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ORIGINAL PAPER

Tax attractiveness and the location of German-controlled subsidiaries

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Abstract This paper analyzes whether taxation has an influence on the location decisions of multinational enterprises. We employ a novel set of 22 tax variables, such as the taxation of dividends and capital gains, withholding taxes, the existence of a group taxation regime, and thin capitalization rules. Furthermore, we use the *Tax Attractiveness Index,* a new aggregate measure containing the 22 tax variables. Our count data regression analysis is based on a novel hand-collected dataset consisting of the subsidiaries of German DAX30 companies in 97 countries. Controlling for non-tax effects, we find that a country's tax environment has a significantly positive effect on the number of German-controlled subsidiaries and, therefore, on the location decisions of German multinational enterprises. Specifically, our analysis reveals that German multinational firms place affiliates in countries that offer favorable statutory tax rates, withholding taxes, double tax treaty networks, and holding incentives. Additionally, we find that the *Tax Attractiveness Index* has explanatory power in subsidiary location decisions and, therefore, it can be used as alternative composite measure, for example, when 22 single tax variables are not at disposal.

Keywords International taxation · Tax attractiveness · Statutory tax rate · Location decision · Multinational enterprise · Composite index

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1 Introduction

In the course of globalization and ongoing economic integration, a growing number of companies have significantly intensified their international activities.[1] The reasons why firms establish subsidiaries in foreign countries are manifold. First, real economic factors, such as the size of the host market, lower factor prices, and market-access may motivate them to locate production abroad.[2] Second, the fact that tax rules are not harmonized gives multinational companies the opportunity to exploit international differences to their advantage. Recent literature contributions reveal that taxation has an influence on location decisions for production and investments (Devereux and Griffith 1998; Buettner and Ruf 2007; Overesch and Wamser 2009, 2010). Moreover, there is evidence that multinational enterprises establish subsidiaries in off-shore tax havens (Desai et al. 2006) and set up intermediate group entities, such as holding or financial companies, for tax purposes only. Anecdotal evidence demonstrates very low effective tax rates of companies, such as Google and Apple, because of their tax-optimized international firm-setup (Drucker 2010; Collins 2011). As a result, complicated group structures may arise, successfully aiming at reduced tax burdens (Mintz and Weichenrieder 2010). However, empirical evidence in this field is scarce. Therefore, we pose the question of how taxation affects the location decisions of multinational enterprises. Specifically, this paper analyzes whether companies place subsidiaries in countries that offer an attractive tax environment, and which specific tax characteristics play a role in this decision.

We are the first to use a large set of 22 tax variables as well as a composite index, the *Tax Attractiveness Index* (Keller and Schanz 2013), that combines these tax variables for the 100 most important countries.[3] Most existing studies either apply the statutory tax rate or effective tax rates to explain the influence of taxation on corporate decisions. It is well-known that, in most cases, the statutory tax rate is an unsatisfactory proxy for the tax environment due to the fact that it neglects timing effects and tax base effects. To overcome this shortcoming at least partially, previous studies apply effective tax rates that capture tax base determinants, such as depreciation allowances and interest deductions. However, existing measures focus on very few tax rules that are important for real investments. Many other important real-world domestic and cross-border tax rules, such as group taxation regimes, thin capitalization rules, or double tax treaty networks have not yet been integrated. We

[1] The stock of German companies' investment abroad has increased by more than 40 % over the 5 years from 2004 to 2009 and has grown from approximately 30 to 40 % of the size of the German GDP (Deutsche Bundesbank 2007, 2013).

[2] Economic theory distinguishes between two main driving forces for becoming a multinational firm. According to the vertical model, differences in factor prices across countries lead to the emergence of multinational companies (Helpman 1984, 1985). According to the horizontal model, the internationalization decision is motivated by market access (Markusen 1984, 2002).

[3] Simmons (2003) constructed a composite index for seven countries for the year 1999.

argue that the location decisions of multinational enterprises depend on a bundle of tax factors. Hence, we employ 22 tax factors, such as the taxation of dividends and capital gains, withholding taxes, the existence of a group taxation regime, the double tax treaty network, and thin capitalization rules. In this way, we reflect tax planning opportunities that multinational enterprises may take advantage of by establishing intermediate group units, such as holding companies, in a particular country.

To investigate the location decisions of multinational firms, we focus on the number of subsidiaries that German parent companies operate in different host countries. Specifically, on the basis of count data regression models, we analyze whether the tax environment, as measured by the tax variables, has an influence on location decisions and, hence, on the number of subsidiaries in a specific country. Furthermore—as a second goal of our paper, we aim to test whether the *Tax Attractiveness Index* has explanatory power for location decisions. The index could qualify as a useful overall tax indicator for future studies, aiming to control for tax effects without having the individual tax variables at their disposal.[4] Moreover, the index can serve as a tool for tax professionals, companies, policymakers and non-tax researchers to rank countries according to the attractiveness of their tax code. Applying this measure to explain corporate location decisions helps to assess the usefulness of the *Tax Attractiveness Index (TAX)* for such rankings. By including another version of the index (*TAX_sig*), that makes use of the results from our disaggregate analysis of the tax variables to select and weight tax components, we are able to check whether methodological choices made for the construction of the original *Tax Attractiveness Index* matter. Therefore, this study serves to validate the usefulness of the index and its methodological robustness in empirical applications.

Our empirical analysis is based on a novel dataset consisting of the subsidiaries[5] of German DAX30 companies[6] over the years 2005–2009. We consider Germany to be a suitable reference country since dividends from foreign affiliates are nearly exempt from taxation.[7] Therefore, domestic parent country taxation can be neglected, and we can focus on the corporate tax environment of the subsidiary's host country. Only 40 out of our sample of 99 countries do not exempt dividends from affiliates. They are mostly countries which apply a credit system to relief double taxation. For the majority of countries (59 in our sample), that have an

[4] In other contexts, the application of indices is widely accepted. A famous example is the creditor rights index introduced by La Porta et al. (1998) that has been applied in many subsequent articles (Djankov et al. 2007; Spamann 2010). In the sense of Hung (2000), Jacob and Goncharov (2014) construct a tax accrual index that counts accrual norms codified in tax law.

[5] We include all legally independent entities held by a parent company. We use the terms "subsidiary" and "affiliate" interchangeably.

[6] DAX30 is the major German stock market index (*Deutscher Aktien Index*) and comprises the 30 largest listed companies based on order book volume and market capitalization.

[7] According to Section 8b of the German corporate income tax code (*Körperschaftsteuergesetz*), dividends distributed by national or foreign affiliates can be received free of tax. Only 5 % of dividends are taxed as non-deductible operating expenditures.

exemption system in place, we deem Germany to be a fairly representative and argue that our analyses' results are likely transferable. To ensure a comprehensive picture of German-controlled affiliates abroad, we do not rely on existing databases, but rather we hand-collect our data. Our final sample (after eliminating two countries due to missing control variables) includes subsidiaries of German DAX30 parent companies that are located in 97 different host countries—including tax havens—spread across the world.

As our main finding, our analysis of host countries' individual tax characteristics indicates that the location choices depend on multiple tax factors with the statutory tax rate, withholding tax rates on interest, the treaty network, and special incentives for holdings being the most influential. Nevertheless, we do not conclude that the other—less influential—tax factors are *not* relevant, as especially the limited variance of several tax factors over our 5-year-time-period makes the identification of significant effects difficult. Moreover, the host country's *overall* tax environment, as measured by the *Tax Attractiveness Index*, plays a significant role in determining the number of German-controlled subsidiaries located there. Controlling for non-tax influences, our analysis indicates that the tax attractiveness of a country has a substantial positive impact on the number of subsidiaries. Multinational companies establish (an increased number of) affiliates in tax attractive countries, suggesting that they implement tax-efficient corporate group structures by placing intermediate holdings or operating subsidiaries in off-shore tax havens. We perform several robustness checks to confirm the reliability of our results. Furthermore, we compare the influence of different tax measures and show that the *Tax Attractiveness Index* has a higher explanatory power for location decisions of multinational enterprises than widely used model-based effective tax rates.[8] Furthermore, we show that the equal-weighting method used for constructing the index is robust.

Our research is relevant for different groups of addressees: first, it is important for policy makers. The *Tax Attractiveness Index* makes it possible to rank countries according to their tax environment, and our analysis reveals which countries succeed in attracting foreign subsidiaries. From this, governments and politicians can compare their current tax position to other countries and learn about firm location decisions. In addition, our study provides insight into the tax factors that multinational enterprises consider to be the most important in their location decisions. Policy makers can utilize this knowledge in regard to future tax reforms that may be targeted to enhance location attractiveness. Second, our findings are relevant for companies, as well as consultants. These groups can gain insight into the location strategies of other multinational enterprises. Furthermore, from the *Tax Attractiveness Index* which is provided per country, they can identify favorable tax jurisdictions that can be used for future tax planning purposes. Third, researchers

[8] We use model-based effective tax rates based on the methodology of Devereux and Griffith (2003), which are widely used in tax research, as an alternative measure of tax attractiveness, and calculated by Endres et al. (2014) for 35 countries and the years 1998–2014.

can benefit from our analysis. We reveal that foreign subsidiary location decisions depend on a bundle of tax factors, most of which have never been previously included in empirical research. We recommend international researchers to employ the *Tax Attractiveness Index* or its 22 components as a tax measure in future studies. Finally, our results are not only important for empirical researchers, but can also help tax researchers to build more sophisticated theoretical models.

The remainder of the paper is organized as follows: in the next section, we relate our topic to existing literature providing the theoretical background for our analysis, and we develop our hypothesis. In Sect. 3, we present the tax variables, our firm dataset, and the econometric methodology that we apply. Section 4 is dedicated to the results of our empirical analysis. In Sect. 5, we subject our results to multiple robustness checks. Furthermore, we check whether alternative weighting methods to construct the index change the results, and we compare the *Tax Attractiveness Index* to effective tax rates. In the last section, we point out limitations of our study and draw conclusions.

2 Prior research and hypothesis

There is a sizeable body of empirical research that mostly confirms the influence of taxation on the location decisions of multinational enterprises.[9] In contrast to our study, tax measures used in prior literature take only very few tax rules into consideration when analyzing the effect of taxation on location decisions. Similar to the *Tax Attractiveness Index*, Simmons (2003) uses a composite index labeled the Corporate Tax Attractiveness Index (CTA) and finds a positive relationship with the FDI inflows of a country. The CTA consists of 13 components measuring the tax burden, administrative issues, and systemic quality for seven countries in 1999. Both the component scores and the weights are based on the assessment of executives and tax professionals from around the world. Our study goes beyond Simmons (2003) in several ways. First, our dataset consists of 97, rather than just seven, countries. This allows us to conduct parametric tests, rather than applying Kendall's tau b, a non-parametric statistic of correlation. Second, we collect data for 5 years (2005–2009) enabling us to test our hypothesis over time. Third, our dataset is fact-based and involves little judgment; whereas, Simmons (2003) bases his research on evaluations and perceptions of professionals. This difference explains why we do not include some of his dimensions (e.g., transparency and predictability

[9] Hines (1997) and Devereux (2007) provide comprehensive reviews of the existing literature. Based on previous studies, De Mooij and Ederveen (2003, 2006) and Feld and Heckemeyer (2011) conduct meta-analyses. Early contributions in the field of taxation and FDI are based on aggregate FDI flows (see Hartman 1984 for pioneering work). Other analyses use aggregated firm-level data on property, plant, and equipment to investigate real economic activity more accurately than FDI in its broad definition (Hines and Rice 1994; Grubert and Mutti 1991, 2000; Altshuler et al. 2001). However, due to the underlying data structure, they are not capable of disentangling the discrete location choice and the subsequent continuous choice of the investment level. With the availability of firm-level data, the number of studies examining international location decisions has increased (see the framework developed by Devereux (2007).

of tax judgments), for which factual data is impossible to retrieve to the best of our knowledge.

Most studies use either the *statutory tax rate* or they apply *model-based effective tax rates*[10] which only include information about the depreciation of assets, financing activities, and the statutory corporate tax rate of a model investment project (see King and Fullerton 1984; Devereux and Griffith 1998, 1999, 2003; Devereux et al. 2002, for the methodological foundations). The BAK Index (Elschner et al. 2014) quantifies *model-based effective tax rates* for a range of countries. The European Tax Analyzer (Oestreicher et al. 2009) provides *simulation-based effective tax rates* based on the effect of several tax aspects on simulated model-firms. Given that the vast majority of research presented in this study uses *model-based effective tax rates,*[11] we refer to this methodology when we use the term '*effective tax rates*' in the following. Based on these methods, several studies find a significant effect of *statutory* and *effective tax rates* on location decisions concerning subsidiaries, outbound FDI, M&A, tax haven investments, joint ventures, and holdings (Papke 1991; Devereux and Griffith 1998; Stöwhase 2002; Buettner and Ruf 2007; Overesch and Wamser 2009, 2010; Hebous et al. 2011; Barrios et al. 2012; Gumpert et al. 2012; Becker et al. 2012). In Sect. 5.3, we show that the *Tax Attractiveness Index* has a higher explanatory power for subsidiary location decisions of German groups than *effective tax rates*, as provided by Endres et al. (2014). We hypothesize that this is due to the fact that the index captures a broader set of tax variables (e.g., controlled-foreign-corporation (CFC) rules, thin capitalization rules, general anti-avoidance rules, special holding incentives).

Next to *statutory tax rates* and tax base determinants, such as depreciation, included in *effective tax rates*, few other tax factors have been analyzed so far. While *double tax treaties* are shown to entice investment and holding companies (Mintz and Weichenrieder 2010; Blonigen et al. 2011; Weyzig 2013) in some studies, others (Blonigen and Davies 2004) do not find an effect, possibly because *double tax treaties* also contain less attractive features, such as information sharing agreements (Blonigen et al. 2011). The introduction of *thin capitalization rules* reduces the tax-sensitivity of internal debt usage (Buettner et al. 2012). Furthermore, companies are found to react to *CFC rules* with relocations of headquarters and passive assets (Voget 2010; Ruf and Weichenrieder 2012). The limitation of *loss offset opportunities* leads to lower investment, especially for multinationals in risky industries (Dreßler and Overesch 2013). *Withholding taxes* are found to influence subsidiary location decisions and foreign investment (Overesch and

[10] There are two kinds of effective tax rates. The *effective marginal tax rate* refers to the influence of taxation on an investment that only earns the cost of capital, while the *effective average tax rate* represents the impact of taxes, assuming a higher profitability of the underlying investment project. A different type of *effective tax rate* is analyzed by Markle and Shackelford (2012). They empirically investigate *accounting effective tax rates* based on financial statement information. These *accounting effective tax rates* are often in the focus of investors, but optimization of *accounting effective tax rates* can lead to sub-optimal investment decisions (Müller and Sureth 2010).

