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WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

WU International Taxation Research Paper Series

No. 2020 - 05

Research Papers

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May 1, 2020

Keywords: income shifting; intellectual property; knowledge diffusion; transfer pricing

JEL Classification: H25, H26, L11; O34

We thank Sebastien Bradley (discussant), Fabio Gaertner, Jing Huang (discussant), Zach King, Stacie Laplante, Mayer Liang, Pete Lisowsky, Dan Lynch, Kevin Markle, Clay Partridge, Leslie Robinson, Hussein Warsame (discussant), Peter Wysocki, conference participants at the 2019 National Tax Association Annual Conference on Taxation in Tampa, the 2020 American Taxation Association Midyear Meeting in Fort Worth, the 2020 Hawaii Accounting Research Conference in Hilo, and workshop participants at Boston University, Dartmouth College, and WU Vienna University of Economics and Business for helpful comments. We are also grateful to Andy El-Zayaty and Bill Spiller for providing practical insights into the pricing of intra-firm transactions for tax purposes.

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Patent Concentration, Asymmetric Information, and Tax-Motivated Income Shifting

Abstract

We study the relation between patent concentration and tax-motivated income shifting. Using affiliate-level data for European multinational corporations (MNCs) and employing the relative share of patents held by an MNC as a measure for patent concentration, we predict and find that tax-motivated income shifting is increasing in the degree of patent concentration. This effect is economically meaningful: A one standard deviation higher patent concentration increases the extent to which affiliate-level profits are sensitive to income-shifting incentives by 25.6 percent. Additional tests exploiting variation in the information set of the local tax authority suggest that patent concentration facilitates tax-motivated income shifting by reducing comparable information available to the local tax authority. Overall, our results suggest that patent concentration shapes an MNC's incentives to shift income via patents. Our findings also indicate that the effectiveness of tax-policy measures in curtailing this form of income shifting critically depends on their ability to improve the information set of the local tax authority.

1. Introduction

Over the past two decades, patent holdings have become increasingly concentrated in firms with an already sizeable patent stock (Akcigit and Ates, 2019). Because multinational corporations (MNCs) can use intellectual property (IP), and patents in particular, for tax-motivated income shifting (Beer and Loeprick, 2015; Griffith, Miller, and O'Connell; Grubert, 2003), this concentration could have implications for firms' tax strategies. In this paper, we examine whether and to what extent the concentration of patents is associated with tax-motivated income shifting.[1] In addition, we shed light on the mechanism through which patent concentration might facilitate this behavior.

Understanding the relation between patent concentration and the income shifting of MNCs is important for at least two reasons. First, several recent court cases indicate that income-shifting strategies based on patents allow an MNC to generate significant tax savings. For instance, GlaxoSmithKline avoided $3.4 billion in taxes by paying intra-firm royalties to low-tax jurisdictions (Matthews and Whalen, 2006). Amazon in Luxembourg, Starbucks in the Netherlands, and Apple in Ireland used similar structures, with the latter resulting in estimated tax savings of $14 billion (Chee, 2019). While prior research shows that patents are used for income shifting (Beer and Loeprick, 2015; Griffith et al., 2014; Grubert, 2003), the factors that might facilitate this behavior remain largely unexplored.

[1] We focus on patents because this form of IP is frequently held by the foreign affiliates of an MNC while tax and legal restrictions imply that other intangible assets, such as trademarks, are mainly held in the MNC home country (Heckemeyer, Olligs, and Overesch, 2018). The wider geographical distribution of patents provides more opportunities to shift income and to exploit country-level differences in corporate income tax rates (Karkinsky and Riedel, 2012; Griffith et al., 2014). In addition, unlike other forms of intangible assets, patents are publicly filed to protect an invention and therefore observable in archival datasets.

Second, recent tax-policy initiatives, such as the OECD Action Plan on Base Erosion and Profit Shifting (OECD, 2015a) and the Platform for Collaboration on Tax (IMF, OECD, UN, WBG, 2017), perceive patents to be a key mechanism for tax-motivated income shifting, because their value is hard to determine for transfer-pricing purposes. In the wake of these initiatives, countries are taking regulatory actions to curtail tax-motivated income shifting, for instance, by introducing anti-avoidance legislation (Lohse and Riedel, 2013) or by tightening tax enforcement (De Simone, Stomberg, and Williams, 2019b). The design of effective tax-policy measures, however, requires a clear understanding of the conditions under which MNCs may shift income via patents and the factors that facilitate this behavior.

For tax purposes, an MNC has to value an intra-firm transaction using the "arm's length" transfer price, i.e., as if the transaction had occurred between unrelated parties (OECD, 2017a). An MNC can justify the transfer price through pricing information from comparable transactions between independent firms or from its own transactions with unrelated parties (IMF et al., 2017). The tax authority also requires comparable information to assess the MNC's transfer price and to challenge potentially aggressive tax positions (OECD, 2017a). Therefore, the availability of comparable information and its distribution between the MNC and the local tax authority could affect an MNC's transfer-pricing strategies (De Simone, 2016).

We hypothesize that patent concentration facilitates tax-motivated income shifting by limiting the amount of comparable information available to the local tax authority. Since the value of patents and royalty payments is often firm specific, the MNC owning the intangible asset has specific knowledge about the underlying value drivers. This feature implies an asymmetry between the information set used by the MNC to value an intra-firm transaction and that held by the local tax authority (Blair-Stanek, 2015; Gallemore, Huang, and Wentland, 2018).[2] Similar to increasing patent concentration hindering knowledge diffusion in the economy (Akcigit and Ates, 2019; Gutiérrez and Philippon, 2019), it could also diminish the number of transactions between unrelated parties and reduce the information set of the local tax authority (De Simone and Sansing, 2018; De Waegenaere, Sansing, and Wielhouwer, 2012). Therefore, patent concentration could intensify the information asymmetry and make it more difficult for the local tax authority to assess an MNC's transfer price for a patent or for royalty payments for the use of a patent. Consequently, we expect tax-motivated income shifting to be increasing in patent concentration.

To examine the relation between patent concentration and tax-motivated income shifting, we use affiliate-level unconsolidated financial statement data from Bureau van Dijk's Orbis database. We link Orbis with the Worldwide Patent Statistical Database PATSTAT, which provides detailed information on patent owners, applications, grants, and citations. We create an *affiliate-level* measure of patent concentration by dividing the number of patents held by all affiliates of an MNC by the sum of patents held by all other MNCs with affiliates operating in the same country-industry-year as the affiliate for which the measure is computed.[3] Our measure is based on the following intuition: If an MNC holds a relatively large share of patents, comparable information is scarce, which facilitates income shifting *from* a non-patent-holding affiliate *to* a foreign patent-holding affiliate ("outbound income shifting", see Figure 1).[4] We

[2] Since the "true" economic value of a patent and of royalty payments is unknown, the MNC and the local tax authority both have incomplete information about the precise value of an intra-firm transaction. However, since the value of a patent is often firm specific, the MNC has more complete information than the local tax authority, leading to asymmetric information between the two parties. A comparable economic problem of information asymmetry under incomplete information arises in emissions taxation (Baron, 1985) or knowledge transfers in a sender-receiver framework (Lin, Geng, and Whinston, 2005).

[3] Our measure includes all patents held by an MNC. However, it is still an *affiliate-level* measure that varies *within* an MNC because the distribution of patents varies across the country-industry-years in which an MNC operates.

[4] In our main tests, we focus on outbound income shifting, because cross-border royalty payments threaten to erode the tax base of countries in which non-patent holding affiliates are located. Hence, comparable information is most critical for a local tax authority that assesses the royalty payments of a non-patent holding affiliate (OECD, 2015b).

include this measure in a modified version of the affiliate-level income-shifting model developed by Huizinga and Laeven (2008) and extended by De Simone, Klassen, and Seidman (2017).

Consistent with our prediction, we find that tax-motivated income shifting is increasing in patent concentration. This effect is economically significant: In response to a one standard deviation increase in patent concentration, the semi-elasticity of the average affiliate's return on assets to income shifting incentives based on statutory corporate income tax rates changes from -1.33 to -1.67. This effect marks a marginal increase in tax-motivated income shifting by 25.6 percent.[5] We also find a significant increase in the sensitivity of affiliate-level return on assets to incremental shifting incentives associated with IP-box regimes, providing preferential tax rates on IP income (e.g., royalty payments). Our results hold when calculating patent concentration based on patent citations as a proxy for patent value, when applying alternative measures of income-shifting incentives, and when excluding loss affiliates from the sample. Overall, these results suggest that the degree of patent concentration is an important driver of tax-motivated income shifting.

To shed light on whether asymmetric information between the MNC and the local tax authority drives our main result, we study two settings in which the set of comparable information available to the local tax authority is likely to vary. First, we exploit comparable information associated with local patent-holding affiliates. To detect an aggressive transfer-pricing strategy, tax authorities could benchmark the transfer price set by the MNC against the price of transactions between local-patent holdings affiliates of other MNCs and their unrelated

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However, our results are qualitatively similar when including patent-holding affiliates. In supplementary tests, we separately examine patent-holding affiliates and find that patent concentration is also associated with the extent to which MNCs shift income *into* these affiliates (see Section 6.3).

[5] Our baseline estimates suggest that a one percent increase in income-shifting incentives is associated with a 1.33 percent lower return on assets at the affiliate level. A one standard deviation higher patent concentration implies a sensitivity of -1.67, which is equivalent to a 25.6 percent change (= -1.67 / -1.33 - 1).

customers (De Simone, 2016). Therefore, we expect a large share of local patent-holding affiliates to mitigate the relation between patent concentration and tax-motivated income shifting. Our results are consistent with this expectation, providing initial evidence that patent concentration limits comparable information available to the local tax authority.

Second, we examine changes in country-level tax enforcement that are likely to alter the local tax authority's set of comparable information. Specifically, we exploit increases in the value of completed tax assessments and the percentage of staff used in tax audits (OECD, 2011, 2013, 2015b, 2017b). Both proxies relate to enforcement actions that provide the local tax authority an opportunity to collect comparable information. Supporting the argument that patent concentration limits comparable information available to the local tax authority, we find that an increase in these enforcement actions weakens the relation documented in our main tests. To rule out that changes in a country's *general* tax-enforcement environment drive this result, we re-run our tests using reductions in the costs of tax collection as a proxy for increases in the overall efficiency of tax collection and administration (OECD, 2013), and find no evidence for a mitigating effect. Taken together, these results support the argument that patent concentration facilitates tax-motivated income shifting, by limiting the set of comparable information available to the local tax authority, and by increasing information asymmetry between the MNC and the local tax authority.

We conduct several additional tests to rule out alternative explanations for our findings and to further explore the relation between patent concentration and income shifting. First, we continue to find that tax-motivated income shifting is increasing in patent concentration after controlling for market power, MNC group size, and R&D activity. Second, we perform a falsification test based on income shifting via debt. We find no relation between patent concentration and this income-shifting channel, providing comfort that patent concentration rather than general firm characteristics explains our results. Third, we examine patent-holding affiliates and find that patent concentration is also associated with inbound income shifting. This result suggests that limited comparable information increases the attractiveness of an affiliate as a target for shifted income.

Our study makes several contributions. First, we expand research on the determinants of tax-motivated income shifting (Bartelsman and Beetsma, 2003; Blouin, Robinson, and Seidman, 2018; De Simone et al., 2017; Markle, 2016; McGuire, Rane, and Weaver, 2018) by identifying patent concentration as an important driver of this behavior. In this regard, our study also adds to emerging research on the role of comparable information in tax-related transfer pricing.
De Simone (2016), for instance, documents that *less* comparable information could constrain an MNC in justifying an aggressive transfer-pricing strategy, which is associated with *less* income shifting. Our results, in contrast, suggest that, because the value of patents and royalty payments is often firm specific, patent concentration and the associated reduction in comparable information *facilitate* income shifting via patents. More generally, because patent concentration depends on the distribution of patents within an industry, our results highlight that industry landscapes and the availability of comparable assets or firms shape income-shifting incentives. On a policy level, our tax-enforcement results indicate that only policy measures that improve the local tax authority's set of comparable information are effective in curtailing tax-motivated income shifting via patents.

Second, our findings add to research on specific income-shifting channels. While prior studies show that MNCs use patents to shift income (Beer and Loeprick, 2015; Griffith et al., 2014; Grubert, 2003), we document that patent concentration shapes the incentives for MNCs to engage in income shifting. Moreover, prior studies have focused on shifting incentives associated with statutory corporate income tax rates (Dharmapala and Riedel, 2013; Heckemeyer and Overesch, 2017). Since we find that MNCs are sensitive to incremental shifting incentives induced by IP-box regimes, our findings suggest that researchers need to consider these incentives in order to capture the full extent of income shifting via patents. Tests limited to statutory corporate income tax rates could be insufficient to achieve this objective.

