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Decomposing Multinational Corporations' Declining Effective Tax Rates

Javier Garcia-Bernardo[1,2] · Petr Janský[3] · Thomas Tørsløv[4]

Abstract

We develop a methodology to decompose the observed decline in multinational corporations' (MNCs') effective tax rates into several components and quantify the role of tax havens. We apply this methodology to the best available data for MNCs headquartered in the USA – from the Bureau of Economic Analysis – and in the EU – from Orbis – and we arrive at three main findings. First, we estimate that between 2005 and 2015 increased profits in tax havens directly explain only 29% and 1% of the 7% and 9% point declines in effective tax rates for US and EU MNCs, respectively. Second, we find that US MNCs have primarily benefited from domestic tax base reductions, most of which can be explained by sectoral changes, while the statutory rate has remained constant. Third, we show that EU MNCs have mainly benefited from falling domestic statutory rates and we observe similar patterns across EU home countries, host countries and sectors.

JEL Classification F21 · F23 · H25 · H26

1 Introduction

In the past decades, public and academic awareness of tax avoidance by multinational corporations (MNCs) has increased dramatically. During the 2010s, the Lux-Leaks (ICIJ, 2014) and Paradise Papers (ICIJ, 2017) revealed how MNCs such as Apple and Amazon had been avoiding virtually all foreign taxes using subsidiaries in countries such as Ireland and Luxembourg. Recent studies show that these cases are not unique, but part of a systematic pattern. The amount of profits shifted

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to tax havens is \$600–\$1100 bn every year, according to some of the latest studies (e.g. OECD, 2015; IMF's Crivelli et al., 2016, Clausing, 2016; Tørsløv et al., 2020; Janský and Palanský, 2019, Garcia-Bernardo & Janský, 2021). This corresponds to approximately 10% of global profits or 40% of all MNCs' non-headquarter profits.

Increases in profits in tax havens are likely to lead to reductions in MNCs' consolidated effective tax rates (ETRs), defined as their global tax payments divided by global profits. The existing empirical evidence points mostly separately to these two phenomena – increasing profit shifting to tax havens and declining ETRs – occurring concurrently over the past several decades. It is thus not yet clear how much of the observed decline in ETRs can be explained by the increased role of tax havens and how much of it is driven by other factors, such as changes in statutory tax rates, tax bases or sectoral composition. Related questions, such as how much corporate income tax MNCs actually pay and where and how this develops over time, also lack definitive answers to date.

In this paper, we investigate the mechanisms behind the observed decline in MNCs' ETRs. In order to investigate the decline, we develop a framework for decomposing the MNCs' consolidated ETRs. This formalised and systematic framework enables us to decompose all of the decline in MNCs' ETRs into meaningful components. It thus enables us to understand whether the decrease in ETRs is caused by a decrease in domestic taxation, i.e. the tax paid by MNCs in their home country – the country where their headquarters are located, by a decrease in foreign taxation, i.e. the tax that MNCs pay in their host countries – countries in which their foreign affiliates are located, including tax havens, or by a number of additional minor factors which we describe below. Moreover, our framework enables us to decompose changes in ETRs into changes in the statutory tax rate and changes in the tax base, i.e. the share of profits taxed at the statutory tax rate. For the sake of simplicity, we label all changes that result in lower ETRs and are *not* changes in the statutory rate as reduced tax bases. These reduced tax bases could arise for a number of different reasons, including new tax holidays or increased tax breaks for research and development. Although even the best available data currently at our disposal lack the necessary detail for distinguishing between these different reasons for reduced tax bases, the data otherwise facilitate a detailed decomposition.

Specifically, we decompose the decline in MNCs' ETRs into eight components. A decline in ETRs could occur due to changes in domestic taxation, either through reductions in domestic statutory rates (component 1) or thanks to a reduced domestic tax base (2). Similarly, changes in foreign taxation may be the outcome of either changes in foreign statutory rates (3) or foreign tax bases (4). A further component related to foreign taxation is the possibility of changes in foreign profit distribution (5), defined as a shift in the location of foreign profits (generally towards countries with lower tax rates). We further decompose component 5 into changes linked to tax havens (defined in Sect. 3) and changes linked to other countries. The final three components, which turn out to be mostly of minor importance, are: globalisation (6), which captures any increases in foreign profits at the cost of domestic profits; residual (7), which reflects the fact that changes in foreign and domestic taxation occur at the same time as their relative weights change; and, finally, changes in unobserved profits (8), which explain any observed decline due to unobserved profits in one

of the data sources. In addition to this main eight-component decomposition, we provide decompositions considering individual home countries separately and as a group (i.e. the EU), analysing the influence of individual host (foreign) countries, including tax havens, and taking into account changes in sectoral compositions.