[11] Papke (1991) is the only exception and uses *simulation-based effective tax rates*.

Wamser 2009; Wamser 2011). Beer and Loeprick (2015) find that the introduction of documentation requirements for transfer prices reduces profit shifting activities of multinationals significantly.

Apparently, existing tax measures focus only on a few tax factors. Using 22 tax variables, as well as the aggregate *Tax Attractiveness Index*, we aim to capture a broader set of relevant tax law details in our contribution. While the disaggregate analysis of the tax variables allows us to analyze which characteristics of countries' tax systems matter most for location decisions, the *Tax Attractiveness Index* is a broad measure of the tax environment suitable for cross-country comparisons. Given that the *Tax Attractiveness Index* captures more tax law details than other aggregate measures, such as effective tax rates, we argue that it is a more suitable indicator for many research questions, since corporate tax planning decisions are mostly driven by a broad, rather than a limited, set of tax characteristics. As in the case of any aggregate measure, the major limitation of the *Tax Attractiveness Index* is its lack of flexibility to account for the specifics of a decision situation. In each corporate decision, different tax characteristics bear varying levels of importance that depend on the industry, corporation, and specific question to be answered. All aggregate tax measures, however, make an assumption about the relative importance of tax law details without accounting for these circumstances. While the *Tax Attractiveness Index* equally weights its 22 components, *effective tax rates* derive the relative importance of tax characteristics from fictitious model investment projects. Therefore, we test alternative methods of aggregation. Moreover, we use another version of the index (*TAX_sig*), which only incorporates the tax variables found to be significant in our main disaggregate regression and weights these variables by their exponentiated coefficients, in all of our analyses. Our hand-collected firm dataset enables us to analyze a broader set of countries than most of the above mentioned studies. Among the 97 countries in our dataset, there are several that have been identified as tax havens in the literature, such as the Netherlands, Switzerland, Luxembourg, Ireland, Bermuda, the Bahamas, and the Cayman Islands (Hines and Rice 1994; Grubert and Slemrod 1998; Hines 2005; Desai et al. 2006; Mintz and Weichenrieder 2010). While the activities of U.S. multinational enterprises in tax havens have been widely studied, evidence for the operations of German multinational firms in tax havens is scarce.[12]

Based on the presented studies, this paper aims to determine whether and which features of countries' tax systems influence subsidiary location decisions of German multinational enterprises. In order to do so, we put forward the theory that the location decisions of multinational enterprises can be explained by the tax attractiveness of countries. Hence, we examine the following hypothesis:

> The more tax attractive a group country is, the more subsidiaries it is expected to host on average.

[12] The aforementioned Gumpert et al. (2012) is a recent exception.

3 Data description and empirical methodology

3.1 Tax variables

In our empirical analysis, we use a set of 22 tax variables[13] that capture tax systems' characteristics that are potentially relevant for location decisions of German multinationals. Furthermore, we aggregate these 22 tax variables to form the *Tax Attractiveness Index (TAX)* (Keller and Schanz 2013)[14] and create the *TAX_sig* from the four tax variables found to be most influential in our disaggregate analysis.

Most of the 22 tax variables are qualitative in nature, but have been quantified in order to be summarized in one value per country. All tax factors are restricted to values between zero and one. In each case, a value of one indicates the optimum (e.g., a statutory tax rate of 0 %; the possibility of cross-border group relief; no thin capitalization rules) while a value of zero signifies least favorable tax conditions (e.g., the highest statutory tax rate in the sample; no group relief; the existence of thin capitalization rules).[15] This scaling enables us to combine the variables to an index and makes them more comparable. As described further below, some of our variables have categorical or binary scales. Here, we necessarily abstract from many tax law details. A limitation of this approach is that in some instances, we award the same value to two countries that slightly differ in the details of their tax rules. Therefore, we add a robustness test using unscaled tax rates and treaty network variables. Adding values for all single tax factors and dividing the sum by 22 yields the country-specific *Tax Attractiveness Index*. As a robustness check, we construct alternative indices based on factor analysis and the regression results described in this paper (see Sect. 5.2 for a detailed description). The alternative index TAX_sig is included in all regression tables.[16] It consists of the four tax variables (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network and holding regime), each of which is weighted by its exponentiated regression coefficient. Consistent with the single tax factors, the indices vary between zero and

[13] Due to multicollinearity reasons, we only include 20 tax variables in our disaggregated regression analyses.

[14] The set of tax variables composing the *Tax Attractiveness Index* described in Keller and Schanz (2013) has been slightly adjusted to reflect the research question and the perspective of German multinational companies in this study. We include depreciation rules, R&D incentives, amount limitations for loss carry forward and loss carry back rules, withholding taxes on dividends, interest and royalties paid to a German parent, and exclude the EU dummy.

[15] Since we use the maximum value observed among all countries within a year to scale our variables in some instances, we cannot infer absolute improvements of these countries' tax systems over time. If, for example, a country's value increases, it has improved its position relative to the most attractive country, but that does not necessarily mean that it has made its tax code more attractive. It could well be that the formerly most attractive country became less attractive. Given that we observe only limited within-country variance of countries' tax rules over time in our sample and since it can well be argued that companies take a relative rather than an absolute perspective when making their location decision, we argue that this is only a minor problem.

[16] We use the TAX as our primary measure since is that it is the more universal measure. While the TAX_sig is tailored to specific subsidiary location decisions, the TAX contains more tax variables and therefore (potentially) is relevant for other types of corporate location decisions (e.g. location of assets such as patents).

one, with high values indicating an attractive tax environment. The indices are constructed for 40 European countries, 18 countries that are situated in Africa and the Middle East, 19 in North and South America, 16 in Asia–Pacific, and six in the Caribbean. They are measured on an annual basis for the years 2005–2009.

As a first tax variable, we include the statutory tax rate since it determines the general level of taxation faced by corporate entities. The statutory tax rate is defined as the corporate income tax rate plus surcharges and local trade taxes. For the purpose of standardization, it is placed in relation to the highest statutory tax rate of the 99 sample countries. Thus, a value of one stands for a zero tax rate, while a value of zero is assigned to the highest tax rate in the sample. Furthermore, the taxation of dividends and capital gains is taken into account. In many countries, a participation exemption applies which allows the collection of dividends from affiliated companies as well as capital gains free of tax. Furthermore, we account for the extent to which dividends and capital gains are tax exempt. Next, withholding taxes that a country levies are measured since it is very much in the interest of multinational companies that withholding taxes are abolished, since they are one of the major causes of double taxation. The EU Parent-Subsidiary Directive and the Interest and Royalties Directive, in effect, eliminate withholding taxes within the European Union. Moreover, in most double tax conventions, the minimization of withholding taxes is codified. To provide a detailed picture, we include six different withholding tax variables. On the one hand, we cover withholding taxes on dividends, interest, and royalties that are constituted in domestic law. These rates are relevant for subsidiaries owned by other subsidiaries that are located in countries with which no double tax treaty has been concluded. On the other hand, we consider withholding taxes on dividends, interest, and royalties that each host country levies in its relationship with Germany. In this way, we account for the possibility that either an EU provision or a double tax treaty abolishes or lowers withholding taxes.[17] These withholding tax rates apply to subsidiaries that are directly owned by their German parent or another German subsidiary.

In addition, we consider the loss offset provisions that a country offers by including two variables considering the time horizon losses that can be carried back or forward and two additional variables capturing provisions that limit the amount of losses that can be carried back or forward. Another included tax factor stands for the possibility of filing a consolidated group return. Under a group relief scheme, losses incurred by one subsidiary can be used to compensate for profits earned by another group member. As a result, the overall group tax burden is lowered. Next, we include the number of double tax treaties that a country has concluded. A comprehensive treaty network may represent an important determinant of the location decision. By setting up a subsidiary in such countries, companies obtain access to favorable tax rules agreed upon in a double tax convention that they could not have otherwise exploited. Furthermore, we incorporate thin capitalization rules, CFC rules, and a country's general anti-avoidance legislation to account for

[17] In its original version, the *Tax Attractiveness Index* contains a dummy variable indicating whether the respective country is part of the European Union and, therefore, benefits from the EU directives (Keller and Schanz 2013). However, in this study, we replace the dummy variable with the specific withholding tax rates to Germany, making our analysis more precise for our Germany-related research question.

measures that countries put into effect in order to secure tax revenue. From the multinational firms' perspective, the existence of such provisions is not desirable as they hinder them from allocating their profits in the most efficient way. Additionally, we incorporate the personal income tax rate to account for the level of taxation faced by the employees of a subsidiary. Next, we consider whether a jurisdiction offers a special holding regime which decreases the corporate tax burden below the standard level, for example, by offering lower corporate tax rates for holding companies. Similarly, we add a variable that captures incentives that a country might offer for resident companies that conduct research and development (R&D). Unfortunately, the details of such incentives vary widely across countries. First, rules vary by incentive type. Some countries allow for a deduction of a certain percentage of R&D expenditures from taxable income (deduction method) and some from tax liability (credit method). Furthermore, countries vary by the scope of expenses recognized. Some countries generously recognize all expenditures related to R&D, while others limit recognition to certain expenditure types (e.g., personnel cost, buildings, etc.). Other countries limit R&D incentives to specific industries or to small enterprises. Moreover, countries differ in their treatment of unused deductions or credits. Some allow for a carry back or carry forward, others do not. In addition, carry back/forward periods vary across countries. In our quantification,[18] we necessarily abstract from most details. Our variable assumes a value of zero if no R&D incentives are offered. If a country offers either a deduction from net income or a tax credit, whose percentage of R&D cost is among the 25 % highest among a sample of 100 countries globally in its respective category (deduction/credit), the variable assumes a value of one. If an incentive scheme is offered, which is not among the 25 % most attractive ones, R&D incentives assume a value of 0.5. Finally, we consider the attractiveness of depreciation rules in a country. Based on the methodology of Endres et al. (2014), we calculate the pre-tax present value of the depreciation allowances granted for one unit of expense on commercial property.[19] Again, we scale the variable to range between zero and one by dividing the resulting present values for each country by the highest observed value among all countries in a year.

Table 7 in the Appendix summarizes the quantification scheme for the 22 tax variables, and Table 8 reports mean values of the *Tax Attractiveness Index (TAX), TAX_sig and TAX_GER* for 100 countries over the 2005–2009 period.[20] The latter

[18] There are existing measures of R&D incentives (Warda 2001; Lohse et al. 2012). However, these measures also abstract from many of the above mentioned details and are available only for a limited time horizon and set of countries.

[19] Instead of 7.1 %, as assumed by Endres et al. (2014), we assume a nominal interest rate of 3.76 %, the average yield of 10-year German government bonds over the sample horizon (2005–2009). We chose commercial property as a representative asset class, since it is relevant for a broad variety of companies from different industries, and its depreciation rules are best documented for a large number of countries (source: Ernst & Young Worldwide Corporate Tax Guide). A cross-check with depreciation rates on machinery for countries with available data reveals a correlation of approx. +0.5.

[20] With 0.689, countries identified as tax havens by Hines and Rice (1994) having a significantly higher average index value than non-haven countries (0.480). 12 out of the most attractive 20 countries are identified as tax havens. However, there are several tax havens, such as Lebanon and Panama, which do not appear among the highest ranking peers according to the *Tax Attractiveness Index*. A similar result is found, if the tax haven definition by the OECD is used (OECD 2000, 2009).

index consists of 19 equally weighted tax variables excluding the variables for withholding taxes on dividends, interest and royalties paid to a German parent. It is only used for Germany in our graphic analysis but not in the regression analyses, in which we focus on the foreign subsidiaries of German multinationals only. Table 1 reports descriptive statistics for all tax variables used in our main analyses of this study. The *Tax Attractiveness Index* ranges between 0.251 indicating the score for Argentina in 2007, and 0.864 reflecting the score for Bermuda and the Bahamas in years 2005–2009. The mean (0.512) and median (0.488) of the index are close to 0.5.

3.2 Firm data

Our empirical analysis is based on a hand-collected dataset consisting of the subsidiaries of German DAX30 companies. We consider the DAX30 enterprises to be most suitable for our purposes since they operate great numbers of subsidiaries in diverse countries all over the world. Due to their location in Germany, a country that nearly exempts foreign-sourced dividends, we can disregard home country taxation. We refrain from using existing databases for several reasons. First, the AMADEUS database provided by Bureau van Dijk that has been used in several previous publications (e.g., Barrios et al. 2012) offers financial data exclusively for European affiliates. Nevertheless, the names and the respective locations of non-European subsidiaries are listed, which would yield sufficient information for our main analysis. However, a crosscheck reveals that the database rarely includes all subsidiaries of German DAX30 companies. At least in some cases, several affiliates are lacking. These are supposed to be predominantly small ones with minor operating activities. However, we consider including virtually all subsidiaries in our sample to be important since certain intermediate group units or small subsidiaries in tax havens might otherwise be disregarded. Next, we took the MiDi database provided by the German Central Bank into consideration. Data collection is enforced by German law,[21] and German companies are required to report their investment positions held abroad if the participation is 10 % or more and the balance sheet total of the investment exceeds € three million.[22] However, small subsidiaries that fall below the threshold do not have to be reported. Therefore, the MiDi database does not include all foreign German-controlled subsidiaries. Comparisons of the number of subsidiaries in our hand-collected dataset with randomly chosen MiDi-based studies reveal much higher numbers in our case. Therefore, to ensure that the number of subsidiaries is correctly specified and to yield a comprehensive picture of the affiliates of German DAX30 companies held abroad, we hand-collect our data. Due to the high level of effort required for data collection, we concentrate solely on the German DAX30 companies.

Table 9 in the Appendix shows that the DAX30 groups are considerably larger than other German multinationals found in the AMADEUS database, while they do

[21] See Section 26 of the Foreign Trade and Payments Act (*Außenwirtschaftsgesetz*) in connection with the Foreign Trade and Payments Regulation (*Außenwirtschaftsverordnung*).

[22] For further information about MiDi, see Lipponer (2009).

