA	Conduit
Total Belgium	Conduit
Total UK Limited	Conduit
Totalerg S.P.A.	Conduit
Air Total Austria Gesellschaft M.B.H.	Conduit
Total Austria GMBH	Conduit
Total Aviazione Italia S.R.L.	Conduit
Total Ceska Republika, S.R.O.	Conduit
Total Denmark A/S	Conduit
Total Espa A SA	Conduit
Total Nederland N.V.	Conduit
Total Nigeria PLC	Conduit
Total Romania S.A.	Conduit
Total Outre-Mer	Holding & Conduit
Aristea	Conduit
Total Oil Turkiye A S	Conduit
Total Petroleum Ghana Ltd.	Conduit
Bostik Holding SA	Holding & Conduit
Bostik Limited Liability Company	Conduit
Mydrin S.R.L.	Conduit
Tekbau Yapi Malzemeleri Madencilik Sanayi A S	Conduit
Hutchinson	Holding & Conduit
Hutchinson Iberia SA.	Conduit
Yamal Razvitie	Holding & Conduit
Artic Russia S.A. R.L. / B.V.	Conduit
Severenergy	Conduit
Sanofi Pasteur	Holding & Conduit
Sanofi Pasteur Ltd Coree	Conduit
Sanofi-Aventis Europe	Holding & Conduit
Zentiva S.A.	Conduit
Sanofi-Aventis Participations	Holding & Conduit
Sanofi Aventis ILA Lari Limited Sirketi	Conduit
Sanofi-Synthelabo (India) Ltd.	Conduit
Secipe	Holding & Conduit
Hoechst Trevira Verwal- Tungs GMBH	Conduit
Total Petrochemicals & Refining	Holding & Conduit
Total International N.V.	Conduit
Aventis Pharma S A	Holding & Conduit
Closed Joint Company Aventis Pharma	Conduit
Sanofi-Aventis Holdings (Ireland) Limited	Conduit
Genzyme Europe B.V.	Holding
Genzyme CEE GMBH	Conduit
Genzyme GMBH	Conduit
Sangstat Luxembourg SARL	Holding
Genzyme International Holdings Limited	Conduit
Zentiva N.V.	Holding & Conduit
Zentiva International, A.S.	Conduit
Aventis Pharma Holdings Limited	Holding & Conduit
H Logaland Kapital As	Conduit
Uformia As	Conduit
Bollore Energie	Holding & Conduit
Satram-Huiles SA	Conduit
Makyol Insaat Sanayi Turizm VE Ticaret Anonim Sirketi	Holding
Dogush Inshaat Tidzharet Limitet Shirketi OOO	Conduit
Dogus Holding A S	Holding & Conduit
Acropolis S.P.A.	Conduit
Azumi Limited	Conduit
D-Marine Investments Holding B.V.	Conduit
D-Marine Investments Holding Cooperatief U.A.	Conduit
Dogus Hoteli D.O.O.	Conduit
Dogus Marine Croatia D.O.O.	Conduit
Dogus Razvitak I Upravljanje D.O.O.	Conduit
Garanti Holding B.V.	Conduit
Lamda Flisvos Holding S.A.	Conduit

Table C.2: Identified affiliates of the top 10 European-based multinationals.

Affiliate	Type
London Doors Restaurant Group Limited	Conduit
Robata Restaurants Limited	Conduit
The Tom Aikens Group Limited	Conduit
Turkiye Garanti Bankasi A.S.	Holding & Conduit
G Netherlands B.V.	Conduit
BMW Group (25)	
BMW Espa A Finance SL	Holding
BMW De M Xico, S.A. De C.V.	Conduit
BMW Portugal, LDA	Conduit
BMW Finanz Verwaltungs GMBH	Holding
BMW Oesterreich Holding GMBH	Conduit
BMW Holding B.V.	Holding & Conduit
BMW (UK) Holdings Limited	Conduit
BMW Australia Finance Limited	Conduit
BMW Belgium Luxembourg	Conduit
BMW Danmark A/S	Conduit
BMW Holding Malaysia SDN BHD	Conduit
BMW Italia SPA	Conduit
BMW Lease (Malaysia) SDN BHD	Conduit
BMW Malta Ltd	Conduit
Elmos Semiconductor AG	Holding
Elmos Design Services B.V.	Conduit
Elmos Services B.V.	Conduit
SGL Carbon Beteiligungs GMBH	Holding
SGL Carbon Holding SL	Conduit
SGL Carbon GMBH	Holding & Conduit
Fisipe-Fibras Sinteticas De Portugal SA	Conduit
SGL Technologies GMBH	Holding
Brembo SGL Carbon Ceramic Brakes S.P.A. In Breve Bsccb S.P.A.	Conduit
SGL Carbon Holdings B.V.	Holding & Conduit
SGL Carbon Polska S.A.	Conduit

