

Micro-evidence of Corporate Tax and Profit Shifting: Focusing on the Role of Intangible Assets*

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This study examines multinational firms' profit shifting focusing on the role of intangible assets. Global firm level data is collected from the Orbis covering 9,932 parent firms and 179,459 subsidiaries for the period of 2012 to 2020. Our results confirm that profit of the multinational firms' affiliates is related to tax rate. Multinational firms' affiliate located in the countries with lower tax rate reports high profit. Moreover, multinational firms' affiliates located in lower tax rate turn out to have higher intangible assets. Profit shifting activity based on the tax difference become more significant for the group with high intangible assets.

JEL Classification: F21, F23, H26, O34

Keywords: multinational firms, profit shifting, intangible assets

1. INTRODUCTION

Tax evasion by multinational enterprises (MNEs) is a growing concern in the global economy. Multinational firms which have subsidiaries across countries with different tax regimes attempt tax savings by shifting profits from countries with high corporate taxes to countries with low corporate taxes. The government's revenue losses by profit shifting by multinational firms have been estimated about 120-240 billion dollars (OECD, 2015).

If foreign affiliates located in high-tax countries systematically report near zero earnings and profits, it can be evidence of profit shifting by multinational firms. The profit shifting across countries is possible through locating intangible assets or intellectual property rights (IPR) in countries with low taxes (Griffith et al., 2014), pricing of goods and services between related

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parties, or inter-subsidiary debts adjustment. In addition, they use patent boxes or establish captive insurance companies or headquarters in low-tax countries to pay little or no tax.

Our analysis is based on the idea that the reported profit of each corporation is determined by its inputs of labour and capital as well as tax rate. If corporations systematically report lower profits under high tax rates, it is considered evidence of profit shifting. In particular, reporting zero profit is evidence of aggressive profit shifting, where all profits are shifted to foreign corporations with lower tax rates and no taxes are paid domestically.

Furthermore, we focus on the profit shifting through the movement of intangible assets within firms. The intangible assets have become increasingly important in production, marketing, and management, playing a crucial role in determining a firm's competitiveness in the market. Since the intangible assets have no clear geographical location, they can be manipulated by the parent company's tax or legal strategies. Additionally, it is challenging to observe the quality of intangible assets and determine arm's length prices, allowing multinational firms to manipulate the prices of intangible assets for intra-firm trade and reduce their corporate tax base. Therefore, it is attractive for MNEs to locate intangible assets in low-tax countries and charge royalties and license fees from several production affiliates, leveraging their public good nature. Based on this idea, we investigate whether firms with larger intangible assets are more likely to shift profits between affiliates to reduce their tax base.

There can be a concern that tax havens usually have low levels of IPR protection, and multinational firms do not prefer to locate intangible assets in the tax havens. Nevertheless, the reason why multinational firms locate intangible assets in tax havens is that the benefits of tax avoidance outweigh the potential loss from IPR infringement. First, they set up foreign affiliates rather than relying on market-based arm's length contract because the internalization of foreign operations lowers risk of knowledge expropriation in the host country. Second, most tax havens are considered dot tax havens, meaning their GDP is relatively small and their actual economic activities are not substantial. In other words, the concern that local rival firms infringe upon their intangible assets is relatively low.

This paper examines the relationship between tax rate, location of intangible assets, and MNEs' profit using micro-level data from Orbis. Orbis provides financial information about individual corporations and offers ownership information, allowing us to link corporations belonging to the same multinational firms. The results show that multinational firms are more likely to report lower profits in high-taxed countries, and they tend to locate intangible assets in low-taxed regime. The detailed analysis reveals that profit shifting often occurs among multinational firms with high intangible assets and in industries that own more intangible assets. Additionally, profit shifting is more common in the service sector rather than manufacturing firms, and multinational firms with subsidiaries in tax havens have more evidence of profit shifting between corporations to reduce their tax base.

This study is related to the existing literature on profit shifting and tax avoidance by multinational firms. Most closely related to our work, Dischinger and Riedel (2011), Griffith et

al. (2014) estimate the relationship between corporate tax rate and, respectively, the quantity of intangible assets and the location where firms choose to place intellectual property. We extend this literature by examining the profit shifting of multinational firms in relation to the decision on the location of intangible assets. Additionally, we investigate the responsiveness of profit shifting and the location of intangible assets concerning the relative tax differences with other affiliates belonging to the same group and parent firm, rather than solely focusing on the tax rate faced by a specific corporation. Moreover, our work is closely related to Hebous and Johannesen (2021), who studied German multinational firms and European countries' tax and profit shifting motivations. While many previous papers focus on European or U.S. multinational corporations due to data limitations, our research extends the coverage to include countries such as China, India, Japan, Korea, etc., encompassing 9,932 parent firms and 179,459 subsidiaries.

The rest of this paper is organized as follows. Section 2 reviews related literature, and section 3 describes data and empirical strategy, section 4 presents the empirical results and concluding remarks are presented in section 5.

2. LITERATURE REVIEW

There is large literature regarding on corporate tax and multinational's decision on location of foreign subsidiaries. Multinational firms operate plants across countries with different tax regimes, and they have incentives to use differences in tax rates to minimize the burden of taxation. Some papers focus on the role of tax havens in reducing global tax bill of the multinational firms (Hines and Rice, 1994; Hebous and Lipatov, 2014; Zucman, 2014). For example, Hines and Rice (1994) find that the profits reported by U.S. multinational firms and their employment of labor and capital are sensitive to tax rates, and tax havens increase tax revenues and employment using their low tax rates. Hebous and Lipatov (2014) argue that the income obtained in countries with higher corruption is more likely to move to tax havens, both theoretically and empirically.

Moreover, previous studies have investigated various method of profit shifting to reduce tax such as transfer pricing (Clausing, 2003; Bernard, Jensen, and Schott, 2008; Christea and Nguyen, 2016; Davies et al., 2018), debt allocation across the affiliates (Desai et al., 2004; Huizinga and Laeven, 2008) and re-location of intangible assets (Grubert and Slemrod, 1998; Dischinger and Riedel, 2011; Desai and Dharmapala, 2006; Karkinsky and Riedel, 2012; Griffith et al., 2014; Hebous and Johannesen, 2021).