Table 1 Descriptive statistics–independent variables

Variable	N	Mean	Std. Dev.	Min.	Median	Max.
TAX	13,360	0.512	0.128	0.251	0.488	0.864
TAX_sig	13,360	0.461	0.163	0.046	0.471	0.816
Statutory tax rate	13,360	0.392	0.233	0.000	0.356	1.000
Taxation of dividends	13,360	0.557	0.494	0.000	0.950	1.000
Taxation of capital gains	13,360	0.447	0.488	0.000	0.000	1.000
WHT no treaty dividends	13,360	0.641	0.314	0.000	0.714	1.000
WHT to GER dividends	13,360	0.847	0.208	0.000	1.000	1.000
WHT no treaty interest	13,360	0.643	0.268	0.000	0.621	1.000
WHT to GER interest	13,360	0.789	0.230	0.000	0.747	1.000
WHT no treaty royalties	13,360	0.555	0.262	0.000	0.559	1.000
WHT to GER royalties	13,360	0.756	0.241	0.000	0.747	1.000
Loss carry back time	13,360	0.159	0.366	0.000	0.000	1.000
Loss carry forward time	13,360	0.471	0.446	0.000	0.500	1.000
Loss carry back amount	13,360	0.132	0.336	0.000	0.000	1.000
Loss carry forward amount	13,360	0.919	0.248	0.000	1.000	1.000
Group relief	13,360	0.193	0.283	0.000	0.000	1.000
Treaty network	13,360	0.326	0.249	0.000	0.327	1.000
Thin capitalization rules	13,360	0.600	0.467	0.000	1.000	1.000
CFC Rules	13,360	0.729	0.444	0.000	1.000	1.000
Anti-avoidance legislation	13,360	0.516	0.306	0.000	0.500	1.000
Personal income tax rate	13,360	0.492	0.239	0.000	0.470	1.000
Holding regime	13,360	0.242	0.428	0.000	0.000	1.000
R&D incentives	13,360	0.208	0.313	0.000	0.000	1.000
Depreciation	13,360	0.653	0.240	0.000	0.657	1.000
GDP	13,360	24.891	1.854	20.846	24.945	30.088
Similarity	13,360	0.367	0.310	0.011	0.240	0.998
Distance	13,360	8.117	1.088	5.934	8.481	9.810
Adjacency	13,360	0.093	0.290	0.000	0.000	1.000
Rule of LAW	13,360	0.377	0.908	−1.774	0.537	1.782
Voice & accountability	13,360	0.383	0.995	−1.914	0.508	1.964

This table reports descriptive statistics for the independent variables used in this study. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009. The *Tax Attractiveness Index (TAX)* and its 22 components shown below represent host country *i*'s tax attractiveness. *TAX_sig* is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model. The tax variables are restricted to values between zero and one. High values indicate a favorable tax environment. WHT stands for withholding tax rates. The detailed measurement of each tax variable is described in Table 7 in the Appendix. Besides tax variables, we include country-level control variables. *GDP* is the natural logarithm of host country *i*'s GDP in constant USD for the year 2000. *Similarity* is an index defined as one minus the ratio of the absolute value of host country *i*'s GDP per capita minus Germany's GDP per capita to the higher of both GDPs per capita (GDP per capita in constant USD for the year 2000, respectively). *Distance* is defined as the natural logarithm of the population-weighted distance between the main agglomerations of Germany and host country *i*. *Adjacency* is a dummy variable obtaining the value of one if host country *i* shares a border with Germany. *Rule of Law* and *Voice & Accountability* represent governance indicators of host country *i*. They may range from −2.5 to 2.5. All country-level variables are measured on an annual basis. See "Appendix 1" for information about country-level control variables and data sources

not differ considerably in their capital structure from the smaller groups. Given that there are economies of scale in tax planning, smaller companies can be hypothesized to pursue less sophisticated strategies. Therefore, basic tax characteristics, such as the statutory tax rate, or depreciation rules might be relatively more important for them than special characteristics, such as incentives for holdings. Given that smaller companies tend to be less diversified (Green and Talmor 1985), their risk of losses tends to be higher and therefore loss offset rules should play a greater role for them. Extending the sample, for example, to non-listed firms, therefore offers room for further research.

We source the enumeration of all subsidiaries from the full list of shareholdings which is part of the group appendix according to German commercial law (Section 313 (2) and Section 285 No. 11 of the German Commercial Code (*Handelsgesetzbuch*)). The full lists of shareholdings are published in the electronic German Federal Gazette (www.ebundesanzeiger.de) and the commercial register or they are available on the firm websites. Our sample period covers the years 2005–2009. To avoid survivorship bias, we include parent companies that have been listed in the DAX30 at any time during the sample period. Furthermore, we restrict our dataset to non-financial firms since financial firms apply different accounting methods.[23] This leads us to 28 parent companies. We collect all subsidiaries (legally independent entities) that each parent company holds per year. However, our data do not allow differentiating between types of subsidiaries (e.g., operative units, holding companies). Although this differentiation seems to be desirable, anecdotal evidence reveals that multinationals often establish mixtures of different types, for example, to avoid CFC rules applicable on passive income only. Taking all 5 years together, we accumulate a total number of 74,396 subsidiaries located in 189 different countries. For each subsidiary, we obtain information on its location, the amount of equity a group owns in a subsidiary (in EUR millions), and its scope of consolidation.[24] For 42,572 affiliates, information on equity is available.

We employ the number of subsidiaries that German multinational enterprises operate per year in different host countries to analyze the determinants of location decisions. The number of affiliates represents the sum of location choices in favor of a distinct country. Therefore, we count the subsidiaries that parent company j holds in year t in host country i. This provides us with the dependent variable of main interest, *Number Subsidiaries*.[25] For the purpose of more detailed analyses and to be able to conduct robustness tests, we generate certain alternative dependent variables. First, we count the number of consolidated subsidiaries (*Number Cons. Subsidiaries*) that parent company j holds in year t in host country i. Next, we generate *Number Subsidiaries (relative)*, defined as the number of subsidiaries that parent

[23] Furthermore, we do not include Fresenius Medical Care AG & Co. KGaA (FMC), since it is owned and consolidated by Fresenius SE. An inclusion of both members of the DAX30 would lead to double-counting the subsidiaries of FMC.

[24] We are able to differentiate between consolidated affiliates, non-consolidated affiliates, associated companies, and joint ventures. However, about 70 % of the subsidiaries included in our initial sample are consolidated affiliates.

[25] The following example illustrates our approach: if parent company 1 operates five affiliates in Spain in year 2006, then *Number Subsidiaries* equals five. The five Spanish subsidiaries count as *one* observation.

company *j* holds in year *t* in host country *i* divided by the total sum of foreign subsidiaries that parent company *j* holds in year *t*. Furthermore, we sum up the equity (i.e. the amount of equity a parent owns in a subsidiary) that parent company *j* holds in year *t* in host country *i* measured in € millions. We use the natural logarithm of this sum as another dependent variable (*Equity*)[26] in one of our robustness tests. Using the natural logarithm has two effects. First, it eliminates the 130 observations showing negative equity. While it is possible for subsidiaries to report a negative book value of equity, for example, due to losses that are not covered by equity, there are indications that the book value is a poor proxy of the market value of equity for firms reporting negative equity (Jan and Ou 2012). Second, our regression model presented in Sect. 5.1 has a considerably improved fit for equity in logarithmic format compared to the mere sum of equity.[27] For an aggregated analysis, we count the subsidiaries that all 28 parent companies together hold in year *t* in host country *i* (*Number Subsidiaries (all)*). Finally, we use the change in the number of subsidiaries company *j* holds in a country *i* from year *t-1* to *t (Number Subsidiaries Change)*.

As a next step, we merge the tax data with our firm sample. Complete tax data are available for 99 countries, excluding Germany. We have to drop observations for the British Virgin Islands and Jersey due to a lack of country-level control variables presented in the next section.[28] Thus, our analysis is based on 97 countries, and our initial sample contains 13,580 observations (28 parent companies × 5 years × 97 countries). We have to drop observations for Belarus 2005, as we lack tax information (−28 observations), and for two parent companies for which we do not have access to the list of shareholdings for 2005 (−2 parent companies × 96 remaining countries for 2005 = 192 observations). Our final sample consists of 13,360 observations representing 97 different host countries.[29]

The dependent variable that we apply in our main analysis is *Number Subsidiaries*. Figure 1 displays its distribution, revealing that our dataset contains 6595 zeros (∼49.36 %).

The high number of zeros can be explained by the fact that each of our 28 parent companies does not operate subsidiaries in all 97 host countries in each year of the sample period. We will address the issue of excess zeros in the next section. Summary statistics for all dependent variables used in this study are presented in Table 2.

Number Subsidiaries ranges from zero to 524. The mean is 3.815, revealing that each German DAX30 company operates on average 3.815 subsidiaries in each of the 97 host countries per year. *Number subsidiaries (all)* has a minimum of zero and a maximum of 2060 affiliates, with a mean of about 112, i.e., the German DAX30 companies together have on average 112 subsidiaries in each of the 97 host countries per year. Comparing

[26] We add € 1 to the sum before calculating the natural logarithm in order not to eliminate observations with € 0 equity.

[27] The R^2 for the disaggregate non-logarithmic regression of 0.07 compares to 0.47 for the logarithmic regression.

[28] If we exclude *Rule of Law* and *Voice & Accountability*, the two control variables for which we do not have data for the British Virgin Islands and Jersey, and rerun our main regressions including the two countries, the results do not change materially (not reported).

[29] Thus, we finally capture 51,075 of the initial 74,396 subsidiaries.

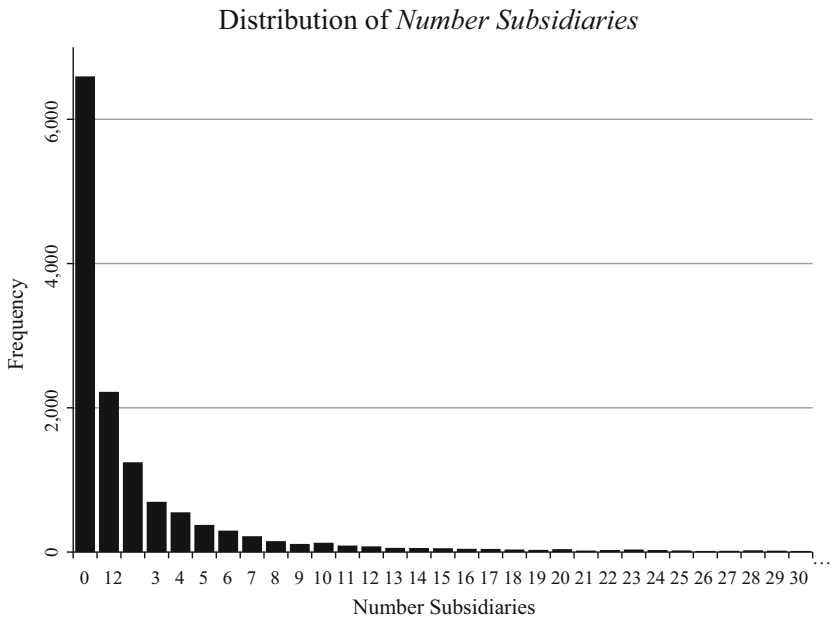

Fig. 1 Displays the distribution of *Number Subsidiaries*, defined as the number of subsidiaries that parent company *j* operates in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009. The subsidiaries are situated in 97 different host countries

Table 2 Descriptive statistics—dependent variables

Variable	N	Mean	Std. Dev.	Min.	Median	Max.
Number subsidiaries	13,360	3.815	15.071	0.000	1.000	524.000
Number subsidiaries (rel.)	13,360	0.007	0.020	0.000	0.001	0.457
Equity	13,230	1.291	2.168	−3.912	0.000	11.431
Number cons. subsidiaries	13,360	2.777	12.854	0.000	0.000	515.000
Number subsidiaries (all)	484	111.774	246.921	0.000	36.000	2060.000
Number subsidiaries change	10,864	0.057	4.920	−109.000	0.000	243.000

This table reports descriptive statistics for the dependent variables used in this study. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005—2009. The subsidiaries are situated in 97 different host countries. *Number Subsidiaries* signifies the number of subsidiaries that parent company *j* operates in year *t* in host country *i*. *Number Subsidiaries (relative)* is defined as the number of subsidiaries that parent company *j* operates in year *t* in host country *i* divided by the total number of foreign subsidiaries that parent company *j* holds in year *t*. *Equity* is the natural logarithm of one plus the sum of equity (in current € millions) that parent company *j* holds in year *t* in host country *i*. *Number Cons. Subsidiaries* refers to the number of consolidated subsidiaries that parent company *j* operates in year *t* in host country *i*. *Number Subsidiaries (all)* is the aggregated number of subsidiaries that all 28 parent companies together operate in year *t* in host country *i*

the mean and median of *Number Subsidiaries* and of *Number Subsidiaries (all)* shows that variance is high in both cases. Equity of one parent company in one host country goes up to € 92 billion per year (11.431 in logarithmic format).

3.3 Econometric approach

3.3.1 General econometric framework

As we want to consider the fact that multinationals might operate more than one subsidiary in one host country, we apply count data regression models, not binary choice models. We employ *Number Subsidiaries*, which reflects the number of subsidiaries that parent company j holds in year t in host country i, to analyze the effect of taxation on the location decisions of German multinational enterprises. Thus, our main dependent variable is a count variable, meaning that it has only non-negative integer outcomes. A natural starting point for the analysis of count data is the Poisson regression model. However, the Poisson model requires the mean of the count variable to equal the conditional variance (*equidispersion*) (Winkelmann and Zimmermann 1995). In applied research, this assumption is frequently violated. Table 2 reveals that this is also true in our case: the variance of *Number Subsidiaries* clearly exceeds its mean, revealing that our data are overdispersed. Further formal tests to reinsure descriptive examination likewise reject the null hypothesis of equidispersion.[30] *Number Cons. Subsidiaries* and *Number Subsidiaries (all)* that we use as alternative dependent count variables are overdispersed, as well. Hence, the Poisson model is not appropriate in our application.

Next, we take the negative binomial model into consideration, since it is more flexible than the Poisson model. In the negative binomial model, the conditional variance is specified differently and, thus, it allows for overdispersion. Specification tests that compare different model-fits confirm that the negative binomial model is more suitable for our data.[31] Therefore, we employ the negative binomial model as the preferred specification in our empirical estimations. Precisely, we apply the negative binomial model of type two that allows for overdispersion (Cameron and Trivedi 1998).[32]

Furthermore, we account for the fact that zero is a frequent observation for *Number Subsidiaries*. A zero-inflated negative binomial model is able to handle the large number of zeros. A Vuong test reveals that the zero-inflated negative binomial model should indeed be preferred over the negative binomial model.[33] Therefore, we apply it as our preferred model (Cameron and Trivedi 2010).

[30] The likelihood-ratio test of the overdispersion parameter (alpha) in the zero-inflated negative binomial model reveals that it is significantly different from zero and therefore, that data are overdispersed. Furthermore, the Chi square test of a Poisson model rejects the hypothesis that it fits well at the one percent level.

[31] Likelihood-ratio tests of the overdispersion parameters (alpha) reveal that it is significantly different from zero at the one percent level. Therefore, the negative binomial model is preferred over the Poisson model.

[32] Becker et al. (2012) and Overesch and Wamser (2009) also opt for this version of the negative binomial model.

[33] The Vuong test statistic ($z = 21.13$) based on our main model specification is significant at the one percent level.