Note: The following list does not include the affiliates of BP, AXA, Allianz, and BNP Paribas, as we were not able to identify their parent companies in the database.

Table C.3: Identified affiliates of the top 10 China-based multinationals.

Affiliate	Type
State Grid (7)	
State Grid International Development Limited	Holding
State Grid Brazil Holding S/A.	Conduit
REN - Redes Energ Ticas Nacionais, Sgps, S.A.	Conduit
Chengdu Electric Machinery Factory	Holding & Conduit
PCC GMBH	Conduit
Omip - Operador DO Mercado IB Rico (Portugal)- Sgps, S.A.	Holding & Conduit
Omi-Polo Espa OL, SAU	Conduit
Sinopec Group (3)	
Sinopec International Petroleum Exploration And Production Corporation	Holding
Daylight Resources Trust	Conduit
Tiptop Energy Limited	Conduit
China National Petroleum (2)	
Petroineos Trading Limited	Holding & Conduit
Ineos Refining Ltd	Conduit
China State Construction Engineering (8)	
China State Construction Engineering Corporation Ltd	Holding
China Overseas Finance Investment Limited	Conduit
China Overseas Grand Oceans Group Limited	Conduit
China Overseas Land & Investment Limited	Conduit
Far East Global Group Limited	Conduit
China State Construction International Holdings Limited	Holding & Conduit
ADD Treasure Holdings Limited	Conduit
Treasure Construction Engineering Limited	Conduit

Table C.3: Identified affiliates of the top 10 China-based multinationals.

Affiliate	Type
China Construction Bank (16)	
CCB International (Holdings) Limited	Holding
Excel Rise Holdings Ltd	Conduit
High Inspiring Limited	Conduit
Mighty SKY Investments Limited	Conduit
CCB International Asset Management Limited	Holding & Conduit
Advance Gain Enterprised Limited	Conduit
Huifu Holdings Limited	Conduit
Ccbi Investments Limited	Holding & Conduit
Chance Talent Management Limited	Conduit
CST Mining Group Limited	Holding & Conduit
Skytop Technology Limited	Conduit
Sound Global Ltd.	Holding
Beijing Epure International Water CO Ltd	Conduit
Beijing Sound Environmental Engineering CO Ltd	Conduit
China Ruifeng Renewable Energy Holdings Limited	Holding
Chengde Beichen High New Technology Co., Ltd	Conduit
China Life Insurance (16)	
Town Health International Medical Group Limited	Holding
Best Pharmaceutical Limited	Conduit
Extrad Assets Limited	Conduit
Fair Jade Group Ltd	Conduit
Town Health (BVI) Limited	Conduit
China Life Trustees Limited	Holding & Conduit
China Jiuhao Health Industry Corporation Limited	Conduit
Yuzhou Properties Company Limited	Conduit
China Resources And Transportation Group Limited	Holding & Conduit
Seapower Resources Australia PTY Ltd	Conduit
Goertek Incorporated Company	Holding & Conduit
Dynaudio A/S	Conduit
Sino-Ocean Land (Hong Kong) Limited	Holding & Conduit
Grand Beauty Management Limited	Conduit
JUN Yang Solar Power Investments Limited	Holding
Plenty Cash Investment Limited	Conduit

Note: The following list does not include affiliates of the Industrial & Commercial Bank of China, Ping An Insurance, SAIC Motor, and the Agricultural Bank of China, as we were not able to identify their parent companies in the database.

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