We apply this decomposition framework to data on MNCs headquartered in the USA (hereafter referred to as US MNCs) – from the Bureau of Economic Analysis – and to data on MNCs headquartered in the EU (EU MNCs) – from Orbis – between 2005 and 2015 and reveal three main findings.

First, we see that the overall ETRs have declined by 7.1 percentage points (ppts) for US MNCs and by 8.7 ppts for the EU. We estimate that changes in the distribution of foreign profit (component 5) explain 30% of the decline in ETRs for US MNCs and 5% for EU MNCs. These changes can be linked to increases in the share of profits in tax havens. The increased share of profits in tax havens directly explained only 29% of the decline in ETRs for US MNCs and 1% for EU MNCs. While it may be tempting to identify these increased profits in tax havens with profit shifting – and a large body of literature indicates that this may be the case (e.g. Tørsløv et al. 2020) – our framework does not directly distinguish between an increase in profits in tax havens due to profit shifting, and due to, for example, an increase in real economic activity in tax havens. We discuss this distinction further in Sect. 4.4, and additional evidence for the US MNCs suggests that the increase in profits in tax havens might be caused by an increase in profit shifting. In addition to these direct effects, tax havens may have explained more of the observed decline in ETRs indirectly through their knock-on effects on both domestic and foreign taxation.

Second, we find that US MNCs have primarily benefited from domestic tax base reductions, i.e. in the USA. Of the 7.1 ppts reduction in ETRs, we find that 3.9 ppts are due to changes in the taxes paid on profits booked in the USA. The remainder is explained by reductions in statutory tax rates abroad (1.5 ppts) and by increases in profits booked in foreign affiliates with lower tax rates. Of that, 97% can be linked to tax havens. The bulk of the reduction in ETRs can be explained by US MNCs paying less tax on the profits they earned in the USA, despite the statutory tax rates remaining constant during this period. Moreover, an additional sectoral decomposition analysis indicates that MNCs' sector composition changes explain slightly more than half of the observed decline in US MNCs' ETRs, primarily as a result of the increasing importance of the finance and insurance sector, which might indicate either a real sectoral shift or an increased financialisation of the firm to enable profit shifting. This identified importance of sectoral changes in the decline of US MNCs' ETRs is in agreement with Barrios & d'Andria (2016), who use Orbis data to show that profit-shifting elasticities have a strong industry-specific component, although we do not find such importance for EU MNCs, as well as the more recent analysis by Janský (2020) which points out industry heterogeneity in tax havens with Bureau of Economic Analysis (BEA) data for US MNCs.

Third, when applying the framework to EU MNCs for the same period, we find that 3.4 ppts of the 8.7 ppts decrease in their ETRs is driven by changes in statutory taxation in these MNCs' home countries. Changes in domestic tax bases account for 2.5 ppts, changes in foreign countries' statutory tax rates for 0.8 ppts, and changes in

foreign tax bases for 0.9 ppts. Similarly to what we observed for US MNCs, changes in the distribution of foreign profits only directly explain a minority of the observed changes in ETRs (0.4 ppts), although in this case only 12% of the effect can be linked to tax havens. In the case of EU MNCs, the role of tax havens may be hidden due to poor data quality. Indeed, changes in unobserved profits account for 1.3 ppts. Overall, we show that EU MNCs have mainly benefited from falling domestic statutory rates and we observe similar patterns across EU home countries, host countries, and sectors. We observe no substantial differences either across individual EU member states or across host countries which EU MNCs invest in. Likewise, taking into account changing sectoral composition over time does not explain much of decline in ETRs in terms of domestic taxation; in fact, it is increasing foreign taxation for EU MNCs.