Moreover, we use OLS estimation in our robustness checks if the dependent variable is not a count variable (such as *Number Subsidiaries (relative), Number Subsidiaries Change* and *Equity*).

3.3.2 Regression equation

Apart from the tax variables, we include several country-level control variables to model the location decisions of multinational enterprises. Our identification strategy resembles the setup of related studies (foremost Overesch and Wamser 2009), to which we compare our results in Sects. 4 and 5. Applying count data models, we estimate the following regression (with host country i, parent company j and year t):

$$\begin{aligned} NumberSubsidiaries_{ijt} = {} & \alpha_0 + \beta_z TaxVariable_{zit} + \beta_{GDP} GDP_{it} + \beta_{Sim} Similarity_{it} \\ & + \beta_{Dist} Distance_{it} + \beta_{Adj} Adjacency_{it} + \beta_{ROL} RuleofLaw_{it} \\ & + \beta_{VA} Voice\&Accountability_{it} + \alpha_{jt} + \varepsilon_{ijt} \end{aligned} \quad (1)$$

As non-tax parameters that may affect the location decision and, hence, the number of subsidiaries, we take account of *GDP*, *Similarity*, *Distance*, *Adjacency*, *Rule of Law*, and *Voice & Accountability*. All country-level control variables are measured on an annual basis. Moreover, we include parent-year fixed effects (α_{jt}) to control for exogenous firm-year characteristics. However, in alternative specifications, parent and year fixed effects are incorporated separately. The error term is denoted with ε_{ijt}.

Our independent variables of interest are the individual tax variables and the *Tax Attractiveness Index* in the aggregate regression. In the disaggregate regression, we exclude the tax variables quantifying withholding taxes on royalties paid to a German parent, loss carry back amount limitations, and the control variable *Rule of Law* due to multicollinearity with the remaining variables. All three mentioned variables have variance inflation factors greater than five.

The higher the score of each tax variable, the more attractive is the tax environment offered by a host country. Therefore, we expect the tax variables to have a positive effect on the location decisions of multinational enterprises and, thus, we expect their coefficients to be positively associated with *Number Subsidiaries*. Over our sample period of 5 years, the individual tax variables and the *Tax Attractiveness Index* show a relatively low within-country variation over time when compared to the cross-country variation.[34] Hence, the identification strategy relies on the latter. For this reason, we pool the data over time, which provides us with a pooled cross-sectional dataset. Accordingly, we refrain from using panel data models, but we apply pooled estimation techniques. However, as a consequence, standard errors may be correlated over time on a within-country basis. To prevent standard errors from being biased, we take two different measures: first,

[34] The within-country variance of the *Tax Attractiveness Index* (0.025) is substantially lower than the between-country variance (0.145). We would expect to see more variables to show significant effects if a longer time horizon is observed over which the tax variables exhibit more variation.

we include parent-year fixed effects to control for special time effects. Second, we cluster the standard errors by country.[35]

In accordance with the existing literature on the determinants of the location decision, we take *GDP* as a first control variable (Buettner and Ruf 2007; Overesch and Wamser 2009, 2010). *GDP* captures the size of the host market and, therefore, we expect it to be positively related to *Number Subsidiaries* (Haufler and Wooton 1999). *GDP* is defined as the natural logarithm of host country *i*'s gross domestic product measured in constant U.S. dollars, based on the year 2000. Second, we include *Similarity* as a proxy for similarity in the endowment with skills and human capital. *Similarity* is an index expressing the difference between Germany's GDP per capita and the GDP per capita of the host country (Buch et al. 2005).[36] It is based on the assumption that a higher GDP represents higher productivity. However, recent literature suggests using measures, such as school enrollment, that reflect the endowment with skilled labor more explicitly (Carr et al. 2001; Overesch and Wamser 2009). Barrios et al. (2012) apply the logarithm of labor costs. However, data coverage for most of the 97 sample countries is poor. This is why we rely on the *Similarity* index. *Similarity* ranges between zero and one, with high values indicating that countries are more similar. Expectations regarding the sign of *Similarity* are ambiguous (Barrios et al. 2012). If market access motives dominate (horizontal model), enterprises are more likely to establish subsidiaries in countries that are similar (Markusen 1984, 2002). This would lead to an expectation of a positive coefficient for *Similarity*. In contrast, if production cost-saving motives dominate (vertical model), companies set up affiliates in countries which are dissimilar in their endowment with human capital and skilled labor (Helpman 1984, 1985). This constitutes an argument for a negative association between *Similarity* and *Number Subsidiaries*.

Next, we control for the geographic distance between Germany and the respective host country.[37] Primarily, geographic distance is regarded as a proxy for transportation costs. Moreover, it may capture cultural distance and, therefore, reflect communication and information costs incurred due to language barriers and differing business practices (Carr et al. 2001; Buch et al. 2005; Overesch and Wamser 2009). Thus, geographic distance should have a negative effect on the location decisions of multinational enterprises. We apply two different measures for geographic distance: first, we use *Distance*, defined as the distance between Germany's main agglomeration and the main agglomeration of host country *i*, weighted by the share of the agglomeration in the overall country's population, respectively, provided by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (Mayer and Zignago 2011). Second, we include a dummy

[35] The clustering by country-year results in lower standard errors. To apply the most conservative specification, we therefore cluster standard errors by country. Moreover, standard errors allow for heteroskedasticity.

[36] The corresponding formula can be written as: 1-(abs[$GDP\ per\ capita_{it} - GDP\ per\ capita\ DEU_t$]/max[$GDP\ per\ capita_{it}$, $GDP\ per\ capita\ DEU_t$]) (Buch et al. 2005). *GDP per capita* is measured in constant U.S. dollars based on the year 2000, respectively.

[37] This is in line with the gravity approach that explains international activity by a combination of mass variables (e.g., GDP and population) and distance variables (Bellak et al. 2009).

variable, obtaining a value of one if host country *i* shares a border with Germany (*Adjacency*) (Barrios et al. 2012). While we anticipate a negative coefficient for *Distance*, we expect *Adjacency* to have a positive sign.

Finally, we control for the perceptions of governance in respective host countries using the *World Governance Indicators* developed by Kaufmann et al. (2010). The authors differentiate six dimensions of governance. We opt for including *Rule of Law* and *Voice & Accountability*.[38] *Rule of Law* reflects the level to which negotiators have confidence in, and adhere to the rules of society. It captures particularly the quality of contract enforcement, property rights, the police, as well as the probability of crime and violence in host country *i*. *Voice & Accountability* indicates the degree to which citizens of host country *i* are given the possibility to elect their government. In addition, it represents the extent to which the freedom of expression, the freedom of association, and a free media are established. Both governance indicators may range between −2.5 and 2.5. The higher the score, the better is the perception of governance. Hence, we expect both variables to be positively related with *Number Subsidiaries*. "Appendix 1" provides detailed descriptions of the independent variables used in this study, as well as the corresponding data sources. Table 1 summarizes descriptive statistics for all country-level parameters. In the Appendix, Table 10 presents a correlation matrix for all independent variables applied in this study.

4 Results

4.1 Graphical evaluation

As a first step, we graphically analyze the location of German-controlled subsidiaries. Figure 2 presents an impression of where parent countries included in our sample place their affiliates. The abscissa indicates the *Tax Attractiveness Index (TAX)* value for all 97 sample countries. On the ordinate, the yearly average of *Number Subsidiaries (all)*, defined as the number of affiliates that all sample parent companies together operate in year *t* in host country *i,* is plotted.

The United States and Great Britain host the highest numbers of subsidiaries. From Fig. 2, it is not possible to deduce motives for the location decisions. However, the increased numbers of affiliates in both countries might be explained by the close relationship and the intense trade connections existing with Germany. The United States and Great Britain are large economies that form important markets for German companies. With regard to the tax environment as expressed by the *Tax Attractiveness Index*, Great Britain has a relatively high score (on average 0.635), while tax conditions in the United States are weak (on average 0.405). The third highest number of German-controlled subsidiaries is located in the Netherlands. Although the Netherlands is a neighboring country, this is a somewhat surprising result since the Dutch economy is not among the largest in Europe. The Netherlands, however, offer a very attractive tax environment as indicated by an index value of

[38] Since the parameters are highly correlated with each other, we are not able to include all six indicators.

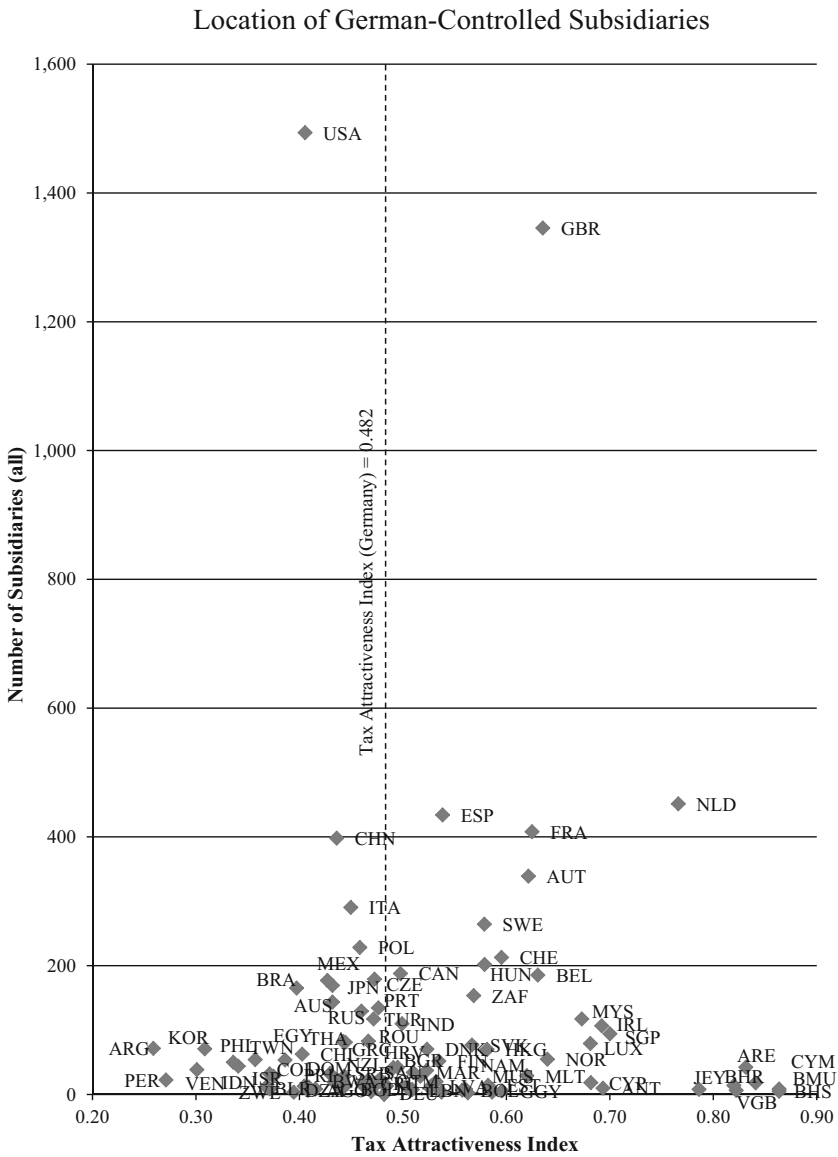

Fig. 2 Exhibits where German-controlled subsidiaries are located. The abscissa is defined by the *Tax Attractiveness Index (TAX)*, an equally weighted sum of 22 tax variables. For Germany, *TAX* consists of 19 components excluding withholding tax rates to Germany on dividends, interest, and royalties. On the ordinate, the average of *Number Subsidiaries (all)* over years 2005–2009 is plotted. *Number Subsidiaries (all)* is defined as the number of affiliates that all sample parent companies together operate in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009. The subsidiaries are situated in 97 different host countries

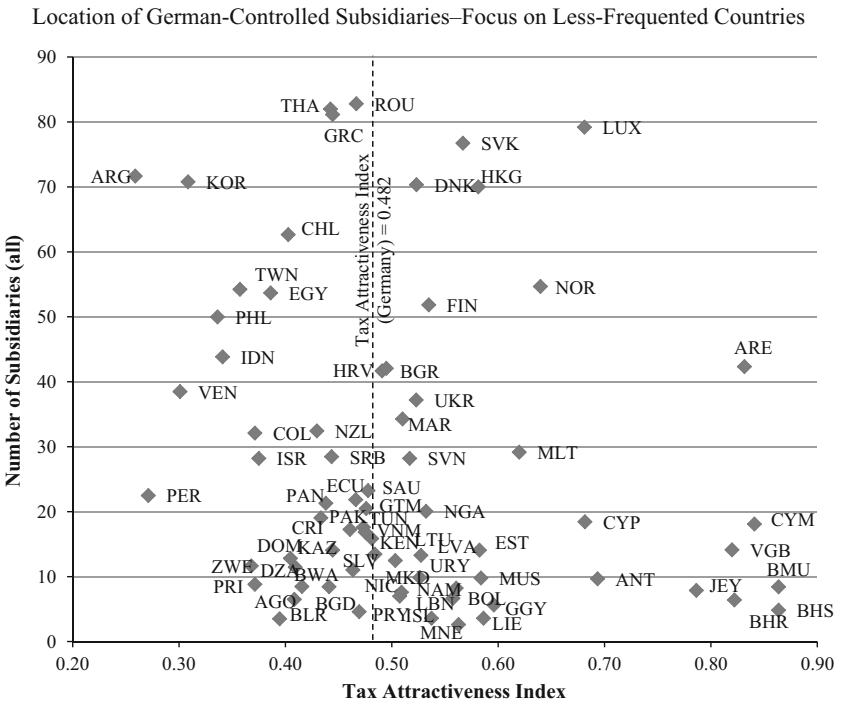

Fig. 3 Exhibits where German-controlled subsidiaries are located. The abscissa is defined by the *Tax Attractiveness Index (TAX)*, an equally weighted sum of 22 tax variables. For Germany, *TAX* consists of 19 components excluding withholding tax rates to Germany on dividends, interest, and royalties. Only countries for which *Number Subsidiaries (all)* is lower than 85 are displayed. On the ordinate, the average of *Number Subsidiaries (all)* over the years 2005–2009 is plotted. *Number Subsidiaries (all)* is defined as the number of affiliates that all sample parent companies together operate in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009

0.766 on average, which is considerably above the value for Germany (0.482).[39] Consistent with previous studies that have identified the Netherlands as an important holding location (Mintz and Weichenrieder 2010), there is reason to assume that some German-controlled subsidiaries located there do not serve operative purposes, but are established mainly for tax motives. Furthermore, a considerable number of German-controlled subsidiaries are located in Austria, Switzerland and Belgium, respectively. Since all countries provide favorable tax conditions (index values of on average 0.621, 0.595 and 0.630, respectively), taxation might play a role in locating large numbers of subsidiaries in these countries.