Multinational firms can manipulate price of goods and services when making transaction among the affiliated firms to reduce tax bases. This is widely used in the digital sector by locating intangible assets in low-tax jurisdictions with other subsidiaries to pay royalties for these assets and reduce the tax base in high-tax jurisdictions (Grubert and Mutti, 2007). Davies et al. (2018) find that multinational firms lower transfer prices with the foreign subsidiaries located in tax

havens, and Hebous and Johannesen (2021) find significant transactions in services with foreign subsidiaries located in tax havens.

Another channel of profit shifting is debt allocation, which is performed by firms to tax base by artificially shifting debt between subsidiaries within the corporate group. Buettener and Wamser (2013) studied how firms use internal debts to shift profits to countries with low tax rates. Buettener et al. (2012) find that limitations on the tax deductibility of interest expenses or thin-capitalization rules are effective in discouraging multinational firms from using internal loans for tax avoidance.

Intangible asset shifting has gained significant attention in the context of corporate taxation. MNEs often strategically allocate income derived from intangible assets to minimize their global tax liability. The highly mobile nature of intangible goods of multinational companies does not necessitate physical presence, making it difficult to determine the jurisdiction that collect taxes. That is, the country of source of income and the country of residence can be different. Moreover, the price of intangible goods can be easily manipulated because a firm's intangible goods are firm-specific, and they can be transferred to other foreign affiliates at a low cost due to their nature as public goods (Grubert, 2003; Harris, 1993). Previous studies show that the multinational firms with higher intangible assets are more likely to invest in tax havens (Grubert and Slemrod, 1998; Desai et al., 2006).

Kim (2023) show that affiliated firms are key innovation partner of R&D activity, and R&D intensive firms actively engage in intra-firm transactions with the aim of profit shifting (Gruber, 2003). Hebous and Johannesen (2021) studied German multinational firms and European countries' tax and profit shifting motivations focusing on service sales including intellectual property. They find that intra-firm service sales with affiliated firms from tax haven, is closely related to profit shifting motivations.

This study focuses on the channel with intangible assets by investigating relationship between corporate tax, intangible assets, and profit shifting. Detailed hypothesis of the study is following:

- H1: Multinational firms' affiliates located in countries with high tax rates tend to report low profit.
- H2: Multinational firms' affiliates located in countries with lower tax rates have high level of intangible assets.
- H3: Affiliated firms' profit more sensitively responds to tax rate, in case of the firms in the industry with high intangible assets.

3. EMPIRICAL ANALYSIS

3.1. Data

We use Orbis dataset, maintained by Bureau Van Dijk, covering the period from 2012 to 2020.¹⁾ This dataset provides balance sheet information such as profit and loss accounts, intangible assets, and global ultimate owner at the corporation level. It also allows us to identify the structures of multinational firms by linking corporations to their headquarters through information on the global ultimate owner (GUO)²⁾ of corporations. Specifically, we use variables such as profits, intangibles, total assets, the number of employees, country, year, and industry classification. Profit is the net income after considering financial income and expenses but before taxation, and the return on assets is calculated as the ratio of profits to total assets.³⁾ However, the data has a limitation in that it covers corporations globally but is inclined towards corporations in Europe.

Only firms with financial information on operating profits, intangibles, and sales over 100 million dollars are included in the analysis. We also remove a group comprising all corporations located in one country because domestic firms do not fit our analysis of cross-border profit shifting. The sample covers 9,932 parent firms and 179,459 foreign affiliates. The corporations are located across 175 countries and the United Kingdom has the highest number of corporations at 22,647, followed by France, Spain, Sweden, and Italy. The number of corporations for top 20 countries is presented in table A.1.

The data on tax rate comes from KPMG Corporate Tax Rate Tables, providing data on statutory corporate tax rates. Table A.2 and table A.3 in appendix show corporate tax rates of the top 25 countries that have the highest number of parent companies and top 25 countries that have the highest number of foreign affiliates. Most of the countries comprise developed countries, which is in accordance with theory on FDI.⁴⁾ The comparison of the two tables show that an average tax rate faced by parent firms are 26.8 percent, which is higher than the average tax rate faced by foreign affiliates, 24.84 percent.

Figure 1 presents average corporate tax rates faced by two groups over the period of 2012 between 2020, and the two groups are divided by parent firm's intangible assets. The figure shows that group with higher intangible assets face lower tax rates. Table A.4 presents basic characteristics of the two groups divided by parent firm's intangible assets. Specifically, the group with higher intangible assets has higher profit, return on asset, employment, and capital.

1) Johannesen et al. (2016a) argue that Orbis identifies the tax heaven presence in 70 percent of the cases by cross checking the firm structures.