Our paper informs two different areas of economic literature: literature on backward-looking ETRs for firms and literature on tax havens, profit shifting and tax competition. Much of the literature on backward-looking effective taxation, where ETRs are estimated from data on firms as in this paper, is based on a method presented by Desai et al. (2004), who used BEA data to estimate ETRs as the ratio of foreign income taxes paid to foreign pre-tax income. For the sake of completeness, let us note that backward-looking ETRs differ from the so-called forward-looking ETRs, which model rates for hypothetical companies on the basis of existing legislation, frequently employing a method developed by Devereux and Griffith (2003a) and used in several subsequently published papers including Da Rin et al. (2010), Spengel et al. (2014) and Hanappi (2018). Thanks to access to affiliate-level microdata behind the BEA, these studies were able to calculate the ETR for each affiliate and use the medians within each country as country-level ETRs. Variations of this method were later used on aggregate data (using means rather than medians) by, for example, Stewart (2014), Clausing (2016), Cobham and Janský (2019), Wright and Zucman (2018), and Tørsløv et al. (2020). Whereas most of these papers only study foreign affiliates, in this paper we additionally include data on the parent country, the USA, which constitutes more than half of the MNCs' activity and value added and is therefore of key importance for the MNCs' overall ETRs.

For EU MNCs, Orbis is the preferred data source and as such has been previously used to estimate ETRs. Egger et al. (2009, 2010), Fuest et al. (2020) and Garcia-Bernardo et al. (2021a, b) have all studied MNCs' ETRs using subsidiary-level data from Orbis or its Europe-only version Amadeus, focusing on the MNCs' foreign-owned subsidiaries. An alternative data source, Compustat, was used recently by Thomsen and Watrin (2018) in a rare paper that estimates ETRs for both the USA and the EU, but does not provide information on subsidiary locations. We therefore use Orbis to create a data set for EU MNCs that is comparable to the BEA's data set on US MNCs, including domestic subsidiaries. Despite still being much less complete than the US data, this enables us to cover most EU MNCs' activity along with the US MNCs' in our analysis, which has not previously been done with these two data sources. In addition, Compustat is used in a related stream of accounting literature focusing on the ETRs of US MNCs (e.g. Dyreng et al., 2008; Markle & Shackelford, 2012). For example, Dyreng et al. (2017) show that ETRs have declined at approximately the same rate as both US multinational and domestic firms over

25 years and that, for MNCs, ETRs on foreign-sourced income have declined more than domestic-sourced ETRs. In contrast with Dyreng et al. (2017), our approach enables us to quantify the different drivers of such a decline for both EU and US MNCs and allows us to quantify the role of tax havens.

This paper is also linked to a vast body of literature on tax competition, spanning back to the early 1980s (see Keen and Konrad, 2012, for a review), and to the more recent literature on profit shifting, including Hines and Rice (1994), Huizinga and Laeven (2008), Dharmapala and Riedel (2013), Cristea & Nguyen (2016), Gumpert et al. (2016), Johannesen et al. (2017), Wier and Reynolds (2018), Guvenen et al. (2021), de Mooij & Liu (2020), Fuest et al. (2021) and recently reviewed by Beer et al. (2020). Profit-shifting literature has mostly either estimated the elasticity of corporate profits or the amount of profits shifted. While the purpose of this paper is to analyse *changes* in corporate taxation, a back-of-the-envelope-calculation puts the "excess" *magnitude* of profits located in tax havens in our data in line with other studies at a minimum of $150–200 bn for US firms alone (see Appendix "Back-of-the-Envelope Calculation of Misreported Profits"). Our analysis does not find any evidence to suggest that the scale of profit shifting to tax havens is smaller than that established by previous papers. We do, however, find that the role of tax havens has intensified moderately in the last two decades and that domestic policy changes and reductions in statutory tax rates have resulted in a much larger decline in MNCs' tax payments than the decline caused by the *direct* effects of increased profits in tax havens.

Our findings are consistent with tax competition between countries, and we now discuss this hypothetical explanation. When trying to compete for MNCs' operations and profits, countries generally use two categories of tax incentive tools: increased permitted deductions to the tax base (usually thought to be important for the extensive margin of tax competition, i.e. whether to invest) or reductions in their statutory tax rates (together with effective marginal tax rates usually thought to be important for the intensive margin, i.e. how much to invest). Recent research has found the extensive margin to be of greater importance (Davies et al., 2021), while Devereux and Sørensen (2006) find that during the 1980s and 1990s the effective *average* taxation (extensive margin) fell throughout the period, whereas the effective *marginal* tax rate on profits (intensive margin) only decreased towards the end of the period. In our results, we observe two different patterns in our two groups of EU MNCs and US MNCs. The EU member states have reduced EU MNCs' tax payments by lowering their statutory tax rates rapidly since the 1990s while broadening the tax bases only moderately, therefore likely reducing both the average *and* marginal ETRs. The USA, conversely, refrained from any statutory tax changes until 2018 and instead reduced the average ETR for its MNCs by allowing firms to pay – on average – considerably lower taxes on their corporate profits despite a constant statutory rate.