Figure 3 focuses on countries hosting, on average, less than 85 German-controlled subsidiaries per year. In this way, it yields a deeper look into the cloud depicted at the bottom of Fig. 2.

[39] Note that the *Tax Attractiveness Index* value for Germany excludes the withholding tax rates on dividends, interest, and royalties paid to a German parent. Therefore, comparisons of this value with other countries are only approximations.

Figure 3 reveals that German multinational enterprises operate subsidiaries in classical off-shore tax havens. Affiliates are located in countries, such as Bermuda, the Bahamas, the Cayman Islands, and the Netherlands Antilles. Due to the fact that these economies are very small, there is hardly any operative reason to establish subsidiaries there. The same is true for highly tax attractive European countries, such as Luxembourg, Liechtenstein, Malta, Cyprus, and Guernsey. Although absolute figures are low, the mere fact that German multinational enterprises establish subsidiaries in these countries may serve as an indication for tax planning and the existence of tax-optimized group structures. Hence, we can conclude that tax havens play a role in the location decisions of German multinational firms.

4.2 Regression results

Table 3 presents results for our regression as specified in Eq. (1). We apply pooled cross-sectional data. Specifications (1) and (2) include the individual tax variables, while specification (3) contains the *Tax Attractiveness Index (TAX)* and specification (4) uses the four most influential individual tax variables *(TAX_sig)*. Results for specifications (1), (3) and (4) stem from a zero-inflated negative binomial model, while specification (2) applies a simple negative binomial model.

Results for specifications (1) and (2) reveal that the statutory tax rate, withholding tax rates on interest paid to a German parent, the treaty network, and special holding incentives are the tax characteristics that have the greatest influence on subsidiary location decisions. Regarding the significant effect of the statutory tax rate, and the insignificant effect of depreciation rules, our results confirm the findings of Overesch and Wamser (2009). For a number of other tax variables (e.g., thin capitalization rules, loss carryforward rules, or withholding taxes on dividends), we do not find a significant result—or significant results in single years only, which confirms the mixed results in prior literature (Barclay and Smith 1995; Antoniou et al. 2008; Overesch and Wamser 2009, 2010; Alberternst and Sureth 2015). Results from specifications (3) and (4) indicate that the *Tax Attractiveness Index (TAX)* and *TAX_sig* play a significant role in determining the number of German-controlled subsidiaries in a particular country. Both indices are significantly positively associated with *Number Subsidiaries* in all specifications, which is in line with our hypothesis. This result also provides evidence that the choice of the weighting scheme in the index construction does not change results materially. Even the reduced *TAX_sig* with four variables proves to be significant, which raises the question whether the other 18 Tax Attractiveness Index components are relevant for this specific type of location question. However, based on the data set at hand which shows little variance of most tax factors during the short 5-year-time-period, we cannot conclude that the other factors are *not* relevant. Observing tax systems over a longer time horizon would likely introduce such variance and help to answer this question.

Regarding the economic interpretation and the magnitude of the effects observed, we focus on the zero-inflated negative binomial model for the individual tax variables and the *Tax Attractiveness Index (TAX)* (specifications 1 and 3). Coefficients can be interpreted as semi-elasticities. However, this direct

Table 3 Tax attractiveness and the location of subsidiaries—main results

	Exp. sign	Zero-inflated (1)	Negative binomial (2)	Zero-inflated (3)	Zero-inflated (4)
TAX	+			2.343***	
TAX_sig	+				1.978***
Statutory tax rate	+	0.563*	0.658*		
Taxation of dividends	+	0.147	0.241**		
Taxation of capital gains	+	0.106	−0.034		
WHT no treaty dividends	+	0.344	0.397*		
WHT to GER dividends	+	0.019	0.073		
WHT no treaty interest	+	−0.134	−0.262		
WHT to GER interest	+	0.689**	0.863**		
WHT no treaty royalties	+	−0.118	0.058		
Loss carry back time	+	0.019	−0.050		
Loss carry forward time	+	0.160	0.187		
Loss carry forward amount	+	−0.226	−0.024		
Group relief	+	0.116	0.139		
Treaty network	+	0.595*	0.751**		
Thin capitalization rules	+	−0.080	−0.138		
CFC rules	+	0.075	0.064		
Anti-avoidance legislation	+	−0.003	−0.117		
Personal income tax rate	+	−0.509	−0.457		
Holding regime	+	0.281**	0.347***		
R&D incentives	+	0.206	0.239		
Depreciation	+	−0.175	−0.231		
GDP	+	0.558***	0.630***	0.639***	0.579***
Similarity	±	−0.879***	−1.086***	−0.910***	−0.705***
Distance	−	0.051	−0.011	−0.100*	0.010
Adjacency	+	0.204	0.287	0.113	0.241
Voice & accountability	+	0.225**	0.317***	0.281***	0.235***
Rule of law	+			0.027	0.048
Parent-year FE		Yes	Yes	Yes	Yes
Observations		13,360	13,360	13,360	13,360
Pseudo log likelihood		−20,687	−21,693	−21,038	−20,996

This table reports regression results for the location of German-controlled subsidiaries. The dependent variable is *Number Subsidiaries*, defined as the number of subsidiaries that parent company *j* operates in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009. The subsidiaries are situated in 97 different host countries. We apply pooled estimation techniques. In columns (1), (3) and (4), we use zero-inflated negative binomial models. In column (2), we apply a negative binomial model. Columns (1) and (2) show the results of disaggregate regressions testing the individual tax variables. In column (3), we use the aggregate *Tax Attractiveness Index (TAX)* consisting of 22 tax variables, and in column (4) we use the *TAX_sig* containing the four significant tax variables from column (1) weighted by their exponentiated coefficients as the tax variable of interest. Higher values for all tax variables indicate a favorable tax environment. The definitions of the tax variables can be found in Table 7 in the Appendix. *GDP* is the natural logarithm of host country *i*'s GDP in constant USD for the year 2000. *Similarity* is an index defined as one minus the ratio of the absolute value of host country *i*'s GDP per capita minus Germany's GDP per capita to the higher of both GDPs per capita (GDP per capita in constant USD for the year 2000, respectively). *Distance* is defined as the natural logarithm of the population-weighted great circle distance between the main agglomerations of Germany and host country *i*. *Adjacency* is a dummy variable obtaining the value of one if host country *i* shares a border with Germany. *Rule of Law* and *Voice & Accountability* represent governance indicators of host country *i*. They may range from −2.5 to 2.5. All country-level variables are measured on an annual basis (2005–2009). We use parent-year fixed effects in all specifications. Standard errors allow for heteroskedasticity and are clustered by country

***, **, * indicate statistical significance at the 1, 5, and 10 % level, respectively

interpretation is not useful in our setting, since a one-unit change in our tax variables cannot be defined. Thus, we make use of the exponentiated coefficients that can be given a multiplicative interpretation (Cameron and Trivedi 2010). Based on the results in specification (1), we can evaluate the economic impact of individual tax characteristics. As an example, countries with a 10 % point higher statutory tax rate[40] ceteris paribus host 15 % ($\exp^{0.250\times0.563}-1 = 0.151$) fewer subsidiaries. Similarly, a 10 % point higher withholding tax rate on interest paid to a German parent translates into 22 % fewer subsidiaries. 10 additionally signed double tax treaties are estimated to result in a 5 % higher number of subsidiaries. Finally, the introduction of special holding incentives is estimated to result in 33 % more subsidiaries. Based on the results shown in specification (3), we find that a one standard deviation increase in the *Tax Attractiveness Index* (about 0.128), which approximately equals the difference in index values between Great Britain (0.635) and the Netherlands (0.766), is associated with about 35 % more subsidiaries ($\exp^{0.128\times2.343}-1 = 0.350$). Evaluated at the mean of *Number Subsidiaries* (3.815), such an increase in the tax attractiveness represents more than one (1.334) additional subsidiary that a host country attracts from each parent company.

Put into a more concrete example, our results indicate: if a country with mediocre tax attractiveness, such as Canada, which ranks 48th with an average *Tax Attractiveness Index* value of 0.498, reformed its tax system by 0.200 index points to rank among the top 10 countries in our sample, it would host 60 % more subsidiaries ($\exp^{0.200\times2.343}-1 = 0.598$). Evaluated at the 2005–2009 average number of DAX30 group-owned subsidiaries in Canada (188), this reform translates into 112 additional subsidiaries. Given that the *Tax Attractiveness Index* incorporates several dimensions of the tax code, Canada could reach such an improvement in several ways. For example, if it reduced its statutory tax rate from 0.33 to 0.20, abolished CFC rules and thin capitalization rules, offered special holding incentives, offered a full participation exemption for capital gains and a national group taxation regime, it would theoretically join the top 10 tax systems worldwide. Given that the increase in subsidiaries is substantial if the tax attractiveness is improved, we can conclude that our results are not only statistically significant, but also have an economic impact.

Looking at our country-level control variables, the results in Table 3 show that *GDP* has a significant influence on the location of German-controlled subsidiaries. In line with our expectations and the findings of Overesch and Wamser (2009), the size of the host market is positively associated with *Number Subsidiaries*. Economically, the coefficient for *GDP* can be interpreted as follows: a one standard deviation change in *GDP*, which approximately represents the difference in *GDP* between Great Britain and Belgium, is related to about 12 additional affiliates (evaluated at the mean of *Number Subsidiaries:* ($\exp^{1.854\times0.558}-1$) $\times$ 3.815 = 11.614) according to specification (1). In accordance with Overesch and Wamser (2009), we find a significantly negative effect for *Similarity*, which is used as a proxy for differences in the endowment with skilled labor, in all four specifications. This allows the conclusion that cost-saving motives realized by differences in factor prices are relevant for

[40] A 10 % point higher statutory tax rate translates into a 0.250 index point lower value of the corresponding scaled tax variable (2009), which is used in our regressions.

location decisions as proposed by the vertical model. Moreover, our disaggregate analysis confirms the findings of previous studies revealing that *Distance* has a significantly negative impact on location decisions in specifications (3) (Buch et al. 2005; Hebous et al. 2011; Overesch and Wamser 2009). Unlike Overesch and Wamser (2009), we do not find a significant effect of *Adjacency,* which indicates whether the host country has a common border with Germany; however, the coefficient has the predicted sign. As expected, *Rule of Law* and *Voice & Accountability*, which serve as proxies for the perceptions of governance in the respective host country, are positively associated with the number of subsidiaries. However, only *Voice & Accountability* proves to be statistically significant.

Our results hold if alternative model specifications with separate parent fixed effects and year fixed effects are applied (tables not reported).

5 Robustness tests and further analyses

5.1 Robustness tests

In order to check for robustness of our results, we replace our main dependent variable of interest, *Number Subsidiaries,* with alternative variables. We first provide an analysis of *Number Subsidiaries (relative)*, which is defined as the number of subsidiaries that parent company j operates in year t in host country i divided by the total number of foreign subsidiaries that parent company j holds in year t. Hence, the dependent variable *Number Subsidiaries (relative)* abstracts from absolute numbers. In this way, we address the issue that the denominator representing the total number of affiliates that a certain parent company operates per year in foreign countries differs heavily across our sample. Observations range from around 20 to more than 1000, revealing that parent companies vary widely in their degree of internationalization. By using the share of affiliates in a certain host country instead of employing the absolute figure, cases in which *Number Subsidiaries* takes on small values may gain importance. Since *Number Subsidiaries (relative)* is not a count variable, we apply OLS estimation. Results are presented in columns (1), (2) and (3) of Table 4.

In the disaggregate regression of specification (1), loss carry back time restrictions, group relief provisions, and special holding incentives exhibit a significant coefficient. The significant influence of the statutory tax rate, withholding taxes on interest paid to a German parent and the treaty network, however, disappears. Consistent with our main results, we find that the *Tax Attractiveness Index (TAX)* and the *TAX_sig* have a significantly positive effect on *Number Subsidiaries (relative)* in specifications (2) and (3).

Next, we apply the amount of equity that German multinational enterprises locate in foreign countries as a dependent variable. So far, we have treated large and small subsidiaries equally. *Equity* adds a size dimension to our dataset. A large strand of literature deals with the influence of taxation on corporate financing structures (Desai et al. 2004; Ramb and Weichenrieder 2005; Huizinga et al. 2008; Massbaum and Sureth 2009; Buettner et al. 2009). The rationale behind these studies is that, in

Table 4 Tax attractiveness and the location of subsidiaries—alternative dependent variables

	Exp. sign	Number subsidiaries (relative)			Equity		
		(1)	(2)	(3)	(4)	(5)	(6)
TAX	+		0.025***			2.495***	
TAX_sig	+			0.022***			2.316***
Statutory tax rate	+	−0.011			−0.509		
Tax. of Div.	+	−0.002			0.150		
Tax. of Cap. gains	+	0.004			0.157		
WHT No Treaty Div.	+	0.007			0.445		
WHT To GER Div.	+	−0.003			−0.244		
WHT No Treaty Int.	+	−0.007			−0.430		
WHT To GER Int.	+	0.015			0.911*		
WHT No Treaty Roy.	+	−0.001			0.186		
LCB Time	+	0.012**			0.453		
LCF Time	+	−0.002			−0.191		
LCF amount	+	−0.002			−0.211		
Group relief	+	0.007*			0.426*		
Treaty network	+	0.003			0.717		
Thin Cap. rules	+	−0.003			−0.215		
CFC rules	+	−0.001			−0.053		
Anti-avoid. Legisl.	+	0.004			0.165		
Pers. Income TR	+	0.003			0.129		
Holding regime	+	0.004***			0.493***		
R&D incentives	+	−0.002			0.301		
Depreciation	+	−0.006			−0.299		
GDP	+	0.004**	0.005***	0.005***	0.464***	0.620***	0.559***
Similarity	±	−0.009	−0.007	−0.005	−0.543	−0.450	−0.271
Distance	−	0.000	−0.001	0.000	−0.042	−0.182***	−0.037
Adjacency	+	−0.001	−0.002	0.000	0.718**	0.690**	0.826**

Table 4 continued

	Exp. sign	Number subsidiaries (relative)			Equity		
		(1)	(2)	(3)	(4)	(5)	(6)
Voice & Account.	+	0.003	0.003*	0.002*	0.276***	0.461***	0.422***
Rule of Law	+		0.000	0.001		−0.149	−0.147
Parent-Year FE		Yes	Yes	Yes	Yes	Yes	Yes
Observations		13,360	13,360	13,360	13,230	13,230	13,230
R^2		0.30	0.23	0.24	0.47	0.45	0.45

This table reports regression results for the location of German-controlled subsidiaries. As dependent variable, we use *Number Subsidiaries (relative)*, defined as the number of subsidiaries that parent company *j* operates in year *t* in host country *i* divided by the total number of foreign subsidiaries that parent company *j* holds in year *t*. *Equity* is the natural logarithm of one plus the sum of equity (in current € millions) that parent company *j* holds in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) in 97 different countries over years 2005–2009. In all columns, we run a pooled OLS model. In the disaggregate specifications (1) and (4), we test the individual tax variables. In the aggregate specifications (2) and (5), we use the *Tax Attractiveness Index (TAX)* consisting of 22 tax components as our main variable of interest. In specifications (3) and (6), we use *TAX_sig*, consisting of the 4 tax variables significant in specification (1) of Table 3. All tax variables are restricted to values between zero (unattractive) and one (attractive). Furthermore, we include control variables: *GDP* is the natural logarithm of host country *i*'s GDP in constant USD; *Similarity* is an index defined as one minus the ratio of the absolute value of host country *i*'s GDP per capita minus Germany's GDP per capita to the higher of both GDPs per capita; *Distance* is defined as the natural logarithm of the population-weighted great circle distance between main agglomerations of Germany and host country *i*; *Adjacency* is a dummy variable obtaining the value of one if host country *i* shares a border with Germany; *Rule of Law* and *Voice & Accountability* represent governance indicators of host country *i*. They may range from −2.5 to 2.5. In all columns, we use parent-year fixed effects. Standard errors allow for heteroskedasticity and are clustered by country

***, **, * indicate statistical significance at the 1, 5, and 10 % level, respectively

most countries, interest expenses are deductible for corporate tax purposes, while dividends have to be paid out of profits after tax. Hence, there is a general incentive to prefer debt financing over equity financing, even for national companies.[41] Empirically, results with regard to the direction of impact of taxes on the capital structure of individual companies are mixed (Barclay and Smith 1995; Graham 1996; Antoniou et al. 2008; Huang and Ritter 2009; Massbaum et al. 2012; Alberternst and Sureth 2015). Multinational enterprises, however, have the opportunity to allocate their debts across countries in the most efficient way by means of internal financing strategies. The deductibility of interest expenses is perceived to be most valuable in high-tax countries. From a multinational's perspective, it is therefore advantageous to equip subsidiaries in low tax locations with equity.[42] Hence, we expect the individual tax variables and the *Tax*

[41] To prevent the extensive use of debt financing, some countries enforce thin capitalization rules.