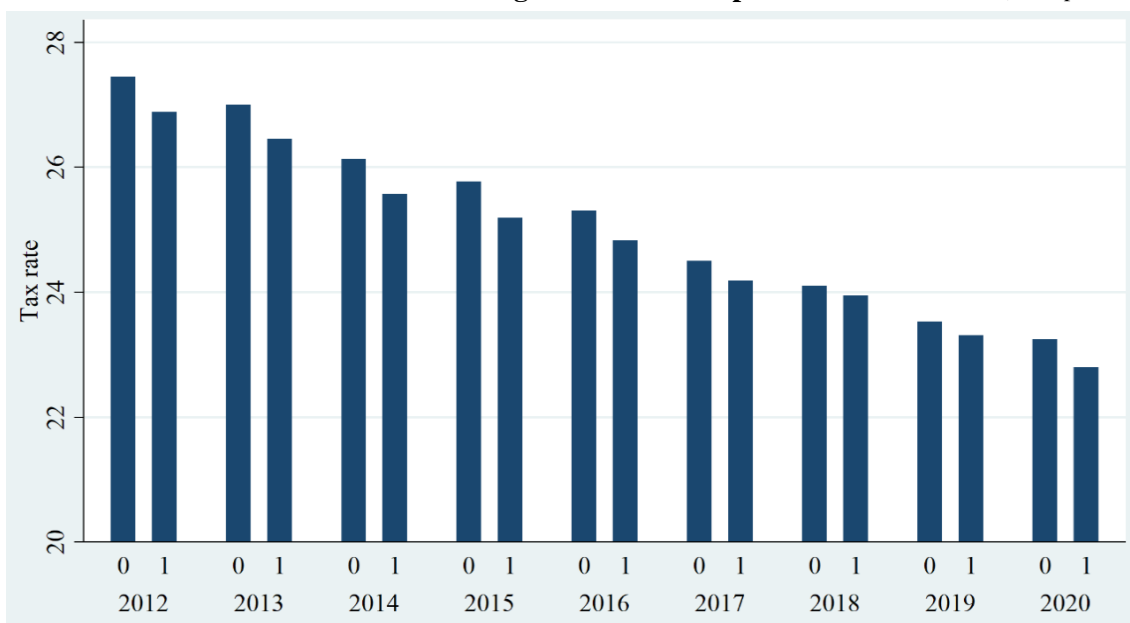
2) The global ultimate owner has over 50 percent of equity with the ability to exercise control over a subsidiary.

3) The foreign affiliates with return on assets greater than 96 percent and less than -0.5 percent are excluded from the analysis.

4) The theory on FDI argues that developed countries are both foreign direct investors and recipients of the foreign direct investment.

The firms with higher intangible assets face larger tax differences with other foreign affiliates and parent firms, implying that they have more incentive to plan tax strategy. Lastly, descriptive statistics for main variables are summarized in table A.5.

Figure 1 Corporate Tax Rates of High Intangible Assets Groups and Low Intangible Assets Groups (unit: percent)



Note: Group 1 includes firms with higher intangible assets and group 0 includes firms with lower intangible assets.
Source: Author calculation based on KPMG and Orbis.

3.2. Empirical Specification

First, we investigate whether the tax facing the firm and tax differences with other corporations belonging to the same global ultimate owner and parent company affect reported profit of the corporations. The empirical strategy follows most widely used method, which related the reported profit of each corporation to its inputs of labour and capital and its tax incentive to engage in profit shifting (Hines and Rice, 1994; Huizinga and Laeven, 2008; Johannesen et al., 2020). Estimation model is following:

$$zero_{ikct} = \beta_0 + \beta_1 tax_{ict} + \beta_2 labor_{ikct} + \beta_3 capital_{ikct} + \tau_k + \nu_c + \mu_t + \varepsilon_{ict}, \quad (1)$$

where $zero_{ikct}$ denotes a binary variable which has value one if a return on asset (ROA)⁵⁾ of corporation i in industry k located in country c falls in the range of -0.5 percent and 0.5 percent

5) The return on asset is a ratio of net profit to total assets.

in year t and zero otherwise⁶⁾. We can observe a bunch of zero profits, accounting for 8.8 percent of the sample. We use three types of tax rates, tax_{ict} , to capture multinational corporation's profit-shifting incentives. They are a corporate tax rate faced by an affiliate i (Tax rate_affiliates), an average of the differences of an affiliate i 's corporate tax rate to a corporate tax rate of other affiliates within the same group (Tax difference_affiliates), and a difference between tax rate faced by an affiliate i and its parent company (Tax difference_parent), respectively. We add inputs of labour and capital as control variables by taking logs on the number of employees and total assets, respectively. Here, we assume that total factor productivity is time-invariant under Cobb-Douglas production technology. Lastly, we include industry, country, and time fixed effects to capture industry-specific characteristics, domestic tax rate of corporations or special tax regimes, and business cycle fluctuations. If multinational firms have tax incentive to shift profits to corporations located in low-tax regime, β_1 is expected to be positive.

In addition, we investigate the intensive margin of profit responses to tax rates by substituting a dummy variable of return on assets with logged profit values.

$$\log(pf_{ikct}) = \beta_0 + \beta_1 tax_{ict} + \beta_2 labor_{ikct} + \beta_3 capital_{ikct} + s_k + v_c + \mu_t + \varepsilon_{ict}. \quad (2)$$

pf_{ikct} is the profit of the corporation i in industry k located in country c in year t . The profit reflects financial income and expenses before taxes. However, this empirical estimation has a limitation in that zero or negative profits are not included in the analysis.

Next, returning to the mechanism through which multinational firms shift profits from high-tax to low-tax regimes, we test whether the affiliates located in low-tax regimes own more intangible assets.

$$int_{ikct} = \beta_0 + \beta_1 int_{ikct-1} + \beta_2 tax_{ict} + \beta_3 size_{ikct} + \tau_k + v_c + \mu_t + \varepsilon_{ict}. \quad (3)$$

The dependant variable, int_{ikct} is a binary variable which is unity if the corporation i in industry k in country c owns intangible property in period t and the value zero otherwise in extensive margin regression. The main independent variables of tax rates include three kinds of tax rates mentioned above. Additionally, we control for the size of the affiliate with the number of employees⁷⁾ because large corporations are likely to own more intangible assets. Furthermore, a full set of industry, year, and country fixed effects are included to control for industry-specific characteristics, non-observable country-specific characteristics such as market size, research potential and domestic corporate taxes, and macro-economic shocks over time. Since multinational firms may have an incentive to locate intangible assets in low-tax countries to

6) Johannesen et al. (2020) uses the same measurement of zero profit to capture aggressive profit shifting. All profits are shifted to foreign affiliates located in lower tax regimes and no taxes are paid domestically. The zero-profit dummy variable is attractive in that it does not require precise measurement of factor inputs and makes no assumptions about the technology that transforms factor inputs into profits.

7) The results are robust when we use sales instead of the number of employees to control for the size of the corporations.

minimize total group tax, we expect β_2 to be negative. Additionally, as a robustness check of the results, we run regressions by replacing the binary dependent variable with log of intangible assets plus one. The small constant is added to the intangible assets to prevent a large loss of observations.