Finally, and more broadly, our study contributes to the innovation and patenting literature. Prior research in this area finds that a higher concentration of patent holdings is associated with a decline in knowledge diffusion and a slowdown in business dynamics (Akcigit and Ates, 2019; Gutiérrez and Philippon, 2019). We add to this literature by showing that patent concentration drives the extent to which MNCs use patents to shift income and that patent concentration increases information asymmetry between the MNC and the local tax authority.

2. Background and hypothesis development

2.1 Transfer pricing for tax purposes and the Arm's Length Standard

While market forces determine the price for a transaction between unrelated parties, an MNC has to set a transfer price when valuing an intra-firm transaction for tax purposes. The OECD defines a transfer price as "the price at which an enterprise transfers physical goods and intangible property or provides services to associated enterprises" (OECD, 2010). According to the OECD Transfer-Pricing Guidelines, the price set by the MNC has to be consistent with the "arm's length standard". This principle, which also applies to U.S. MNCs under Internal Revenue Code §482, requires the price charged for an intra-firm transaction to be equivalent to the price charged between unrelated parties for similar transactions entered into under similar economic circumstances (OECD, 2017a).

The OECD Transfer-Pricing Guidelines provide several methods to determine the arm's length transfer price. An MNC has to select the most appropriate method by analyzing the functions performed, assets contributed, and the risks borne by the affiliates involved in the transaction (OECD, 2017a).[6] All methods require information from economically comparable transactions to derive inputs such as mark-ups or profit margins, necessary to value an intra-firm transaction. The MNC can obtain comparable information from comparable transactions between independent firms or from its own transactions with unrelated parties. The latter includes firms operating in the same industry, performing similar functions, and bearing similar risks. If comparable information is unavailable, the MNC may use valuation techniques to estimate the arm's length transfer price (OECD, 2017a).

The local tax authority also requires comparable information to detect and challenge potentially aggressive transfer-pricing strategies. More specifically, the tax authority could assess the transfer price set by an MNC by benchmarking it against the prices of economically similar transactions between independent firms. Consistent with this argument, anecdotal evidence from court cases suggest that local tax authorities collect comparable information when assessing whether the transfer-pricing strategies of an MNC are compliant with the arm's length standard (Amazon v. Commissioner, 2017; Veritas v. Commissioner, 2009).

The amount of comparable information available depends on the characteristics of an intra-firm transaction. For goods and services sold on external markets, market prices are readily observable (IMF et al., 2017). However, comparable information may be scarce or difficult to obtain for goods or services without an external market. This also applies to intra-firm transactions involving patents (De Simone and Sansing, 2018; De Waegenaere et al., 2012).

[6] An MNC may choose from traditional transaction methods or cost plus methods (OECD, 2017a).

These assets are therefore considered hard to value for transfer-pricing purposes, posing a challenge to the arm's length standard and to local tax authorities scrutinizing an MNC's transfer-pricing strategies (IMF et al., 2017; Veritas vs. Commissioner, 2009).

2.2 Patents and tax-motivated income shifting

Because of their global operations, MNCs can lower their worldwide tax burden by shifting income to low-tax countries. Patents are perceived as a key element for tax-motivated income shifting(OECD, 2015a).[7] In order to shift income, an MNC has to develop or locate a patent in a low-tax jurisdiction (Karkinsky and Riedel, 2012). If a high-tax affiliate subsequently pays tax-deductible royalty payments for the intra-firm use of the patent to the low-tax patent-holding affiliate, income is relocated from the high-tax jurisdiction to the low-tax jurisdiction, reducing the overall tax burden of the MNC.[8]

Prior research employs different approaches to identify income shifting via patents. One stream of research studies the relation between corporate income tax rates and the locational choice for patents. Dischinger and Riedel (2011) and Karkinsky and Riedel (2012) find the statutory corporate income tax rate is negatively related to the level of intangible investment and the number of patent applications in a given country. Griffith et al. (2014) show that MNCs strategically locate valuable patents in countries that offer tax benefits for IP income. A second

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[7] Other income-shifting strategies are based on intra-firm interest payments and the manipulation of transfer prices for the intra-firm sale of goods, services, or assets (Dharmapala, 2014; Dyreng and Markle, 2016; Riedel, 2018; Hopland, Lisowsky, Mardan, and Schindler, 2018).

[8] Patents can be used for least two additional income-shifting strategies. First, an MNC can develop a patent in a high-tax country and then transfer the IP to a foreign affiliate at an artificially low transfer price. Second, an MNC can enter into a cost sharing agreement (CSA), where the parent of the MNC contributes domestically developed IP in exchange for an artificially low "buy-in" payment from its foreign affiliate. In both cases, the patent ends up in the hands of a low-tax affiliate, reducing the tax burden on any future profits earned from the patent (Avi-Yonah, 2012; Blair-Stanek, 2015). We focus on income-shifting strategies based on intra-firm royalty payments, because cost contribution agreements, which are similar to CSAs, are less attractive for MNCs headquartered in the European Union (EU). The local tax authorities in the EU follow the OECD guidelines, which, in comparison to the IRS guidelines in the U.S., require an active involvement to share the benefits of IP developed under a CSA (Okten, 2013).

stream of research examines an MNC's transfer-pricing strategies and shows that firms respond to country-level differences in tax rates by adjusting their intra-firm transfer prices. This result is concentrated in MNCs with high levels of intangible assets and greater organizational complexity (Bartelsman and Beetsma, 2003; Clausing, 2003). Moreover, Grubert (2003) finds that the profits of U.S. MNCs respond to income-shifting incentives and that this effect is strongest for R&D-intensive firms. De Simone, Mills, and Stomberg (2019a) use IRS data to construct an outbound-shifting score and find that firms in high-tech industries are more likely to shift income out of the U.S. Similarly, De Simone, Huang, and Krull (2020) find a positive relation between foreign profit margins and the domestic R&D activity of U.S. firms.

2.3 Hypothesis development

As noted, the availability and the distribution of comparable information depends on the characteristics of an intra-firm transaction. Comparable information for the pricing of intra-firm royalty payments is scarce, because market prices for these payments are often unavailable (Blair-Stanek, 2015; De Simone and Sansing, 2018; De Waegenaere et al., 2012). In addition, the value of a patent – and the associated royalty payments – is largely firm-specific and its owner has greater knowledge about the profit potential and the underlying value drivers than the local tax authority (Gallemore et al., 2018; Qiu and Wan, 2015). Therefore, the "true" economic value of intra-firm royalty payments is often ambiguous and both parties have incomplete information sets. However, the information set of the MNC owning the patent appears more complete than that of the local tax authority. This implies an asymmetry between the information used by the MNC to value an intra-firm transaction and that held by the local tax authority when evaluating the MNC's transfer-pricing strategy.

Akcigit and Ates (2019) show that patent concentration hinders knowledge diffusion in an economy. Similarly, we expect patent concentration to reduce the information set of the local tax authority and to intensify the information asymmetry. That is, if a small number of firms in an industry holds a large share of patents (i.e., patent concentration is high), the number of comparable transactions involving patents is low, and knowledge about the underlying value drivers is concentrated in a small subset of firms. As a result, the local tax authority lacks benchmarks to assess the transfer price set by the MNC (Mescall and Klassen, 2018; OECD, 2015b; OECD, 2017a), and the MNC might be able to justify a broader range of potential transfer prices. Moreover, if comparable information is scarce, the MNC could substantiate the arm's length transfer price with pricing information from its own transactions or by applying valuation techniques to estimate the transfer price. These transfer prices seem more difficult to verify for the tax authority than the prices derived from transactions between independent firms. Hence, high patent concentration is likely to reduce the risk that the local tax authority might detect and challenge an aggressive tax position, increasing an MNC's incentives to shift income. Based on these arguments, we hypothesize that tax-motivated income shifting is increasing in the degree of patent concentration. This leads to our main hypothesis:

H1: Tax-motivated income shifting is increasing in the degree of patent concentration.

There are at least two reasons we might not find the hypothesized relation. First, several countries have recently tightened their tax enforcement (De Simone et al., 2019b) where the OECD stresses the importance of assessing firms with high intangible-asset intensity (OECD, 2017a). If these efforts increase the risk that the local tax authority might detect and challenge a transfer-pricing strategy, an MNC's incentives to shift income might diminish, and we might not find a relation between patent concentration and tax-motivated income shifting. Second, recent survey evidence suggests that a significant share of MNCs prefers compliance with the arm's length standard over aggressive income shifting (Klassen, Lisowsky, and Mescall, 2017). If MNCs seek tax compliance or income-shifting aggressiveness independent from the degree of patent concentration, we also might not find support for our hypothesis.

3. Research design, data, and sample

3.1 Baseline income-shifting model

Our research design is based on the income-shifting model developed by Hines and Rice (1994) and expanded by Huizinga and Laeven (2008). The main challenge to empirically examine tax-motivated income shifting is observing taxable income prior to income shifting ("true income"), because the book income reflects the income after shifting has occurred. The model by Hines and Rice (1994) and Huizinga and Laeven (2008) applies a Cobb-Douglas production function to estimate an affiliate's true income as a function of capital, labor, and productivity. We use the recent extension by De Simone et al. (2017), which allows us to keep unprofitable affiliates in the sample.[9] Equation (1) depicts this baseline income-shifting model:

$$
\begin{aligned}
LN(1+ROA)_{it} = {} & \alpha_c + \alpha_j + \alpha_t + \beta_1 LN(TangibleAssets)_{it} + \beta_2 LN(CompExpense)_{it} + \\
& \beta_3 IndustryROA_{cjt} + \beta_4 LN(Age)_{it} + \beta_5 GDPGrowth_{ct} + \\
& \beta_6 \Delta MarketSize_{cjt} + \beta_7 C_{it} + \beta_8 Loss_{it} + \beta_9 C * Loss_{it} + \varepsilon_{it}
\end{aligned} \tag{1}
$$

The dependent variable, *LN(1+ROA)* is the natural logarithm of affiliate *i*'s return on assets (*ROA*) in year *t.* Adding 1 to *ROA* before taking logs keeps unprofitable affiliate-years in the sample (Claessens and Laeven, 2004; De Simone et al., 2017). We follow prior research (Blouin

[9] We include unprofitable affiliates, because prior research suggests that affiliate-level losses could affect an MNC's incentives to shift income via patents. Hopland et al. (2018) show that royalty payments offer sufficient flexibility to reap the tax benefits associated with temporary losses. In Table 8, we modify the income-shifting model to exclude loss affiliates. Results are consistent with our main findings, suggesting that loss affiliates do not drive our results.

et al., 2018; De Simone, 2016; Huizinga and Laeven, 2008; Klassen and Laplante, 2012; Markle, 2016) and use book income as a proxy for affiliate *i*'s taxable income. *ROA* is calculated as earnings before interest and taxes (EBIT), divided by total assets. We use EBIT instead of pre-tax income, because EBIT is unaffected by income shifting via intra-firm interest payments (Heckemeyer and Overesch, 2017), providing a cleaner identification of the income-shifting channel of interest. In Section 6.2, we explore income shifting via interest payments in a falsification test.

We include the logarithm of affiliate tangible fixed assets and affiliate compensation expenses to proxy for capital and labor input. To measure productivity, we add *IndustryROA* as the median ROA by country-industry-year based on all affiliates and independent firms operating in a two-digit NACE country-industry-year (De Simone et al., 2017). *LN(Age)* is the natural logarithm of affiliate age, calculated as year *t* less the first year affiliate *i* appears in the database. To capture profitability shocks at the affiliate country- and the affiliate industry-level, we include annual GDP growth in affiliate country *c* (*GDPGrowth*) and the annual percentage change in total sales of all affiliates and independent firms by two-digit NACE country-industry-year (*ΔMarketSize*).

C captures the tax incentive to shift income for affiliate *i* in year *t*. Following Huizinga and Laeven (2008), we calculate *C* based on weighted tax-rate differentials between affiliate *i* and all other affiliates of the MNC (see Equation (2)). We calculate tax-rate differentials based on statutory corporate income tax rates. In addition, we follow Huizinga and Laeven (2008) and weigh the tax-rate differentials by total affiliate assets (*K*) to account for the costs of income shifting, which are assumed to increase in an affiliate's scale of operations.

$$C_{it} = \frac{1}{(1-\tau_{it})} * \frac{\sum_{k\neq i}^{n} \frac{K_{kt}}{(1-\tau_{kt})} * (\tau_{it} - \tau_{kt})}{\sum_{k\neq i}^{n} \frac{K_{k,t}}{(1-\tau_{kt})}} \tag{2}$$

By including weighted tax-rate differentials between affiliate *i* and all other affiliates of the MNC, this measure captures the sum of all income-shifting incentives associated with affiliate *i*, taking the costs of income shifting into account. *C* could take positive or negative values. A higher (lower) value of *C* suggests that affiliate *i* is a high-tax (low-tax) affiliate relative to all other affiliates of the MNC, implying a tax incentive to shift income to (from) affiliates with lower (higher) values of *C*. A negative coefficient on β_7 therefore indicates that the taxable income of affiliate *i* is sensitive to shifting incentives associated with statutory corporate income tax rates. Less taxable income is reported in high-tax affiliates while more taxable income is reported in low-tax affiliates, providing evidence for tax-motivated income shifting. *C* varies across affiliates due to country-level differences in statutory corporate income tax rates, differences in tax-rate differentials between the affiliates of the MNC, and affiliate-level differences in income-shifting costs. *C* varies over time due to changes in statutory corporate income tax rates. We add *Loss* as an indicator variable with the value of one if EBIT of affiliate *i* is less than zero in year *t*. Since income-shifting incentives could differ for unprofitable affiliates, we interact *C* with *Loss* (De Simone et al., 2017).