[42] Mintz (2004) suggests that financial structures involving an intermediate entity in a low-tax country are used to achieve a double dip of interest deductions. In such cases, the parent company borrows capital and passes it on to the intermediate company in the form of equity. The intermediate company, in turn, lends the capital to another subsidiary located in a high-tax country. Hence, interest can be deducted twice, once at the level of the high-tax affiliate and again at the level of the parent company. Interest is taxed at the level of the intermediate group unit. The overall group tax burden can be decreased if the

Attractiveness Index to be positively associated with the amount of equity in a particular location. However, this prediction is not straightforward, since the statutory tax rate alone seems to be the decisive tax parameter for financing structures, and some countries have high index values while, at the same time, levying high statutory tax rates. Nevertheless, there are other tax factors that might incentivize companies to place large amounts of equity in certain countries, such as a notional interest deduction or a preferential tax treatment of interest income.[43] These special regimes can be found in countries that offer an attractive tax environment. Hence, we expect the individual tax variables and the *Tax Attractiveness Index* to have a positive effect on the amount of equity. We use *Equity*, defined as the natural logarithm of the sum of equity (in € millions) that parent company *j* holds in year *t* in host country *i* (weighted by the respective share in equity).[44] For the disaggregate regressions shown in specification (4) of Table 4, we find that withholding tax rates on interest paid to a German parent, group relief provisions, and holding incentives impact the amount of equity allocated to a country. We find that the coefficient for the *Tax Attractiveness Index (TAX)* and *TAX_sig* are significantly positive in specifications (5) and (6), revealing that a host country's tax environment has a positive effect on the amount of equity that German multinational enterprises allocate there.

Next, we use *Number Subsidiaries (all)* as an alternative dependent variable. It specifies how many affiliates all parent companies together operate in year *t* in host country *i*. Since we refrain from considering each parent country separately, this enables us to analyze the location decisions of German multinational enterprises in aggregated form (see Figs. 2 and 3). We run a negative binomial model and find that our results hold (not reported).[45] In the disaggregate regression, we find a significantly positive coefficient for withholding taxes on interest paid to a German parent, the treaty network, and special holding incentives in accordance with our main results. While the coefficients of the statutory tax rate lose their significance, loss carry forward time restrictions now exhibit a significantly positive influence on *Number Subsidiaries (all)*. The significantly negative coefficient of the personal income tax rate, however, does not correspond to expectations. Taking an aggregated view, the *Tax Attractiveness Index (TAX)* and *TAX_sig* still have a significant impact on the number of subsidiaries and, thus, on the location decisions of German multinational enterprises. All coefficients for the control variables show the same signs as in our initial regression. Significance levels also correspond to those depicted in Table 3.

Footnote 42 continued
local tax rate of the interposed company is comparably low or if interest income is subject to a reduced tax rate.

[43] A notional interest deduction applies, for instance, in Belgium. It allows the deduction of a fictitious interest on equity.

[44] Before calculating the natural logarithm, we add € 1 to the sum in order not to drop observations with € 0 equity.

[45] Zero is not a frequent observation for *Number Subsidiaries (all)*. Therefore, we refrain from using a zero-inflated negative binomial model.

Moreover, we check whether the scaling of our tax rate and treaty network variable changes results (not reported). We use the tax rates as stated in tax law and use the count of the double tax treaties, because these values can quite easily be transformed into un-scaled variables. As expected, the sign of the statutory tax rate and withholding tax rate variable now is negative, i.e. lower tax rates imply a higher number of subsidiaries. The treaty network and holding regime keep their significant positive coefficients. Significance of the results remains unchanged for all variables. We can conclude that our results are robust against the scaling methodology of our variables. Apart from these eight variables which are un-scaled in this robustness-check, there are several other tax factors which we cannot transform into un-scaled, unrestricted or even continuous variables. We can only assess possible consequences of these model restrictions: Transforming tax law (e.g., thin capitalization rules, anti-avoidance legislation) into categorical values reduces variance of the tax variables between countries and also over time. If the hypothesized relationship between these tax aspects and subsidiary location decisions exists, we would expect results to be even more distinct if other, more detailed tax variables were built. When looking at the one-year-change in the number of subsidiaries (*Number Subsidiaries Change*) instead of their absolute number, we find that the treaty network and holding regimes exert a significant influence [Table 11, specification (1)]. The significantly negative coefficients of the variables for withholding tax rates on dividends paid to a German parent and loss carry forward time restrictions, however, do not correspond to expectations. Surprisingly, the influence of the statutory tax rate is not significant. In specifications (2) and (3), the *Tax Attractiveness Index (TAX)* and *TAX_sig*, are found to positively influence the change in the number of subsidiaries.

Furthermore, we find that restricting our sample to fully consolidated subsidiaries only or removing outliers in the dependent variable does not change the results materially[46] (results not reported).

5.2 Test of alternative weights for the tax attractiveness index

The *Tax Attractiveness Index* is part of a growing family of composite indices from various fields, such as accounting, gender studies, or overall economic situations. One often cited critique of these indices is that their construction involves several subjective decisions (Booysen 2002). The weighting of the individual components represents one of these decisions. The *Tax Attractiveness Index* assigns equal weights to its 22 components. The almost identical results of the *Tax Attractiveness Index* and *TAX_sig* in our empirical analysis already give a hint that the weighting scheme does not matter that much. In order to further check for robustness, we

[46] When running regressions for each year separately, our results for the aggregate regression hold. When including the individual tax variables separately, our model does not converge for the year 2007. When looking at the remaining years, we find significant evidence for the four tax variables that show significant coefficients in the main regression (Table 3) in single years. In addition, we find significantly positive coefficients for withholding tax rates on dividends (no treaty), group relief provisions, as well as (unexpected) significantly negative coefficients for thin capitalization rules, the personal income tax rate and loss carry forward amount limitations in single years (results not reported).

derive four other indices besides *TAX_sig* using alternative weights from factor analysis and the results from count-data location regressions. We then compare the resulting indices to our original, equally weighted index.

First, we build an alternative index (*TAX_sig_EW*) that equally weights the four tax variables (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives), that exhibit significant coefficients in our main analysis (Table 3).[47]

Second, we conduct a factor analysis. In order to find weights based on factor analysis, we conduct a standard principal component analysis. Applying the Kaiser criterion, we retain seven factors that have eigenvalues of greater than one. These seven factors combined explain 72 % of the total variance of all 22 components. In the next step, we varimax-rotate these factors and weight them by their eigenvalues in order to recombine them to an index (*TAX_FA*).

Furthermore, we generate index weights based on the regression results shown in specifications (3) and (4) of Table 3. For each of the two models, we generate an index (*TAX_ZINB* and *TAX_NB*) by assigning weights to each of the included 20 components[48] based on their exponentiated regression coefficients divided by the sum of the exponentiated coefficients of all 20 components.

Table 5 shows the Pearson correlations of the five alternative indices with the original, equally weighted *Tax Attractiveness Index*. With correlations of >0.70, all indices are highly correlated with the original, equally weighted *Tax Attractiveness Index*. The indices based on factor analysis and the regression analysis even exhibit correlation coefficients >0.92. Furthermore, we rerun the analysis presented in this paper with the new indices. The result is that the outcomes do not materially change (not reported). This finding is supported by Permanyer (2011), who reports that popular composite indices, such as the Human Development Index (HDI), the Gender-related Development Index (GDI) and the Human Poverty Index (HPI), are robust against the choice of the weighting scheme.[49] Slottje (1991) and McGranahan (1995) obtain the same result for their self-created indices. We can conclude that the *Tax Attractiveness Index* is fairly stable when subject to a change in the weighting method. We therefore suggest sticking to the equal-weighting method.

5.3 Comparison of the tax attractiveness index and the effective tax rate

In Sect. 2, we have discussed effective tax rates as an aggregate measure of tax attractiveness that has been applied in several empirical studies. Endres et al. (2014) calculate effective tax rates for a sample of 35 countries (32 European countries, Canada, Japan, and the United States) based on the methodology of Devereux and

[47] The correlation between TAX_sig_EW and TAX_sig is 0.99. Regression results for TAX_sig_EW are almost identical to those for TAX_sig.

[48] As indicated in the previous section, we use all components of the *Tax Attractiveness Index* except for w*ithholding taxes on royalties paid to a German parent* and *loss carry back amount limitations* due to multicollinearity concerns. *Rule of Law*, the other factor excluded from the regression, is not part of the index.

[49] Permanyer (2011) also finds two indices, the Gender Empowerment Measure (GEM) and the Gender Relative Status (GRS), which are not fully robust against the choice of alternating weighting schemes.

Table 5 Correlations of indices with alternative weights

Tax attractiveness index	Equally-weighted (original)
(1) TAX_sig	0.704
(2) TAX_sig_EW	0.703
(3) TAX_FA	0.927
(4) TAX_ZINB	0.985
(5) TAX_NB	0.990

This table reports correlation coefficients for five versions of the *Tax Attractiveness Index* with the original equally-weighted index version. *TAX_sig* is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model. *TAX_sig_EW* is the equally weighted aggregate index of the four tax variables that turn out to be statistically significant. *TAX_FA* is an index resulting from the seven factors derived by principal component analysis. The seven factors are weighted by their eigenvalues. *TAX_ZINB* and *TAX_NB* are indices consisting of the 20 *Tax Attractiveness* components excluding withholding taxes on interest paid to a German parent and loss carry back time restrictions. The weights for these components are derived from the coefficients of the location regressions reported in Table 3, in which the exponentiated coefficient of a component is divided by the sum of all components' exponentiated coefficients. The index values are calculated on an annual basis (2005–2009) for each country separately

Griffith (2003).[50] The tax characteristics that they incorporate in their measure include corporate statutory tax rates, corporate property tax rates (e.g., on real estate), the tax accounting rules for inventories, and depreciation rates/methods. In order to benchmark the *Tax Attractiveness Index (TAX)* and *TAX_sig*, we rerun our regression for this sample employing the index and the effective average tax rates as regressors. Since effective average tax rates are scaled in resemblance of statutory tax rates, a lower effective tax rate indicates higher tax attractiveness. We therefore expect a negative association between this measure and the number of subsidiaries.

Results as shown in specifications (1) and (2) of Table 6 indicate that the *Tax Attractiveness Index (TAX) and TAX_sig* still have a significantly positive impact in this reduced sample. However, unlike Overesch and Wamser (2009, 2010),[51] we do not find a significant impact of the effective tax rate. This result resembles the finding by Buettner and Ruf (2007) who find a weaker explanatory power of the effective average tax rate compared to the statutory tax rate. The different results with regard to effective tax rates can potentially be explained by the different samples used. Overesch and Wamser (2009, 2010) employ a sample of subsidiaries owned by a broad set of German parents and whose balance sheet total exceeds € three million, while our hand-collected sample focuses on the largest German multinationals and also includes smaller subsidiaries.[52] The effective tax rate data mainly incorporate tax characteristics (e.g., depreciation) that are particularly relevant for companies involved in real economic activity (e.g. manufacturing). As

[50] We use the mean effective average tax rates at the corporate level shown in section C of Endres et al. (2014).

[51] Overesch and Wamser (2009, 2010) calculate effective tax rates based on a methodology similar to Endres et al. (2014); therefore, we can compare our results to theirs.

[52] Furthermore, Overesch and Wamser (2010) can distinguish between industries and types of FDI which is not possible with our data at hand.