Lastly, we investigate effects of tax rate and intangible asset on corporate profit using interaction variable between tax and intangible asset dummy in equation (4). We calculate an intangible asset dummy variable using industry level intangible asset intensity. Intangible asset dummy variable takes value one for the industries with high intangible asset intensity and zero, otherwise. By investigating empirical equation, we can confirm the negative relationship between tax and profit becomes larger in case of the industries with high intangible assets.

$$\log(pf_{ikct}) = \beta_0 + \beta_1 tax_{ict} + \beta_2 tax_{ict} \times intangible\ asset\ dummy_{kct} + \beta_3 size_{ikct} + s_k + v_c + u_t + \varepsilon_{ict}. \quad (4)$$

3.3. Empirical Results

3.3.1. Tax and profit shifting

Table 1 provides regression results for higher propensity to report zero profits of multinational firms. The columns (1)-(3) support that firms are more likely to report zero profit as tax rate faced by the corporation is higher, tax rate relative to other corporations belonging to the same group is higher, and tax rate relative to parent firm is higher. Specifically, 10 percentage point increase in tax rate faced by the corporation increases the propensity to report zero profits by 0.004%, and 10 percentage point increases in the relative tax difference with other affiliates in the same group and parent firms increase zero profit by 0.006% and 0.005%, respectively. Similar effects are found when we use log transformation of gross profits as a dependent variable. The columns (4)-(6) support that higher tax rate faced by the corporation, higher tax rate relative to other corporations in the same group, and higher tax rate relative to parent firm contribute to lower profits. We find that 10 percentage point increases in the domestic tax rate facing a corporation and the corporation-other foreign affiliates tax differential and corporation-parent tax differential result in reductions in the reported gross profits by 0.1-0.2 percentage point, and they are statistically significant. This highlights that multinational firms which have affiliates across countries tend to shift profits from high-taxed countries to low-taxed countries to lower total group tax.

In addition, we examine whether tax haven plays a role in shifting profit within multinational firms by identifying the multinational firms which have affiliates in tax havens.⁸⁾ The results are summarized in table 2, and it shows that multinational firms which establish foreign affiliates in tax havens more aggressively shift profits to reduce tax liabilities.

8) The list of tax havens is presented in table A.6.

Table 1 Tax Rate and Profit Shifting

	Dummy of zero profit			<i>ln(profit)</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Tax rate</i>	0.000360*			-0.0137***		
<i>_affiliates</i>	(0.000207)			(0.00151)		
<i>Tax difference</i>		0.000595***			-0.0159***	
<i>_affiliates</i>		(0.000113)			(0.000776)	
<i>Tax difference</i>			0.000452***			-0.00718***
<i>_parent</i>			(0.0000509)			(0.000370)
<i>ln(employment)</i>	-0.0217***	-0.0218***	-0.0218***	0.498***	0.498***	0.498***
	(0.000316)	(0.000316)	(0.000317)	(0.00280)	(0.00281)	(0.00282)
<i>ln(capital)</i>	0.0121***	0.0121***	0.0121***	0.252***	0.253***	0.252***
	(0.000199)	(0.000199)	(0.000199)	(0.00181)	(0.00181)	(0.00181)
constant	0.0470***	0.0562***	0.0573***	5.035***	4.687***	4.676***
	(0.00534)	(0.00115)	(0.00116)	(0.0383)	(0.0102)	(0.0103)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	538,318	538,279	537,722	213,270	213,251	213,042
Adj <i>R</i> ²	0.042	0.042	0.042	0.713	0.713	0.714

Note: Robust Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

Table 2 Tax Rate and Profit Shifting Considering Tax Haven

<i>ln(profit)</i>	Group with Affiliates in Tax Haven			Group with No Affiliates in Tax Haven		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Tax rate</i>	0.00931			-0.0144***		
<i>_affiliates</i>	(0.0503)			(0.00152)		
<i>Tax difference</i>		-0.0214***			-0.0162***	
<i>_affiliates</i>		(0.00641)			(0.000782)	
<i>Tax difference</i>			-0.00778***			-0.00722***
<i>_parent</i>			(0.00211)			(0.000378)
<i>ln(employment)</i>	0.411***	0.409***	0.409***	0.500***	0.501***	0.501***
	(0.0156)	(0.0156)	(0.0156)	(0.00287)	(0.00288)	(0.00288)
<i>ln(capital)</i>	0.257***	0.258***	0.258***	0.252***	0.253***	0.252***
	(0.00859)	(0.00859)	(0.00858)	(0.00186)	(0.00186)	(0.00187)
constant	5.376***	5.237***	5.377***	5.033***	4.669***	4.656***
	(0.607)	(0.105)	(0.0753)	(0.0392)	(0.0103)	(0.0104)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	5,793	5,789	5,785	20,7461	207,446	207,241
Adj <i>R</i> ²	0.684	0.685	0.685	0.716	0.716	0.716

Note: Robust Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

3.3.2. Tax and location of intangible assets

Next, we empirically test whether multinational firms have an incentive to locate intangible assets in countries with low-tax regime.

