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The use of tax havens in exemption regimes

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The use of tax havens in exemption regimes[☆]

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Abstract

This paper analyzes the tax haven investment behavior of multinational firms from a country that exempts foreign income from taxation. High foreign tax rates generally encourage firms to invest in tax havens, though significant costs of reallocating taxable income dampen these incentives. The behavior of German manufacturing firms from 2002-2008 is consistent with this prediction: at the mean, one percentage point higher foreign tax rates are associated with three percentage point greater likelihoods of owning tax haven affiliates. This contrasts with earlier evidence for U.S. firms subject to home country taxation, which are more likely to invest in tax havens if they face lower foreign tax rates. Foreign tax rates appear to be unrelated to tax haven investments of German firms in service industries, possibly reflecting the difficulty they face in reallocating taxable income.

Keywords: Tax Havens, Multinational Firms, Tax Avoidance, Profit Shifting, Manufacturing FDI, Service FDI
JEL: H87, F23

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1. Introduction

Tax havens are typically small, well-governed states that impose low or zero tax rates on foreign investors (Dharmapala and Hines, 2009). Multinational enterprises (MNEs) are widely believed to use tax havens to avoid taxation. Sophisticated tax planning strategies involving tax havens have received considerable attention in the media (e.g. Drucker, 2010), and tax havens have repeatedly been in the focus of national and international policy measures. To name a few examples, the OECD launched the "Initiative on Harmful Tax Competition" in 1998 to pressure tax havens to abolish harmful tax provisions and practices. France announced plans to introduce a 50% tax on income earned by French affiliates in tax havens in February 2010. Most recently, the U.S. House Committee on Ways and Means held a background hearing on the transfer pricing practices of U.S. taxpayers, with an emphasis on income reallocation to offshore tax havens.[1]

Despite considerable policy interest, the determinants of incentives to invest in tax havens are not fully understood. This paper develops a simple theoretical model identifying that high non-haven tax rates and low costs of profit reallocation generally encourage tax haven investment by firms located in countries that exempt foreign income from taxation. Evidence from the foreign activities of a panel of German multinationals from 2002-2008 is consistent with the implications of the model. Profits of foreign affiliates are nearly tax-free under German law, so German MNEs face clear incentives with regard to foreign taxation (IBFD, 2009).[2]

The analysis separately studies manufacturing and service companies in order to investigate how sectoral differences in the costs of establishing and using tax haven affiliates affect tax haven investment incentives. In addition, the detailed affiliate-level panel data set makes it possible to control for unobserved firm characteristics by using firm-fixed effects. Thus, it is possible to capture unobserved firm-specific differences in the marginal cost of profit shifting, for example. Such differences may appear due to differences in a firm's R&D intensity or its intangible assets, as these factors influence the ease of strategically choosing transfer prices.

To gauge the impact of foreign taxation on tax haven investment, we estimate a linear probability model of tax haven investment using the size of the MNEs' domestic and foreign activities as additional control variables. This empirical strategy accounts for the fact that the tax rates a firm faces at its foreign locations may be endogenous to its decision to invest in a tax haven. Holding a tax haven affiliate, an MNE may be more likely to invest in countries that it would not invest in unless it could use tax haven operations to reduce global tax burdens. We therefore follow Desai, Foley, and Hines

[1] The Staff of the Joint Committee on Taxation prepared a detailed report including six case studies of the tax avoidance practices of large US firms (Joint Committee on Taxation, 2010).

[2] For a summary of the legal situation in Germany, see section 2.

(2006) in using competitors' average foreign non-haven tax rates as instruments for the firm level foreign tax rates at non-haven locations.

The evidence indicates that the probability that a manufacturing firm invests in a tax haven increases with the rate at wich its other foreign operations are taxed. This finding is robust across specifications. Further, larger parent size, higher parent productivity and larger size of foreign non-haven activities raise the probability of tax haven investment. In contrast, neither parent variables nor foreign non-haven tax rates significantly influence tax haven investment for firms in the service sector, after controlling for endogeneity due to simultaneity or omitted firm-specific characteristics.

The difference between the tax haven investment patterns of manufacturing and service firms is robust and is difficult to attribute either to the instrumentation strategy or to potential selection bias of the regression sample of service firms towards larger entities. The results suggest the following interpretation. Due to their lower variable costs of profit reallocation, and possibly the greater variation in these costs between firms, manufacturing firms respond more strongly to incentives from higher tax rates in their choice of tax haven investment. Service firms' tax haven investments may not vary significantly with foreign taxation because of their higher marginal cost of profit reallocation, and relative uniformity of profit reallocation costs among service firms. Nonetheless, service firms invest in tax havens because their fixed cost of doing so is lower, which may stem both from lower cost of setting up an affiliate and from profits which service firms earn from ordinary business activities in tax haven countries. Using sector-level data on R&D intensities, we offer further evidence that this difference may be driven by differences in (unobservable) costs of reallocating taxable income.

This paper is related to two strands of the literature, the literature on tax haven use by multinational enterprises and on profit reallocation in general.

Studies of the use of tax havens by multinational companies have been largely confined to U.S. enterprises and thus to firms subject to a tax credit system; the literature also does little to distinguish the activities of manufacturing and service firms. Income earned by foreign subsidiaries of U.S. firms is subject to U.S. taxation when repatriated, foreign branch income is taxed by the U.S. as earned, and U.S. firms are granted credits for taxes paid at their foreign locations. Thus, U.S. multinationals have two different avoidance motives for the use of tax havens: avoiding host country taxes and deferring U.S. taxation of foreign income. By analyzing firms subject to a tax exemption system, it is possible to identify the impact of tax rate differences without the added (U.S.) complication that some firms use tax haven operations to facilitate deferral of home country taxes. We thus use a sample of firms which face clear incentives with regard to foreign taxation, because their international revenues will generally not be subject to German taxation, no matter how high or low host country tax rates are.

Harris, Morck, Slemrod, and Yeung (1993) use a five-year panel on 200 large U.S.

manufacturing firms and find that U.S. tax liabilities of U.S. firms holding affiliates in Ireland or one of the four low tax "dragon" Asian countries are systematically lower than those of U.S. firms without such activities. Hines and Rice (1994) analyze a cross-section of country level data on the activities of U.S. multinational firms, finding that U.S. multinationals report disproportionate shares of profits in tax havens, which suggests that income may be reallocated for tax purposes. Grubert and Slemrod (1998) use a cross-section of data and estimate a joint model of the investment and profit shifting decision of U.S. multinationals in Puerto Rico which, due to its special status, can serve as a tax haven for U.S. firms. They find that firms with intangible assets are more likely than others to invest in Puerto Rico.

Desai et al. (2006), who are closest to our analysis, use an affiliate-level data set on U.S. multinationals' foreign activities in four years between 1982 and 1999. They estimate a logit model of tax haven investment given parent characteristics and take into account the endogeneity of the foreign non-haven tax rate due to simultaneity of a parent's location decisions. They find a negative effect of the average foreign non-haven tax rate on the probability of investing in a tax haven, interpreting their finding as evidence of the impact of incentives induced by the ability to defer home country taxation of unrepatriated foreign profits. Thus, it is particularly interesting to compare the U.S. evidence with the tax haven investment behavior of firms that are subject to a tax exemption regime, as German firms are, which have clear incentives to use tax haven operations to reallocate taxable income.

The literature on international profit shifting is vast, and for brevity, we will restrict our review to a few recent examples for the different strands of the literature. That taxes matter for profit shifting of international firms has been documented by Huizinga and Laeven (2008), amongst others. They use a cross-section of European MNEs and find evidence for substantial profit shifting between different countries in Europe, which fits international profit shifting incentives that arise from tax differences both between the parent and host country and among different affiliate locations. Weichenrieder (2009) analyzes a panel data set of German inbound and outbound FDI and identifies empirical patterns that are consistent with profit shifting in both cases.

With respect to different profit shifting strategies, Clausing (2001, 2003, 2006) provides empirical evidence that taxes exert a substantial impact on transfer prices and intra-firm trade flows of U.S. firms. Dischinger and Riedel (2011) offer evidence from a panel data set of European firms that MNEs prefer locating intangible assets at low-tax locations, arguably doing so because they are able to choose favorable transfer prices for intangible assets. Karkinsky and Riedel (2009) report similar findings with respect to patent location within MNEs. Egger, Eggert, Keuschnigg, and Winner (2010) compare the debt-to-asset ratios of domestically and foreign owned European firms and identify a gap in the ratios which is systematically related to corporate tax rates. Buettner, Overesch, Schreiber,

and Wamser (2009) provide further evidence on tax-motivated choice of capital structure using a panel data set of German MNEs. Using the same data, Buettner and Wamser (2007) analyse the use of intrafirm-loans for profit shifting, but find that they have rather small tax revenue effects. Weichenrieder and Mintz (2010) as well as Wamser (2008) show, using data on German MNEs, that firms tactically locate their direct and indirect affiliates and strategically use ownership chains in a way that facilitates tax avoidance.

The paper is structured as follows. First, we provide a brief overview of German international tax law provisions. In the following section, we present our theoretical model and derive the hypotheses for our empirical analysis. Section 4 describes the data used in the analysis and provides descriptive statistics; section 5 outlines our empirical approach. Section 6 summarizes our regression results, section 7 provides some robustness checks and section 8 discusses the implications. The last section concludes.

2. German taxation of foreign income

Germany generally exempts foreign income from taxation: dividends from foreign subsidiaries, and a German parent's income earned in foreign branches, are virtually tax exempt in Germany.

Affiliates, whether national or foreign, are treated as entities separate from the German parent. Dividends distributed by national or foreign affiliates as well as capital gains are tax free. Only 5% of dividends and capital gains are taxed as non-deductible operating expenditures (§8b KStG (German corporate income tax code)). This is an important difference with the U.S. tax system, since a U.S. tax is due when the parent company receives dividends from foreign affiliates, and the parent company is entitled to claim an indirect tax credit for income taxes paid by foreign affiliates.

On paper, German tax is due on the income earned in foreign branches independently of repatriation, because the worldwide income of German companies is in principle subject to German profit taxation (Hoehn and Hoering, 2010, IBFD, 2009). Companies are granted a tax credit or a rebate for taxes paid abroad. There is no German tax if Germany has a double taxation treaty with the host country, as Germany generally stipulates tax exemption of foreign income in double taxation treaties (Hoehn and Hoering, 2010, p. 116). Due to the tight network of double taxation treaties, income earned in foreign branches is de facto exempt from taxation in Germany.

An exception to these general rules is the anti-avoidance provision of German tax law (part of the German "Aussensteuergesetz (AStG)" commonly referred to as "CFC-legislation"). The anti-deferral rules apply if a German parent controls an affiliate or branch abroad which earns income from passive investment that accounts for more than 10% of total income and is taxed at a rate of less than 25%. In this case, the passive income of the branch or affiliate is apportioned to the parent and subject to German tax independent of repatriation (§§7-9 AStG).

Passive income is defined in a negative way as income which is not active, that is, income which is not generated through agriculture, production, trade, services, dividends, disposal of shares, and, subject to further requirements, banking, insurance, renting or leasing. Income from borrowing or lending is classified as active income if capital is raised in foreign capital markets only and from unrelated parties and lent to active foreign businesses or permanent establishments (§8 AStG). Until recent changes for the years from 2011 onwards (draft Jahressteuergesetz 2010 (tax law for the year 2010)), these rules did not apply if the nominal tax rate was higher than 25%, even if the effective tax burden was much lower, as for example in Malta or Panama.

Since the judgement of the European Court of Justice in the Case of Cadbury Schweppes, the provisions explicitly provide for the opportunity to demonstrate substantive activities if the affiliate is located in the EU or EEA, which include Ireland, Luxembourg and Liechtenstein on the list of tax havens. The rules do not apply if the affiliate can be demonstrated to participate in the host country markets, to employ qualified personnel and generate its own income (Bundesministerium der Finanzen, 2007).

A number of recent research papers analyze the effect of the anti-avoidance regulation and yield a nuanced picture on the effect of these provisions on profit shifting by multinational enterprises. On the one hand, Ruf and Weichenrieder (2009) report that the CFC rules significantly reduced passive investment in low-tax jurisdictions. They take a multinational's location decisions as given and define passive income as the total financial assets of an affiliate minus equity holdings in and lending to affiliated enterprises to avoid double counting. Using the same set up and a regression discontinuity approach, Egger and Wamser (2010) find that the CFC rules are also associated with less investment in fixed assets around the threshold from non-applicability to applicability. On the other hand, Overesch and Wamser (2010) provide evidence that the German CFC rules do not affect internal lending of foreign affiliates in low-tax locations to other foreign subsidiaries. They find that internal debt shares react positively to tax rate differentials between different locations and that CFC rules do not influence this relationship. Whether and how these provisions affect profit shifting through other strategies such as transfer pricing has not yet been explored.

Overall, this research suggests that the CFC provisions do not foreclose tax planning by MNEs per se, but they render it cumbersome. MNEs can still strategically relocate activities to low tax countries and tax havens, but they have to generate income from active local investment and may not benefit from simply setting up a "letterbox company". The significance of this requirement is that using a tax haven may entail considerable fixed costs, as MNEs must generate active income to benefit fully from their tax haven investments.

3. Incentives to establish tax haven operations

In this section we lay out a stylized theoretical framework to describe the incentives of a multinational firm to invest in a tax haven and to derive the empirical predictions to be tested later on. For this purpose, we study a multinational firm that can invest in a range of countries $i = 0, ..., n$, including a tax haven, which is denoted as country 0. Starting a foreign affiliate involves fixed set-up cost c_i. Let ρ_i denote before-tax profits earned in country i by the affiliate once it is installed. Reported profits are taxed at rate τ_i in country i. Without loss of generality we assume that $\tau_0 = 0$, i.e. there is no taxation in the tax haven.