Table 6 Tax attractiveness Index and the effective average tax rate

	Exp. sign	Zero-inflated (1)	Zero-inflated (2)	Zero-inflated (3)
TAX	+	2.662**		
TAX_sig	+		2.189**	
Effective average tax rate	–			−0.224
GDP	+	0.659***	0.573***	0.614***
Similarity	±	−1.088**	−0.802*	−0.726*
Distance	−	−0.249	−0.154	−0.428***
Adjacency	+	−0.091	−0.066	−0.243
Voice & accountability	+	0.314	0.243	0.142
Rule of law	+	0.062	0.208	0.308
Parent-year FE		Yes	Yes	Yes
Observations		4278	4278	4278
Pseudo log likelihood		−9769	−9725	−9792

This table reports regression results for the location of German-controlled subsidiaries. As dependent variable, we use *Number Subsidiaries*, defined as the number of subsidiaries that parent company *j* operates in year *t* in host country *i*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) in 35 different countries over years 2005–2009. In all columns, we run a pooled zero-inflated negative binomial model. In specification (1), we use the *Tax Attractiveness Index (TAX)* consisting of 22 tax variables as our main variable of interest. *TAX_sig* in specification (2) is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model. Both tax variables are restricted to values between zero (unattractive) and one (attractive). In specification (3), we use the *Effective Average Tax Rate*. Furthermore, we include control variables: *GDP* is the natural logarithm of host country *i*'s GDP in constant USD; *Similarity* is an index defined as one minus the ratio of the absolute value of host country *i*'s GDP per capita minus Germany's GDP per capita to the higher of both GDPs per capita; *Distance* is defined as the natural logarithm of the population-weighted great circle distance between the main agglomerations of Germany and host country *i*; *Adjacency* is a dummy variable obtaining the value of one if host country *i* shares a border with Germany; *Rule of Law* and *Voice & Accountability* represent governance indicators of host country *i*. They may range from −2.5 to 2.5. In all columns, we use parent-year fixed effects. Standard errors allow for heteroskedasticity and are clustered by country

***, **, * indicate statistical significance at 1, 5, and 10 % level, respectively

Overesch and Wamser (2009, 2010) show, these characteristics play a role for large subsidiaries. Furthermore, the smaller multinationals, which they include in their sample, but we do not, might not be engaged in sophisticated tax planning strategies and therefore focus on the above mentioned basic tax characteristics. As our research only covers large multinationals, we cannot draw conclusions about transferability of our results to smaller companies which might apply simpler tax planning techniques. Our results indicate that tax characteristics (e.g., holding incentives) relevant for subsidiaries involved in passive activities play a role when all subsidiaries, including the small ones (e.g. holdings), of large multinationals are considered. The model fit, as indicated by a lower Akaike's information criterion (AIC) of specification (1) compared to specification (3),[53] is also better for the

[53] The AIC assumes a value of 19,611 for specification (1) and 19,647 for specification (2).

model involving the *Tax Attractiveness Index*. We therefore conclude that the *Tax Attractiveness Index* has better explanatory power than the effective tax rate for subsidiary location decisions of German multinationals.

6 Conclusion and limitations

This paper analyzes whether taxation has an influence on the location decisions of multinational enterprises and which characteristics of the tax system are most relevant to that decision. In contrast to previous studies, we employ a very broad set of tax measures available across a wide variety of jurisdictions. Additionally, we apply a novel aggregate indicator, the *Tax Attractiveness Index* (Keller and Schanz 2013). Capturing 22 different tax factors, the index aims at providing a detailed picture of a country's tax conditions. Employing count data regression models, we find that a country's tax environment has a positive effect on the number of German-controlled subsidiaries and, therefore, on the location decisions of German multinational enterprises. Specifically, our analysis reveals that German multinational firms place affiliates in countries that offer favorable statutory tax rates, withholding taxes, double tax treaty networks, and holding incentives. For other aspects, such as the taxation of dividends and capital gains, the existence of a group taxation regime, or thin capitalization rules, we do not find strong evidence for their role in subsidiary location decisions.

The graphical evaluation of our data shows that German multinational firms operate affiliates in off-shore tax havens. Moreover, they hold an increased number of subsidiaries in countries with extremely attractive tax environments, such as the Netherlands, Belgium, Austria, and Switzerland. Hence, there is reason to assume that multinational firms implement indirect group structures by means of holding companies in third countries and by establishing profit-shifting entities in tax havens. Additionally, we show that the *Tax Attractiveness Index* has explanatory power in subsidiary location decisions, while we do not find a significant effect of *effective tax rates*.

However, our study suffers from several limitations, most of which are inherent in the dataset that we explore. First, the sample does not yield the linkage between the subsidiaries, making it impossible to explore corporate group structures. Therefore, we are not able to analyze whether the affiliates located in favorable tax locations do actually serve as intermediate entities. Moreover, due to the fact that we do not have balance sheet data (e.g., assets, property, plant, and equipment) or any further information (e.g., employees) about the subsidiaries, we are not able to identify the type of the respective group unit. Hence, it is impossible to identify whether a certain subsidiary serves predominantly operative purposes or is a pure holding or profit-shifting entity. From the (increased number of) subsidiaries that German multinational enterprises locate in tax attractive countries, we can only assume that at least some of them are holdings or financial companies with little operative activities. Being able to identify the ownership chain and subsidiary type would enable the use of more tailored

[53] The AIC assumes a value of 19,611 for specification (1) and 19,647 for specification (2).

tax variables and likely result in larger effect sizes. Finally, the sample period that we have chosen does not cover an overall "event", such as a tax reform, making it impossible to conduct a "before and after analysis" in the form of, for example, a difference-in-difference approach. Therefore, we are not able to verify a causal link between the *Tax Attractiveness Index* and location decisions. Furthermore, the variance of some of our tax factors over the 5-year-time-period is limited, which impedes the identification of significant effects. Given both the geographic allocation of subsidiaries and tax legislation are long-term processes, a longer sample horizon would likely yield stronger results.

Nevertheless, our study has several implications. First, the finding of multinational enterprises taking various tax parameters into account when deciding where to locate their subsidiaries is important for governments and politicians. Policy makers might take this into consideration with respect to future tax reforms or the current struggle against the tax avoidance of large multinationals (OECD 2013). Second, researchers might be interested in learning that several tax factors besides the statutory tax rate explain location decisions. Thus, regarding the statutory tax rate as the only important tax signal for a country's attractiveness will not be sufficient in the future. Applying a broad measure, such as the *Tax Attractiveness Index*, in future analyses might help to reveal a more comprehensive picture of a country's tax environment. Moreover, our investigation reveals that German multinational enterprises place their subsidiaries in tax havens and other tax attractive countries, which supports the assertion that tax motivations, rather than production costs and market access alone, play a role in the location decisions of large multinationals.

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Appendix 1: Variable definitions

Tax Attractiveness Index	Index covering 22 different tax factors. For Germany, TAX consists of 19 components excluding withholding tax rates to Germany on dividends, interest, and royalties. The index represents host country *i*'s tax attractiveness and is constrained to values between zero and one. The more the index approaches one, the more attractive the tax environment that host country *i* offers. The index is measured on an annual basis (2005–2009). Data sources: the Global Corporate Tax Handbook and the European Tax Handbook published by the International Bureau of Fiscal Documentation (IBFD), PricewaterhouseCoopers' Corporate Taxes—Worldwide Summaries and Individual Taxes—Worldwide Summaries, Ernst & Young's Worldwide Corporate Tax Guide, Deloitte's Taxation and Investment Guides, KPMG's Corporate Tax Rate Survey and Individual Income Tax Rate Survey, and the OECD tax database

continued

GDP	Logarithm of host country *i*'s gross domestic product measured in constant U.S. dollars based on the year 2000. *GDP* is measured on an annual basis. Data sources: World Development Indicators of the World Bank. For Taiwan, we source data from the National Statistics of China (Taiwan) (http://eng.stat.gov.tw/) and the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. Taiwan (http://eng.dgbas.gov.tw/). For the Netherlands Antilles, we source data from the Central Bureau of Statistics Curaçao (http://www.cbs.cw/) and Statistics Netherlands (http://www.cbs.nl/). For the Cayman Islands, we source data from the Economics and Statistics Office, Government of the Cayman Islands (http://www.eso.ky/). For Guernsey, we source data from the States of Guernsey (http://www.gov.gg/)
Similarity	An index reflecting the difference between Germany's gross domestic product per capita and the gross domestic product per capita of host country *i*. The index is defined as one minus the ratio of the absolute value of host country *i*'s gross domestic product per capita minus Germany's gross domestic product per capita to the higher of both gross domestic products per capita. Gross domestic product per capita is measured in constant U.S. dollars based on the year 2000, respectively. The index uses values between one and zero; a higher score indicates that countries are more similar. *Similarity* is measured on an annual basis. Data source: World Development Indicators of the World Bank. For Taiwan, we source data from the National Statistics of China (Taiwan) (http://eng.stat.gov.tw/) and the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. Taiwan (http://eng.dgbas.gov.tw/). For the Netherlands Antilles, we source data from the Central Bureau of Statistics Curaçao (http://www.cbs.cw/) and Statistics Netherlands (http://www.cbs.nl/). For the Cayman Islands, we source data from the Economics and Statistics Office, Government of the Cayman Islands (http://www.eso.ky/). For Guernsey, we source data from the States of Guernsey (http://www.gov.gg/)
Distance	The great circle distance between Germany's main agglomeration and host country *i*'s main agglomeration, weighted by the share of the agglomeration in the overall country's population, respectively. Data source: Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). For Liechtenstein, we take the Swiss value (Zurich). For Montenegro, we take the Serbian value (Belgrade). For Guernsey, we take the value of Great Britain (London)
Adjacency	A dummy variable obtaining the value of one if host country *i* shares a border with Germany
Rule of Law	Reflecting the level to which negotiators have confidence in and adhere to the rules of society. It captures particularly the qualities of contract enforcement, property rights, the police, as well as the probability of crime and violence in host country *i*. *Rule of Law* may range between −2.5 and 2.5 and is measured on an annual basis. Data source: World Governance Indicators of the World Bank. For Guernsey, we take the value of Great Britain
Voice & Accountability	Indicating the degree to which citizens of host country *i* are given the possibility to elect their government. In addition, it represents the extent to which the freedom of expression, the freedom of association, and a free media are established in host country *i*. *Voice & Accountability* may range between −2.5 and 2.5, and is measured on an annual basis. Data source: World Governance Indicators of the World Bank. For Guernsey, we take the value of Great Britain

Appendix 2: Additional analysis

See Tables 7, 8, 9, 10 and 11.

Table 7 Measurement of tax variables

Tax factor	Measurement
(1) Statutory tax rate	(Max. tax rate$_t$−tax rate$_{it}$)/max. tax rate$_t$
(2) Taxation of dividends	Percentage of tax exemption
(3) Taxation of capital gains	Percentage of tax exemption
(4–6) Withholding tax rate no treaty (dividends, interest, royalties)	(Max. tax rate$_t$−tax rate$_{it}$)/max. tax rate$_t$
(7–9) Withholding tax rate to GER (dividends, interest, royalties)	(Max. tax rate$_t$−tax rate$_{it}$)/max. tax rate$_t$
(10) Loss carry back time	1—Loss carry back $\geq$ 1 year
	0—Loss carry back $<$ 1 year
(11) Loss Carry Forward Time	1—Unlimited loss carry forward
	0.5—Loss carry forward $>$ 5 year & $\leq$ 20 year
	0—Loss carry forward $\leq$ 5 years
(12) Loss carry back amount	1—No amount limitations
	0.5—Amount limitations
	0—Loss carry back not possible
(13) Loss carry forward amount	Percentage of pretax profit up to which losses carried forward can be deducted
(14) Group relief	1—Cross-border group relief possible
	0.5—National group relief possible
	0—No group relief possible
(15) Treaty network	Number double tax treaties$_{it}$/max. number double tax treaties$_t$
(16) Thin capitalization rules	1—No thin capitalization rules apply
	0.5—Thin cap rules not clearly defined
	0—Thin capitalization rules apply
(17) CFC rules	1—No CFC rules apply
	0—CFC rules apply
(18) Anti-avoidance legislation	1—No anti-avoidance legislation applies
	0.5—General anti-avoidance rule applies
	0—GAAR and special rules apply
(19) Personal income tax rate	(Max. tax rate$_t$−tax rate$_{it}$)/max. tax rate$_t$
(20) Holding regime	1—Holding regime applies
	0—No holding regime applies
(21) R&D incentives	1—Incentives among 25 % most attractive
	0.5—Incentives not among 25 % most attractive
	0—No Incentives available
(22) Depreciation	PV(depr. allow.)$_{it}$/max. PV(depr. allow)$_t$

The measurement of the 22 tax variables forming the *Tax Attractiveness Index*. Each tax factor is measured on annual basis (t) and for each country (i) separately. All variables range between zero (low attractiveness) and one (high attractiveness)

Table 8 Tax attractiveness index per country

Country	Tax	TAX_sig	TAX_ GER	Country	Tax	Tax_sig	Tax_ GER	Country	Tax	TAX_sig	Tax_ GER	Country	Tax	TAX_sig	Tax_ GER
Algeria	0.41	0.34	0.38	Denmark	0.52	0.54	0.54	Korea (South)	0.31	0.44	0.24	Poland	0.46	0.56	0.39
Angola	0.41	0.21	0.37	Dom. Rep.	0.40	0.22	0.22	Latvia	0.53	0.46	0.48	Portugal	0.48	0.59	0.42
Argentina	0.26	0.25	0.21	Ecuador	0.44	0.37	0.37	Lebanon	0.51	0.62	0.46	Puerto Rico	0.37	0.07	0.37
Australia	0.43	0.37	0.39	Egypt	0.39	0.39	0.39	Liechtenstein	0.59	0.58	0.53	Romania	0.47	0.60	0.39
Austria	0.62	0.55	0.56	El Salvador	0.46	0.25	0.25	Lithuania	0.48	0.46	0.43	Russia	0.46	0.55	0.38
Bahamas	0.86	0.74	0.84	Estonia	0.58	0.49	0.49	Luxembourg	0.68	0.66	0.63	Saudi Arabia	0.48	0.37	0.43
Bahrain	0.82	0.57	0.79	Finland	0.53	0.53	0.53	Macedonia	0.53	0.54	0.48	Serbia	0.44	0.55	0.39
Bangladesh	0.44	0.32	0.40	France	0.62	0.59	0.59	Malaysia	0.67	0.59	0.66	Singapore	0.70	0.59	0.67
Belarus	0.39	0.47	0.32	*Germany*	–	–	*0.48*	Malta	0.62	0.62	0.56	Slovak Rep.	0.57	0.55	0.50
Belgium	0.63	0.72	0.57	Great Brit.	0.64	0.81	0.81	Mauritius	0.58	0.58	0.55	Slovenia	0.52	0.49	0.44
Bermuda	0.86	0.74	0.84	Greece	0.44	0.39	0.39	Mexico	0.43	0.36	0.37	South Africa	0.57	0.50	0.50
Bolivia	0.56	0.31	0.54	Guatemala	0.48	0.27	0.27	Montenegro	0.54	0.55	0.50	Spain	0.54	0.69	0.47
Botswana	0.42	0.29	0.39	Guernsey	0.60	0.57	0.57	Morocco	0.51	0.52	0.47	Sweden	0.58	0.55	0.51
Brazil	0.40	0.27	0.35	Hong Kong	0.58	0.44	0.44	Namibia	0.56	0.35	0.52	Switzerland	0.60	0.80	0.53
Br. Virg. Isl.	0.82	0.72	0.80	Hungary	0.58	0.56	0.56	Netherlands	0.77	0.75	0.73	Taiwan	0.36	0.26	0.35
Bulgaria	0.49	0.61	0.42	Iceland	0.56	0.51	0.51	Neth. Antil.	0.69	0.53	0.64	Thailand	0.44	0.35	0.42
Canada	0.50	0.44	0.45	India	0.50	0.41	0.41	New Zealand	0.43	0.34	0.39	Tunisia	0.47	0.35	0.43
Cayman Isl.	0.84	0.74	0.82	Indonesia	0.34	0.41	0.41	Nicaragua	0.51	0.18	0.49	Turkey	0.47	0.61	0.44
Chile	0.40	0.39	0.46	Ireland	0.69	0.76	0.76	Nigeria	0.53	0.30	0.50	Ukraine	0.52	0.49	0.47
China	0.44	0.47	0.39	Israel	0.37	0.49	0.49	Norway	0.64	0.55	0.58	Unit. Arab Emir.	0.83	0.62	0.80
Colombia	0.37	0.06	0.38	Italy	0.45	0.50	0.50	Pakistan	0.43	0.35	0.39	United States	0.41	0.44	0.32
Costa Rica	0.46	0.24	0.46	Japan	0.43	0.31	0.31	Panama	0.47	0.25	0.44	Uruguay	0.50	0.51	0.47
Croatia	0.49	0.52	0.42	Jersey	0.79	0.64	0.64	Paraguay	0.47	0.35	0.45	Venezuela	0.30	0.34	0.21
Cyprus	0.68	0.58	0.63	Kazakh.	0.44	0.37	0.37	Peru	0.27	0.13	0.25	Vietnam	0.47	0.38	0.42