Finally, we include a series of fixed effects. First, we add affiliate country-fixed effects (α_c) to control for country-specific deviations from the statutory corporate tax rate (De Simone, 2016) and for time invariant country-level differences in tax regimes and institutions. Second, we include affiliate industry-fixed effects (α_j) to capture time invariant differences in income-shifting opportunities, productivity, and profitability across industries. Third, we add year-fixed effects (α_t) to absorb the effects of business cycles and economic shocks. We cluster standard errors by affiliate to account for serial correlation in the data (Petersen, 2009).

3.2 Extended income-shifting model to test for the effect of patent concentration

To test our hypothesis, we extend Equation (1) as follows:

$$LN(1+ROA)_{it} = \alpha_c + \alpha_j + \alpha_t + \sum Controls + \beta_7 C_{it} + \beta_8 C\_Patents_{it} + \beta_9 Loss_{it} + \beta_{10} C * Loss_{it} + \beta_{11} C\_Patents * Loss_{it} + \beta_{12} PatentConc_{it} + \beta_{13} C * PatentConc_{it} + \beta_{14} C\_Patents * PatentConc_{it} + \varepsilon_{it} \quad (3)$$

First, we add *C_Patents* and its interaction with *Loss* to account for income-shifting incentives not captured by *C*. Several countries in our sample offer IP-box regimes and provide preferential tax rates for IP income (Bornemann, Laplante, and Osswald, 2019; Evers, Miller, and Spengel, 2015). To obtain *C_Patents*, we recalculate *C* for affiliate *i* in year *t*, using IP tax rates instead of statutory corporate income tax rates (*C_IP*). We then subtract *C* from *C_IP* to isolate incremental income-shifting incentives associated with IP tax rates.[10] A negative coefficient on β_8 indicates that the taxable income of affiliate *i* is sensitive to these shifting incentives, again providing evidence for tax-motivated income shifting.[11]

Second, we include *PatentConc* as an affiliate-level measure for patent concentration. For affiliate *i*, we derive the number of patents held by all domestic and foreign affiliates of the MNC

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[10] We compute *C_Patents* to capture *incremental* income-shifting incentives associated with IP tax rates, because IP-box regimes differ in the conditions under which patent income may qualify for this tax incentive. For instance, the UK offers a reduced tax rate for income derived from acquired patents that were further developed by the acquirer. The Portuguese IP-box regime, in contrast, is limited to income from self-developed patents (Evers et al., 2015). Since our data does not provide information on whether a patent is eligible for this tax incentive, we include separate measures for income-shifting incentives associated with statutory tax rates (*C*) and the incremental incentives associated with IP tax rates (*C_Patents*). In a robustness test, we include *C_IP* and find consistent results (Table 8).

[11] We provide a numerical example in Appendix B. In addition, we to provide background on the calculation of C*_Patents* and outline why a negative coefficient on β_8 is consistent with tax-motivated income shifting.

in year *t*. We divide this number by the sum of patents held by domestic and foreign affiliates of all other MNCs operating in the same country-industry-year as affiliate *i*.[12] As depicted in Figure 1, *PatentConc* is based on the following intuition: If affiliate *i* belongs to an MNC that holds a small fraction of patents compared to all other MNCs operating in the same country-industry-year, patent concentration is low. When assessing the transfer price for intra-firm royalty payments of affiliate *i*, the local tax authority should have access to a large set of comparable information from the transactions of other MNCs with their unrelated customers (panel A).[13] If affiliate *i* belongs to an MNC that holds a large fraction of patents, patent concentration is high and comparable information from transactions of other MNC is limited (panel B).

Overall, our measure captures differences in the incentive to shift income via patents *from* a non-patent holding affiliate (affiliate *i*) *to* a foreign patent-holding affiliate. We focus on this outbound shifting mechanism, because cross-border royalty payments threaten to erode the tax base of countries in which non-patent holding affiliates are located (OECD, 2015b). By limiting *PatentConc* to affiliates of MNCs operating in the same country-industry-year, we also measure the degree of patent concentration for affiliate *i* relative to its industry peers. This approach mitigates concerns that differences in patenting strategies across industries might affect our measure (Hall, Helmers, Rogers, Sena, 2014). Moreover, the degree of internationalization is a key criterion for tax authorities in identifying comparable firms (OECD, 2015b; IMF et al.,

[12] We provide a numerical example in Appendix B.

[13] Ideally, one would like to observe licensing agreements between MNCs and their unrelated customers to measure the extent of comparable information available to the local tax authority. These are unobservable, so we assume that the relative share of patents held by an MNC is correlated with the number of licensing agreements in a country-industry-year. The results of our tests based on local-patent holdings affiliates (Table 6) support this assumption.

2017). Therefore, and because we are interested in cross-border royalty payments, we focus on patents held by the affiliates of MNCs.[14]

To examine whether patent concentration is associated with tax-motivated income shifting, we interact *PatentConc* with *C* and *C_Patents*, respectively. If patent concentration facilitates tax-motivated income shifting, we expect β_{13} and β_{14} to be negative. That is, the extent to which taxable income reported by affiliate *i* is sensitive to *C* and *C_Patents* should increase in patent concentration.

INSERT FIGURE 1 HERE

3.3 Data and sample

We obtain affiliate-level unconsolidated financial statement data and ownership data from Bureau van Dijk's Orbis database for the period 2008 to 2016. We obtain patent data from the Worldwide Patent Statistical Database PATSTAT.[15] This database is maintained by the European Patent Office (EPO) and offers rich bibliographic data on patents.[16] We merge PATSTAT with Orbis using Bureau van Dijk's reverse search algorithm, taking into account the affiliate's name and country of residence. This procedure links patent ownership to the affiliates recorded in Orbis, yielding the location of patent holdings within an MNC.

We start our sample selection by identifying MNCs with affiliates in at least two different countries. We require direct and indirect ownership links of greater than 50 percent within the

[14] Our main inferences are unchanged when including independent firms in the calculation of *PatentConc*.
[15] We use the "Autumn 2017" edition of PATSTAT.
[16] PATSTAT collects data from more than 100 patent offices worldwide, including patent applications and grants from patent offices in the member states of the European Patent Convention (EPC) and other major patent offices, such as the United States Patent and Trademark Office (USPTO). For more information, see https://www.epo.org/searching-for-patents/business/patstat.html#tab-1.

MNC.[17] To be consistent with prior research (De Simone, 2016), we require the parent of the MNC and its foreign affiliates to be located in a European country.[18] We also require non-missing NACE industry codes and positive values for total assets, tangible fixed assets, and compensation expenses. These requirements yield an initial sample of 163,865 affiliate-year observations, representing 28,733 unique affiliates and 9,088 unique MNCs.

We exclude affiliates of MNCs active in banking or insurance industries, because these sectors provide distinct income-shifting incentives (Merz and Overesch, 2016). We require the MNC to be profitable as a group since consolidated losses could alter shifting incentives (De Simone et al., 2017).[19] We further exclude observations with missing values for EBIT and with values for *LN(1+ROA)* less than or equal to zero. Finally, we drop observations with insufficient data to calculate our regression variables. The final sample includes 138,293 affiliate-year observations, representing 26,608 unique affiliates and 8,489 unique MNCs. The average MNC in our sample owns 3.1 affiliates, and we observe 5.2 observations per affiliate. We summarize the sample selection in Appendix A.

3.4 Descriptive statistics

Table 1 presents the sample composition by country.[20] We observe the largest number of affiliate-years for France, Italy, and Spain while the number is lowest for Ireland, Iceland, and

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[17] Ownership information in Orbis is stale and reflects the status of the last year in the dataset. This limitation could lead to measurement error, because we might classify an independent firm that was acquired by an MNC later in the sample as being an affiliate throughout. Because we examine tax-motivated income shifting in a cross-border context, these ownership changes tend to bias against us finding results. Therefore, our effect sizes are likely to constitute lower bound estimates.

[18] More specifically, we limit our sample to affiliates located in the member states of the European Union and the European Free Trade Association (EFTA). The latter includes Switzerland, Liechtenstein, Norway, and Iceland. We relax this requirement when calculating *C* and *C_Patents* for affiliate *i* and take non-European affiliates with data on total assets into account.

[19] We follow De Simone et al. (2017) and calculate the consolidated return on sales using data for the affiliates in our sample. We drop affiliate-years belonging to an MNC with a negative return on sales in year *t*.

[20] Due to our sample selection requirements, the final sample is limited to affiliates located in 27 European countries.

Switzerland. In columns 2 and 3, we present information on corporate income tax rates and IP tax rates, respectively. The mean corporate income tax rate varies across countries and ranges from 10 percent in Bulgaria to 35 percent in Malta. Similarly, the mean IP tax rate ranges from 6 percent in Luxembourg to 30 percent in Germany. 12 countries in our sample operate an IP-box regime, resulting in differences between the mean corporate income tax rate and the mean IP tax rate. A difference ranging from 2 percentage points in Italy to 27 percentage points in Belgium indicates that *C* based on statutory corporate income tax rates is unlikely to capture all income-shifting incentives associated with patents.

INSERT TABLE 1 HERE

Table 2 presents descriptive statistics. We winsorize continuous variables at the 1st and the 99th percentile to mitigate the influence of outliers. Panel A shows information for the full sample. The average affiliate in our sample reports earnings before interest and taxes of EUR 3.08 million (*EBIT*), a return on assets of 7.5 percent (*ROA*), tangible fixed assets of EUR 7.05 million (*TangibleAssets*), and compensation expenses of EUR 5.86 million (*CompExpense*). 17.1 percent of the affiliate-years report a negative EBIT (*Loss*). The average affiliate in our sample holds 2.85 patents (*PatStock*) and belongs to an MNC owning 35.62 patents (*SumPatents*).[21] The median values of *PatStock* and *SumPatents* are both equal to zero. This suggests that relatively few firms in our sample hold patents, which is consistent with the findings in Hall et al. (2014).

Panels B and C present descriptive statistics for patent-holding and non-patent-holding affiliates, respectively. 10.4 percent of the affiliate-years in our sample hold at least one patent (panel B). These affiliates are larger (*TangibleAssets*) and exhibit a higher *EBIT* and higher

[21] *PatStock* is the number of granted patents held by affiliate *i* in year *t*. We include all patents granted in the last 19 years, because patents generally protect an invention for 20 years.

compensation expenses (*CompExpense*) than non-patent-holding affiliates ($p < 0.01$; two-tailed). However, both groups do not differ in their return on assets (*ROA*; $p = 0.79$; two-tailed). In panel B, the mean (median) value of *PatStock* is equal to 27.3 (5), which suggests that patent holdings are strongly skewed even among patent-holding affiliates.

INSERT TABLE 2 HERE

Table 3 reports Pearson correlation coefficients for the full sample. Pairwise correlations between our regression variables are generally consistent with prior research using unconsolidated financial statement data for European affiliates (De Simone et al., 2017; Huizinga and Laeven, 2008). Further, *C* and *C_Patents* are weakly correlated ($\rho = 0.13$), which indicates that both measures capture distinct income-shifting incentives.

INSERT TABLE 3 HERE

4. Main results

4.1 Extending the income-shifting model

Before testing our hypothesis, we extend the income-shifting model by De Simone et al. (2017) and include our measure for incremental income-shifting incentives associated with IP-box regimes (*C_Patents*). We report the results in Table 4. In column 1, we replicate their model on the full sample and find consistent results. That is, the negative and significant coefficient on *C* ($p < 0.01$) provides evidence for tax-motivated income shifting, and the coefficients estimates on *C* (-0.097) and *C*Loss* (0.289) are close to the estimates reported in De Simone et al. (2017) (-0.088 and 0.251).[22] In columns 2 and 3, we include *C_Patents* and the interaction of *C_Patents*

[22] The coefficients on *C* and *C*Loss* translate into a semi-elasticity at the mean *ROA* of -0.97 for profitable affiliates and of +1.79 for unprofitable affiliates. These elasticities are slightly larger than the estimates in De Simone et al. (2017).

with *Loss*, respectively. While the results for the initial variables are similar to those reported with column 1, the coefficients on *C_Patents* and *C_Patents*Loss* are insignificant in both columns ($p > 0.17$).[23] These results suggest that adding *C_Patents* and *C_Patents*Loss* does not alter the inferences drawn from the De Simone et al. (2017) income-shifting model.