Firms can reallocate an amount ψ_i of their actual profits in country i to a country that taxes reported profits at a lower tax rate, most notably to the tax haven country, for example by adjusting their transfer prices. This is possible only at some cost. Firms may need to set up additional facilities to make transfer prices seem plausible, inefficient relocation of production and intra-firm trade may be needed to arrange income reallocation, and transaction costs are incurred, like legal expenses. We assume that income reallocation gets increasingly expensive as the amount reallocated increases relative to income earned in country i. Following Hines and Rice (1994), these income reallocation costs are assumed to be $(a/2)({\psi_i}^2/\rho_i)$.[3] Parameter a captures how much the cost of income reallocation increases with the amount reallocated. Note that a is a firm-specific parameter because income reallocation costs vary with firm-specific characteristics such as the R&D intensity of a firm. As indicated above, firms with more R&D activities and larger intangible assets have been shown to be more easily able to reallocate income due to the lack of comparable market prices. The reported profit in country i, π_i, after incurring fixed cost c_i, is thus

$$\pi_i = \rho_i - \psi_i - \frac{a}{2}\frac{{\psi_i}^2}{\rho_i} \quad . \tag{1}$$

Consider now the option of setting up an affiliate in a tax haven at cost c_0. To save on notation, we set $\rho_0 = 0$ and let c_0 capture the net cost of investing in a tax haven, after deducting any profits that arise genuinely in this country. For $c_0 < 0$, the multinational has an interest in investing in a tax haven country, and does so, independent of investments in other countries. This interest could arise from plans to reallocate income from the home country, though since our data set contains information on parent firms from only one home country, Germany, it is not possible to gauge the impact of this tax incentive empirically. Thus, we focus on multinationals that invest in non-haven countries as well.

[3]For simplicity, we assume that the cost of reallocating income to a tax haven and to another non-haven country are equal. This assumption does not affect the main intuition of the model, but renders notation far more tractable.

In order to evaluate the incentive to invest in a tax haven, consider first the situation of a multinational with a tax haven affiliate. The firm chooses in which other countries to locate affiliates and how much of their profits to reallocate to the tax haven. Thus, the investor's maximization problem, given that it has a tax haven affiliate, is

$$\max_{d_i,\psi_i} \sum_{i=1}^{n} d_i \left[\psi_i + (1-\tau_i)(\rho_i - \psi_i - \frac{a}{2}\frac{{\psi_i}^2}{\rho_i}) - c_i \right] \tag{2}$$

with $d_i \in \{0,1\}$, s.t.

$$\rho_i - \psi_i - \frac{a}{2}\frac{{\psi_i}^2}{\rho_i} \geq 0 \ \forall i = 1, ..., n \ . \tag{3}$$

We assume first that this constraint is fulfilled and subsequently reconsider what happens if this is not the case. The first order condition for ψ_i is thus

$$1 - (1-\tau_i) - (1-\tau_i)\frac{a\psi_i}{\rho_i} = 0 \tag{4}$$

which implies

$$\psi_i^{*th} = \frac{\tau_i \rho_i}{a(1-\tau_i)} \tag{5}$$

Inserting ψ_i^{*th} into condition (3) produces a condition for a and τ_i that must be fulfilled for 3 to hold.

$$\rho_i \quad - \quad \frac{\tau_i \rho_i}{a(1-\tau_i)} - \frac{{\tau_i}^2 \rho_i}{2a(1-\tau_i)^2} \geq 0 \tag{6}$$

$$\Leftrightarrow \qquad \tau_i \leq 1 - \sqrt{\frac{1}{2a+1}} \tag{7}$$

Consider now values of τ_i and a such that the constraint (3) is not fulfilled for ψ_i^{*th} as determined by the first order condition. In this case, ψ_i is chosen such that condition (3) is satisfied with equality, which yields

$$\bar{\psi}_i = \frac{\rho_i}{a}\left(\sqrt{2a+1} - 1\right) \tag{8}$$

In this case, there are no more positive profits reported by the affiliate in the non-haven country and hence $\bar{\psi}_i$ equals the multinational's profit from investing in country i, re-allocated to the tax haven, after incurring fixed cost c_i. For ease of presentation, in the following we restrict consideration to cases in which condition (3) holds, and discuss deviations only when necessary for the results.

Let countries be numbered such that country $i = 1$ yields the highest after-tax profit, including the fixed cost of setting up the affiliate, and country $i = n$ yields the lowest profit. Then the multinational chooses $d_i = 1$ for all countries $i = 1, ..., \tilde{n}$, where $\tilde{n}$ is

determined by the condition

$$\psi_{\tilde{n}}+(1-\tau_{\tilde{n}})(\rho_{\tilde{n}}-\psi_{\tilde{n}}-\frac{a}{2}\frac{\psi_{\tilde{n}}^2}{\rho_{\tilde{n}}})-c_{\tilde{n}} \geq 0 > \psi_{\tilde{n}+1}+(1-\tau_{\tilde{n}+1})(\rho_{\tilde{n}+1}-\psi_{\tilde{n}+1}-\frac{a}{2}\frac{\psi_{\tilde{n}+1}^2}{\rho_{\tilde{n}+1}})-c_{\tilde{n}+1} \ . \quad (9)$$

Using ψ_i^{*th} as determined by the first order condition for ψ_i, this condition simplifies to

$$(1-\tau_{\tilde{n}})\rho_{\tilde{n}}+\frac{\tau_{\tilde{n}}^2\rho_{\tilde{n}}}{2a(1-\tau_{\tilde{n}})}-c_{\tilde{n}} \geq 0 > (1-\tau_{\tilde{n}+1})\rho_{\tilde{n}+1}+\frac{\tau_{\tilde{n}+1}^2\rho_{\tilde{n}+1}}{2a(1-\tau_{\tilde{n}+1})}-c_{\tilde{n}+1} \ . \quad (10)$$

Consider now the multinational's situation if it has no tax haven affiliate. In this case, profit-shifting has to be directed to the country charging the lowest tax rate among those in which the multinational holds an affiliate.[4] Let $\underline{\tau}$ denote the minimum of all tax rates charged in countries in which the multinational invests. Then the profit maximization problem is the following

$$\max_{d_i,\psi_i} \sum_{i=1}^{n} d_i \left[(1-\underline{\tau})\psi_i+(1-\tau_i)(\rho_i-\psi_i-\frac{a}{2}\frac{{\psi_i}^2}{\rho_i})-c_i\right] \quad (11)$$

with $d_i \in \{0,1\}$, subject to the same constraint (3) as above. The first order condition yields

$$\psi_i^{*nth}=\frac{(\tau_i-\underline{\tau})\rho_i}{a(1-\tau_i)} \ . \quad (12)$$

Note that for the parameter condition on τ_i and a assumed above, this optimal ψ_i^{*nth} also satisfies constraint (3). The first order condition for d_i yields that the multinational chooses $d_i=1$ for all countries $i=1,...,\hat{n}$ and $d_i=0$ otherwise, where $\hat{n}$ is determined by the condition that

$$(1-\underline{\tau})\psi_{\hat{n}}+(1-\tau_{\hat{n}})(\rho_{\hat{n}}-\psi_{\hat{n}}-\frac{a}{2}\frac{\psi_{\hat{n}}^2}{\rho_{\hat{n}}})-c_{\hat{n}} \geq 0 > (1-\underline{\tau})\psi_{\hat{n}+1}+(1-\tau_{\hat{n}+1})(\rho_{\hat{n}+1}-\psi_{\hat{n}+1}-\frac{a}{2}\frac{\psi_{\hat{n}+1}^2}{\rho_{\hat{n}+1}})-c_{\hat{n}+1} \ . \quad (13)$$

Using ψ_i^{*nth} as determined by the first order condition for ψ_i, this condition simplifies to

$$(1-\tau_{\hat{n}})\rho_{\hat{n}}+\frac{(\tau_{\hat{n}}-\underline{\tau})^2\rho_{\hat{n}}}{2a(1-\tau_{\hat{n}})}-c_{\hat{n}} \geq 0 > (1-\tau_{\hat{n}+1})\rho_{\hat{n}+1}+\frac{(\tau_{\hat{n}+1}-\underline{\tau})^2\rho_{\hat{n}+1}}{2a(1-\tau_{\hat{n}+1})}-c_{\hat{n}+1} \ . \quad (14)$$

A comparison with (10) shows that $\tilde{n} \geq \hat{n}$, since the profits realized from each country are potentially larger if it is possible to reduce taxes by reallocating income to a tax haven.

For the multinational, investing in a tax haven is worth the set up cost c_0 if and only

[4] We assume for simplicity that the multinational shifts profits to one country only. Giving up this assumption would yield computation far more complicated, but would not affect our results qualitatively.

if

$$\sum_{i=1}^{\tilde{n}}\left[\psi_i+(1-\tau_i)(\rho_i-\psi_i-\frac{a}{2}\frac{{\psi_i}^2}{\rho_i})-c_i\right]-c_0\geq\sum_{i=1}^{\hat{n}}\left[(1-\underline{\tau})\psi_i+(1-\tau_i)(\rho_i-\psi_i-\frac{a}{2}\frac{{\psi_i}^2}{\rho_i})-c_i\right] \tag{15}$$

Inserting the optimal ψ_i^{*th} and ψ_i^{*nth} and simplifying yields the following condition:

$$Inc_{th}=\sum_{i=1}^{\hat{n}}\frac{\rho_i\underline{\tau}(2\tau_i-\underline{\tau})}{2a(1-\tau_i)}+\sum_{i=\hat{n}+1}^{\tilde{n}}\left[(1-\tau_i)\rho_i+\frac{{\tau_i}^2\rho_i}{2a(1-\tau_i)}-c_i\right]-c_0\geq 0, \tag{16}$$

where Inc_{th} denotes the net benefit ("*Inc*entive") from investing in a tax haven. If this net benefit is positive the multinational chooses to invest in a tax haven.

Consider first the case where $c_0>0$. To determine the impact of tax rates we have to distinguish the tax rates in countries in which the multinational is active independent of a tax haven investment versus those that only become attractive with a tax haven. Simple inspection of Inc_{th} yields the following comparative statics.

$$\frac{dInc_{th}}{d\tau_i}=\frac{\rho_i\underline{\tau}(2-\underline{\tau})}{2a(1-\tau_i)^2}>0\ \forall i=1,...,\hat{n}\ . \tag{17}$$

Thus, the higher are the tax rates in countries in which the multinational would be active without a tax haven investment, the more profitable it becomes to invest in a tax haven. Furthermore,

$$\frac{d^2Inc_{th}}{d\tau_i d\rho_i}=\frac{\underline{\tau}(2-\underline{\tau})}{2a(1-\tau_i)^2}>0\ \forall i=1,...,\hat{n}\ . \tag{18}$$

This shows that the effect of a foreign tax rate is sensitive to the profitability of the respective affiliate, with higher profits increasing the effect of the foreign tax rate. In addition,

$$\frac{d^2Inc_{th}}{d\tau_i da}=-\frac{\rho_i\underline{\tau}(2-\underline{\tau})}{2a^2(1-\tau_i)^2}<0\ \forall i=1,...,\hat{n}\ . \tag{19}$$

Thus, the more difficult profit-shifting is for the multinational, the less sensitive will be its reaction to foreign tax rate changes. It is instructive to evaluate the effect of tax changes in countries in which the multinational is active only in case of a tax haven investment.

$$\frac{dInc_{th}}{d\tau_i}=\ -\rho_i+\tfrac{\tau_i(2-\tau_i)\rho_i}{2a(1-\tau_i)^2}<0\quad\forall i=\hat{n}+1,...,\tilde{n}\ \ \forall\tau_i\leq 1-\sqrt{\frac{1}{2a+1}}\ , \tag{20}$$

$$\frac{dInc_{th}}{d\tau_i}=\qquad 0\qquad\qquad\forall i=\hat{n}+1,...,\tilde{n}\ \ \forall\tau_i>1-\sqrt{\frac{1}{2a+1}}\ . \tag{21}$$

This result has the notable implication that a multinational may in fact be tempted to invest in a tax haven following a tax reduction in a country in which it has not been present so far. This counterintuitive situation can arise if this tax reduction makes an investment in this country attractive and hence adds to the potential base for profit shifting.

Inspection of equation (16) further shows that firms in industries with lower fixed costs of establishing tax haven affiliates are more likely than others to have haven affiliates. It is noteworthy that the fixed cost c_0 should be interpreted as the net cost of establishing a tax haven affiliate to use for tax avoidance purposes: c_0 is reduced to the extent that firms can recoup some of their setup costs with profits from ordinary activity. If a tax haven affiliate would be profitable in the course of ordinary business activity that does not include any tax-motivated income reallocation, then c_0 would be negative. In this case, the multinational's investment decision is driven not only by the profit shifting potential from foreign affiliates, but also by profits which genuinely arise in the tax haven or by profit shifting considerations concerning the parent company that are captured by c_0. Hence firms in industries in which tax haven operations can serve the dual function of facilitating profit reallocation and generating ordinary business returns effectively face lower costs of engaging in profit reallocation through havens, and are therefore likely to do more of it.

We can summarize these results in the following empirical predictions. From equation (17), it is clear that the larger the tax rate in a foreign non-haven country in which the multinational holds an affiliate, the more likely it is that a multinational invests in a tax haven. The second prediction is based on equation (19): the less costly it is to shift profits to a tax haven country, the stronger is the influence of foreign taxation on a multinational firm's tax haven investment.

Average foreign tax rates and values of the shifting cost parameter are likely to differ between firms, and may vary systematically between industries. Industries may differ in average values of the shifting cost parameter a, reflecting differences in the importance of intangible assets and other business features that facilitate profit reallocation; and industries may also differ in the extent to which a varies among firms in the industry. Differentiating (19) with respect to a indicates that:

$$\frac{d^3 Inc_{th}}{d\tau_i d^2 a} = \frac{\rho_i \underline{\tau}(2-\underline{\tau})}{a^3(1-\tau_i)^2} > 0 \tag{22}$$

Since the expression in (22) is positive, it follows that the effect of a on $\frac{dInc}{d\tau_i}$ is nonlinear, and more specifically, that a mean-preserving spread in the distribution of a produces a greater average value of $\frac{dInc}{d\tau_i}$. Consequently, industries in which firms have very different costs of profit reallocation should be expected to display greater average sensitivity of tax haven demand to non-haven tax rates than do other industries, even though average costs of profit reallocation do not differ.