Table 3 Tax Rate and Location of Intangible Assets

	Dummy of Intangible Asset			<i>ln(intangible assets)</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>ln(intangible asset)_lag1</i>	0.0873*** (0.000173)	0.0873*** (0.000173)	0.0873*** (0.000173)	0.855*** (0.00101)	0.854*** (0.00101)	0.854*** (0.00101)
<i>Tax rate _affiliates</i>	-0.0000452 (0.000313)			-0.0112*** (0.00122)		
<i>Tax difference _affiliates</i>		-0.00177*** (0.000157)			-0.00358*** (0.000634)	
<i>Tax difference _parent</i>			-0.0000486 (0.0000732)			0.00112*** (0.000345)
<i>ln(employment)</i>	0.0104*** (0.000323)	0.0105*** (0.000323)	0.0105*** (0.000323)	0.166*** (0.00185)	0.166*** (0.00185)	0.166*** (0.00185)
constant	0.284*** (0.00789)	0.283*** (0.00123)	0.283*** (0.00125)	0.165***	-0.115*** (0.00519)	-0.112*** (0.00524)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	516,044	515,996	515,377	515,971	515,923	515,304
<i>Adj R²</i>	0.557	0.557	0.556	0.839	0.839	0.839

Note: Robust Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

The columns (1)-(6) in table 3 present the coefficient estimates of the equation (3). The first three columns show results when a dependent variable is a dummy variable for intangible assets, and the last three columns show the results when a dependent variable indicates log of intangible assets. The results suggest that the location decision on intangible assets is affected by the tax rate faced by the firm and the relative tax rate to other foreign affiliates belonging to the same multinational group both extensively and intensively. Specifically, the estimates in column (4) and column (5) indicate that an increase of tax rate faced by the focal firm and tax rate relative to other foreign affiliates within the same group by 10 percentage points are associated with a decrease in the intangible assets by 0.1 and 0.04 percent points, respectively.⁹⁾ On the other hand, column (6) does not support the premise that the lower tax rate compared to the parent tax rate leads to locating intangible assets in the corporation. The tax difference with parent firm is not likely to be critical for intangible assets location decision. It may be due to that other factors such as the capacity of management or availability of high-skilled workers are more important determinants for intangible asset location decisions rather than tax rate.

3.3.3. Tax, intangible asset, and profit shifting

Table 4 shows whether multinational firms with more intangible assets are more active in profit shifting. Total sample is divided into two groups by total intangible assets of parent firm and affiliates. Columns (1)-(3) and columns (4)-(6) correspond to the bottom 50 percent group and

9) For robustness checks of the results, we include interactions of fixed effects, country*industry, industry*year, and country*year. The negative estimates on the tax difference with other affiliates within the same group remain.

top 50 percent of group in terms of total intangible assets. The negative estimates support that higher tax rates faced by the firm, relative to other foreign affiliates within the same group, and relative to parent firm have negative association with reported total profit. More importantly, the comparison of the estimates on the tax rate differences with other foreign affiliates belonging to the same group between the two groups (−0.013 vs. −0.018) support that the profit shifting across corporations is highly responsive to tax rates in the group with higher intangible assets.

Table 4 Tax Rate and Profit Shifting by Intangible Assets Group

<i>ln(profit)</i>	Group with Low Intangible Assets			Group with High Intangible Assets		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Tax rate_affiliates</i>	−0.0187*** (0.00208)			−0.00970*** (0.00220)		
<i>Tax difference _affiliates</i>		−0.0126*** (0.000982)			−0.0181*** (0.00130)	
<i>Tax difference _parent</i>			−0.00547*** (0.000590)			−0.00635*** (0.000496)
<i>ln(employment)</i>	0.482*** (0.00430)	0.483*** (0.00433)	0.483*** (0.00434)	0.499*** (0.00373)	0.499*** (0.00373)	0.499*** (0.00374)
<i>ln(capital)</i>	0.243*** (0.00271)	0.244*** (0.00271)	0.244*** (0.00272)	0.252*** (0.00242)	0.253*** (0.00242)	0.253*** (0.00242)
constant	5.174*** (0.0555)	4.691*** (0.0142)	4.682*** (0.0144)	5.046*** (0.0535)	4.794*** (0.0148)	4.789*** (0.0149)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	99,488	99,482	99,425	113,758	113,745	113,593
Adj <i>R</i> ²	0.697	0.697	0.697	0.724	0.724	0.724

Note: Robust Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

We also examine equation (4) to determine whether multinational firms have higher incentive to shift profits under the different tax regime and intangible asset intensity. We first calculate the industry-level intangible intensity by taking a simple average of intangible assets of parent firms. Then, we generate a dummy variable which takes a value one for corporations belonging to the industry with high intangible asset intensity and zero otherwise. The estimation results are summarized in columns (1) to (3) of table 5. The estimates on three kinds of tax rates are all negative and statistically significant, implying that multinational firms report higher profits in countries with low tax rates. More importantly, the estimates on the interaction term between tax rates and a dummy variable for industry-level intangible asset intensity are negative and statistically significant for tax difference relative to other foreign affiliates within same group and parent firm. It supports that tax incentive to shift profits to low-tax regimes is larger in industries with high intangible asset intensity, and tax rates relative to other foreign affiliates and parent firms are more important driver rather than tax rates faced by the focal corporations.

Since the simple average can be highly influenced by extreme values, we use a median of intangible assets of parent firms to identify intangible asset-intensive industries as a robustness check. The regression results presented in columns (4) to (6) are similar to those obtained using a simple average of parent firm's intangible assets.¹¹⁾

Table 5 Tax Rate and Profit Shifting: Industry with High Intangible Asset Intensity

<i>ln(profit)</i>	(1)	(2)	(3)	(4)	(5)	(6)
<i>Tax rate_affiliates</i>	-0.0168*** (0.00152)			-0.0152*** (0.00151)		
<i>Tax rate_affiliates</i> <i>*intangible asset</i> <i>dummy</i>	0.00429*** (0.000187)			0.00248*** (0.000186)		
<i>Tax difference</i> <i>_affiliates</i>		-0.0140*** (0.000933)			-0.0124*** (0.000865)	
<i>Tax difference</i> <i>_affiliates*intangible</i> <i>asset dummy</i>		-0.00341*** (0.000835)			-0.00704*** (0.000809)	
<i>Tax difference _parent</i>			-0.00223*** (0.000598)			-0.00402*** (0.000486)
<i>Tax difference</i> <i>_parent*intangible</i> <i>asset dummy</i>			-0.00652*** (0.000638)			-0.00555*** (0.000571)
<i>ln(employment)</i>	0.497*** (0.00282)	0.499*** (0.00283)	0.499*** (0.00284)	0.496*** (0.00281)	0.498*** (0.00282)	0.498*** (0.00283)
<i>ln(capital)</i>	0.252*** (0.00182)	0.253*** (0.00182)	0.252*** (0.00183)	0.252*** (0.00181)	0.253*** (0.00182)	0.252*** (0.00182)
constant	5.043*** (0.0385)	4.681*** (0.0103)	4.673*** (0.0104)	5.050*** (0.0384)	4.690*** (0.0103)	4.682*** (0.0104)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	211,493	211,475	211,265	212,128	212,110	211,900
Adj <i>R</i> ²	0.714	0.714	0.714	0.712	0.713	0.713

Notes: 1) The intangible asset dummy variable is formulated based on the intangible asset intensity. Industries with high intangible asset-intensive takes value one while the industries with lower intangible asset intensity takes value zero. We use average to identify different group in columns (1) to (3), and median of intangible assets of parent firms in columns (4) to (6).