INSERT TABLE 4 HERE

4.2 Tests of H1: Patent concentration and tax-motivated income shifting

To test our hypothesis, we examine the relation between patent concentration and tax-motivated income shifting. In this test, we limit the sample to non-patent-holding affiliates, because *PatentConc* captures the incentive to shift income via intra-firm royalty payments *from* a non-patent-holding affiliate *to* a foreign patent-holding affiliate. We estimate Equation (3) and present the results in Table 5.

Consistent with the results in Table 4, the coefficient on *C* is negative and significant in column 1 ($p < 0.01$), while the coefficient on *C_Patents* is again insignificant ($p = 0.83$). Most importantly, the coefficients on *C*PatentConc* and *C_Patents*PatentConc* are both negative and significant ($p < 0.04$). These results suggest that tax-motivated income shifting is increasing in patent concentration, providing support for H1. In column 2, we replace the continuous measure for patent concentration with an indicator variable taking the value of one if *PatentConc* is in the top sample quartile (*HighPatentConc)*. The negative and significant coefficients on

[23] The insignificant coefficient on *C_Patents* is reasonable, because the descriptive statistics in Table 2 suggest that a relatively small number of affiliates hold patents in our sample. Thus, the average affiliate in our sample is unlikely to be used for income shifting based on patents, which is a precondition to benefit from the incremental income-shifting incentives captured by *C_Patents*. When limiting the sample in column 2 to affiliates of MNCs that hold at least one patent, the coefficients on *C* and *C_Patents* are negative and significant ($p < 0.03$).

*C*HighPatentConc* and *C_Patents*HighPatentConc* ($p < 0.08$) are consistent with column 1 and again suggest that affiliates with high patent concentration tend to shift more income.

In economic terms, the coefficient estimates on *C* (-0.087) and *C*PatentConc* (-0.144) in column 1 imply a semi elasticity of -1.33. That is, for the average affiliate in our sample, a one percent increase in *C* is associated with a 1.33 percent lower return on assets.[24] Based on this estimate, a one standard deviation increase in *PatentConc* (0.162) leads to a semi elasticity of -1.67. This change marks a 25.6 percent greater sensitivity of the average affiliate's return on assets to income-shifting incentive captured by *C* ([-1.67 / -1.33] – 1), which is consistent with 25.6 percent more tax-motivated income shifting at the margin. The semi elasticity of the average affiliate's return on assets to incremental shifting incentives associated with IP-box regimes (*C_Patents*) changes from -0.01 to -0.16 in response to a one standard deviation increase in patent concentration.

INSERT TABLE 5 HERE

Taken together, the results in this section support our hypothesis: Tax-motivated income shifting is increasing in patent concentration. Moreover, the degree of patent concentration is an economically important determinant of tax-motivated income shifting.

5. Testing for the underlying mechanism

In this section, we shed light on the mechanism behind our main results. We argue that patent concentration increases the incentives to shift income by limiting comparable information

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[24] We calculate the semi-elasticity assuming a one percent change in *C*: (exp[(coefficient on *C* + coefficient on *C*PatentConc* * Mean *PatentConc*) * Δ *C* + LN(mean *ROA* + 1)] – 1 – mean *ROA*) / mean *ROA*; (exp[(-0.087 + -0.144 * 0.042) * 0.01 + LN(0.075 + 1)] – 1 – 0.075) / 0.075 = -1.33. Our estimate falls in the range of estimates provided by prior studies (see Dharmapala (2014) and Riedel (2018) for reviews of the estimates provided by prior research).

available to the local tax authority and by intensifying asymmetric information between the MNC and the local tax authority. If this mechanism explains our results, we expect the relation between patent concentration and income shifting to vary with the extent of comparable information available to the local tax authority. To test this conjecture, we exploit two settings that are likely to provide variation in comparable information. First, we study the presence of local patent-holding affiliates. Second, we examine changes in tax-enforcement actions that allow the local tax authority to collect comparable information.

5.1 Local patent-holding affiliates

When assessing a transfer-pricing strategy, the local tax authority could benchmark the transfer price determined by the MNC against the prices set by unrelated firms performing similar functions and bearing similar risks (OECD, 2017a). As suggested by Figure 1, the local tax authority could thereby draw on the transactions of other MNCs with their unrelated customers. If patent concentration limits the local tax authority's set of comparable information, the relation found in our main tests should be weaker in the presence of sufficient local patent-holding affiliates. Such a mitigating effect would also corroborate the framework proposed in Figure 1 and support the rationale underlying our measure for patent concertation.

We create *HighCompInfo* as an indicator variable with the value of one if the share of local patent-holding affiliates relative to all affiliates operating in the country-industry-year of affiliate *i* is in the top sample quartile.[25] We include *HighCompInfo* in Equation (3) and interact this variable with *C*, *C_Patents*, *PatentConc*, *C*PatentConc*, and *C_Patents*PatentConc*, respectively. Based on the above arguments, we expect a weaker relation between patent

[25] Instead of using the affiliates included in our sample, we calculate *HighCompInfo* based on *all* affiliates available in the Orbis database, alleviating concerns that country-level differences in data availability affect our inferences.

concentration and tax-motivated income shifting in country-industry-years characterized by a high share of local-patent holding affiliates, suggesting positive coefficients on both triple interactions. We present the results in Table 6.

In column 1, we use the continuous patent-concentration measure and continue to find negative and significant coefficients on *C*PatentConc* and *C_Patents*PatentConc* ($p < 0.03$).[26] These results again suggest that tax-motivated income shifting is increasing in patent concentration. The coefficients on the triple interactions *C*PatentConc*HighCompInfo* and *C_Patents*PatentConc*HighCompInfo* are positive but insignificant ($p = 0.17$ and $p = 0.35$). However, for affiliates with high patent concentration (column 2), the coefficients on both triple interactions are positive and significant ($p < 0.03$). For these affiliates, the presence of local patent-holding affiliates mitigates the relation between patent concentration and tax-motivated income shifting. These results suggest that local patent-holding affiliates provide the local tax authority with a source of comparable information, providing initial support for the argument that patent concentration limits the local tax authority's set of comparable information.

INSERT TABLE 6 HERE

5.2 Changes in tax enforcement

Tax-enforcement actions could also provide the local tax authority with more comparable information. In a tax audit, for example, the local tax authority could collect pricing information on royalty payments between unrelated parties (De Simone, 2016). If patent concentration limits the comparable information available to the local tax authority, we expect changes in tax-

[26] The loss in sample size is due to affiliate-years in country-industry-years with zero patent holdings. We drop these observations when calculating *HighCompInfo*. In additional tests, we set these observations to zero and find qualitatively similar results (untabulated).

enforcement actions that allow the local tax authority to collect comparable information to mitigate the relation documented in our main tests.

We collect country-level tax-enforcement data from the OECD's tax-administration surveys (OECD, 2011; OECD, 2013; OECD, 2015a; OECD, 2017b). From this data, we extract information on i) the value of completed tax assessments over total net revenue collections in country *c* and ii) the percentage of staff used for tax audit and verification in country *c*. Both proxies relate to enforcement actions, such as tax audits, that enable the local tax authority to collect comparable information. We construct *Enforcement* as an indicator variable with the value of one if country *c* experienced an increase in these enforcement actions in the previous year. We add *Enforcement* to Equation (3) and interact it with *C*, *C_Patents*, *PatentConc*, *C*PatentConc*, and *C_Patents*PatentConc*. We present the results in Table 7.[27]

In columns 1 and 2, we define *Enforcement* based on the value of completed tax assessments over total net revenue collections. In column 1, we still find that income shifting is increasing in patent concentration. As expected, the coefficients on the triple interactions *C*PatentConc*Enforcement* and *C_Patents*PatentConc*Enforcement* are positive and significant ($p < 0.04$). We find similar results for affiliates subject to high patent concentration, where the coefficient on *C_Patents*HighPatentConc*Enforcement* is positive and significant in column 2 ($p < 0.01$). In columns 3 and 4, we apply the percentage of staff used in tax audit and verification to measure *Enforcement*. The results are somewhat weaker, yet generally consistent with the findings in columns 1 and 2. Overall, these results suggest that increases in tax-enforcement actions that enable the local tax authority to collect comparable information weaken

[27] The loss in sample size is due to the OECD data being unavailable for all sample years. Moreover, data availability varies across our proxies, leading to different sample sizes for each test.

the association between patent concentration and tax-motivated income shifting.

One concern with these tests is that *Enforcement* could capture changes in the *general* tax-enforcement environment in country *c* rather than changes in enforcement actions that improve the local tax authority's set of comparable information. To alleviate this concern, we measure *Enforcement* using the costs of tax collection, defined as administrative costs relative to net revenue collected. This proxy captures increases in the *efficiency* of tax collection and administration (OECD, 2013) and therefore relates to changes in the general tax-enforcement environment of country *c*. In columns 5 and 6, we continue to find that tax-motivated income shifting is increasing in patent concentration. However, the coefficients on all triple interactions are insignificant ($p > 0.23$) and smaller in magnitude than in columns 1 to 4. These results suggest that changes in the general tax-enforcement environment are unlikely to drive the results in columns 1 to 4.

INSERT TABLE 7 HERE

Taken together, the results in this section suggest that the relation between patent concentration and tax-motivated income shifting varies with comparable information available to the local tax authority. Therefore, patent concentration seems to facilitate income shifting via patents by limiting the local tax authority's set of comparable information.

6. Robustness tests and supplementary analyses

6.1 Robustness tests

Table 8 reports the results for several sets of robustness tests. First, we follow Hall, Jaffe, and Trajtenberg (2005) and recalculate our measure for patent concentration using the number of patent citations as a proxy for patent value (*PatentQualityConc*). In addition to being associated with the relative number of patents held by an MNC, patent concentration could also increase in the value of these patents. Corroborating our main results, the coefficients on *C*PatentQualityConc* and *C_Patents*PatentQualityConc* remain negative and significant in column 1 ($p < 0.03$).

Second, we employ alternative approaches to measure income-shifting incentives. In our main tests, *C* and *C_Patents* capture the incentive to shift income associated with affiliate *i* relative to *all* other affiliates of the MNC. However, weighting tax-rate differentials by affiliate total assets raises the concern that changes in an affiliate's asset base could affect our results. In column 2, we replace *C* and *C_Patents* with the statutory corporate income tax rate of country *c* in year *t* (*CTR*).[28] The coefficients on *CTR* and *CTR*PatentConc* are negative and significant ($p < 0.01$), consistent with patent concentration being associated with less (more) income reported in high-tax (low-tax) affiliates. In column 3, we include a *C* measure based on tax rates for IP income in year *t* (*C_IP*). We again find a negative and significant coefficient on *C_IP*PatentConc* ($p = 0.02$), again consistent with tax-motivated income shifting increasing in patent concentration. Collectively, the results of these tests suggest that our main findings are robust to several measures for income-shifting incentives.

Third, we modify our dependent variable and assess the sample selection associated with our empirical approach. In columns 4 and 5, we replace *LN(1+ROA)* with the natural logarithm of earnings before interest (*LN(EBIT)*) and the natural logarithm of pre-tax income (*LN(PLBT)*),

[28] We do not include the IP tax rate in this test, because non-patent-holding affiliates are unlikely to report taxable income subject to this preferential rate. When including the difference between the IP tax rate and the corporate income tax rate (*CTR_Patents*) to capture incremental income-shifting incentives associated with IP-box regimes, the coefficients on *CTR_Patents* and *CTR_Patents*PatentConc* are indeed insignificant (untabulated; $p > 0.36$). However, when re-estimating this test for patent-holding affiliates, we obtain a negative and significant coefficient on *CTR_Patents*PatentConc* ($p = 0.07$). Thus, the extent to which taxable income reported by patent-holding affiliates is sensitive to preferential IP tax rates is increasing in patent concentration.

respectively. This approach follows Huizinga and Laeven (2008) and has been used in prior research (Blouin et al., 2018; De Simone, 2016; Markle, 2016). Since the natural logarithm is undefined for negative values, loss observations are automatically excluded from the sample. In column 4, we find a negative and significant coefficient on *C*PatentConc* ($p < 0.01$) while the negative coefficient on *C_Patents*PatentConc* is marginally insignificant ($p = 0.14$). In column 5, the coefficients on both interactions remain negative and significant ($p < 0.02$). These results suggest that our main findings are robust to several specifications of the income-shifting model. These results also indicate that loss observations are unlikely to drive our main findings.