When attempting to identify the effect of foreign tax rates on the tax haven decision empirically, we need to take into account that the multinational is potentially engaged in several countries and that therefore the tax rates of all these countries matter. As equation (18) shows, they do so to a different extent, however, depending on the profitability of the

individual affiliates. We capture this by investigating the impact of the average non-haven tax rate, where all the foreign tax rates are weighted by the profitability of the individual affiliate. If the multinational has not invested in a tax haven, this average foreign tax rate is given by

$$\frac{\sum_{i=1}^{\hat{n}} \tau_i \rho_i}{\sum_{i=1}^{\hat{n}} \rho_i} \ . \tag{23}$$

In our empirical analysis we encounter the difficulty that we are not able to observe the actual profits ρ_i in country i, only reported after-tax profits $(1-\tau_i)\pi_i$. These reported profits are distorted due to taxation and income reallocation. In case of a tax haven investment they are given by

$$(1-\tau_i)\pi_i = (1-\tau_i)(\rho_i - \psi_i - \frac{a}{2}\frac{{\psi_i}^2}{\rho_i}) = (1-\tau_i)\left[1 - \frac{\tau_i(2-\tau_i)}{2a(1-\tau_i)^2}\right]\rho_i \ . \tag{24}$$

Inspection shows that this distortion is the higher the higher the country's tax rate τ_i. Thus, we require appropriate proxies to capture the effect of an affiliate's profitability on the decision to invest in a tax haven.

Furthermore, we need to account for the fact that the average foreign tax rate we observe is potentially affected by the multinational's decision to invest in a tax haven. The tax haven investment may make it profitable to invest in foreign countries that would not have been attractive destinations for investments without the income reallocation opportunities created by the tax haven investment.

Consider a change in tax rates $\Delta_i \geq 0$ in countries $i = 1, ..., \tilde{n}$ such that the investor chooses to invest in a tax haven after this change in tax rates, but would not do so before. Both an increase in the tax rates at locations $i = 1, ..., \hat{n}$ where the multinational already holds an affiliate and a decrease in the tax rates at locations $i = \hat{n}+1, ..., \tilde{n}$ which become attractive only after tax haven investment could render tax haven investment optimal. The average non-haven tax rate for the investor changes from the status quo to the new average non-haven tax rate

$$\frac{\sum_{i=1}^{\tilde{n}} (\tau_i + \Delta_i)\rho_i}{\sum_{i=1}^{\tilde{n}} \rho_i} \ . \tag{25}$$

The observed change in the non-haven average tax rate is thus

$$\frac{\sum_{i=1}^{\tilde{n}} (\tau_i + \Delta_i)\rho_i}{\sum_{i=1}^{\tilde{n}} \rho_i} - \frac{\sum_{i=1}^{\hat{n}} \tau_i \rho_i}{\sum_{i=1}^{\hat{n}} \rho_i} \tag{26}$$

which can be rewritten as

$$\frac{\sum_{i=1}^{\hat{n}} \Delta_i \rho_i}{\sum_{i=1}^{\tilde{n}} \rho_i} + \frac{\sum_{i=\hat{n}+1}^{\tilde{n}} \rho_i \left(\frac{\sum_{i=\hat{n}+1}^{\tilde{n}} (\tau_i \rho_i + \Delta_i \rho_i)}{\sum_{i=\hat{n}+1}^{\tilde{n}} \rho_i} - \frac{\sum_{i=1}^{\hat{n}} \tau_i \rho_i}{\sum_{i=1}^{\hat{n}} \rho_i} \right)}{\sum_{i=1}^{\tilde{n}} \rho_i} \ . \tag{27}$$

In our empirical analysis we are interested in identifying the effect of exogenous changes in tax rates, captured by the first term. As we have seen above, investing in a tax haven is positively influenced by an increase in the tax rates of the countries in which the multinational already holds affiliates. Thus, when estimating the impact of foreign tax rates, higher tax rates in countries in which a multinational firm would invest under any circumstances should stimulate greater demand for tax haven affiliates.

The second term captures the change in the observed non-haven tax rate that is due to endogeneity of the multinational's investment decision. Evaluating the numerator of the second term we find that the observed change in the average non-haven tax rate exceeds the change of interest if the new affiliates the multinational opens due to the tax haven investment are located in countries that exhibit on average higher tax rates than the previous average tax rate, and conversely. This has important implications for the interpretation of the causal effects of tax changes. In particular, OLS results overestimate the true effects, as captured by the IV estimates, if the tax rates at the firm's new locations increase the firm's average foreign non-haven tax rate, and underestimate the true effects if the tax rates faced at the new locations are lower than the previous average foreign non-haven tax rate. We discuss in section 4 how our empirical strategy accounts for this potential endogeneity of the observed tax rate.

The second prediction cannot be tested directly with the available data, since it is not possible to measure firm-specific income reallocation costs. Instead, we use firm-fixed effects in the baseline econometric analysis to control for differences in marginal costs of income reallocation and distinguish firms by industrial sectors in an attempt to proxy for cost differences that vary with industry.

4. Data and descriptive statistics

Our analysis is based on the Microdatabase Direct investment (MiDi) provided by the Bundesbank, the German central bank. We use the information on outward foreign direct investment by German companies. The database consists of a panel of yearly information on the foreign affiliates of German firms for the period from 1996 until 2008. By the German Foreign Trade and Payment Regulation (Aussenwirtschaftsverordnung), any resident who holds shares or voting rights of at least 10% in a company with a balance sheet total of more than 3 million euro is obliged to report information on the financial characteristics of these affiliates to the Bundesbank (Lipponer, 2009).[5] The same information has to be provided on branches or permanent establishments abroad if their operating assets exceed 3 million euro. The comprehensiveness of these data suggest that they can be used to draw a very reliable picture of the foreign investment of German

[5]The reporting thresholds have changed several times in the past. We only refer to the reporting threshold as of 2002 that is relevant to us.

companies.

The MiDi data include information on parent companies only for the years 2002 to 2008, so the analysis is restricted to these years. During the 2002-2008 period, the MiDi contains 173,312 affiliate-year observations. Some affiliates are reported several times, because multiple investors hold participating interests in them. We focus our analysis on directly held foreign affiliates and thus abstract from more complex incentive structures that may exist in multi-level holding chains.[6] This limits the analysis to 117,585 affiliate-year observations.

For consistency across parents, we delete 218 observations for which the degree of participation of the parent is smaller than the reporting requirement of 10%. In addition, we drop observations on parents in a number of sectors, including government institutions and private households. We drop observations on parents in the financial sector, because they are subject to special balancing requirements, and the reporting requirements for these companies changed during the period of analysis. We delete the sectors housing enterprises and other real estate activities, as they report neither sales nor employees, which we will use as size measure in our analysis. Similarly, we drop the sector "holding companies" as reported sales and employees are very often zero, even though these companies are not small.[7] We later remove this restriction as a robustness check and find that our results are unaffected.

We finally obtain a sample of 54,367 affiliate-year observations that correspond to 19,165 parent-year observations. The observations are distributed evenly across years with a minimum of 2,639 observations and a maximum of 2,875 observations.[8]

We augment the MiDi with information on statutory tax rates mainly from the International Bureau of Fiscal Documentation (IBFD) and information on GDP from the International Monetary Fund (IMF). We use the definition of tax havens derived by Hines and Rice (1994) which is widely accepted in the literature and was only recently used by Dharmapala and Hines (2009).[9] Alternatively, we could have used the definition propagated by the OECD (OECD, 2000). We chose Hines and Rice (1994)'s tax haven definition to derive results which are comparable to the literature, in particular the study by Desai et al. (2006). Further, no OECD member countries appear on the OECD's tax haven list, which thereby omits a number of tax havens popular with German firms, such as Switzerland. Very few investors in the MiDi data hold branches or affiliates in the island states on the OECD tax haven list. Using the OECD's tax haven definition would also preclude using a linear probability model, because the model may not yield accurate coefficients

[6]For an in-depth discussion of the complex determinants of ownership chains, see Weichenrieder and Mintz (2010).

[7]In addition, we delete 331 affiliate-year observations for parents which are not classified holdings, but are de facto holdings after consultations with the statistical department of the Bundesbank.

[8]The distribution of observations across years is provided in Appendix C, Table C.7.

[9]For a list of tax havens, please refer to Appendix A.

given the low incidence of investment in those tax havens (see also Durlauf, Navarro, and Rivers (2010)).

Table 1 presents descriptive evidence on the use of tax havens by sectoral group. For comparative purposes, information on financial firms is provided in addition to information on firms in the manufacturing and service sector which are analyzed later on. On average, a tax haven affiliate is held in 20.4% of parent-years (17.9% excluding financial companies). This figure seems low by international standards: Desai et al. (2006) report that tax haven investment is observed for 37.8% of parent-years in their sample of U.S. multinationals. This difference reflects, in part, the inclusiveness of the German data, in that the size thresholds for reporting are much lower than in the U.S. data analyzed by Desai et al. (2006), resulting in a higher proportion of small firms and those with relatively small foreign operations.[10]

The proportion of firms owning tax haven affiliates is higher for service firms (19.9%) than for manufacturing firms (17.0%), and a larger proportion of service firms own a tax haven affiliate but are not internationally active in non-haven countries. About a fifth of both manufacturing and service firms that are present in tax havens own more than one tax haven affiliate, and the mean number of tax haven affiliates is also approximately equal. In contrast, 37.2% of financial firms hold affiliates in tax havens, and they own on average twice as many tax haven affiliates as do manufacturing and service firms.

The share of affiliates in tax havens that are in the service sector is disproportionately high. For manufacturing firms, the share of service affiliates in tax havens is about 17 percentage points higher than their overall share of affiliates in the service sector, and for service firms, it is eight percentage points higher. Also for financial companies, investment in service affiliates is more common in tax havens than in non-haven countries.

The lower panel of Table 1 reports the number of affiliate-year and parent-year observations by tax haven and sectoral group of the parent firm. It shows that the preferred tax haven destination varies by sectoral group. Manufacturing firms clearly prefer the big tax havens. More than 90% of observations are accumulated there; about 48% in Switzerland alone. The island tax havens, in particular Bermuda, the Cayman Islands and the Channel Islands, are very rare investment destinations. Switzerland is similarly popular among service firms; about half of their tax haven affiliates are located there. Service firms more extensively use the small havens, where almost a fifth of tax haven affiliates are located, most prominently 9% in Luxembourg. For financial companies, Luxembourg is distinctly the most popular destination with 38% of affiliate-year observations in tax

[10]Desai et al. (2006) do not report the mean number of affiliates per parent. Their summary statistics are based on 81,604 affiliate-years and their regressions use 8,435 parent-years, so crude calculations imply a mean of 9.7 affiliates per parent. Desai, Foley, and Hines (2004) use the same data set and report that U.S. parents own between 7.5 and 7.8 affiliates on average in the years 1982, 1989 and 1994. In contrast, parents in our sample average only 2.8 foreign affiliates (4.0 affiliates if indirectly held affiliates are included).

havens. The Cayman Islands are their fourth most important tax haven destination: 10% of affiliate-year observations in tax havens are located there. Evidently, the attractiveness of tax havens strongly depends on sector characteristics.

Table 2 provides an overview of the main variables used in our regression analysis for the full sample and the two subgroups we are going to consider. The variables will be explained in detail in the next section. The proportion of firms investing in a tax haven is lower (around 14%) than for the full data and equal across sectoral groups, because firms only investing in a tax haven drop from the regression sample. As firms with zero sales or employees drop, the average size of the firms used in our regressions is slightly higher than the average size of all firms in the sample. The statistics of the average foreign non-haven tax rate and the instruments for the regression sample are similar.[11] The third columns for every group report mean difference tests of the main regressors by the dependent variable. Firms that invest in a tax haven are on average significantly larger, both domestically and internationally. Manufacturing firms are also significantly more productive, as measured by the ratio of sales to employees. Furthermore, firms investing in tax havens face significantly higher average foreign tax rates, which is consistent with the incentives discussed earlier.

[11] 4.1% of manufacturing firms and 8.6% of service firms drop because only investment in tax havens is observed. 4.0% of the remaining manufacturing firms and 18.0% of service firms drop due to their zero number of employees. Table C.8 in Appendix C presents the corresponding summary statistics for the full data.

Table 1: Choice of tax havens, by sectoral group

Parent sector	Manufacturing		Service		Financial	
Total number of parent years	11,603		6,733		2,506	
of which with tax haven affiliate	1,976		1,337		932	
of which						
internationally active parents	75.81%		52.43%		57.19%	
with more than one t.h. affiliate	22.87%		18.03%			
	non haven	tax haven	non haven	tax haven	non haven	tax haven
Number of affiliate years	33,203	2,829	14,427	1,768	7,897	2,294
of which						
in manufacturing sector	51.19%	32.63%	12.08%	4.81%	3.89%	0.74%
in service sector	46.69%	63.56%	82.20%	90.16%	15.35%	18.09%
in financial sector	1.38%	3.39%	4.76%	4.58%	79.84%	81.17%
other	0.75%	0.42%	0.96%	0.45%	0.92%	–
Mean number of affiliates per parent	3.77	1.43	4.07	1.32	3.75	2.46

Choice of haven	Manufacturing		Service		Financial	
	aff. years	par. years	aff. years	par. years	aff. years	par. years
Big havens: more than 1 million inhabitants						
Hong Kong	459	410	233	219	164	104
Ireland	226	215	78	61	252	188
Lebanon	12	12	.	.	8	8
Liberia	.	.	16	16	.	.
Panama	19	19	20	20	3	3
Singapore	517	467	204	185	203	127
Switzerland	1,368	1,242	880	814	359	312
Small havens: less than 1 million inhabitants						
Bermuda	.	.	13	13	23	19
British Virgin Islands	21	17	11	11	22	20
Cayman Islands	.	.	3	3	233	127
Cyprus	22	22	60	17	8	8
Channel Islands	.	.	19	19	89	28
Luxembourg	124	114	163	151	864	587
Malta	38	38	39	30	16	10
Other	23	21	29	27	50	32
Total	2,829	2,577	1,768	1,586	2,294	1,573

. denotes tax havens where fewer than three affiliate-years or parent-years are observed, so the exact number of investments must not be reported for confidentiality reasons.