2) Robust Standard errors in parentheses, * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

In table 6, we investigate whether the manufacturing and service sectors have different incentives for profit shifting. Since service sector is highly dependent on intangible assets and transfer of intangible assets between affiliates within the same group is more common in the service sector, multinational firms in the service sectors might be more actively participating in profit shifting. By comparing coefficient of tax variable in columns (2)-(3) and (5)-(6) in table 6, we find that size of the coefficient in service sector is larger than manufacturing sector. It

11) In addition, we test whether affiliates with more intangible assets report higher profits to confirm the mechanism of profit shifting through intangible asset reallocation, and the coefficient on the intangible assets is positive and statistically significant, supporting that affiliates with more intangible assets report higher profits. The regression results can be provided upon request.

confirms that firms in service sectors are more responsive to tax differences with other affiliates within the group.

Table 6 Tax Rate and Profit Shifting by Industry (Manufacturing vs. Service)

<i>ln(profit)</i>	Manufacturing Sector			Service Sector		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Tax rate (affiliates)</i>	-0.0249*** (0.00252)			-0.000914 (0.00195)		
<i>Tax difference _affiliates</i>		-0.0122*** (0.00135)			-0.0132*** (0.00101)	
<i>Tax difference _parent</i>			-0.00407*** (0.000546)			-0.00778*** (0.000489)
<i>ln(employment)</i>	0.385*** (0.00551)	0.385*** (0.00557)	0.384*** (0.00556)	0.532*** (0.00336)	0.532*** (0.00336)	0.532*** (0.00337)
<i>ln(capital)</i>	0.338*** (0.00389)	0.340*** (0.00391)	0.339*** (0.00391)	0.224*** (0.00215)	0.225*** (0.00214)	0.224*** (0.00215)
constant	4.885*** (0.0662)	4.260*** (0.0216)	4.257*** (0.0217)	4.944*** (0.0480)	4.908*** (0.0118)	4.893*** (0.0119)
Country, Industry, Year effects	O	O	O	O	O	O
<i>N</i>	65,736	65,729	65,722	128,409	128,400	128,201
Adj <i>R</i> ²	0.711	0.711	0.711	0.708	0.709	0.709

Note: Robust Standard errors in parentheses * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

4. CONCLUSION

This study examines multinational firms' profit shifting activities to minimize the tax liabilities using an extended global firm dataset. Our results provide important implications by presenting evidence on the complicated mechanism through which multinational firms can shift profits via intangible assets. The empirical results support the notion that multinational firms' affiliates located in countries with lower tax rates tend to have high intangible assets. Multinational firms prefer to locate intangible assets in affiliates with lower tax rates to reduce the effective tax rate. We also find empirical evidence supporting the active participation of multinational firms with higher intangible assets and those in intangible asset-intensive industries in cross-border profit-shifting activities.

The empirical findings of this study highlight the crucial role played by intangible assets in facilitating tax avoidance and profit shifting by multinational firms. Intangible assets can be an important channel of profit shifting since it does not require physical presence and location. As digital transformation and technology-based development become more important, managing intangible assets become an essential part of multinational firms' activities.

As tax avoidance is more active by multinational firms in countries with lower incomes and lower quality of governance, government role and policy enforcement would be important. There is increasing concerns of geopolitical tensions which can play a crucial role in international

transactions. Multinational firms' intangible asset related activities can be disrupted by geopolitical tensions. Domestic IPR protection or geopolitical tensions may affect the multinational firm's cross-border profit shifting, and those can be interesting avenue for future research.

Due the multinational firms' profit shifting and tax avoiding activities, governments have failed to collect an adequate amount of tax revenue to provide infrastructure and favourable business environment for domestic corporations. It is required to monitor intangible asset and profit structure to secure tax revenue. Government needs to pay more attention to monitoring the multinational firms' intangible assets management. Multinational firms can gain an advantage over domestic enterprises by reducing tax expenditures and distorting competition. It is necessary to incorporate a comprehensive tax mechanism to impose responsible tax behaviour on multinational corporation.