INSERT TABLE 8 HERE

Finally, we control for alternative channels that could drive the relation between patent concentration and tax-motivated income shifting. More specifically, we interact *C* and *C_Patents* with *MarketShare*, *GroupSize*, and *R&DActivity*, respectively, to control for the effect of market power, MNC group size, and R&D activity on tax-motivated income shifting.[29] We continue to find negative and significant coefficients on *C*PatentConc* and *C_Patents*PatentConc* (untabulated; $p < 0.08$). We obtain similar results when simultaneously including *MarketShare*, *GroupSize*, and *R&DActivity*. Overall, after controlling for market power, MNC group size, and R&D activity, tax-motivated income shifting is still increasing in patent concentration, which suggests that differences in these firm characteristics are unlikely to drive our findings.

[29] We proxy for an MNC's total R&D activity by calculating the number of unique inventors for the patents filed by the MNC in year *t*, scaled by total MNC assets. Alternatively, we control for an MNC's R&D activity in country *c*. Following De Simone et al. (2020), we extract information on the location of patent inventors from PATSTAT. We then count the number of patents filed by the MNC in year *t* with a unique inventor located in country *c*. Our results are qualitatively similar when using this measure for R&D activity (untabulated).

6.2 Falsification test: patent concentration and income shifting via debt

To further address the concern that general firm characteristics might drive our results, we conduct a falsification test and test whether patent concentration is unrelated with income shifting in a non-patent setting. More specifically, we examine income shifting via debt, because intra-firm interest payments allow an MNC to shift income similar to royalty payments. However, the extent to which an MNC exploits this channel should not vary with patent concentration. We re-estimate our main tests after replacing the dependent variable with *LN(1+FROA)*. This variable is defined as financial income of affiliate *i* in year *t* over total assets, and captures income shifting via intra-firm debt (Heckemeyer and Overesch, 2017). We present the results in Table 9.

In column 1, we replicate the De Simone et al. (2017) income-shifting model with *LN(1+FROA)* as a dependent variable.[30] The coefficient on *C* is negative and significant ($p < 0.01$), providing evidence for tax-motivated income shifting via debt. In columns 2 and 3, we interact C with *PatentConc* and *HighPatentConc*, respectively, and estimate Equation (3) on the subsample of non-patent-holding affiliates. As expected, the coefficients on *C*PatentConc* and *C*HighPatentConc* are insignificant in both columns ($p > 0.16$). These results suggest that patent concentration is unrelated to tax-motivated income shifting via debt, providing additional comfort that general firm characteristics are unlikely to drive our main results.

INSERT TABLE 9 HERE

[30] We do not include *C_Patents* in these tests, because this variable captures incremental income-shifting incentives associated with IP-box regimes, which do not apply to intra-firm interest payments. The sample in Table 9 is slightly larger than in our main tests, since more affiliates report data on financial income.

6.3 Patent concentration and inbound income shifting

Our analysis so far has focused on non-patent-holding affiliates, because *PatentConc* captures the incentives to shift income *from* a non-patent-holding affiliate *to* a foreign patent-holding affiliate (*outbound* income shifting). However, the degree of patent concentration could also be relevant for the MNC when selecting a patent-holding affiliate as a target for shifted income (*inbound* income shifting). More specifically, patent concentration could limit comparable information required by the local tax authority to assess the royalty payments received by a patent-holding affiliate. Thus, we expect the incentives to shift income *to* a particular patent-holding affiliate to increase in the relative share of patents held by that affiliate.

We modify our measure for patent concentration and calculate *PatentConcHold* as the number of patents held by all affiliates of the MNC located in country *c* in year *t*, divided by the sum of patents held by the affiliates of all other MNCs operating in the same country-industry-year. Thus, we focus on the patents held in the country-industry-year of the patent-holding affiliate *i* as opposed to all patents held by MNCs with affiliates operating the country-industry-year of affiliate *i*. We include this measure in Equation (3) and examine the subsample of patent-holding affiliates. We expect negative coefficients on *C*PatentConcHold* and *C_Patents*PatentConcHold*, respectively. Table 10 presents the results.

As expected, the coefficients on *C*PatentConcHold* and *C_Patents*PatentConcHold* are negative and significant in column 1 ($p < 0.08$). In column 2, we again use an indicator variable with the value of one if *PatentConcHold* is in the top sample quartile. Corroborating the results in column 1, the coefficients on *C*HighPatentConcHold* and *C_Patents*HighPatentConcHold* are negative and significant ($p < 0.04$). Overall, these results suggest that the extent to which taxable income reported by a patent-holding affiliate is sensitive to income-shifting incentives increases in patent concentration. Thus, by reducing the local tax authority's set of comparable information, patent concentration may not only facilitate outbound income shifting, but may also increase the attractiveness of a patent-holding affiliate as a target for shifted income.

INSERT TABLE 10 HERE

7. Conclusion

In this study, we examine whether and to what extent patent concentration is associated with tax-motivated income shifting. Using unconsolidated financial statement data and information on MNCs' patent holdings, we show that tax-motivated income shifting is increasing in the degree of patent concentration. To identify the mechanism behind this result, we exploit two settings in which comparable information available to the local tax authority is likely to vary. Our results suggest that patent concentration facilitates tax-motivated income shifting via patents by reducing the local tax authority's set of comparable information and by increasing asymmetric information between the MNC and the local tax authority.

Our study contributes to research on the determinants of tax-motivated income shifting by identifying patent concentration as an economically important driver of the extent to which MNCs shift income via patents. Moreover, our findings indicate that industry landscapes in which an MNC operates and the availability of comparable firms or assets tend to shape the incentives for income shifting. More broadly, our results add to the patent literature by showing that patent concentration is associated with tax-motivated income shifting. From a policy perspective, our findings suggest that the success of tax-policy measures in curtailing tax-motivated income shifting via patents critically depends on their ability to improve the local tax authority's set of comparable information.

References

Akcigit, U., Ates, S., 2019. What Happened to U.S. Business Dynamism? (No. w25756). National Bureau of Economic Research, Cambridge, MA. https://doi.org/10.3386/w25756.

Avi-Yonah, R., 2012. Avi-Yonah Testimony For Hearing On Profit Shifting. September 20, 2012.

Baron, D.P., 1985. Regulation of Prices and Pollution under Incomplete Information. J. Public Econ. 28, 211–231.

Bartelsman, E.J., Beetsma, R.M.W.J., 2003. Why pay more? Corporate tax avoidance through transfer pricing in OECD countries. J. Public Econ. 87, 2225–2252. https://doi.org/10.1016/S0047-2727(02)00018-X.

Beer, S., Loeprick, J., 2015. Profit shifting: drivers of transfer (mis)pricing and the potential of countermeasures. Int. Tax Public Finance 22, 426–451. https://doi.org/10.1007/s10797-014-9323-2.

Blair-Stanek, A., 2015. Intellectual Property Law Solutions to Tax Avoidance. UCLA REV 2 62 (1), 1–73.

Blouin, J.L., Robinson, L.A., Seidman, J.K., 2018. Conflicting Transfer Pricing Incentives and the Role of Coordination. Contemp. Account. Res. 35, 87–116. https://doi.org/10.1111/1911-3846.12375.

Bornemann, T., Laplante, S.K., Osswald, B., 2019. The Effect of Intellectual Property Boxes on Innovative Activity & Effective Tax Rates. Working Paper.

Chee, F.Y., 2019. Apple says $14 billion EU tax order “defies reality and common sense.” Reuters Business News.

Claessens, S., Laeven, L., 2004. What Drives Bank Competition? Some International Evidence. J. Money Credit Bank. 36, 563–583.

Clausing, K.A., 2003. Tax-motivated transfer pricing and US intrafirm trade prices. J. Public Econ. 87, 2207–2223. https://doi.org/10.1016/S0047-2727(02)00015-4.

De Simone, L., 2016. Does a common set of accounting standards affect tax-motivated income shifting for multinational firms? J. Account. Econ. 61, 145–165. https://doi.org/10.1016/j.jacceco.2015.06.002.

De Simone, L., Klassen, K.J., Seidman, J.K., 2017. Unprofitable Affiliates and Income Shifting Behavior. Account. Rev. 92, 113–136. https://doi.org/10.2308/accr-51555.

De Simone, L., Sansing, R.C., 2018. Income Shifting Using a Cost Sharing Arrangement. J. Am. Tax. Assoc. https://doi.org/10.2308/atax-52142.

De Simone, L., Mills, L.F., Stomberg, B., 2019a. Using IRS data to identify income shifting to foreign affiliates. Rev. Account. Stud. 24, 694–730. https://doi.org/10.1007/s11142-019-9484-4.

De Simone, L., Stomberg, B., Williams, B., 2019b. Does Tax Enforcement Disparately Affect Domestic versus Multinational Corporations around the World? Working Paper.

De Simone, L., Huang, J., Krull, L.K., 2020. R&D and the Rising Foreign Profitability of U.S. Multinational Corporations. Account. Rev. Forthcom. https://doi.org/10.2139/ssrn.3050016.

De Waegenaere, A., Sansing, R.C., Wielhouwer, J.L., 2012. Multinational Taxation and R&D Investments. Account. Rev. 87, 1197–1217. https://doi.org/10.2308/accr-10281.

Dharmapala, D., Riedel, N., 2013. Earnings shocks and tax-motivated income-shifting: Evidence from European multinationals. J. Public Econ. 97, 95–107. https://doi.org/10.1016/j.jpubeco.2012.08.004.
Dharmapala, D., 2014. What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature. Fisc. Stud. 35, 421–448.
Dischinger, M., Riedel, N., 2011. Corporate taxes and the location of intangible assets within multinational firms. J. Public Econ. 95, 691–707. https://doi.org/10.1016/j.jpubeco.2010.12.002.
Dyreng, S., Markle, K., 2016. The effect of financial constraints on income shifting by US multinationals. Account. Rev. 91, 1601-1627.
Evers, L., Miller, H., Spengel, C., 2015. Intellectual property box regimes: effective tax rates and tax policy considerations. Int. Tax Public Finance 22, 502–530. https://doi.org/10.1007/s10797-014-9328-x.
Gallemore, J., Huang, J., Wentland, K., 2018. The Role of Intellectual Property Value Protection in Tax-Motivated Profit Shifting. Working Paper.
Griffith, R., Miller, H., O'Connell, M., 2014. Ownership of intellectual property and corporate taxation. J. Public Econ. 112, 12–23. https://doi.org/10.1016/j.jpubeco.2014.01.009.
Grubert, H., 2003. Intangible Income, Intercompany Transactions, Income Shifting, and the Choice of Location. Natl. Tax J. 56, 221–242. https://doi.org/10.17310/ntj.2003.1S.05.
Gutiérrez, G., Philippon, T., 2019. Fading Stars. AEA Pap. Proc. 109, 312–316. https://doi.org/10.1257/pandp.20191065.
Hall, B.H., Jaffe, A., Trajtenberg, M., 2005. Market Value and Patent Citations. RAND J. Econ. 36, 16–38.
Hall, B., Helmers, C., Rogers, M., Sena, V., 2014. The Choice between Formal and Informal Intellectual Property: A Review. J. Econ. Lit. 52, 375–423. https://doi.org/10.1257/jel.52.2.375.
Heckemeyer, J.H., Overesch, M., 2017. Multinationals' profit response to tax differentials: Effect size and shifting channels. Can. J. Econ. Can. Déconomique 50, 965–994. https://doi.org/10.1111/caje.12283.
Heckemeyer, J.P., Olligs, P., Overesch, M., 2018. "Home Sweet Home" versus International Tax Planning: Where Do Multinational Firms Hold their U.S. Trademarks? Natl. Tax J. 71, 485–520.
Hines, J.R., Rice, E.M., 1994. Fiscal paradise: Foreign tax havens and American business. Q. J. Econ. 109, 149–182.
Hopland, A.O., Lisowsky, P., Mardan, M., Schindler, D., 2018. Flexibility in Income Shifting under Losses. Account. Rev. 93, 163–183. https://doi.org/10.2308/accr-51907.
Huizinga, H., Laeven, L., 2008. International profit shifting within multinationals: A multi-country perspective. J. Public Econ. 92, 1164–1182. https://doi.org/10.1016/j.jpubeco.2007.11.002.
International Monetary Fund (IMF), Organisation for Economic Co-operation and Development (OECD), United Nations (UN), World Bank Group (WBG), 2017. A Toolkit for Addressing Difficulties in Accessing Comparables Data for Transfer Pricing Analyses.
Karkinsky, T., Riedel, N., 2012. Corporate taxation and the choice of patent location within multinational firms. J. Int. Econ. 88, 176–185. https://doi.org/10.1016/j.jinteco.2012.04.002.