Manufacturing firms: firms classified NACE 1500-3700, *service firms:* firms classified NACE 5000-9300, with the before mentioned sample restrictions, *financial firms:* firms classified NACE 6500-7000.

If a parent invests in several tax havens, it is counted multiple times (once per tax haven).

Table 2: Summary statistics, regression sample

	Full sample			Manufacturing firms			Service firms		
	Mean	SD	Mean Diff.	Mean	SD	Mean Diff.	Mean	SD	Mean Diff.
Have haven	.140	.347	—	.141	.348	—	.139	.346	—
[within variation]		.132	—		.127	—		.129	—
# parent employees (in 1,000)	1.252	7.255	3.660***	1.268	6.471	3.790***	1.258	9.058	3.602***
Ln (# parent employees)	5.512	1.784	1.217***	5.932	1.407	1.094***	4.618	2.128	1.409***
Parent productivity	5.765	1.102	.063*	5.496	.765	.096***	6.313	1.426	.017
# non-haven employees (in 1,000)	.463	2.306	1.418***	.525	2.677	1.761***	.340	1.375	.757***
Ln (# non-haven employees)	4.484	1.737	1.369***	4.679	1.666	1.504***	4.097	1.790	1.085***
Ave. foreign non-haven tax rate	30.617	5.406	1.679***	31.120	5.163	1.578***	30.013	5.529	1.552***
Comp. foreign non-h. tax rate	33.419	1.358	.057	33.696	1.076	.090**	33.124	1.386	-.002
Observations	16409			10661			5052		

Note: Regression sample if number of employees used as size measure. Full sample additionally includes parent firms in the sectors agriculture, mining, electricity and water supply, and construction. Mean difference by haven status; base category: does not hold an affiliate in tax haven. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Manufacturing firms: firms classified NACE 1500-3700, *service firms:* firms classified NACE 5000-9300, with the before mentioned sample restrictions. *Have haven:* indicator variable; 1 if parent firm owns at least one affiliate in at least one tax haven in a given year, 0 otherwise. *# parent employees:* number of employees, parent firm. *Parent productivity:* natural logarithm of parent sales over parent employees. *# non-haven employees:* sum of number of employees in affiliates which are not located in tax havens, reduced according to share of participating interests. *Average foreign non-haven tax rate:* GDP weighted average of the statutory tax rates at the foreign non-haven locations per parent firm. *Comp. foreign non-h. tax rate:* GDP weighted average of the statutory tax rates at the foreign non-haven locations of the other firms in the same NACE 2-digit sector.

5. Empirical Approach

As outlined in section 3, a multinational firm's decision to invest in a tax haven depends on the taxation it faces at its foreign non-haven locations, its marginal cost of reallocating taxable income and the fixed cost of tax haven investment. The probability of tax haven investment should increase as foreign non-haven tax rates rise, with this effect being strongest for firms with low costs of reallocating profits.

We specify the following linear probability model:

$$y_{jt} = \beta_0 + \beta_1 \tau_{jt} + \beta_2 p_{jt} + \beta_3 p_{jt}^2 + \beta_4 nh_{jt} + \beta_5 nh_{jt}^2 + \gamma_t + u_{jt} \tag{28}$$

The dependent variable y_{jt} is a dummy which is equal to one if a firm j holds at least one affiliate in at least one tax haven in a year t. Our independent variables are τ_{jt}, the average of the statutory tax rates faced by j's non-haven affiliates in t weighted by host country GDP, p_{jt}, the natural log of the size of company j in period t and its square, p_{jt}^2, nh_{jt}, the natural log of the size of j's foreign non-haven activities in t and its square, nh_{jt}^2, and γ_t, a year fixed effect.

The coefficient of main interest is β_1. It captures the effect of the taxes levied on profits of a multinational's foreign non-haven affiliates on the probability that it invests in a tax haven. Equation (18) implies that greater firm profitability increases the impact of non-haven tax rates on the likelihood of investing in a tax haven affiliate. Thus, we use a weighted, not a simple average of the foreign non-haven tax rates. We cannot use before-tax profits as weights, as our data contain only after-tax profits which are doubly distorted due to taxation and profit reallocation, so we use host country GDP instead. Profits should increase with host country market size, so weighting the foreign non-haven tax rates with GDP enables us to exogenously approximate their relative importance for a multinational.[12] As indicated above, we expect $\beta_1 > 0$.

In principle, the probability of tax haven investment is also influenced by taxation in the multinational's home country. As we use a panel data set of German multinational firms, this effect cannot be gauged explicitly due to lack of sufficient variation. Still, changes in home country taxation are indirectly taken into account through the year fixed effect.

[12] Earlier studies indicate that GDP correlates very closely with foreign investment and foreign profitability, both in an aggregate cross section (e.g. Hines and Rice, 1994) and in a firm-level panel (e.g. Desai et al., 2006). As an alternative to GDP weights, we considered using firm-level weights, such as assets, sales or the number of employees. None of these measures is similarly satisfactory however. We observe only fixed *and* intangible assets, not fixed assets separately, so this variable is very likely influenced by tax-avoidance behavior. As pointed out below, a similar concern can be raised against the use of sales. Concerning the number of employees, high taxes will be systematically underweighted and low taxes overweighted if taxation affects the intensive margin of firm decisions. Nonetheless, we checked the correlation of our tax measure and the measures resulting from other weighting schemes, and we found that our measure is very highly and significantly correlated with them, see Appendix C, Table C.9.

Other independent variables include parent size and the size of the parent's non-haven activities, capturing the impact of size on profitability. Recent literature on foreign direct investment suggests that larger firms with bigger international activities can be expected to be more productive than their smaller competitors (Helpman, Melitz, and Yeaple, 2004, Tomiura, 2007, Yeaple, 2009, Chen and Moore, 2010, e.g.). Consequently, these firms are better able to overcome the fixed and variable costs associated with setting up an affiliate in a tax haven and its subsequent use for income reallocation.

We use numbers of employees to measure parent size and the size of the company's foreign non-haven activities, reduced according to the share of participation interests where applicable. The advantage of this size measure is that it is less likely to be affected by profit reallocation activities than are alternatives such as sales. For example, foreign affiliates may be permitted to use the distribution network of the parent company in exchange for a small fee to sell their products directly to customers, so sales and profits accrue abroad.[13] As the distribution of the size variables is strongly skewed to the right, the regressions use the natural log of sales as a size measure. Thus, observations for which the size variables are zero drop from our regression sample. Following Desai et al. (2006), regressions include the size measures both linearly and squared.

The variable cost of using a tax haven should vary with firm-specific characteristics such as the R&D intensity of a firm. The location of intangible assets, licence arrangements and royalty payments have been shown to be used as income reallocation tools (e.g. Dischinger and Riedel, 2011, Karkinsky and Riedel, 2009).[14] A firm with larger intangible assets should have greater discretion in choosing transfer prices due to the lack of comparable market transactions. Thus, and as also shown in equation (19), the response to changes in foreign taxation should vary across firms depending on their marginal cost of income reallocation. These firm specific characteristics are, however, unobservable.

We take two measures to address this issue. On the one hand, we conduct our analysis separately for the group of manufacturing firms (NACE 1500-3700) and for the group of service firms (NACE 5000-9300, with the before mentioned sample restrictions),[15] because the latter have a systematically smaller R&D intensity than the former. Using sector-level data from the Innovation Survey of the Center for European Economic Research (Zentrum für Europäische Wirtschaftsforschung, ZEW) for the years 1996-2008, we find that the average R&D intensity for the manufacturing sector is twice as high as the R&D intensity

[13]For an illustrative example, see the case study "Alpha Company" in the report prepared by the Joint Committee on Taxation for the public background hearing by the House Committee on Ways and Means in July 2010 (Joint Committee on Taxation, 2010).

[14]In addition, a variant of this type of strategy is part of all six case studies of the report by the Joint Committee on Taxation prepared for the public hearing before the House Committee on Ways and Means (Joint Committee on Taxation, 2010).

[15]This implies that we do not consider parent firms in agriculture, mining, electricity and water supply, and construction in our analysis.

for service sectors. At the same time, the descriptive evidence provided in section 4 shows that the proportion of service firms owning tax haven affiliates and the share of service firms' affiliate-years observed in tax havens are higher than the corresponding statistics for manufacturing firms. This could point to lower fixed costs of tax haven investment for service firms. In addition, the share of service affiliates of manufacturing parents located in tax havens is disproportionately higher than the share located in non-haven countries. Overall, there is thus reason to believe that the processes governing tax haven investment by service firms and by manufacturing firms may differ significantly, which suggests that they should be analyzed separately.

The empirical analysis uses firm-fixed effects to capture the influence of firm-specific differences in the marginal cost of income reallocation, at least to the extent that they are approximately constant over the sample period. Fixed effects also account for unobserved firm-specific characteristics such as the degree of tax sensitivity, that is, the importance that a firm assigns to the amount of its tax payments, which may render firms ex ante more or less likely to invest in tax havens.[16] Likewise, the data provide information on the sector of the affiliates mostly at the two-digit NACE Rev. 1 level, so particular incentive schemes for firms in sub-sectors cannot be taken into account, and we do not have information on the sub-national location of firms, so we cannot account for local taxation. The use of firm-fixed effects controls for time-invariant aspects of these firm attributes.

In estimating equation (28), it is necessary to take into account that the average foreign non-haven tax rate is endogenous because entry in a tax haven has a feedback effect on the optimal profit shifting and location decisions of a firm. To address this issue, we follow one of the methods used by Desai et al. (2006), and instrument the parent's foreign non-haven tax rate with the competitors' average foreign non-haven tax rate. The competitors are defined as the other firms in the same sector. Firms in the same sector react to similar incentives in choosing their investment destinations because similar location factors are beneficial for them. At the same time, the competitors' investment decision is exogenous to whether a certain firm in the sector invests in a tax haven.[17]

A potential concern which could be raised against our instrumentation strategy is that the propensity of a firm to invest in a tax haven could be affected by the prevalence of tax haven investment in its sector. One could suspect that a firm's tax haven investment decision is directly affected by the choices of other firms in the same sector. Alternatively, it is possible that the tax haven investment by firms in the same sector is correlated because entry in a tax haven of some firms exerts competitive pressure on the remaining firms in the sector to follow suit. In short, one could query whether endogenous and

[16] This issue has already been raised, but not addressed in Desai et al. (2006, p. 514).

[17] Note that this instrumentation strategy implies that we cannot use sector dummies in our analysis.

correlated group effects as discussed by Manski (1993) are present. Yet, as highlighted by Manski (1993), the existence and detection of group effects presupposes that the reference group relevant to an individual is correctly specified and that the group mean behavior can be correctly perceived by the individual group members. Given these prerequisites, this source of endogenous or correlated group effects seems unlikely to exert a significant effect on the estimates.

Firms usually offer multiple products and are active in various national and foreign markets. Their choice of products and markets determines their competitors and thus the reference groups for their decisions. Our data only contain German multinational firms. The sector classification is the NACE two digit sector code assigned to the firm by the statistical department of the Bundesbank based on a description of the main activity of a firm. It is coarse and the resulting firm groups are sizeable.[18]

For some endogenous effect to exist, a firm would have to be able to observe the other firms' mean tax haven investment and activities. There is no evident way how firms could obtain this information. One potential channel for tax haven investment to spread might be that firms consult the same tax advisory company. Tax consultancies are not specialized with respect to certain sectors however, and immediate competitors can be expected to take care to choose different tax advisory companies. Suggestive evidence for this conjecture can be found in Asker and Ljungqvist (2010) who study the choice of investment banks and M&A advisors.

With regard to correlation due to competitive pressure, one could argue that firms are forced to invest in tax havens by similar mechanisms as they may be coerced to adopt a technological innovation: competitors could be able to offer higher returns on investment to investors or could entice clients away as they are able to charge lower prices due to savings through their tax haven activities. Tax haven investment and technological innovation are only seemingly parallel, however. Investors will not compare firms within the same sector, but investment options across all firms. Further, firms will usually spread that they have succeeded to innovate, but, for sake of reputation, are unlikely to announce that they have opened a tax haven affiliate and intend to reallocate taxable income there.

Finally, there is also the possibility that firms in similar industries are influenced by correlated omitted variables that influence the location of all of their foreign investments, including tax havens and non-havens. It is difficult to rule out this possibility, though its implication is likely to be that estimated tax effects are biased in the direction of low non-haven tax rates increasing the likelihood of tax haven investment. Tax havens, after all, are low-tax locations. If firms in a given industry are prone to invest in low-tax jurisdictions, with little or no causal interaction among these investment decisions, then the regression estimates are apt to show that low non-haven tax rates are correlated with

[18]For an overview of the size of sectoral groups and their scope, please refer to Appendix C, Table C.10.

tax haven investments. Since the estimated effects come out the opposite of this, there may be reason to expect that the impact of correlated omitted variables is not particularly strong. Further evidence suggesting that correlated omitted variables do not excessively bias the estimates comes from the panel-based estimation that removes the impact of firm fixed effects and nevertheless produces results that are similar to those reported for the cross-section.

In sum, we estimate our regression equation in four different ways:

- pooled linear probability model,

- pooled linear instrumental variables model,

- linear fixed effects model,

- linear fixed effects model with instrumental variables.

The linear fixed effects model with instrumental variables is our preferred specification because it takes all sources of endogeneity into account. Nevertheless, we report the results of all four specifications, because they offer evidence of the factors that drive a firm's decision to invest in a tax haven beyond that available from only the fixed effects IV regression. By comparing pooled and instrumental variables estimates, it is possible to assess the bias due to endogeneity of the foreign location decisions. Juxtaposing the results of pooled and fixed effects specifications facilitates a balanced assessment of the influence of taxation, abstracting from unobservable differences in costs of using tax haven operations.