REFERENCES

- Barrios, S., H. Huizinga, L. Laeven, and G. Nicodème, “International taxation and multinational firm location decisions,” *Journal of Public Economics*, 96, 2012, pp. 946-958.
- Behrens, K., P. Susana, and M. P. Pierre, “Transfer pricing rules, OECD guidelines, and market distortions,” *Journal of Public Economic Theory*, 16(4), 2014, pp. 650-680.
- Bernard, A. B., J. B., Jensen and P. K. Schott, “Transfer pricing by US-based multinational firms,” *National Bureau of Economic Research*, 2006, working paper 12493.
- Bieltvedt Skeie, Ø., Åsa Johansson, C. Menon, and S. Sorbe, “Innovation, patent location and tax planning by multinationals,” OECD Economics Department Working Papers, No. 1360, 2017, Paris: OECD Publishing (<https://doi.org/10.1787/b08459e5-en>).
- Buettner, T. and W. Georg, “Internal debt and multinational profit shifting: Empirical evidence from firm-level panel data,” *National Tax Journal*, 66(1), 2013, pp. 63-95.
- Buettner, T., O. Michael, and W. Georg, “Anti profit-shifting rules and foreign direct investment,” *International Tax and Public Finance*, 25, 2018, pp. 553-580.
- Clausing, K. A., “Tax-motivated transfer pricing and US intrafirm trade prices,” *Journal of public economics*, 87(9, 10), 2003, pp. 2207-2223.
- _____, “Profit shifting before and after the Tax Cuts and Jobs Act,” *National Tax Journal*, 73(4), 2020, pp. 1233-1266.
- Cobham, A. and J. Petr, “Measuring misalignment: The location of US multinationals’ economic activity versus the location of their profits,” *Development Policy Review*, 37(1), 2019, pp. 91-110.
- Cristea, A. D. and X. N. Daniel, “Transfer pricing by multinational firms: New evidence from foreign firm ownerships,” *American Economic Journal: Economic Policy*, 8(3), 2016, pp. 170-202.
- Davies, R. B., M. Julien, P. Mathieu, and T. Farid, “Knocking on tax haven’s door: Multinational firms and transfer pricing,” *Review of Economics and Statistics*, 100(1), 2018, pp. 120-134.
- De Simone L., J. J. Huang, and K. Krull. Linda, “R&D and the rising foreign profitability of US multinational corporations,” *The Accounting Review*, 95(3), 2020, pp. 177-204.
- Delis, F., M. D. Delis, L. A. Laeven, and S. R. G. Ongena, “Global Evidence on Profit Shifting Within Firms and Across Time,” Swiss Finance Institute Research Paper No. 22-94, December 1, 2022 (<http://dx.doi.org/10.2139/ssrn.4291888>).
- Desai, M. A. and D. Dharmapala, “Corporate tax avoidance and high-powered incentives,” *Journal of financial Economics*, 79(1), 2006, pp. 145-179.
- Dhammika, D., “What do we know about base erosion and profit shifting? A review of the empirical literature,” *Fiscal Studies*, 35(4), 2014, pp. 421-448.
- Dischinger, M. and N. Riedel, “Corporate taxes and the location of intangible assets within multinational firm,” *Journal of Public Economics*, 95(7-8), 2011, pp. 691-707.

- Dischinger, M., B. Knoll, and N. Riedel, "The role of headquarters in multinational profit shifting strategies," *International Tax and Public Finance*, 21, 2014, pp. 248-271.
- Fuest, C., S. Hebous, and N. Riedel, "International debt shifting and multinational firms in developing economies," *Economics letters*, 113(2), 2011, pp. 135-138.
- Griffith, R., H. Miller, and M. O'Connell, "Ownership of intellectual property and corporate taxation," *Journal of Public Economics*, 112, 2014, pp. 12-23.
- Grubert, H., "Intangible income, intercompany transactions, income shifting, and the choice of location," *National Tax Journal*, 56(1), 2003, pp. 221-242.
- Grubert, H. and J. Mutti, "The effect of taxes on royalties and the migration of intangible assets abroad," NBER Working Paper, No. w13248, 2007.
- Grubert, H. and J. Slemrod, "The effect of taxes on investment and income shifting to Puerto Rico," *Review of Economics and Statistics*, 80(3), 1998, pp. 365-373.
- Harris, C. I., "Whiteness as property," *Harvard law review*, 1993, pp. 1707-1791.
- Hebous, S. and N. Johannesen, "At your service! The role of tax havens in international trade with services," *European Economic Review*, 135, 2021, 103737.
- Hebous, S. and V. Lipatov, "A journey from a corruption port to a tax haven," *Journal of Comparative Economics*, 42(3), 2014, pp. 739-754.
- Hines Jr., J. R. and E. M. Rice, "Fiscal paradise: Foreign tax havens and American business," *The Quarterly Journal of Economics*, 109(1), 1994, pp. 149-182.
- Huizinga, H. and L. Laeven, "International profit shifting within multinationals: A multi-country perspective," *Journal of Public Economics*, 92(5-6), 2008, pp. 1164-1182.
- Johannesen, N. and J. Pirttilä, "Capital flight and development: an overview of concepts, methods, and data sources," UNU-WIDER Working Paper Series, 19, 2016, pp. 1-18.
- Johannesen, N., T. Tørsløv, and L. Wier, "Are less developed countries more exposed to multinational tax avoidance? Method and evidence from micro-data," *The World Bank Economic Review*, 34(3), 2020, pp. 790-809.
- Karkinsky, T. and N. Riedel, "Corporate taxation and the choice of patent location within multinational firms," *Journal of international Economics*, 88(1), 2012, pp. 176 -185.
- Kim, B. W., "Analysis for R&D Organization Choice in Innovative Firms," *Korea and the World Economy*, 24(1), 2023, pp. 45-72.
- OECD, *Measuring and Monitoring BEPS*, Action 11 - 2015 Final Report, OECD/G20 Base Erosion and Profit Shifting Project, Paris: OECD Publishing, 2015 (<https://doi.org/10.1787/9789264241343-en>).
- Tørsløv, T., L. Wier, and G. Zucman, "The missing profits of nations," *The Review of Economic Studies*, 90(3), 2023, pp. 1499-1534.
- Zucman, G., "Taxing across borders: Tracking personal wealth and corporate profits," *Journal of economic perspectives*, 28(4), 2014, pp. 121-148.

Appendix

Table A.1 Number of Corporations for Top 50 Countries

Country	Number of Corporations	Country	Number of Corporations
United Kingdom	22,647	Norway	5,030
France	17,740	India	4,862
Spain	9,663	Malaysia	4,722
Sweden	9,095	Australia	4,647
Italy	9,016	Russia	4,478
Singapore	8,507	Poland	4,396
Germany	6,615	Thailand	3,716
China	6,574	Denmark	3,453
Japan	6,503	Ireland	3,133
Belgium	6,197	Czech Republic	2,616

Note: The countries are presented from a country with the largest number of corporations in descending order.

Source: Orbis, calculation by author.