Klassen, K.J., Laplante, S.K., 2012. Are U.S. Multinational Corporations Becoming More Aggressive Income Shifters? J. Account. Res. 50, 1245–1285. https://doi.org/10.1111/j.1475-679X.2012.00463.x.
Klassen, K.J., Lisowsky, P., Mescall, D., 2017. Transfer Pricing: Strategies, Practices, and Tax Minimization. Contemp. Account. Res. 34, 455–493. https://doi.org/10.1111/1911-3846.12239.
Lin, L., Geng, X., Whinston, A.B., 2005. A Sender-Receiver Framework for Knowledge Transfer. MIS Q. 29, 197. https://doi.org/10.2307/25148677.
Lohse, T., Riedel, N., 2013. Do Transfer Pricing Laws Limit International Income Shifting? Evidence from European Multinationals. Working Paper.
Markle, K., 2016. A Comparison of the Tax-Motivated Income Shifting of Multinationals in Territorial and Worldwide Countries. Contemp. Account. Res. 33, 7–43. https://doi.org/10.1111/1911-3846.12148.
Matthews, R.G., Whalen, J., 2006. Glaxo to Settle Tax Dispute With IRS Over U.S. Unit for $3.4 Billion. Wall Street Journal.
McGuire, S.T., Rane, S.G., Weaver, C.D., 2018. Internal Information Quality and Tax-Motivated Income Shifting. J. Am. Tax. Assoc. 40, 25–44. https://doi.org/10.2308/atax-51959.
Merz, J., Overesch, M., 2016. Profit shifting and tax response of multinational banks. J. Bank. Finance 68, 57–68. https://doi.org/10.1016/j.jbankfin.2016.03.015.
Mescall, D., Klassen, K.J., 2018. How Does Transfer Pricing Risk Affect Premiums in Cross-Border Mergers and Acquisitions?: Transfer Pricing and M&A Premiums. Contemp. Account. Res. 35, 830–865. https://doi.org/10.1111/1911-3846.12397.
OECD, 2010. OECD transfer pricing guidelines for multinational enterprises and tax administrations. OECD Publishing, Paris.
OECD, 2011. Tax Administration in OECD and Selected Non-OECD Countries: Comparative Information Series (2010). OECD Publishing, Paris.
OECD, 2013. Tax Administration 2013: comparative information on OECD and other advanced and emerging economies. OECD Publishing, Paris.
OECD, 2015a. Aligning Transfer Pricing Outcomes with Value Creation, Actions 8-10 - 2015 Final Reports, OECD/G20 Base Erosion and Profit Shifting Project. OECD Publishing.
OECD, 2015b. Tax Administration 2015: Comparative Information on OECD and Other Advanced and Emerging Economies. OECD Publishing, Paris.
OECD, 2017a. OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2017 -. OECD Publishing, Paris.
OECD, 2017b. Tax Administration 2017 - Comparative Information on OECD and Other Advanced and Emerging Economies. OECD Publishing, Paris.
Okten, R., 2013. A Comparative Study of Cost Contribution Arrangements: Is Active Involvement Required To Share in the Benefits of Jointly Developed Intangible Property? Int. Transf. Pricing J. 3–17.
Petersen, M.A., 2009. Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. Rev. Financ. Stud. 22, 435–480. https://doi.org/10.1093/rfs/hhn053.
Qiu, J., Wan, C., 2015. Technology spillovers and corporate cash holdings. J. Financ. Econ. 115, 558–573. https://doi.org/10.1016/j.jfineco.2014.10.005.
Riedel, N., 2018. Quantifying International Tax Avoidance: A Review of the Academic Literature. Rev. Econ. 69, 169–181. https://doi.org/10.1515/roe-2018-0004.
United States Tax Court, 2009. Veritas vs. Commissioner.
United States Tax Court, 2017. Amazon vs. Commissioner.

APPENDIX A: VARIABLE DEFINITIONS AND SAMPLE SELECTION

Dependent variables	
LN(EBIT)	Natural logarithm of affiliate *i*'s *EBIT* in year *t*.
LN(PLBT)	Natural logarithm of affiliate *i*'s *PLBT* in year *t*.
LN(1+FROA)	Natural logarithm of 1 plus affiliate *i*'s *FROA* in year *t*.
LN(1+ROA)	Natural logarithm of 1 plus affiliate *i*'s *ROA* in year *t*.
Measures for income-shifting incentives	
C	Income-shifting incentives associated with affiliate *i* based on statutory corporate income tax rates. To calculate *C*, we follow the approach in Huizinga and Laeven (2008): $$C_{it} = \frac{1}{(1-\tau_{it})} * \frac{\sum_{k\neq i}^{n} \frac{K_{kt}}{(1-\tau_{kt})} * (\tau_{it}-\tau_{kt})}{\sum_{k\neq i}^{n} \frac{K_{k,t}}{(1-\tau_{kt})}}$$ *C* includes the tax-rate differentials between affiliate *i* and all other affiliates of the MNC in year *t*. We weight tax-rate differentials by total affiliate assets. Source: EY Corporate Tax Guides.
C_IP	Income shifting incentives associated with affiliate *i* based on the tax rates on IP income in year *t*. *C_IP* includes the tax-rate differentials between affiliate *i* and all other affiliates of the MNC in year *t*. We weight tax-rate differentials by total affiliate assets. Source: EY Corporate Tax Guides.
C_Patents	Incremental income-shifting incentives associated with affiliate *i* based on preferential tax rates on IP income. *C_Patents* is calculated by subtracting *C* from *C_IP*. Source: EY Corporate Tax Guides.
CTR	Statutory corporate income tax rate in country *c* in year *t*. Source: EY Corporate Tax Guides.
CTR_Patents	Preferential tax rate on IP income in country *c* in year *t* less *CTR* in year *t*. Source: EY Corporate Tax Guides.
Measures for patent concentration	
PatentConc	Patent concentration for affiliate *i* in year *t* calculated as the number of patents held by all affiliates of the MNC in year *t*, divided by the sum of patents held by all MNCs with affiliates operating in the same country-industry-year as affiliate *i*. Industry is defined based on two-digit NACE industry codes. Source: Orbis and PATSTAT.

PatentConcHold	Patent concentration for patent-holding affiliate *i* in year *t* calculated as the number of patents held by all domestic affiliates of the MNC located in country *c* in year *t*, divided by the sum of patents held by affiliates of all other MNCs operating in the same country-industry-year. Industry is defined based on two-digit NACE industry codes. Source: Orbis and PATSTAT.
HighPatentConc	Indicator variable with the value of one if *PatentConc* of affiliate *i* is in the top sample quartile, and zero otherwise.
HighPatentConcHold	Indicator variable with the value of one if *PatentConcHold* of affiliate *i* is in the top sample quartile, and zero otherwise.
PatentQualityConc	Patent concentration for affiliate *i* in year *t* based on the number of patent citations on the patents held by all affiliates of the MNC in year *t*, divided by the number of patent citations on the patents held by all MNCs with affiliates operating in the same country-industry-year as affiliate *i*. Industry is defined based on two-digit NACE industry codes. Source: Orbis and PATSTAT.
Measures for patent stock	
PatStock	Number of granted patents held by affiliate *i* in year *t*. We include all patents granted between the year *t* and *t-19*. Source: PATSTAT.
SumPatents	Number of patents held by all affiliates of the MNC (*PatStock*) in year *t*. Source: Orbis and PATSTAT.
Control variables	
TangibleAssets	Total fixed assets of affiliate *i* in year *t*. Source: Orbis.
LN(TangibleAssets)	Natural logarithm of affiliate *i*'s *TangibleAssets* in year *t*.
CompExpense	Compensation expenses of affiliate *i* in year *t*. Source: Orbis.
LN(CompExpense)	Natural logarithm of affiliate *i*'s *CompExpense* in year *t*.
IndustryROA	Country-industry-year median *ROA* for all firms included in the Orbis database. Industry is defined based on two-digit NACE industry codes. Source: Orbis
Age	Year *t* less the first year in which affiliate *i* appears in the Orbis database. Source: Orbis.
LN(Age)	Natural logarithm of *Age*.
GDPGrowth	Annual change in GDP from year *t-1* to year *t* in affiliate country *c*. Source: World Bank National Accounts Data.

ΔMarketSize	Annual percentage change in total sales of all affiliates and independent firms by country-industry-year. Industry is defined based on two-digit NACE industry codes. Source: Orbis.
Loss	Indicator variable with the value of one if *EBIT* of affiliate *i* is negative, and zero otherwise.
Other variables	
EBIT	Earnings before interest and taxes of affiliate *i* in year *t*. Source: Orbis.
FROA	Financial income of affiliate *i* in year *t*, scaled by total assets of affiliate *i* in year *t*. Source: Orbis.
GroupSize	Natural logarithm of the MNC's number of affiliates in year *t*. Source: Orbis.
MarketShare	Total sales of affiliate *i* in year *t*, divided by total sales of all firms in the same country-industry-year. Industry is defined based on two-digit NACE industry codes. Source: Orbis.
PLBT	Pre-tax profit of affiliate *i* in year *t*. Source: Orbis.
R&DActivity	Number of unique investors for the patents filed by all affiliates of the MNC in year *t*, divided by aggregate total assets of all affiliates of the MNC in year *t*. Source: Orbis and PATSTAT.
ROA	*EBIT* of affiliate *i* in year *t*, scaled by total assets of affiliate *i* in year *t*. Source: Orbis.
Partitioning variables	
HighCompInfo	Indicator variable with the value of one if the ratio of patent-holding affiliates relative to all affiliates of MNCs operating in a country-industry-year is in the top sample quartile. Industry is defined based on two-digit NACE industry codes. Source: Orbis and PATSTAT.
Enforcement	First, an indicator variable with the value of one if country *c* experienced an increase in the value of completed tax assessments over total net revenue collections in the previous year (i.e., from year *t-2* to *t-1*), and zero otherwise. Second, an indicator variable with the value of one if country *c* experienced an increase in the percentage of staff used for tax audit and verification in the previous year. Third, an indicator variable with the value of one if country *c* experienced a decrease in the cost of collection ratio (measured as administrative costs for tax administration, scaled by net revenue collected) in the previous year. Source: OECD, 2011; 2013; 2015a; 2017b.

Sample selection

Sample selection	**Affiliate-Years**
European firms in Bureau van Dijk's Orbis database with at least one affiliate located in another European country, non-missing NACE industry codes, and positive values for total assets, tangible fixed assets and compensation expenses (sample period: 2008-2016).	163,865
Less: Affiliates of MNCs active in banking or insurance industries (two-digit NACE codes: 64, 65, or 66).	(2,148)
Less: Affiliate-years of MNCs with a negative return on sales in year *t*.	(20,873)
Less: Affiliate-years with missing values for *EBIT* and with values for *LN(1+ROA)* less than or equal to zero.	(566)
Less: Affiliate-years with missing data to compute regression variables.	(1,985)
Final sample	**138,293**

Note: This table summarizes the sample selection procedure. We obtain unconsolidated affiliate-level financial statement data and ownership data from Bureau van Dijk's Orbis database.

APPENDIX B:
NUMERICAL EXAMPLES FOR *C_PATENTS* AND *PATENTCONC*

Numerical example for C_Patents

In this section, we provide additional background on the calculation of *C_Patents*. In addition, we discuss why a negative coefficient on *C_Patents* in Equation (3) is consistent with tax-motivated income shifting. As discussed in Section 3.2, we calculate *C_Patents* to account for incremental income-shifting incentives not captured by *C*, because several countries in our sample provide preferential tax rates for IP income. To obtain *C_Patents*, we first recalculate *C* for affiliate *i* in year *t*, using IP tax rates instead of statutory corporate income tax rates (*C_IP*). We then subtract *C* from *C_IP* to obtain a measure that captures the *incremental* income-shifting incentives associated with IP tax rates (*C_Patents*).

In the numerical example below, which is based on the examples provided by Markle (2016), we calculate *C*, *C_IP*, and *C_Patents* for Affiliates 1-4. All affiliates belong to the same MNC. The negative value of *C* for Affiliate 1 (-0.24) indicates an incentive to shift income *from* affiliates with higher values of *C to* Affiliate 1. The positive value of *C_Patents* (0.14), however, suggests that preferential IP tax rates weaken the incentive to shift income *from* other affiliates. If the MNC is sensitive to this weaker incentive, less taxable income should be reported by Affiliate 1 compared to a situation without preferential IP tax rates (i.e., less income is shifted *to* Affiliate 1 via patents), suggesting a negative coefficient on *C_Patents* in our analysis.

Conversely, *C* is positive for Affiliate 2 (0.15), indicating an incentive to shift income *from* Affiliate 2 *to* affiliates with lower values of *C*. The positive value of *C_Patents* (0.03) strengthens the incentive to shift income *from* Affiliate 2 *to* other affiliates via patents. If the MNC is responsive to this incentive, less taxable income is reported in Affiliate 2 compared to a situation without preferential IP tax rates, again suggesting a negative coefficient on *C_Patents* in our analysis.