We use a linear probability model because otherwise it would be difficult to address the endogeneity issues satisfactorily in a limited dependent variables framework.[19] Using logit or probit would yield more accurate marginal effects at different points of the distribution of the covariates. In the logit framework, using firm fixed effects would be possible, but it is more problematic to use instruments.[20] In the probit framework, we could conduct an instrumental variables analysis (though under very strong distributional assumptions), but would not be able to use firm fixed effects.

We generally use standard errors clustered at the level of the parent. For the fixed effects instrumental variables regression, we use bootstrapped standard errors, as clustered standard errors cannot be estimated. As recommended by Efron and Tibshirani (1998), the bootstrap estimates are based on 200 replications.

[19] As far as possible, we have replicated our results using logit, probit, fixed effects logit and IV probit, see section 7.1 below.

[20] Purely practically, one could construct an IV variant of fixed effects logit by plugging in the predicted values from an OLS first stage regression in place of the endogenous variable and run a fixed effects logit second stage regression. We refrain from doing so because this approach may not produce consistent estimates, as conditional expectations do not pass through non-linear functions (see Wooldridge (2002, p. 235-237) and Angrist and Pischke (2009, p. 190-192)).

Table 3: Regression results

	Manufacturing firms				Service firms			
	1	2	3	4	5	6	7	8
	OLS	2SLS	FE	FE IV	OLS	2SLS	FE	FE IV
Ave. foreign	0.007***	0.027***	0.002***	0.039*	0.007***	0.029	-0.000	-0.046
n.h. tax rate	(0.001)	(0.007)	(0.001)	(0.023)	(0.001)	(0.021)	(0.001)	(0.165)
Parent size	-0.064***	-0.060***	-0.013	-0.008	0.024	0.023	-0.002	0.007
	(0.021)	(0.021)	(0.025)	(0.030)	(0.016)	(0.017)	(0.013)	(0.053)
Parent size,	0.008***	0.007***	0.003	0.002	-0.000	-0.000	0.001	-0.001
squared	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.006)
Foreign non-	-0.051***	-0.042***	-0.052***	-0.036	-0.063***	-0.046	-0.037*	-0.051
haven size	(0.015)	(0.015)	(0.014)	(0.024)	(0.024)	(0.029)	(0.020)	(0.051)
Foreign n.h. size,	0.011***	0.011***	0.009***	0.006*	0.011***	0.010***	0.009***	0.011
squared	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.010)
Constant	-0.006	-0.597***	0.051	-0.995	-0.160**	-0.742	0.119**	1.357
	(0.060)	(0.212)	(0.068)	(0.684)	(0.069)	(0.604)	(0.055)	(4.443)
# of observations	10661	10661	10661	10661	5052	5047	5052	5047
# of parents	2320	2320	2320	2320	1270	1269	1270	1269
R-squared	0.17	0.09	0.01	–	0.11	–	0.02	–
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
Instrument	N	Y	N	Y	N	Y	N	Y
F-Statistics	–	40.95***	–	6.53**	–	5.76**	–	3.36*
Standard errors	Cluster	Cluster	Cluster	Bootstrap	Cluster	Cluster	Cluster	Bootstrap

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses. Standard errors are clustered at the level of the parent firm or bootstrapped with 200 replications.

Note: the coefficients of foreign non-haven size in column 4 are significant at 12.5% (linear term) and 5.3% (squared term). The F-statistic for the instrument is significant at 1.07%. In column 6, the coefficient of linear non-haven size has a P-value of 10.7%.

Regression sample: column 1-4 manufacturing firms, i.e. firms classified NACE 1500-3700; column 5-8 service firms, i.e. firms classified NACE 500-9300, except NACE 65xx, 70xx, 7490, 75xx, 95xx. Dependent variable: dummy variable which denotes whether a parent owns at least one affiliate in at least one tax haven in a given year. Independent variables: see Table 2.

6. Results

Table 3 presents the regression results. The first four columns in the table present results for the sample of manufacturing firms and columns 5-8 present results for the sample of service firms. The odd-numbered columns present the results if no instrument is used, and the even-numbered columns contain the IV estimates.

For the sample of manufacturing firms, the F-test for exclusion of the instrument in the first stage regression is rejected at high significance levels in all cases. The value of the F-statistic is smaller than ten in the fixed effects IV setting, that is, below the threshold recommended by Staiger and Stock (1997) commonly referred to in the literature. Note, however, that the F-statistic is examined to prevent bias due to weak instruments, which is proportional to the degree of overidentification. Our model is just identified and therefore median-unbiased. The value of the F-statistic is thus less of a concern in our case (Angrist and Krueger, 2001, Angrist and Pischke, 2009).

The average foreign non-haven tax rate is estimated to have a significantly positive effect on the probability of a manufacturing firm's investing in a tax haven throughout regressions. The coefficient in the 2SLS regressions is about four times higher, and significantly so, than the coefficient in the pooled OLS regression, which does not take the endogeneity of the average foreign non-haven tax rate into account. Likewise, the coefficient in the fixed effects IV specification is higher than in the simple fixed effects regressions. This suggests that the true effect of the average foreign non-haven tax rate is underestimated if its endogeneity due to simultaneity is not taken into account. As explained in section 3, this finding indicates that multinationals expand their activities in a way such that their average foreign non-haven tax rate decreases following tax haven investment. Given that some of the largest and most popular investment destinations of German firms, such as the United States or France, also have the highest statutory tax rates, this is consistent with multinationals' investing in more sizeable and profitable markets first.

Greater domestic and foreign activities are associated with higher likelihood of tax haven investment, and the estimated coefficients on the size variables are largely unaffected by the use of the instruments. The effect of parent size turns insignificant in specifications that include fixed effects.

As the regression results in the columns 5-8 of Table 3 show, the estimated effect of the average foreign non-haven tax rate on tax haven investment by service firms varies with the estimation approach. It is positive and significant in the pooled OLS specification; larger, but only with P-values of 16.9% when estimated with 2SLS, though the point estimates of the tax coefficients in the regressions for service firms in columns 5 and 6 are almost identical to the point estimates of the tax coefficients in the corresponding regressions for manufacturing firms presented in columns 1 and 2. The tax coefficients in the fixed effects regressions for service firms reported in columns 7 and 8 are statistically zero.

The probability of tax haven investment by service firms is generally unaffected by the size of the parent company. Levels of foreign activity outside of tax havens are estimated to have nonlinear, and, except in the regressions reported in column 8, significant effects on tax haven operations, similar to the effects found for manufacturing firms.

None of our covariates is significant in the fixed effects instrumental variables regressions. The low level of significance of the F-statistics for the instrument indicates that our instrument is not strong enough to draw valid inferences. This is also reflected in the constant being larger than one even though none of the other covariates is estimated to have a significant effect. Our result does not stem from the within variation of the tax variables being too low for service firms to identify a tax effect. The within standard deviation is 2.42 for the service firms compared to 2.27 for manufacturing firms. The insignificance of the tax rate thus suggests that omitted variables play a comparatively larger role in tax

haven investment decisions of service firms than they do for manufacturing firms.

Our preferred estimates come from the fixed effects IV specification. They show that manufacturing firms are more likely to invest in tax havens if they face higher tax rates in their foreign non-haven locations, even if unobservable differences in the cost of income reallocation are taken into account. In contrast, we do not find a clear tax effect for service firms in our preferred framework. This difference may reflect a combination of factors: that service firms have higher costs of reallocating profits, or exhibit lower variability in these costs. Manufacturing firms may rely to a greater average extent than service firms on the returns to intangible property, the location of which may be more readily reallocated for tax purposes than are other forms of income, but the distribution of which is highly skewed, with some manufacturing firms earning significant fractions of their profits from intangible property, and others very little. These factors would imply that foreign non-haven tax rates should affect tax haven demand by manufacturing firms more heavily than service firms, even though service firms are at least as likely as manufacturing firms to establish tax haven operations in the first place. The 2SLS estimates appear to pick up the effect of omitted differences in the costs of income reallocation. A further indication in this direction is that the sector-level R&D intensities that are used in subsequent regressions to proxy for the costs of reallocating taxable income in section 7.3 are positively correlated with average foreign non-haven tax rates.

A further interesting finding is that parent size is a significant determinant of tax haven use by manufacturing firms only. Together with the relatively higher prevalence of tax haven investment by service firms described in section 4, this evidence is in accord with a much lower fixed cost of tax haven investment by service firms. As outlined above, the German anti-deferral provisions imply that a multinational does not only need to formally establish a company in a tax haven (often referred to as "letterbox company"), but has to locate some productive activity there. Our evidence suggests that this could be more costly on net for manufacturing than for service firms.

7. Robustness checks

The following two subsections present estimated coefficients from specifications that modify the basic econometric framework; from this evidence it appears that the results reported in section 6 are largely robust. The estimates in subsection 7.3 attempt to shed light on the firm characteristics captured by the firm fixed effects. Subsections 7.4 and 7.5 explicitly address three purely econometric interpretations of the results. The first of these is that a firm investing in a tax haven may find it attractive to invest at further non-haven locations to broaden the base of profits. Thus, not only the average foreign non-haven tax rate, but also non-haven size may be endogenous. Second, the F-test for exclusion of the instrument in the fixed effects instrumental variables regression

for service firms is rejected only at the 10% level, so we may face bias due to weakness of the instrument. Third, the regression sample of service firms could be non-randomly selected and biased towards larger firms, because 18.0 percent of available observations on service firms drop as the observed size measure is zero.[21] In contrast, only 5 percent of observations on manufacturing firms with non-haven investment drop for this reason. On closer inspection, none of these issues appears to explain our results.

7.1. Simple modifications of baseline specification

To test whether our results are driven by the specific setup of our baseline econometric analysis, we explore a number of variations, none of which substantially affects our main findings. The results of these robustness checks are tabled in Appendix C.

First, we re-estimate the linear probability model using sales as size measure. For the sample of manufacturing firms, the sign pattern of the coefficients is unaffected. Merely parent size turns insignificant in all specifications. This is noteworthy given the above mentioned possibility to use sales for profit shifting, Germany's high tax rate and the resulting potential for tax haven operations to be used to reallocate profits out of Germany and into a tax haven, particularly by large firms with more taxes to save. The main difference for service firms is that the tax variable becomes significant at the 10% level in the 2SLS specification. It remains insignificant in the fixed effects specifications, though there is still evidence of weakness of the instrument in the fixed effects instrumental variables regression. Overall, this finding is in accord with our interpretation that the fixed cost of tax haven investment and the marginal cost of profit shifting are more important determinants of tax haven investment by service firms than by manufacturing firms (see Tables C.15 and C.16 in Appendix C).

In addition, we re-estimate our model with employees as the size measure, but replace the parent size variables with a simple estimate of parent productivity, the natural log of parent sales over parent employees, as used by Helpman et al. (2004). We cannot use a more sophisticated productivity estimate, as sector, number of employees, sales and balance sheet total are the only parent company information in the data. We conduct this regression both for the full period and for the years 2004-2008 only, because parent sales and employees were both surveyed compulsorily only from 2004 on. For earlier years, in case of missing values, one item may have been estimated based on the other, so using both variables in the same regression would not be appropriate. Our results are largely robust to this modification (see Tables C.11-C.14 in Appendix C). In particular, the average foreign non-haven tax rate is still insignificantly negative in the fixed effects IV specifications for service firms, but the F-statistic is highly significant, so this finding

[21] Overall, only 75 percent of service firms are used in the regression. 8.6 percent of firms drop because they only invest in a tax haven. The proportion reported above is calculated relative to the sample of firms for which non-haven investment is observed.

is not clearly attributable to some weakness of the instrumental variable in this case.

Further, we re-estimate our baseline equation using limited dependent variable models as far as possible: probit, logit, IV probit and fixed effects logit. The IV probit model rests on the assumption that the endogenous variable is normally distributed conditional on the instrument and parameters are only consistent if the error term is homoskedastic. As it is uncertain whether these assumptions are valid in our case, the results have to be interpreted with caution. The findings for manufacturing firms largely confirm our previous results. Similarly to before, the tax variable is significant at the 10% level in the IV probit regression for service firms, but insignificant in the fixed effects logit framework (see Tables C.17 and C.18 in Appendix C).

Next, we re-include the sector "holding companies" in our analysis. We dropped this sector before because holding companies usually report zero sales and employees even though the actual companies are not small, and as the sector comprises firms with the same administrative structure, but activities that actually belong to various other sectors. To address the diversity of the sector, we assign parents the sector of the corporate group, using a variable specifically created to address this issue in our data set. After dropping financial companies, government institutions and private households, we obtain a sample of 21,104 parent-year observations in the manufacturing sector and 13,059 parent-year observations in the service sector.[22] Our findings both for manufacturing firms and for service firms are robust. Note in particular that again the average foreign non-haven tax rate is estimated to have an insignificantly negative effect on the probability that a service firm invests in a tax haven in the fixed effects IV specification, but the F-statistic indicates sufficient strength of the instrument (see also Tables C.19 and C.20 in Appendix C).

7.2. Sensitivity to choice of tax havens and tax rates

The descriptive statistics in section 4 show that Switzerland is by far the most important tax haven for German firms. This is not surprising given its geographical, linguistic and cultural proximity to Germany. It is nonetheless potentially worrisome that the findings could be driven by the dominance of this single tax haven, but as it happens, the results are robust to dropping all affiliates located in Switzerland (see Tables C.21 and C.22 in Appendix C).

The main analysis uses statutory corporate tax rates to capture incentives for income reallocation and thus tax haven use. This may not correctly capture tax differences because profits may not be taxed in full at this rate. To address this concern, we alternatively use the effective tax rates collected by Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010). As these data are available for the year 2004 only, we can only test the robustness

[22]Note that only two thirds of observations on manufacturing firms and only half of observations on service firms are usable in our regressions because the reported number of employees is zero.

of the pooled specifications. We obtain coefficients of the same sign and significance and similar magnitude as before (see Table C.23 in Appendix C).