Table 8 continued

Country	Tax	TAX_sig	TAX_GER	Country	Tax	Tax_sig	Tax_GER	Country	Tax	TAX_sig	Tax_GER	Country	Tax	TAX_sig	Tax_GER
Czech Rep.	0.47	0.56	0.40	Kenya	0.48	0.26	0.26	Philippines	0.34	0.30	0.29	Zimbabwe	0.37	0.30	0.31

This table reports mean values of the *Tax Attractiveness Index* per sample country over years 2005–2009. *TAX* represents an equally-weighted sum of 22 tax factors. *TAX_sig* is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model. *TAX_GER* consists of 19 components excluding withholding tax rates to Germany on dividends, interest, and royalties. The index is restricted to values between 0 and 1. The closer the *TAX* is to one, the more attractive is the tax environment that country *i* offers

Table 9 Sample Selection

	Operating revenue	Total assets	Number of employees	Total liabilities/total assets
DAX				
Volkswagen	113.091.000	177.178.000	329.423	79 %
EON	105.491.000	152.614.000	87.884	69 %
Daimler	79.617.000	128.821.000	258.628	75 %
BMW	51.489.000	101.953.000	96.207	80 %
Siemens	77.716.000	94.926.000	413.650	71 %
BASF	51.882.000	51.268.000	102.956	64 %
Metro	67.178.000	33.667.000	286.329	82 %
Deutsche Telekom	66.106.000	127.774.000	257.601	67 %
Deutsche Post	48.342.000	34.738.000	484.763	76 %
RWE	48.055.000	93.438.000	68.828	85 %
MAN	12.026.000	15.895.000	47.743	68 %
ThyssenKrupp	40.945.000	41.367.000	188.084	77 %
Bayer	32.090.000	51.042.000	105.930	60 %
Continental	20.167.000	23.049.200	133.416	82 %
Lufthansa	25.039.000	26.392.000	110.882	77 %
TUI	17.471.467	9.116.000	69.536	55 %
Fresenius	14.165.000	21.148.000	127.903	63 %
Linde	11.444.000	24.381.000	49.093	56 %
SAP	10.716.000	13.374.000	48.471	37 %
Henkel	13.713.000	15.818.000	51.361	59 %
Adidas	10.567.000	8.875.000	39.071	57 %
Merck	7.838.400	16.712.600	32.850	43 %
Salzgitter	7.982.300	8.051.500	23.770	52 %
Baiersdorf	5.842.000	4.594.000	21.337	43 %
Infineon	2.201.000	4.366.000	26.740	50 %
K + S	3.728.300	5.217.100	12.487	60 %
Deutsche Boerse	2.322.600	161.360.500	3.549	98 %
Altana	1.188.871	1.707.834	4.703	31 %
Total	948.413.938	1.448.843.734	3.483.195	NA
Average	33.871.926	51.744.419	124.400	75 %
P-25	9.920.825	12.309.500	37.516	56 %
P-50	18.819.233	25.386.500	78.710	65 %
P-75	51.587.250	93.810.000	147.083	77 %
# of companies	28	28	28	28
AMADEUS ex. DAX				
Total	1.146.946.021	1.167.903.372	4.870.881	NA
Average	721.350	710.404	3.153	68 %
P-25	31.925	27.170	112	48 %
P-50	133.632	105.043	746	62 %

Table 9 continued

	Operating revenue	Total assets	Number of employees	Total liabilities/total assets
P-75	287.091	244.685	1.452	75 %
# of companies	1.618	1.672	1.573	1.672

This table shows descriptive statistics for the 28 German DAX multinationals included in the sample and aggregate statistics for other German multinational groups found in the AMADEUS database. All statistics are sourced from consolidated group accounts

Table 10 Correlation between different dependent variables and country-level controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) TAX	1.0														
(2) TAX_sig	0.7	1.0													
(3) Stat. Tax Rate	0.6	0.5	1.0												
(4) Tax. of Dividends	0.5	0.3	0.3	1.0											
(5) Tax. of Cap. Gains	0.6	0.3	0.2	0.6	1.0										
(6) WHT No Treaty Div.	0.4	0.0	0.3	0.1	0.0	1.0									
(7) WHT To GER Div.	0.5	0.4	0.1	0.3	0.2	0.5	1.0								
(8) WHT No Treaty Int.	0.6	0.4	0.4	0.4	0.3	0.3	0.3	1.0							
(9) WHT To GER Int.	0.6	0.7	0.3	0.3	0.2	0.0	0.5	0.6	1.0						
(10) WHT No Treaty Roy.	0.7	0.5	0.4	0.3	0.3	0.4	0.3	0.6	0.4	1.0					
(11) WHT To GER Roy.	0.6	0.8	0.3	0.3	0.2	0.0	0.5	0.4	0.8	0.5	1.0				
(12) LCB Time	0.5	0.4	0.3	0.1	0.2	0.0	0.1	0.1	0.2	0.1	0.3	1.0			
(13) LCF Time	0.5	0.3	0.1	0.2	0.5	0.0	0.1	0.3	0.2	0.3	0.3	0.4	1.0		
(14) LCB Amount	0.6	0.4	0.3	0.1	0.3	0.0	0.1	0.1	0.1	0.2	0.2	0.9	0.4	1.0	
(15) LCF Amount	0.1	0.2	0.0	0.0	0.0	−0.2	−0.1	−0.1	0.1	0.1	0.2	0.0	0.1	0.1	1.0
(16) Group Relief	0.2	0.3	−0.1	0.2	0.2	−0.3	0.2	0.2	0.3	−0.1	0.3	0.1	0.3	0.1	0.2
(17) Treaty Network	0.1	0.5	−0.2	0.1	0.0	−0.3	0.3	−0.1	0.4	0.0	0.5	0.1	0.1	0.1	0.2
(18) Thin Cap. Rules	0.3	0.0	0.1	−0.1	0.1	0.3	0.0	0.2	−0.1	0.3	−0.1	0.0	0.0	0.0	−0.2
(19) CFC Rules	0.2	−0.1	0.3	0.0	−0.1	0.4	−0.1	0.1	−0.1	0.3	−0.2	−0.1	−0.1	−0.1	−0.1
(20) Anti-avoid. Leg.	0.2	−0.1	0.2	0.0	0.0	0.2	0.0	0.2	0.1	0.2	0.0	−0.1	−0.2	0.0	0.0
(21) Pers. Inc. Tax Rate	0.2	0.0	0.6	0.0	0.0	0.4	0.0	0.2	0.0	0.3	−0.1	0.1	0.0	0.1	−0.2
(22) Holding Regime	0.5	0.6	0.2	0.1	0.3	0.0	0.1	0.1	0.1	0.3	0.2	0.3	0.2	0.3	0.2
(23) R&D Incentives	0.0	0.1	−0.3	0.0	0.0	−0.1	0.1	−0.2	−0.1	−0.2	0.0	0.2	0.2	0.2	0.1
(24) Depreciation	0.1	−0.1	0.1	0.1	−0.1	0.2	0.1	0.1	0.0	0.0	−0.1	0.0	−0.1	0.0	0.0

Table 10 continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(25) GDP	−0.3	0.0	−0.5	−0.2	−0.1	−0.4	0.0	−0.4	0.0	−0.4	0.1	0.2	0.1	0.1	0.1
(26) Similarity	0.4	0.5	0.1	0.3	0.4	−0.3	0.2	0.1	0.3	0.1	0.4	0.4	0.5	0.4	0.2
(27) Distance	−0.3	−0.6	−0.2	−0.3	−0.1	0.1	−0.4	−0.2	−0.5	−0.2	−0.5	0.0	−0.1	0.0	−0.1
(28) Adjacency	0.2	0.3	−0.1	0.2	0.2	−0.3	0.2	0.1	0.3	0.0	0.3	0.1	0.2	0.1	0.1
(29) Voice & Account.	0.3	0.4	0.0	0.4	0.4	−0.3	0.1	0.1	0.3	0.0	0.3	0.2	0.3	0.2	0.2
(30) Rule of Law	0.5	0.5	0.1	0.4	0.4	−0.2	0.2	0.2	0.4	0.2	0.5	0.4	0.5	0.4	0.3

	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
(1) TAX															
(2) TAX_sig															
(3) Stat. Tax Rate															
(4) Tax. of Dividends															
(5) Tax. of Cap. Gains															
(6) WHT No Treaty Div.															
(7) WHT To GER Div.															
(8) WHT No Treaty Int.															
(9) WHT To GER Int.															
(10) WHT No Treaty Roy.															
(11) WHT To GER Roy.															
(12) LCB Time															
(13) LCF Time															
(14) LCB Amount															
(15) LCF Amount															
(16) Group Relief	1.0														
(17) Treaty Network	0.4	1.0													

Table 10 continued

	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
(18) Thin Cap. Rules	−0.2	−0.4	1.0												
(19) CFC Rules	−0.3	−0.5	0.4	1.0											
(20) Anti-avoid. Leg.	−0.2	−0.3	0.3	0.4	1.0										
(21) Pers. Inc. Tax Rate	−0.5	−0.5	0.3	0.4	0.3	1.0									
(22) Holding Regime	0.0	0.0	0.2	0.1	−0.1	0.0	1.0								
(23) R&D Incentives	0.2	0.4	−0.4	−0.4	−0.3	−0.3	0.1	1.0							
(24) Depreciation	−0.3	−0.2	0.0	0.1	0.2	0.2	−0.2	−0.2	1.0						
(25) GDP	0.3	0.6	−0.3	−0.6	−0.4	−0.5	−0.1	0.5	−0.1	1.0					
(26) Similarity	0.5	0.4	0.0	−0.3	−0.2	−0.4	0.3	0.3	−0.3	0.4	1.0				
(27) Distance	−0.4	−0.6	0.1	0.0	0.0	0.2	−0.2	0.0	0.2	0.0	−0.3	1.0			
(28) Adjacency	0.3	0.5	−0.1	0.0	0.0	−0.3	0.2	0.2	−0.1	0.2	0.3	−0.5	1.0		
(29) Voice & Account.	0.4	0.3	−0.1	−0.3	−0.2	−0.4	0.3	0.2	−0.2	0.1	0.6	−0.4	0.3	1.0	
(30) Rule of Law	0.5	0.4	0.0	−0.3	−0.3	−0.4	0.4	0.2	−0.3	0.2	0.8	−0.4	0.3	0.8	1.0

This table reports Pearson correlation coefficients for all independent variables used in this study. *TAX* represents an equally-weighted sum of 22 tax factors. *TAX_sig* is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model

Table 11 Robustness test—change in number of subsidiaries

	Exp. sign	OLS (1)	OLS (2)	OLS (3)
TAX	+		1.108**	
TAX_sig	+			1.016***
Statutory tax rate	+	0.171		
Taxation of dividends	+	−0.037		
Taxation of capital gains	+	0.089		
WHT No treaty dividends	+	0.359		
WHT to GER dividends	+	−0.521*		
WHT no treaty interest	+	0.278		
WHT to GER interest	+	0.137		
WHT no treaty royalties	+	0.133		
Loss carry back time	+	0.056		
Loss carry forward time	+	−0.152**		
Loss carry forward amount	+	−0.042		
Group relief	+	−0.144		
Treaty network	+	0.572**		
Thin capitalization rules	+	−0.103		
CFC rules	+	0.156		
Anti-avoidance legislation	+	0.008		
Personal income tax rate	+	−0.263		
Holding regime	+	0.130*		
R&D incentives	+	0.091		
Depreciation	+	−0.030		
GDP	+	0.072	0.095**	0.068**
Similarity	±	−0.099	−0.242	−0.177
Distance	−	0.029	−0.033	0.031
Adjacency	+	−0.099	−0.135	−0.073
Voice & accountability	+	0.022	0.026	0.012
Rule of law	+		−0.040	−0.036
Parent-year FE		Yes	Yes	Yes
Observations		10,864	10,864	10,864
R^2		0.05	0.05	0.05

This table reports regression results for the location of German-controlled subsidiaries. The dependent variable is *Delta Number Subsidiaries* defined as the delta of the number of subsidiaries that parent *j* operates in host country *i* in year *t−1* versus *year t*. The underlying sample is based on the subsidiaries of 28 German parent companies (DAX30) over years 2005–2009. The subsidiaries are situated in 97 different host countries. We use a pooled OLS model. Column (1) shows the results of the disaggregate regression testing the individual tax variables. In column (2), we use the aggregate *Tax Attractiveness Index (TAX)* consisting of 22 tax variables as the tax variable of interest. *TAX_sig* in column (3) is an index consisting of the four significant tax variables in our main regression (statutory tax rate, withholding tax rates on interest paid to a German parent, treaty network, and special holding incentives) weighted by their exponentiated coefficients in the zero-inflated negative binomial model. *GDP* is the natural logarithm of host country *i*'s GDP in constant USD for the year 2000. *Similarity* is an index defined as one minus the ratio of the absolute value of host country *i*'s GDP per capita minus Germany's GDP per capita to the higher of both GDPs per capita (GDP per capita in constant USD for the year 2000, respectively). *Distance* is defined as the natural logarithm of the population-weighted great circle distance between the main agglomerations of Germany and host country *i*. *Adjacency* is a dummy variable obtaining the value of one if host country *i* shares a border with Germany. *Rule of Law* and *Voice & Accountability* represent governance indicators of host country *i*. They may range from −2.5 to 2.5. All country-level variables are measured on an annual basis (2005–2009). We use year fixed effects in all specifications. Standard errors allow for heteroskedasticity and are clustered by country

***, **, * indicate statistical significance at the 1, 5, and 10 % level, respectively

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