For Affiliates 3 and 4, the negative values of *C* (-0.08 and -0.02) indicate an incentive to shift taxable income *from* other affiliates of the MNC *to* Affiliates 3 and 4. In both cases, the negative values of *C_Patents* (-0.03 and -0.02) imply a stronger incentive to shift income *to* Affiliates 3 and 4 via patents. Thus, compared to a situation without preferential IP tax rates, both affiliates should report more taxable income, again suggesting a negative coefficient on *C_Patents* in our analysis.

Affiliate	**Statutory Tax Rate (%)**	**IP Tax Rate (%)**	**Assets**	***C***	***C_IP***	***C_Patents* *(C_IP – C)***
Affiliate 1	10%	5%	10	-0.24	-0.10	0.14
Affiliate 2	40%	30%	80	0.15	0.18	0.03
Affiliate 3	25%	0%	100	-0.08	-0.12	-0.03*
Affiliate 4	30%	10%	50	-0.02	-0.04	-0.02

* Rounding difference: -0.084 - 0.116 = -0.032.

Numerical example for PatentConc

Figure 1 illustrates our approach to measure *PatentConc*. In this section, we provide a numerical example for how to calculate *PatentConc* for the German affiliate of MNC 1 in Figure 1 (hereafter, affiliate *i*). We assume that affiliate *i* and the German affiliates of the other MNCs included in Figure 1 (i.e., of MNCs 2-4 in panel A and of MNC 2 in panel B) operate in the same two-digit NACE industry-year.

We calculate *PatentConc* for affiliate *i* as the sum of patents held by all domestic and foreign affiliates of MNC 1, divided by the sum of patents held by all domestic and foreign affiliates of MNCs operating in the same country-industry-year (CIY) as affiliate *i*. The latter includes the number of patents held by MNC 1. This measure reflects the share of patents held by MNC 1 relative to all other MNCs with affiliates operating in the same CIY as affiliate *i*.

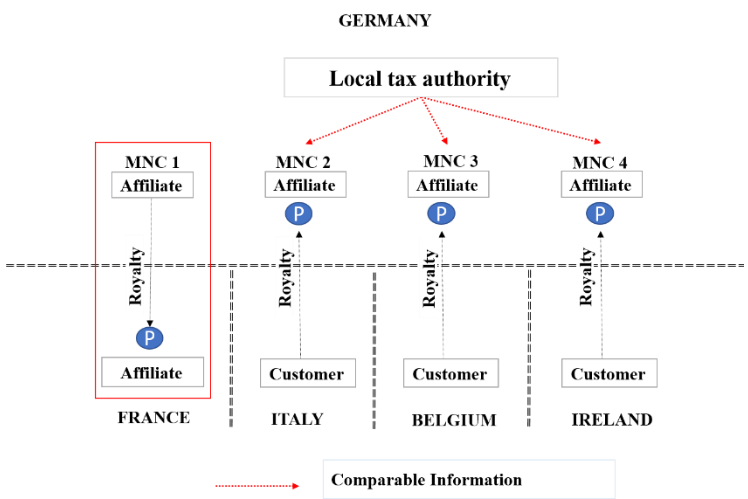
In both panels of Figure 1, the sum of patents held by MNCs operating in the same CIY as affiliate *i* is equal to four. In the case of low patent concentration (panel A), MNC 1 holds one patent so that *PatentConc* of affiliate *i* is equal to 0.25 (= 1 / (1+3)). In the case of high patent concentration (panel B), MNC 1 holds three patents. *PatentConc* of affiliate *i* is therefore equal to 0.75 (= 3 / (3+1)). Due to dividing the number of patents held by the affiliates of an MNC by the number of patents held by all MNCs operating in the same CIY, *PatentConc* is constrained to range from zero to one. We summarize this example in the table below.

Patent Concentration	**Low**	**High**
Σ of Patents held by MNC 1	1	3
Σ of Patents held by all other MNCs operating in the same CIY	3	1
Σ of Patents held in CIY	4	4
PatentConc = Σ of Patents held by MNC 1 / Σ of Patents held in CIY	0.25	0.75

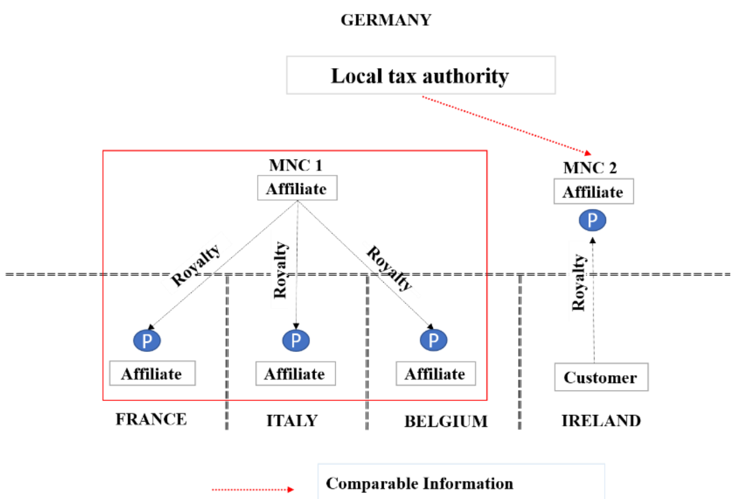
FIGURES AND TABLES

Figure 1: Patent Concentration

Panel A: Low Patent Concentration



Panel B: High Patent Concentration



Note: This figure illustrates our empirical approach to measure patent concentration (*PatentConc*). In panel A, patent concentration is low, because several MNCs operating in the same country-industry-year as MNC 1 hold at least one patent. Therefore, when assessing the transfer price for intra-firm royalty payments set by MNC 1, the local tax authority has access to a large set of comparable information from the transactions of other MNCs with their unrelated customers. In panel B, patent concentration is high, because patent holdings are strongly concentrated in MNC 1. Therefore, the local tax authority has limited comparable information from the transactions of other MNCs when assessing the transfer price set by MNC 1.

Table 1: Sample composition by country

Country	**Affiliate-Years**	**Mean Corporate Tax Rate**	**Mean IP Tax Rate**
Austria	2,602	0.25	0.25
Belgium	10,963	0.34	0.07
Bulgaria	708	0.10	0.10
Czech Republic	6,218	0.19	0.19
Denmark	104	0.24	0.24
Estonia	1,350	0.21	0.21
Finland	4,776	0.23	0.23
France	19,254	0.33	0.16
Germany	12,118	0.30	0.30
Hungary	2,452	0.19	0.09
Iceland	41	0.19	0.19
Ireland	3	0.13	0.10
Italy	18,278	0.31	0.29
Latvia	52	0.15	0.15
Luxembourg	745	0.29	0.06
Malta	32	0.35	0.12
Netherlands	540	0.25	0.06
Norway	5,870	0.27	0.27
Poland	5,721	0.19	0.19
Portugal	6,788	0.24	0.20
Romania	4,228	0.16	0.16
Slovakia	3,463	0.21	0.21
Slovenia	1,356	0.18	0.18
Spain	18,019	0.29	0.14
Sweden	10,197	0.24	0.24
Switzerland	41	0.18	0.12
United Kingdom	849	0.24	0.18
All Countries	**138,293**	**0.23**	**0.17**

Note: This table presents the sample composition by country. Our sample includes 138,293 affiliate-year observations for the sample period 2008-2016. Column 1 presents the number of affiliate-years. Column 2 (3) presents the mean statutory corporate income tax rate (the mean IP tax rate) by country.

Table 2: Descriptive statistics

Panel A: Full Sample						
Variables	**N**	**Mean**	**P25**	**Median**	**P75**	**SD**
EBIT	138,293	3,082,883	55,000	395,000	1,564,000	42,753,300
ROA	138,293	0.075	0.014	0.057	0.131	0.135
LN(1+ROA)	138,293	0.065	0.014	0.055	0.123	0.128
TangibleAssets	138,293	7,045,321	103,000	740,000	4,056,000	20,896,530
CompExpense	138,293	5,860,280	626,000	1,804,000	4,993,000	12,607,610
LN(TangibleAssets)	138,293	6.434	4.635	6.607	8.308	2.561
LN(CompExpense)	138,293	7.461	6.439	7.498	8.516	1.628
IndustryROA	138,293	0.038	0.020	0.037	0.055	0.026
LN(Age)	138,293	1.430	1.099	1.609	1.946	0.653
GDPGrowth	138,293	-0.008	-0.078	0.011	0.046	0.083
ΔMarketSize	138,293	0.012	-0.066	0.009	0.073	0.123
Loss	138,293	0.171	0.000	0.000	0.000	0.376
C	138,293	-0.008	-0.008	0.001	0.010	0.050
C_Patents	138,293	-0.004	-0.019	0.000	0.012	0.074
PatentConc	138,293	0.048	0.000	0.000	0.004	0.168
PatStock	138,293	2.849	0.000	0.000	0.000	40.035
SumPatents	138,293	35.622	0.000	0.000	5.000	230.668

Panel B: Patent-holding affiliates (*PatStock* > 0)

Variables	N	Mean	P25	Median	P75	SD
EBIT	14,412	10,682,310	455,500	1,913,000	6,103,000	77,282,440
ROA	14,412	0.076	0.023	0.059	0.119	0.102
LN(1+ROA)	14,412	0.068	0.022	0.057	0.112	0.096
TangibleAssets	14,412	17,919,270	1,250,000	5,453,500	16,493,000	33,040,140
CompExpense	14,412	16,401,390	3,044,000	7,639,000	19,524,000	21,687,950
LN(TangibleAssets)	14,412	8.319	7.131	8.604	9.711	2.074
LN(CompExpense)	14,412	8.908	8.021	8.941	9.879	1.380
IndustryROA	14,412	0.047	0.030	0.043	0.066	0.026
LN(Age)	14,412	1.498	1.099	1.609	1.946	0.626
GDPGrowth	14,412	-0.009	-0.083	0.011	0.046	0.079
ΔMarketSize	14,412	0.008	-0.072	0.006	0.073	0.123
Loss	14,412	0.112	0.000	0.000	0.000	0.316
C	14,412	0.005	-0.001	0.002	0.011	0.028
C_Patents	14,412	0.008	-0.004	0.001	0.016	0.060
PatentConc	14,412	0.095	0.002	0.012	0.070	0.208
PatStock	14,412	27.341	2.000	5.000	16.000	121.289
SumPatents	14,412	69.727	3.000	10.000	40.000	259.430

Panel C: Non-patent-holding affiliates (*PatStock* = 0)

Variables	N	Mean	P25	Median	P75	SD
EBIT	123,881	2,198,785***	45,000	333,000***	1,275,000	36,581,430
ROA	123,881	0.075	0.013	0.056***	0.132	0.138
LN(1+ROA)	123,881	0.064***	0.013	0.055***	0.124	0.132
TangibleAssets	123,881	5,780,274***	85,000	586,000***	3,096,000	18,577,340
CompExpense	123,881	4,633,954***	558,000	1,541,000***	4,054,000	10,406,500
LN(TangibleAssets)	123,881	6.215***	4.443	6.373***	8.038	2.521
LN(CompExpense)	123,881	7.293***	6.324	7.340***	8.307	1.571
IndustryROA	123,881	0.037***	0.018	0.036***	0.054	0.026
LN(Age)	123,881	1.422***	1.099	1.609***	1.946	0.656
GDPGrowth	123,881	-0.008	-0.078	0.011	0.046	0.083
ΔMarketSize	123,881	0.013***	-0.065	0.010***	0.073	0.123
Loss	123,881	0.178***	0.000	0.000***	0.000	0.382
C	123,881	-0.010***	-0.011	0.000***	0.010	0.051
C_Patents	123,881	-0.005***	-0.022	0.000***	0.012	0.076
PatentConc	123,881	0.042***	0.000	0.000***	0.002	0.162
PatStock	123,881	0.000***	0.000	0.000***	0.000	0.000
SumPatents	123,881	31.654***	0.000	0.000***	3.000	226.754

Note: This table presents descriptive statistics. Panel A presents descriptive statistics for the full sample of 138,293 affiliate-year observations (sample period 2008-2016). Panel B presents descriptive statistics for patent-holding affiliates (14,412 affiliate-year observations) and panel C for non-patent-holding affiliates (123,811 affiliate-year observations), respectively. We conduct a two-sample t-test (Wilcoxon rank-sum test) to compare means (medians) between panels B and C. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 3: Correlation table

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
(1) LN(1+ROA)	1.000										
(2) LN(TangibleAssets)	**-0.061**	1.000									
(3) LN(CompExpense)	**0.037**	**0.588**	1.000								
(4) IndustryROA	**0.111**	**0.014**	**0.195**	1.000							
(5) LN(Age)	0.001	**0.029**	**0.077**	**-0.127**	1.000						
(6) GDPGrowth	**0.026**	0.004	0.006	**0.118**	**-0.224**	1.000					
(7) ΔMarketSize	**0.039**	0.004	**-0.008**	**0.135**	**-0.434**	**0.381**	1.000				
(8) Loss	**-0.622**	**-0.050**	**-0.098**	**-0.077**	**-0.037**	**-0.013**	**-0.014**	1.000			
(9) C	**-0.031**	**0.020**	**0.176**	**0.071**	**0.034**	**-0.040**	**-0.060**	**-0.014**	1.000		
(10) C_Patents	**0.007**	**0.010**	**0.056**	**0.060**	**0.012**	**-0.013**	**-0.027**	**-0.015**	**0.132**	1.000	
(11) PatentConc	**-0.018**	**0.090**	**0.072**	**-0.035**	**-0.033**	**0.017**	**0.026**	**0.034**	**-0.135**	**-0.053**	1.000

Note: This table presents univariate Pearson correlation coefficients for the full sample of 138,293 affiliate-year observations (sample period 2008-2016). Bold coefficients denote significance at the 1% level.