7.3. Sector-level R&D intensities as proxy for the marginal cost of profit shifting

A firm's R&D intensity is a factor that is particularly likely to influence the marginal cost of income reallocation. We use firm-fixed effects in our main econometric analysis to capture firm-specific differences in the marginal costs of income reallocation, because we do not have a firm level measure of R&D activities.

In order to shed light on the question of the extent to which the marginal costs of income reallocation play a role for tax haven investment, we use sectoral data on R&D intensity, which are provided by the Center for European Economic Research (Zentrum für Europäische Wirtschaftsforschung, ZEW) based on its annual Innovation Survey. We include the sectoral R&D intensities in our pooled regressions. We refrain from doing so in the regressions with firm fixed effects because the firm fixed effects capture firm level heterogeneity with regard to the R&D intensity, so the firm fixed effects and the sectoral R&D data are collinear.[23]

We cluster the standard errors on sector level and drop firms assigned to different sectors in different years to avoid artificial variation.[24] Our findings are presented in Table 4.

The estimates for manufacturing firms are largely unaffected by the inclusion of R&D intensity, which has an insignificantly negative coefficient in both specifications. This is in line with the hypothesis that the variable costs of income reallocation by manufacturing firms are low, and that manufacturing firms therefore strongly respond to taxation in their decision to invest in tax havens.

For service firms, the estimated effect is positive with a P-value of 13.3% and 19.4%. The most notable change in the other coefficients is that the average foreign non-haven tax rate becomes negative and insignificant in the IV regressions if R&D intensity is included. This corresponds to our finding for the fixed effects instrumental variables regressions. Taken together, these observations are evidence in favor of the interpretation that the baseline results point to the marginal costs of income reallocation being higher for service firms, which consequently do not strongly react to taxation in their choice of tax haven investment.

7.4. Potential endogeneity of foreign non-haven size

A comparison of equations (10) and (14) shows that investing in a tax haven renders investing at other foreign non-haven locations more attractive for a multinational firm,

[23] We also included an interaction term of R&D and the tax rate. As both R&D and the interaction term usually turned out insignificant however, we do not report these results here. The results are available from the authors upon request.

[24] 639 manufacturing firms and 322 service firms are dropped for this reason.

Table 4: Regressions including sector R&D intensity

	Manufacturing		Services	
	1	2	3	4
	OLS	IV	OLS	IV
Average foreign nh. tax rate	0.007***	0.033***	0.006***	-0.053
	(0.001)	(0.010)	(0.001)	(0.065)
Parent size	-0.060**	-0.057**	0.014	0.013
	(0.022)	(0.023)	(0.015)	(0.015)
Parent size, squared	0.008***	0.007***	0.002	0.003**
	(0.002)	(0.002)	(0.002)	(0.002)
Non-haven size	-0.051**	-0.038	-0.076***	-0.115**
	(0.021)	(0.025)	(0.022)	(0.048)
Non-haven size, squared	0.011***	0.010***	0.013***	0.016***
	(0.003)	(0.003)	(0.002)	(0.004)
Sector R&D intensity	-0.001	-0.007	0.009	0.027
	(0.006)	(0.007)	(0.006)	(0.021)
Constant	-0.026	-0.755***	-0.112**	1.544
	(0.077)	(0.291)	(0.050)	(1.805)
# of observations	9915	9915	3860	3860
# of sectoral groups	23	23	14	14
R-squared	0.17	0.04	0.16	–
Year Dummies	Y	Y	Y	Y
Instrument	N	Y	N	Y
F-Statistics	–	11.88***	–	4.78*
Standard errors	Cluster	Cluster	Cluster	Cluster

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses. Standard errors are clustered at the level of the parent firm.

Note: The coefficient of the sector R&D intensity has a P-value of 13.3% in column 3 and of 19.4% in column 4. Dependent variable: dummy variable which denotes whether a parent owns at least one affiliate in at least one tax haven in a given year. Independent variables: see Table 2; *sector R&D intensity:* calculated as expenditures on innovation over total sales by sector.

because it can thereby enlarge its base of income available to reallocate. Therefore, not only the average foreign non-haven tax rate, but also non-haven size, may be endogenous. To address this issue, we use an instrumentation strategy that abstracts from changes in non-haven locations. We use this idea both to take endogeneity of the non-haven size into account and to conduct a robustness check of our previous instrumentation strategy.

We focus our analysis on the years 2002 and 2008.[25] We restrict our regression sample to firms that changed their tax haven use between 2002 and 2008. Thus, our strategy mimics fixed effects logit, where the coefficients are identified given that the dependent variable has changed. We define a new dependent variable that takes the value zero if a firm holds a tax haven affiliate in 2002 and does not in 2008, and the value one if a firm

[25]Note that considerable fraction of variation is lost in this manner, because firms exit before 2008 or enter after 2002, or because they revise their decision to invest in a tax haven more than once during our period of analysis.

does not have a tax haven affiliate in 2002 and does so in 2008:

$$\Delta_i = \begin{cases} 0 & \text{if } y_{i2002} = 1 \text{ and } y_{i2008} = 0 \\ 1 & \text{if } y_{i2002} = 0 \text{ and } y_{i2008} = 1 \end{cases} \tag{29}$$

About 60% of firms start using a tax haven, around 40% of firms close down their tax haven activities. As independent variables, we use changes in parent size, the size of non-haven activities and the average foreign non-haven tax rate. This way, we partial out the firm fixed effect.

To construct the instrument, we focus on affiliates that a multinational holds in both 2002 and 2008, because tax rate changes at these locations are exogenous to any locational changes that a firm has made after opening an affiliate in a tax haven or closing down its haven activities. To take the endogeneity of the foreign non-haven size into account, we use the insight that affiliate growth can be very well explained by GDP growth with a coefficient that is not significantly different from one (Desai et al., 2006). We inflate the size of the foreign non-haven affiliates in 2002 by GDP growth between 2002 and 2008 and use the resulting hypothetical change in the foreign non-haven size as an instrument for the actual change in foreign non-haven size between 2008 and 2002. Only actual non-haven size includes affiliates which may have been opened or closed due to the decision to invest or stop investing in a tax haven. Note that we can only include size linearly in our regression because our strategy yields only one instrument.

We instrument the difference of the average foreign non-haven tax rates with the difference of tax rates had a firm refrained from adjustments in its location choices. The idea of this alternative instrument is to capture changes in the firm's average tax rate that are exogenous to the firm and do not depend on changes in tax haven use.

We calculate the sum of the differences of the tax rates interacted with GDP at the locations where a firm is present in both 2002 and 2008 and weight the single differences with the difference in GDP:

$$T_{it} = \frac{\sum_{l=1}^{L}(\tau_{l,2008} \cdot GDP_{l,2008} - \tau_{l,2002} \cdot GDP_{l,2002})}{\sum_{l=1}^{L}(GDP_{l,2008} - GDP_{l,2002})}, \tag{30}$$

where $l = 1, ..., L$ are the locations of a firm in both 2002 and 2008.

Table 5 presents the estimation results, which, for manufacturing firms, are largely consistent with estimated tax effects obtained earlier using different identification methods and much larger samples. In the specification that instruments only for the average foreign non-haven tax rate, the 0.052 coefficient indicates that firms whose average foreign non-haven tax rates increase are more likely than others to add a tax haven affiliate. This effect is significant at the 5.9% level in a two-tailed test, implying that it is possible to reject (using a one-tailed test) that high non-haven foreign tax rates discourage tax haven

Table 5: Regression results, alternative instrumentation strategy

	Manufacturing firms		Service firms	
	1	2	3	4
Δ ave. foreign	0.052*	0.048	0.052	0.056
n.h. tax rate	(0.027)	(0.036)	(0.030)	(0.030)
Δ parent size	0.120***	0.122***	0.134	0.134
	(0.041)	(0.041)	(0.143)	(0.134)
Δ non-haven size	0.153**	0.181	0.128***	0.205**
	(0.069)	(0.128)	(0.044)	(0.101)
Constant	0.704***	0.683***	0.731***	0.686***
	(0.123)	(0.170)	(0.162)	(0.189)
# of parents	88	88	32	32
R-squared	0.20	0.20	0.22	0.18
Endogenous variable	Tax	Tax & Size	Tax	Tax & Size
F-statistics (tax)	27.35***	32.86***	27.24***	14.77***
F-statistics (size)	–	42.80***	–	2.56*
Partial R-squared (tax)	–	0.16	–	0.45
Partial R-squared (size)	–	0.12	–	0.17
Standard errors	Robust	Robust	Robust	Robust

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Note: the significance level of the coefficient of non-haven size is 15.6% in column 2. The coefficient of the average foreign non-haven tax rate has a P-value of 18.7% in column 2 and 24.7% in column 4. Dependent variable: dummy variable; 1 if a parent firm did not hold an affiliate in a tax haven in 2002, but does so in 2008, zero if it did hold a tax haven affiliate in 2002 and does not so in 2008. Independent variables: differences in the average foreign non-haven tax rate, the number of parent employees and the number of non-haven employees between 2002 and 2008.

affiliate ownership, as reported by Desai et al. (2006) for U.S. firms. If both non-haven size and taxation are instrumented, the resulting coefficients are of similar magnitude but lower significance levels, reflecting in part the small sample size. Firms with growing parent companies are more likely than others to add tax haven affiliates, which is consistent with earlier findings.

It is difficult to draw ambitious inferences about the behavior of service firms from the regressions reported in columns 3-4, largely due to the problem of using instrumental variables methods with a small (32 firms) sample, though greater size of non-haven foreign operations is associated with adding tax haven operations, which is again consistent with patterns appearing in other regressions.

7.5. Imputation of missing values of size variable

Almost a fifth of observations on parent firms in services drop from the regression sample because the number of parent or non-haven employees is zero, so size is not defined. The regression results for service firms may consequently reflect this aspect of sample selection, and possibly produce estimates of behavioral parameters that are not representative of the entire sample.

The reason for observed zero employees is not clear. We exclude the sector holding companies and housing and real estate where such a figure may (and does frequently)

occur. Zero observed sales are a result of the reporting requirements. Sales are surveyed in million euros, so they are zero for any firm with a turnover of strictly less than 500,000 euros. This implies that a reported figure x disguises possible true sales values ranging from $1,000,000x - 500,000$ to $1,000,000x + 500,000$, except for 0 which disguises the interval $[0; 499,999]$.

We exploit this insight to impute the sales variables in order to use all the observations. Imputation does not recreate the true values of sales, but it enables us to handle the missing values in a way that results in valid statistical inferences. We use a model for grouped data developed in the statistical literature by Heitjan and Rubin (1990), imputing parent and non-haven sales based on the assumption that sales are log-normally distributed. This assumption is reasonable given the distribution of observed sales in our data. Conditional on the other covariates we impute 120 sets of potential true values that are in accord with reported observations.[26] We re-run our analyses and re-calculate coefficients and standard errors based on the formulas developed by Rubin (1987) which take into account that our data are imputed.

Instead of this rather complex procedure, one could opt for a more pragmatic solution such as plugging in "1" in place of the zeros. One could argue that "1" is close to zero relative to the other values observed, so measurement error should be negligible, but nonetheless, all observations could be used in the analysis. We prefer imputation because plugging in "1" would create an artificial censoring value. According to a recent literature started by Rigobon and Stoker (2007, 2009), this could introduce further bias in our analysis because previously missing observations then pile up at $ln(1)$. For the same reason, plugging in any other value below 500,000 instead of the zeros is not a viable option. Further, the imputation procedure takes into account the correlation between the sales variables and the other variables employed in our analysis, so it deals with the missing data in a statistically appropriate way.

Table C.26 in Appendix C provides the estimated coefficients for regressions using data on service firms. The use of imputed data does not appear to produce major changes in the coefficient and significance patterns. In particular, higher average non-haven foreign tax rates continue to be associated with greater likelihood of tax haven affiliate ownership in the uninstrumented regressions and with no effect on tax haven affiliate ownership in the instrumented regressions. There are small differences in the estimated effects of parent size on tax haven affiliate ownership, but these are largely unimportant, so this evidence suggests that the difference in the effect of taxes on tax haven investment between manufacturing and service firms is unlikely to be attributable to sample selection among service firms.

[26] The imputation procedure is described in detail in Appendix B.

8. Discussion

Table 6 lists the effect of an increase of the independent variables by one standard deviation according to our estimates, expressed relative to the standard deviation of the dependent variable. The upper panel is calculated based on the estimates involving employees and the lower panel is based on the estimates involving sales as size measure.

Table 6: Economic significance

	Manufacturing firms		Service firms	
	IV	FE IV	IV	*FEIV*
Ave. foreign n.h. tax rate	**0.41**	**0.58**	0.46	−0.73
Parent employees	**0.27**	0.15	0.10	−0.02
Foreign non-haven employees	**0.56**	**0.27**	**0.40**	0.47
Ave. foreign n.h. tax rate	**0.47**	**0.56**	**0.68**	−0.93
Parent sales	0.08	-0.06	0.20	0.04
Foreign non-haven sales	**0.90**	0.25	0.21	0.58

The table contains the effect of an increase in one of the independent variables by one standard deviation at the mean of all independent variables on the probability of tax haven investment, expressed in standard deviations. Statistically significant effects are printed in bold.

The left part of the table shows the implied effects for manufacturing firms and the right part for service firms. The differences in the estimated coefficients outlined above translate to substantive differences in the implied economic effects of changes in the independent variables. For manufacturing firms, the implied effect of a change in the tax rate is sizeable. Throughout the specifications, an increase in the average foreign non-haven tax rate at the mean is estimated to cause an increase in the probability to invest in a tax haven by 0.4 to 0.6 standard deviations. The effect is stable if fixed effects are used, that is, it is not driven by unobservable differences in the cost of income reallocation. In contrast, the implied effect of an increase in non-haven size is two to three times as high in the pooled IV estimates as in the fixed effects IV specifications, which suggests that this variable takes up unobserved firm-specific characteristics. Parent size plays a subordinate role.