Table A.2 Parent Firm's Tax Rate of Top 25 Countries

Country	Tax Rate(%)	Number of Parent Companies	Ratio(%)
Japan	33.3	1,405	14.15
U.S.	35.7	1,308	13.17
Germany	29.8	778	7.83
U.K.	20.4	625	6.29
China	25.0	526	5.30
Italy	28.1	491	4.94
France	32.4	400	4.03
Sweden	22.3	328	3.03
Spain	27.0	324	3.26
Netherlands	25.0	317	3.19
India	33.3	277	2.79
Korea	24.2	215	2.16
Australia	30.0	198	1.99
Taiwan	18.0	197	1.98
Belgium	32.3	178	1.79
Malaysia	24.3	163	1.64
Denmark	22.9	157	1.58
Norway	25.1	156	1.57
Finland	21.0	149	1.50
Canada	26.4	138	1.39
Austria	25.0	131	1.32
Singapore	17.0	128	1.29
Cayman Islands	0.0	123	1.24

Bermuda	0.0	104	1.05
Switzerland	17.6	98	0.99
Total	26.8	9,932	-

Note: The countries are presented from a county with the largest number of parent companies in descending order.
Source: Orbis and KPMG, calculation by author.

Table A.3 Foreign Affiliate's Tax Rate of Top 25 Countries

Country	Tax Rate (%)	Number of Parent Companies	Ratio (%)
U.K.	20.4	23,070	12.9
France	32.4	18,242	10.2
Spain	27.0	9,812	5.5
Sweden	22.3	9,317	5.2
Italy	28.1	9,128	5.1
Singapore	17.0	8,818	4.9
China	25.0	6,808	3.8
Japan	33.3	6,526	3.6
Belgium	32.3	6,313	3.5
Germany	29.8	5,555	3.1
Norway	25.1	5,053	2.8
India	33.3	4,936	2.8
Malaysia	24.3	4,870	2.7
Australia	30.0	4,696	2.6
Russia	20.0	4,503	2.5
Poland	19.0	4,447	2.5
Thailand	20.3	3,738	2.1
Denmark	22.9	3,478	1.9
Ireland	12.5	3,155	1.8
Czech Republic	19.0	2,642	1.5
Finland	21.0	2,621	1.5
Luxembourg	27.6	2,474	1.4
Portugal	22.1	2,444	1.4
Netherlands	25.0	2,409	1.3
Korea	24.2	2,041	1.1
Total	24.8	179,459	-

Table A.4 Basic Statistics by Groups

(1) Group with Higher Intangible Assets					
Variable	Obs.	Mean	Std. Dev.	Min	Max
<i>ln(intangible assets)</i>	527,822	2.61	3.46	-1.23	19.44
<i>ln(profit)</i>	229,672	8.92	2.24	-10.05	20.43
<i>ROA</i>	527,971	11.78	13.38	-0.50	96.00
<i>ln(employment)</i>	331,303	4.19	1.90	0.00	13.38
<i>ln(capital)</i>	524,467	7.55	3.72	-1.49	21.78
<i>tax rate(affiliates)</i>	527,638	24.74	6.18	0.00	55.00
<i>tax difference_affiliates</i>	527,613	-0.08	5.52	-40.00	31.94
<i>tax rate(parent)</i>	527,494	27.58	7.66	0.00	55.00
<i>tax difference_parent</i>	527,212	-2.84	8.60	-42.50	38.01

(2) Group with Lower Intangible Assets					
Variable	Obs.	Mean	Std. Dev.	Min	Max
<i>ln(intangible assets)</i>	406,200	2.02	3.06	-0.84	18.11
<i>ln(profit)</i>	125,049	8.46	2.26	-10.05	16.71
<i>ROA</i>	406,271	10.44	13.26	-0.50	95.99
<i>ln(employment)</i>	232,997	3.81	1.98	0.00	13.12
<i>ln(capital)</i>	380,823	7.24	3.65	-0.63	20.02
<i>tax rate(affiliates)</i>	405,518	25.17	6.28	0.00	55.00
<i>tax difference_affiliates</i>	405,464	0.02	5.13	-40.00	35.00
<i>tax rate(parent)</i>	405,307	26.95	6.63	0.00	55.00
<i>tax difference_parent</i>	404,727	-1.77	7.17	-46.00	40.00

Note: The *tax difference_affiliates* is an average of the differences between tax rate faced by an affiliate and tax rates faced by other affiliates within the same group, and *tax difference_parent* indicates the difference between tax rate faced by an affiliate and tax rate faced by parent firm.

Source: Author calculation based on KPMG and Orbis.

Table A.5 Basic Statistics of Main Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
<i>ln(intangible assets)</i>	961,640	2.35	3.30	-1.23	19.44
<i>ln(profit)</i>	363,740	8.75	2.26	-10.05	20.43
<i>ROA</i>	961,873	11.18	13.35	-0.50	96.00
<i>ln(employment)</i>	579,966	4.04	1.94	0.00	13.38
<i>ln(capital)</i>	931,512	7.42	3.70	-1.49	21.78
<i>tax rate (affiliates)</i>	960,746	24.94	6.24	0.00	55.00
<i>tax difference_affiliates</i>	958,779	-0.03	5.33	-40.00	35.00
<i>tax rate (parent)</i>	958,655	27.27	7.24	0.00	55.00
<i>tax difference_parent</i>	957,767	-2.33	8.00	-46.00	40.00

Note: The *tax difference_affiliates* is an average of the differences between tax rate faced by an affiliate and tax rates faced by other affiliates within the same group, and *tax difference_parent* indicates the difference between tax rate faced by an affiliate and tax rate faced by parent firm.

Source: Author calculation based on KPMG and Orbis.

Table A.6 List of Tax Havens

Bahamas	Ireland	Panama
Bahrain	Jersey Islands	Samoa
Barbados	Jordan	Seychelles
Belize	Luxembourg	Singapore
Bermuda	Macao	St. Lucia
British Virgin Islands	Maldives	St. Vincent
Cayman Islands	Malta	Switzerland
Costa Rica	Marshall Islands	Tonga
Djibouti	Mauritius	Vanuatu
Gibraltar	Monaco	