Table 4: Extending the De Simone et al. (2017) income-shifting model

Dependent Variable	*LN(1+ROA)* (1)	*LN(1+ROA)* (2)	*LN(1+ROA)* (3)
LN(TangibleAssets)	-0.005***	-0.005***	-0.005***
	(0.000)	(0.000)	(0.000)
LN(CompExpense)	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
IndustryROA	0.217***	0.218***	0.218***
	(0.033)	(0.033)	(0.033)
LN(Age)	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)
GDPGrowth	0.022**	0.022**	0.022**
	(0.010)	(0.010)	(0.010)
ΔMarketSize	0.005	0.005	0.005
	(0.003)	(0.003)	(0.003)
C	-0.097***	-0.105***	-0.101***
	(0.014)	(0.015)	(0.016)
C_Patents		-0.009	-0.003
		(0.007)	(0.008)
Loss	-0.208***	-0.208***	-0.208***
	(0.002)	(0.002)	(0.002)
*C*Loss*	0.289***	0.289***	0.269***
	(0.027)	(0.027)	(0.031)
*C_Patents*Loss*			-0.026
			(0.019)
Country-FE	Y	Y	Y
Industry-FE	Y	Y	Y
Year-FE	Y	Y	Y
N	138,293	138,293	138,293
Adjusted R^2	0.419	0.419	0.419

Note: This table presents regression results for extending the income-shifting model by De Simone, Klassen, and Seidman (2017) on the full sample of 138,293 affiliate-year observations. The dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 5: Patent concentration and tax-motivated income shifting

Dependent Variable	*LN(1+ROA)* (1)	*LN(1+ROA)* (2)
C	-0.087***	-0.084***
	(0.016)	(0.017)
C_Patents	0.002	0.003
	(0.009)	(0.009)
Loss	-0.211***	-0.211***
	(0.002)	(0.002)
*C*Loss*	0.253***	0.252***
	(0.032)	(0.032)
*C_Patents*Loss*	-0.030	-0.030
	(0.020)	(0.020)
PatentConc	-0.010**	
	(0.004)	
*C*PatentConc*	-0.144***	
	(0.050)	
*C_Patents*PatentConc*	-0.064**	
	(0.031)	
HighPatentConc		-0.002
		(0.002)
*C*HighPatentConc*		-0.071**
		(0.032)
*C_Patents*HighPatentConc*		-0.035*
		(0.020)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	123,881	123,881
Adjusted R^2	0.425	0.425

Note: This table presents regression results for the relation between patent concentration and tax-motivated income shifting. All columns include the subsample of non-patent-holding affiliates (123,811 affiliate-year observations). The dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 6: Local patent-holding affiliates

Dependent Variable	*LN(1+ROA)*	*LN(1+ROA)*
	(1)	(2)
C	-0.100***	-0.096***
	(0.019)	(0.019)
C_Patents	-0.002	0.000
	(0.010)	(0.010)
Loss	-0.209***	-0.209***
	(0.002)	(0.002)
*C*Loss*	0.254***	0.253***
	(0.035)	(0.035)
*C_Patents*Loss*	-0.019	-0.019
	(0.021)	(0.021)
*C*PatentConc*	-0.185***	
	(0.068)	
*C_Patents*PatentConc*	-0.071*	
	(0.041)	
*C*PatentConc*HighCompInfo*	0.191	
	(0.140)	
*C_Patents*PatentConc*HighCompInfo*	0.076	
	(0.082)	
*C*HighPatentConc*		-0.118***
		(0.042)
*C_Patents*HighPatentConc*		-0.063**
		(0.026)
*C*HighPatentConc*HighCompInfo*		0.184**
		(0.076)
*C_Patents*HighPatentConc*HighCompInfo*		0.102**
		(0.044)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	112,687	112,687
Adjusted R^2	0.421	0.421

Note: This table presents regression results for the moderating effect of local patent-holding affiliates. The dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 7: Changes in tax enforcement

Dependent Variable	*LN(1+ROA)*	*LN(1+ROA)*	*LN(1+ROA)*	*LN(1+ROA)*	*LN(1+ROA)*	*LN(1+ROA)*
	(1)	(2)	(3)	(4)	(5)	(6)
Enforcement	*Completed Tax Assessments*		*Staff Usage for Verification*		*Costs of Collection Ratio*	
C	-0.064**	-0.059**	-0.082***	-0.081***	-0.083***	-0.084***
	(0.025)	(0.025)	(0.028)	(0.028)	(0.020)	(0.021)
C_Patents	0.026**	0.025**	0.013	0.017	0.006	0.007
	(0.013)	(0.013)	(0.017)	(0.017)	(0.011)	(0.011)
Loss	-0.195***	-0.195***	-0.197***	-0.197***	-0.205***	-0.205***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
*C*Loss*	0.198***	0.197***	0.237***	0.235***	0.259***	0.258***
	(0.043)	(0.043)	(0.057)	(0.057)	(0.037)	(0.037)
*C_Patents*Loss*	-0.038	-0.039	-0.000	0.000	-0.043*	-0.042*
	(0.029)	(0.029)	(0.034)	(0.034)	(0.023)	(0.023)
*C*PatentConc*	-0.195**		-0.285***		-0.184***	
	(0.080)		(0.104)		(0.070)	
*C_Patents*PatentConc*	-0.070		-0.213***		-0.078*	
	(0.047)		(0.070)		(0.042)	
*C*Enforcement*	0.002	0.007	-0.014	-0.018	-0.002	-0.000
	(0.022)	(0.023)	(0.030)	(0.030)	(0.016)	(0.016)
*C_Patents*Enforcement*	0.002	-0.004	-0.016	-0.021	-0.001	-0.002
	(0.012)	(0.012)	(0.018)	(0.018)	(0.009)	(0.009)
*C*PatentConc*Enforcement*	0.191**		0.203		0.055	
	(0.092)		(0.152)		(0.069)	
*C_Patents*PatentConc*Enforcement*	0.162***		0.163		0.035	
	(0.055)		(0.104)		(0.042)	
*C*HighPatentConc*		-0.099**		-0.123*		-0.071*
		(0.047)		(0.063)		(0.042)
*C_Patents*HighPatentConc*		-0.022		-0.135***		-0.046*
		(0.033)		(0.041)		(0.027)
*C*HighPatentConc*Enforcement*		0.060		0.104		0.008
		(0.052)		(0.080)		(0.040)
*C_Patents*HighPatentConc*Enforcement*		0.132***		0.115**		0.031
		(0.035)		(0.053)		(0.026)

Additional Controls	Y	Y	Y	Y	Y	Y
Country-FE	Y	Y	Y	Y	Y	Y
Industry-FE	Y	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y	Y
N	41,632	41,632	22,409	22,409	78,418	78,418
Adjusted R^2	0.422	0.422	0.409	0.409	0.423	0.423

Note: This table presents regression results for the moderating effect of changes in country-level tax enforcement. In columns 1 and 2 (3 and 4), *Enforcement* is an indicator variable with the value of one if country *c* experienced an increase in the value of completed tax assessments (staff usage for verification) in the previous year. In columns 5 and 6, *Enforcement* is an indicator variable with the value of one if country *c* experienced a decrease in the costs of collection ratio in the previous year. The dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 8: Robustness tests

Dependent Variable	*LN(1+ROA)*	*LN(1+ROA*	*LN(1+ROA)*	*LN(EBIT)*	*LN(PLBT)*
	(1)	(2)	(3)	(4)	(5)
C	-0.085***			0.100	-0.197
	(0.016)			(0.229)	(0.262)
C_Patents	0.002			0.188	0.232*
	(0.009)			(0.123)	(0.138)
CTR		-0.114***			
		(0.032)			
Loss	-0.211***	-0.316***	-0.214***		
	(0.002)	(0.008)	(0.002)		
*C*Loss*	0.252***				
	(0.032)				
*C_Patents*Loss*	-0.030				
	(0.020)				
*CTR*Loss*		0.370***			
		(0.028)			
C_IP			-0.006		
			(0.009)		
*C_IP*Loss*			-0.000		
			(0.019)		
PatentQualityConc	-0.008*				
	(0.004)				
*C*PatentQualityConc*	-0.152***				
	(0.051)				
*C_Patents*PatentQualityConc*	-0.072**				
	(0.032)				
PatentConc		0.038***	-0.005	0.028	0.135*
		(0.013)	(0.004)	(0.066)	(0.072)
*CTR*PatentConc*		-0.167***			
		(0.052)			
*C_IP*PatentConc*			-0.070**		
			(0.030)		
*C*PatentConc*				-2.230***	-2.294**
				(0.829)	(0.900)
*C_Patents*PatentConc*				-0.781	-1.444**
				(0.530)	(0.587)
Additional Controls	Y	Y	Y	Y	Y
Country-FE	Y	Y	Y	Y	Y
Industry-FE	Y	Y	Y	Y	Y
Year-FE	Y	Y	Y	Y	Y
N	123,881	123,881	123,881	101,654	99,380
Adjusted R^2	0.425	0.426	0.422	0.486	0.440

Note: This table presents regression results for robustness tests. In columns 1-3, the dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. In column 4, the dependent variable is *LN(EBIT*). In column 5, the dependent variable is *LN(PLBT)*. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).

Table 9: Falsification test: income shifting via debt

Dependent Variable	*LN(1+FROA)*	*LN(1+FROA)*	*LN(1+FROA)*
	(1)	(2)	(3)
C	-0.014***	-0.017***	-0.017***
	(0.004)	(0.005)	(0.005)
Loss	-0.032***	-0.032***	-0.032***
	(0.000)	(0.000)	(0.000)
*C*Loss*	0.034***	0.039***	0.039***
	(0.005)	(0.005)	(0.005)
PatentConc		-0.001	
		(0.001)	
*C*PatentConc*		-0.013	
		(0.010)	
HighPatentConc			-0.001
			(0.000)
*C*HighPatentConc*			-0.008
			(0.006)
Additional Controls	Y	Y	Y
Country-FE	Y	Y	Y
Industry-FE	Y	Y	Y
Year-FE	Y	Y	Y
N	138,595	124,169	124,169
Adjusted R^2	0.353	0.347	0.347

Note: This table presents regression results for a falsification test based on income shifting via debt. Column 1 presents results for the income-shifting model by De Simone, Klassen, and Seidman (2017) based on the full sample (138,595 affiliate-year observations). Columns 2 and 3 present results for the relation between patent concentration and income-shifting via debt based on the subsample of non-patent-holding affiliates (124,169 affiliate-year observations). The dependent variable is *LN(1+FROA)*. *FROA* is defined as financial income of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% level, respectively.

Table 10: Patent Concentration and patent-holding affiliates

Dependent Variable	LN(1+ROA)	LN(1+ROA)
	(1)	(2)
C	-0.002	-0.042
	(0.072)	(0.069)
C_Patents	0.012	0.008
	(0.026)	(0.025)
Loss	-0.166***	-0.166***
	(0.005)	(0.005)
*C*Loss*	0.212	0.207
	(0.155)	(0.155)
*C_Patents*Loss*	-0.017	-0.017
	(0.052)	(0.052)
PatentConcHold	-0.004	
	(0.006)	
*C*PatentConcHold*	-0.622***	
	(0.175)	
*C_Patents*PatentConcHold*	-0.133*	
	(0.077)	
HighPatentConcHold		-0.002
		(0.004)
*C*HighPatentConcHold*		-0.459***
		(0.147)
*C_Patents*HighPatentConcHold*		-0.118**
		(0.057)
Additional Controls	Y	Y
Country-FE	Y	Y
Industry-FE	Y	Y
Year-FE	Y	Y
N	14,412	14,412
Adjusted R^2	0.383	0.382

Note: This table presents regression results for the relation between patent concentration and inbound income shifting. All columns include the subsample of patent-holding affiliates (14,412 affiliate-year observations). The dependent variable is *LN(1+ROA)*. *ROA* is defined as earnings before interest and taxes of affiliate *i*, divided by total assets. All columns include country, industry, and year fixed-effects. We report heteroscedasticity-robust standard errors clustered by affiliate in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively (two-tailed).