For service firms, there is a clear difference between the estimates with and without fixed effects. Given the pooled IV specifications, changes in the average foreign non-haven tax rate should positively influence tax haven investment. The fixed effects IV estimates imply on the contrary that taxation is the most important impediment, though these coefficients are not statistically different from zero. It appears likely that the estimates of tax effects in the pooled specification reflect the impact of omitted firm-specific characteristics. Our findings are consistent with either high marginal costs of income reallocation by service firms, or - compared to manufacturing firms - relatively little variability in

the cost of income reallocation, either of which would be consistent with small effects of foreign tax rates on tax haven investment.

9. Conclusion

This paper analyzes factors that influence tax haven investment and test these using data on firms subject to a tax exemption system. The estimates control for firm fixed effects and separately analyze tax haven investments of manufacturing and service firms.

The model implies that high foreign tax rates encourage tax haven investment, but that this effect is dampened by firm-specific marginal costs of income reallocation. Further, the model indicates that the relationship between non-haven taxation and the incentive to invest in a tax haven is complex and composed of two opposite effects. Higher tax rates at the locations where a firm is already present before investing in a tax haven increase the probability of investing in a tax haven, as expected. In contrast, the opposite relationship holds for tax rates at locations that become attractive investment venues only for firms that also have tax haven investments: the attractiveness of tax havens increases as tax rates fall in these potential investment locations. This mechanism may in part explain the persistence of tax haven investment despite falling tax rates elsewhere.

There appear to be significant differences between the tax haven investment patterns of service and manufacturing firms. High foreign tax rates are associated with tax haven investments of manufacturing firms, which is consistent with tax havens being used to reallocate taxable income from jurisdictions in which it is taxed more heavily. At the mean, an increase in the average foreign non-haven tax rate of one percentage point increases the probability that a manufacturing firm invests in a tax haven by three percentage points. This effect is robust to controlling for unobservable firm-specific differences. Tax haven investment by service firms is not significantly influenced by taxation if unobservable firm-specific characteristics are taken into account. This evidence is consistent with service firms facing high marginal costs of income reallocation, and relatively little variability in these costs, which together depress the effects of foreign tax rate differences. Still, tax haven investment is relatively more common among service firms than among manufacturing firms, reflecting the attractiveness of tax haven locations for ordinary business activities in service industries. This suggests that policy measures that raise the cost of income reallocation may discourage tax haven investment. At the same time, such policy measures may encourage firms to shift real activities to tax havens.

Given the increasing share of service industries in Western economies, the tax avoidance activities of service firms, and their consequences, offers a fruitful area for further research.

Appendix A. List of countries classified as tax havens

The following countries are classified as tax havens according to Hines and Rice (1994, p. 178):
Andorra, Anguilla, Antigua and Barbuda, Bahamas, Bahrain, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Channel Islands, Cook Island, Cyprus, Dominica, Gibraltar, Grenada, Hong Kong, Ireland, Isle of Man, Jordan, Lebanon, Liberia, Liechtenstein, Luxembourg, Macao, Maldives, Malta, Marshall Islands, Monaco, Montserrat, Netherlands Antilles, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, Singapore, Switzerland, Turks and Caicos Islands, Vanuatu.

We are unable to distinguish investment in Monaco and Saint Martin from investment in France. Therefore, these tax havens are neglected in our analysis.

The OECD's list of tax havens contains the following countries (OECD, 2000): Andorra, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Belize, British Virgin Islands, Cook Islands, Dominica, Gibraltar, Grenada, Guernsey/ Sark/ Alderney, Isle of Man, Jersey, Liberia, Liechtenstein, Maldives, Marshall Islands, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, Samoa, Seychelles, St Lucia, St. Christopher and Nevis, St. Vincent and the Grenadines, Tonga, Turks & Caicos, US Virgin Islands, Vanuatu.

Appendix B. Imputation procedure

The imputation procedure basically consists of two steps. First, we estimate the relationship of the natural log of parent sales and the natural log of non-haven sales and the other variables employed in our analysis using the EM-algorithm proposed by Hasselblad, Stead, and Galke (1980). Then, we follow Heitjan and Rubin (1990) and impute plausible values for parent sales and non-haven sales given the other variables as well as the coefficients derived in the first step and based on the assumption of a normally distributed error term. We generate 120 sets of plausible data, as Heitjan and Rubin (1990) use a similar number of imputations in their study.

Tables C.24 and C.25 provide summary statistics on several sets of imputed sales compared to the observed parent and non-haven sales. The left parts of the tables show statistics for all parent-years, that is, including those units with missing observed sales. As expected, the mean of the imputed sales are lower and the standard deviation is higher. The right part of the table shows the statistics only for those units with non-missing observed parent and non-haven sales. The moments of the distributions of the imputed data sets are very close to the corresponding moments of the observed data. We are thus assured of not introducing some artificial correlation or bias into our analysis through our imputation procedure.

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Appendix C. Additional tables

Table C.7: Distribution of observations across years

	All firms						Regression sample					
	Full sample		Manufacturing		Services		Full Sample		Manufacturing		Services	
Year	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
2002	2875	15.00	1741	15.00	1016	15.09	2421	14.75	1581	14.83	746	14.77
2003	2716	14.17	1639	14.13	971	14.42	2313	14.10	1500	14.07	724	14.33
2004	2649	13.82	1611	13.88	935	13.89	2262	13.79	1483	13.91	691	13.68
2005	2639	13.77	1613	13.90	910	13.52	2278	13.88	1490	13.98	691	13.68
2006	2735	14.27	1656	14.27	956	14.20	2372	14.46	1530	14.35	739	14.63
2007	2798	14.60	1684	14.51	985	14.63	2407	14.67	1550	14.54	746	14.77
2008	2753	14.36	1659	14.30	960	14.26	2356	14.36	1527	14.32	715	14.15
Total	19165	100.00	11603	100.00	6733	100.00	16409	100.00	10661	100.00	5052	100.00

Note: Regression sample given number of employees used as size measure.

Table C.8: Summary statistics

	Definition	Full sample			Manufacturing firms			Service firms		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Have haven	*Indicator variable. 1 if parent firm holds at least one affiliate in at least one tax haven in a given year, 0 otherwise.*	19165	.179	.383	11603	.170	.376	6733	.199	.399
# parent employees (in 1,000)	*Number of employees, parent firm.*	19165	1.140	6.879	11603	1.211	6.230	6733	1.050	8.207
Ln (# parent employees)	*Natural logarithm of number of parent employees.*	18033	5.435	1.831	11444	5.896	1.422	5826	4.521	2.167
Parent sales (in 1,000,000)	*Sales, parent firm.*	19165	436.845	2648.203	11603	452.217	3125.319	6733	367.121	1568.150
Ln (parent sales)	*Natural logarithm of parent sales.*	17977	11.289	1.698	11405	11.412	1.470	5790	10.982	2.005
Parent productivity	*Natural logarithm of parent sales over parent employees.*	17527	5.774	1.126	11332	5.494	.768	5464	6.309	1.450
# non-haven employees (in 1,000)	*Sum of number of employees in affiliates which are not located in tax havens, reduced according to share of participating interests.*	18158	.437	2.211	11153	.505	2.619	6185	.326	1.328
Ln (# non-haven employees)	*Natural logarithm of the number of foreign non-haven employees.*	17266	4.472	1.742	10824	4.672	1.665	5696	4.124	1.807
Non-haven sales (in 1,000,000)	*Sum of sales in affiliates which are not located in tax havens, reduced according to share of participating interests.*	18158	114.501	960.484	11153	131.348	1189.014	6185	82.815	354.199
Ln (non-haven sales)	*Natural logarithm of foreign non-haven sales.*	17297	9.949	1.591	10802	10.009	1.555	5730	9.829	1.617
Average foreign non-haven tax rate	*Average of statutory tax rates faced by a firm's foreign non-haven affiliates weighted by GDP.*	18048	30.610	5.413	11123	31.104	5.168	6155	30.114	5.539
Comp. foreign non-h. tax rate	*Average of statutory tax rates faced by a firm's competitors foreign non-haven affiliates weighted by GDP.*	18030	33.418	1.362	11123	33.694	1.083	6147	33.186	1.363

Note: *Manufacturing firms:* firms classified NACE 1500-3700, *service firms:* firms classified NACE 5000-9300, with the before mentioned sample restrictions. *Full sample* additionally includes parent firms in the sectors agriculture, mining, electricity and water supply, and construction. Mean difference by haven status; base category: does not hold an affiliate in tax haven. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table C.9: Correlation of average foreign non-haven tax rate given different weighting schemes

	Manufacturing	**Service**
Weighting by	GDP	GDP
Observed profits, positive	0.8286	0.8641
N	8952	4665
Fixed and intangible assets	0.8482	0.8948
N	10,849	5800
Number of employees	0.8480	0.9175
N	10,779	5670
Sales	0.8931	0.9347
N	10,777	5704

All correlations are significant with a P-value of 0.00%.

Table C.10: Distribution of observations by sector

Manufacturing			**Service**		
Sector	Parent-years	Parents	Sector	Parent-years	Parents
1500	589	114	5000	159	33
1600	26	6	5100	2933	700
1700	318	69	5200	420	86
1800	187	42	5500	56	10
1900	75	16	6000	299	76
2000	87	18	6100	137	34
2100	227	50	6200	22	4
2200	281	58	6300	246	58
2300	55	12	6400	97	26
2400	1097	241	7100	193	41
2500	912	191	7200	393	105
2600	446	98	7300	77	15
2700	451	97	7400	1465	437
2800	1098	235	8000	14	4
2900	2503	529	8500	36	6
3000	82	21	9000	51	15
3100	799	178	9200	125	33
3200	332	74	9300	10	4
3300	922	195			
3400	708	139			
3500	142	31			
3600	242	51			
3700	24	8			

Table C.11: Regression results, parent productivity 2004-2008, manufacturing firms

	OLS	IV	FE	FEIV
Ave. foreign	0.008***	0.028***	0.002**	0.059
n.h. tax rate	(0.001)	(0.007)	(0.001)	(1.262)
Parent	0.011	0.020**	-0.011	0.001
productivity	(0.009)	(0.010)	(0.010)	(0.137)
Foreign non-	-0.077***	-0.061***	-0.050***	-0.036
haven size	(0.014)	(0.016)	(0.015)	(0.786)
Foreign n.h. size,	0.015***	0.013***	0.009***	0.005
squared	(0.002)	(0.002)	(0.002)	(0.132)
Constant	-0.175***	-0.815***	0.160***	-1.510
	(0.068)	(0.251)	(0.057)	(37.407)
# of observations	7538	7538	7538	7538
# of parents	2019	2019	2019	2019
R-squared	0.15	0.05	0.02	–
Instrument	N	Y	N	Y
F-Statistics	–	37.60***	–	3.87**
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.12: Regression results, parent productivity 2004-2008, service firms

	OLS	IV	FE	FEIV
Ave. foreign	0.007***	0.025	-0.000	-0.023
n.h. tax rate	(0.002)	(0.022)	(0.001)	(0.228)
Parent	0.008	0.010	0.017*	0.019
productivity	(0.008)	(0.009)	(0.009)	(0.072)
Foreign non-	-0.068**	-0.053	-0.035	-0.043
haven size	(0.027)	(0.034)	(0.022)	(0.038)
Foreign n.h. size,	0.013***	0.011***	0.008**	0.009
squared	(0.003)	(0.004)	(0.003)	(0.011)
Constant	-0.113	-0.585	0.027	0.630
	(0.100)	(0.669)	(0.079)	(5.495)
# of observations	3413	3410	3413	3410
# of parents	998	998	998	998
R-squared	0.09	0.01	0.02	–
Instrument	N	Y	N	Y
F-Statistics	–	4.78**	–	6.78***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Note: in column 2, the coefficient of linear non-haven size has a P-value of 11.8%.

Note: the number of observations in the regressions with productivity is lower than the number of observations in the regressions with parent size because we restrict our sample to the years 2004-2008 in the former case. This explains why the coefficients are insignificant in the fixed effects framework: too much variation over time is deleted.

Table C.13: Regression results, parent productivity 2002-2008, manufacturing firms

	OLS	IV	FE	FEIV
Ave. foreign non-haven	0.0082***	0.0307***	0.0025***	0.0383
tax rate	(0.0009)	(0.0076)	(0.0009)	(0.0236)
Parent productivity	0.0093	0.0183**	-0.0126*	-0.0101
	(0.0079)	(0.0090)	(0.0068)	(0.0072)
Foreign non-haven	-0.0782***	-0.0592***	-0.0511***	-0.0360
size	(0.0127)	(0.0148)	(0.0144)	(0.0241)
Foreign non-haven	0.0152***	0.0135***	0.0089***	0.0063*
size, squared	(0.0015)	(0.0016)	(0.0020)	(0.0036)
Constant	-0.1514**	-0.8911***	0.1566***	-0.8896
	(0.0630)	(0.2641)	(0.0475)	(0.6946)
# of observations	10568	10568	10568	10568
# of parents	2288	2288	2288	2288
R-squared	0.15	0.05	0.02	–
Instrument	N	Y	N	Y
F-Statistics	–	37.28***	–	6.95***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.
Note: the P-value of the coefficient of the average foreign non-haven tax rate in the FE IV regression is 10.5%.

Table C.14: Regression results, parent productivity 2002-2008, service firms

	OLS	IV	FE	FEIV
Ave. foreign non-haven	0.0077***	0.0304	0.0000	-0.0436
tax rate	(0.0015)	(0.0226)	(0.0013)	(0.0787)
Parent productivity	0.0058	0.0087	0.0120	0.0132
	(0.0073)	(0.0081)	(0.0083)	(0.0125)
Foreign non-haven	-0.0667***	-0.0484	-0.0364*	-0.0453
size	(0.0250)	(0.0312)	(0.0221)	(0.0484)
Foreign non-haven	0.0127***	0.0110***	0.0088***	0.0111
size, squared	(0.0030)	(0.0034)	(0.0032)	(0.0079)
Constant	-0.1346	-0.7463	0.0403	1.2152
	(0.0930)	(0.6802)	(0.0795)	(2.1456)
# of observations	4788	4783	4788	4783
# of parents	1198	1197	1198	1197
R-squared	0.09	–	0.03	–
Instrument	N	Y	N	Y
F-Statistics	–	5.13**	–	3.49*
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.15: Regression results, manufacturing firms, sales as size measure

	OLS	IV	FE	FEIV
Average foreign non-haven	0.004***	0.032***	0.002***	0.037**
tax rate	(0.001)	(0.008)	(0.001)	(0.019)
Ln (parent sales)	0.026	-0.006	0.043	0.032
	0.039)	(0.043)	(0.037)	(0.041)
Ln (parent sales), squared	-0.001	0.001	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Ln (non-haven sales)	-0.234***	-0.255***	-0.105***	-0.076
	(0.038)	(0.041)	(0.040)	(0.051)
Ln (non-haven sales),	0.015***	0.015***	0.007***	0.004
squared	(0.002)	(0.002)	(0.002)	(0.003)
Constant	0.629***	0.205	0.208	-0.794
	(0.239)	(0.284)	(0.240)	(0.596)
# of observations	10614	10614	10614	10614
# of parents	2297	2297	2297	2297
R-squared	0.17	0.02	0.01	–
Instrument	N	Y	N	Y
F-Statistics	–	38.89***	–	7.47***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Note: Non-haven sales are significant at 13.3% (linear term) and 12.3% (squared term) in column 4.

Table C.16: Regression results, service firms, sales as size measure

	OLS	IV	FE	FEIV
Average foreign non-haven	0.005***	0.042*	0.000	-0.058
tax rate	(0.001)	(0.022)	(0.001)	(2.944)
Ln (parent sales)	-0.047	-0.063	-0.050	0.033
	(0.047)	(0.052)	(0.050)	(3.663)
Ln (parent sales), squared	0.003	0.004	0.003	-0.001
	(0.002)	(0.002)	(0.002)	(0.175)
Ln (non-haven sales)	-0.114**	-0.064	-0.160***	-0.207
	(0.056)	(0.066)	(0.055)	(3.997)
Ln (non-haven sales),	0.008**	0.004	0.010***	0.014
squared	(0.003)	(0.004)	(0.003)	(0.258)
Constant	0.474	-0.609	0.911**	2.150
	(0.312)	(0.743)	(0.372)	(75.897)
# of observations	5053	5048	5053	5048
# of parents	1275	1274	1275	1274
R-squared	0.11	–	0.03	–
Instrument	N	Y	N	Y
F-Statistics	–	6.37**	–	2.89*
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.17: Limited dependent variable models, manufacturing firms

	Probit	IV probit	Logit	FE logit
Average foreign non-haven	0.045***	0.149***	0.088***	0.202***
tax rate	(0.007)	(0.027)	(0.014)	(0.072)
Parent size	-0.198*	-0.142	-0.327	0.201
	(0.105)	(0.092)	(0.214)	(1.384)
Parent size, squared	0.029***	0.017*	0.049***	0.073
	(0.010)	(0.009)	(0.019)	(0.144)
Non-haven size	-0.077	-0.015	0.003	-2.001**
	(0.079)	(0.073)	(0.168)	(0.994)
Non-haven size, squared	0.030***	0.025***	0.042**	0.314***
	(0.008)	(0.008)	(0.017)	(0.104)
Constant	-2.766***	-5.564***	-5.555***	–
	(0.409)	(0.733)	(0.847)	–
Observations	10661	10661	10661	920
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.18: Limited dependent variable models, service firms

	Probit	IV probit	Logit	FE logit
Average foreign non-haven	0.042***	0.128*	0.079***	0.050
tax rate	(0.009)	(0.066)	(0.018)	(0.116)
Parent size	0.240**	0.206**	0.503**	0.200
	(0.097)	(0.101)	(0.216)	(1.555)
Parent size, squared	-0.012	-0.012	-0.028	-0.004
	(0.010)	(0.009)	(0.021)	(0.149)
Non-haven size	-0.198*	-0.108	-0.333	-1.099
	(0.107)	(0.133)	(0.225)	(1.068)
Non-haven size, squared	0.037***	0.028*	0.064**	0.234*
	(0.012)	(0.016)	(0.025)	(0.128)
Constant	-3.026***	-5.248***	-5.671***	–
	(0.402)	(1.537)	(0.845)	–
Observations	5052	5047	5052	447
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.19: Regression results including data on holding companies, manufacturing firms

	OLS	IV	FE	FEIV
Average foreign non-haven	0.008***	0.021***	0.002***	0.035**
tax rate	(0.001)	(0.007)	(0.001)	(0.017)
Parent size	-0.029***	-0.026**	-0.008	-0.006
	(0.010)	(0.010)	(0.017)	(0.017)
Parent size, squared	0.004***	0.004***	0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.002)
Non-haven size	-0.051***	-0.045***	-0.049***	-0.033*
	(0.012)	(0.013)	(0.013)	(0.019)
Non-haven size, squared	0.011***	0.011***	0.009***	0.006**
	(0.002)	(0.002)	(0.002)	(0.003)
Constant	-0.118***	-0.499**	0.082*	-0.877*
	(0.039)	(0.219)	(0.047)	(0.494)
# of observations	13611	13611	13611	13611
# of parents	3035	3035	3035	3035
R-squared	0.14	0.11	0.02	–
Instrument	N	Y	N	Y
F-Statistics	–	61.96***	–	19.07***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.20: Regression results including data on holding companies, service firms

	OLS	IV	FE	FEIV
Average foreign non-haven	0.010***	0.042**	0.000	-0.014
tax rate	(0.001)	(0.019)	(0.001)	(0.031)
Parent size	0.002	0.003	0.002	0.004
	(0.013)	(0.014)	(0.015)	(0.016)
Parent size, squared	0.002	0.002	0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Non-haven size	-0.044***	-0.028	-0.008	-0.007
	(0.016)	(0.020)	(0.019)	(0.021)
Non-haven size, squared	0.010***	0.009***	0.004*	0.005*
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-0.195***	-1.076**	0.120**	0.489
	(0.053)	(0.545)	(0.060)	(0.841)
# of observations	6848	6843	6848	6843
# of parents	1711	1711	1711	1711
R-squared	0.14	–	0.01	–
Instrument	N	Y	N	Y
F-Statistics	–	9.85***	–	7.47***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.21: Dropping affiliates in Switzerland, manufacturing firms

	OLS	2SLS	FE	FE IV
Average foreign non-haven tax rate	0.005***	0.023***	0.002**	0.046*
	(0.001)	(0.005)	(0.001)	(0.027)
Parent size	-0.058***	-0.055***	-0.010	-0.004
	(0.016)	(0.016)	(0.024)	(0.027)
Parent size, squared	0.007***	0.005**	0.003	0.001
	(0.002)	(0.002)	(0.003)	(0.003)
Foreign non-haven size	-0.075***	-0.067***	-0.042***	-0.023
	(0.013)	(0.013)	(0.014)	(0.024)
Foreign non-haven size, squared	0.012***	0.012***	0.007***	0.004
	(0.002)	(0.002)	(0.002)	(0.003)
Constant	0.081*	-0.432**	0.006	-1.251
	(0.045)	(0.162)	(0.061)	(0.771)
# of observations	10661	10661	10661	10661
# of parents	2320	2320	2320	2320
R-squared	0.19	0.09	0.02	–
Instrument	N	Y	N	Y
F-statistics instrument	–	40.95***	–	6.53**
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Note: ownership of a tax haven affiliate is observed in 7.9% of firms-years in the regression sample.

Table C.22: Dropping affiliates in Switzerland, service firms

	OLS	2SLS	FE	FE IV
Average foreign non-haven	0.005***	0.018	0.000	-0.012
tax rate	(0.001)	(0.013)	(0.001)	(0.058)
Parent size	0.004	0.003	-0.006	-0.004
	(0.010)	(0.010)	(0.007)	(0.010)
Parent size, squared	0.000	0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.002)
Foreign non-haven size	-0.067***	-0.057**	-0.036*	-0.040
	(0.020)	(0.022)	(0.018)	(0.033)
Foreign non-haven size,	0.011***	0.011***	0.008**	0.009
squared	(0.003)	(0.003)	(0.003)	(0.007)
Constant	-0.053	-0.421	0.067	0.409
	(0.054)	(0.361)	(0.034)	(1.570)
# of observations	5052	5047	5052	5047
# of parents	1270	1269	1270	1269
R-squared	0.11	0.03	0.03	–
Instrument	N	Y	N	Y
F-statistics instrument	–	5.76**	–	3.36*
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Note: ownership of a tax haven affiliate is observed in 6.6% of firms-years in the regression sample.

Table C.23: Regressions using tax rates from Djankov et al. (2010)

	Manufacturing		Services	
	OLS	2SLS	OLS	2SLS
Average foreign non-haven	0.004***	0.017**	0.007***	0.011
tax rate	(0.001)	(0.007)	(0.002)	(0.011)
Parent size	-0.078**	-0.076**	0.027	0.028
	(0.030)	(0.031)	(0.019)	(0.019)
Parent size, squared	0.009***	0.008***	-0.000	-0.000
	(0.003)	(0.003)	(0.002)	(0.002)
Foreign non-haven size	-0.072***	-0.066***	-0.033	-0.023
	(0.020)	(0.021)	(0.033)	(0.040)
Foreign non-haven size,	0.013***	0.013***	0.007*	0.006
squared	(0.002)	(0.002)	(0.004)	(0.004)
Constant	0.179**	-0.090	-0.125	-0.233
	(0.087)	(0.166)	(0.084)	(0.274)
# of observations	1482	1482	686	685
# of parents	1482	1482	686	685
Instrument	N	Y	N	Y
Standard errors	Cluster	Cluster	Cluster	Cluster

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.

Table C.24: Comparison: distribution of observed parent sales and nine example sets of imputed parent sales

	All parent-years					Only non-zero observed sales				
	N	Mean	SD	Skew.	Kurt.	N	Mean	SD	Skew.	Kurt.
Ln (parent sales), observed	16978	18.240	1.688	.111	3.877	16978	18.240	1.688	.111	3.877
Ln (parent sales), imputed	18048	17.896	2.138	-.679	4.239	16978	18.238	1.692	.090	3.922
Ln (parent sales), imputed	18048	17.896	2.140	-.684	4.252	16978	18.239	1.691	.095	3.914
Ln (parent sales), imputed	18048	17.897	2.137	-.676	4.230	16978	18.238	1.692	.091	3.920
Ln (parent sales), imputed	18048	17.899	2.132	-.669	4.225	16978	18.239	1.690	.100	3.908
Ln (parent sales), imputed	18048	17.896	2.139	-.682	4.244	16978	18.238	1.692	.091	3.924
Ln (parent sales), imputed	18048	17.899	2.133	-.668	4.216	16978	18.239	1.690	.098	3.908
Ln (parent sales), imputed	18048	17.897	2.138	-.678	4.240	16978	18.238	1.693	.089	3.924
Ln (parent sales), imputed	18048	17.898	2.135	-.674	4.227	16978	18.239	1.690	.010	3.906
Ln (parent sales), imputed	18048	17.895	2.143	-.690	4.265	16978	18.238	1.692	.090	3.924

Table C.25: Comparison: distribution of observed non-haven sales and nine example sets of imputed parent sales

	All parent-years					Only non-zero observed sales				
	N	Mean	SD	Skew.	Kurt.	N	Mean	SD	Skew.	Kurt.
Ln (non-haven sales), observed	17201	16.858	1.589	.458	3.670	17201	16.858	1.589	.458	3.670
Ln (non-haven sales), imputed	18048	16.655	1.809	-.062	3.767	17201	16.859	1.590	.443	3.714
Ln (non-haven sales), imputed	18048	16.657	1.803	-.042	3.736	17201	16.860	1.587	.456	3.688
Ln (non-haven sales), imputed	18048	16.657	1.803	-.040	3.720	17201	16.860	1.588	.456	3.680
Ln (non-haven sales), imputed	18048	16.658	1.801	-.035	3.708	17201	16.859	1.591	.443	3.702
Ln (non-haven sales), imputed	18048	16.657	1.804	-.045	3.726	17201	16.860	1.589	.446	3.708
Ln (non-haven sales), imputed	18048	16.657	1.801	-.034	3.706	17201	16.858	1.591	.439	3.717
Ln (non-haven sales), imputed	18048	16.658	1.802	-.040	3.726	17201	16.861	1.586	.463	3.675
Ln (non-haven sales), imputed	18048	16.657	1.802	-.035	3.699	17201	16.859	1.590	.447	3.696
Ln (non-haven sales), imputed	18048	16.658	1.801	-.036	3.717	17201	16.860	1.589	.446	3.707

Table C.26: Regressions based on imputed data, service firms

	OLS	IV	FE	FE IV
Average foreign non-haven	0.005***	0.034***	0.000	-0.029
tax rate	(0.001)	(0.001)	(0.015)	(0.208)
Ln (parent sales)	-0.065*	-0.064**	-0.024	-0.016
	(0.034)	(0.025)	(0.036)	(0.043)
Ln (parent sales), squared	0.002**	0.002***	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)
Ln (non-haven sales)	-0.176***	-0.090*	-0.172**	-0.217
	(0.055)	(0.055)	(0.072)	(0.033)
Ln (non-haven sales),	0.007***	0.004*	0.006***	0.008
squared	(0.002)	(0.002)	(0.002)	(0.011)
Constant	1.536***	0.0757	1.414	2.4513
	(0.144)	(0.427)	(0.866)	(7.684)
# of observations	6140	6140	6140	6140
# of imputations	120	120	120	120
Instrument	N	Y	N	Y
Mean F-statistics	—	12.03***	—	10.30***
Standard errors	Cluster	Cluster	Cluster	Bootstrap

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications contain year dummies.