Literature on tax competition covers both competition over tangible capital and competition over reported profits and profit shifting (see e.g. Mendoza & Tesar, 2005; Slemrod and Wilson, 2009; Hong & Smart, 2010; Johannesen, 2010; Davies & Eckel, 2010; Baccini et al., 2014, Parchet, 2019, and the application in Keen & Konrad 2012, of the model by Kanbur & Keen, 1993, on commodity tax competition to measure profit shifting). Our paper contributes by setting up a simple framework

that can be used to compare the potential direct effects of tax havens, which include profit shifting, with the effects of changes in how countries tax profits domestically. We find that other effects potentially affect ETRs more than twice as much compared to the upper bound of the direct effects of tax havens on US MNCs. For EU MNCs, the direct tax haven effects are negligible, contributing less than a tenth of a ppt to the 8.7 ppt decline in ETRs. It is thus possible that the use of changes in domestic taxation – in an attempt to avoid losing tax base – results in much greater revenue costs than the loss of revenues through tax havens directly.

The remainder of the paper is structured as follows: Sect. 2 introduces the data used, first BEA for US MNCs and then Orbis for EU MNCs, and describes the basic descriptive statistics on ETRs over time, Sect. 3 provides a formal framework for the decomposition of the ETRs, Sect. 4 presents and discusses the results of the applied decomposition, and Sect. 5 concludes.

2 Data Description

2.1 Data on US MNCs: BEA – Foreign Affiliate Statistics

To describe US MNCs' ETRs, we utilise the BEA's Activities of US Multinational Enterprises data set. It provides worldwide information on profits and taxes paid by US MNCs and is freely available on the BEA website, from which we used, in particular, the tables "US parent companies" and "Majority-owned foreign affiliates". These data have been published since the 1950s and on an annual basis since 1982. In addition, a benchmark survey which covers every US MNC and provides a host of additional data is being carried out every 5 years. The earliest year with profit and tax statistics comparable across parent firms and affiliates, as well as across years, is the 1994 benchmark survey. This means that we can follow where profits were reported and where taxes were paid in a consistent manner from 1994 onwards, which covers both the global financial crisis and the subsequent crackdown on tax havens (Johannesen & Zucman, 2014). The latest year we use is 2016; we therefore do not cover the tax reform approved in the USA in December 2017 (Auerbach, 2018).

It is important to note that due to data aggregation, it is impossible to balance the "panel" of firms to determine what differences are driven by changes in the sample over time. We define an MNC as any firm with a permanent establishment abroad, permanent establishment being the legal definition of a firm's permanent base of operations. This means that in any given year, a number of new firms are included in the sample because they recently established activity abroad. Conversely, any firm that closes its last permanent establishment abroad is dropped from the sample. It should thus be noted that while the share of profits reported domestically in the USA seems quite constant over time, it may be affected by the properties of firms entering and exiting the data. Firms newly active abroad as well as those terminating their foreign activities are likely to have a high share of activity in the USA. A period of rapid growth (or decline) in the number of firms in the BEA could thus

underestimate (or overestimate) the share of profits booked domestically vis-à-vis a balanced panel.

An important consideration on using aggregate data for calculating ETRs is that in aggregate data, one firm's losses offset another firm's profits. If, in a given year, firms suffer large losses, the total taxable profits will be low and this will inflate the tax rate. On average, however, this should be offset by firms that suffered losses in previous years and deduct these in their current profit base. Naturally, the one-sided risk of firms never using their accrued deductions persists, e.g. due to bankruptcies. While it is important to keep these things in mind, even if tax rates are affected by such problems, this paper analyses changes over time and thus removes all level differences of the potential bias. In other words: for a bias to occur in analyses of differences over time, the above effects must be increasing or decreasing over time, since all level effects are removed.

We had to make a number of important choices with regard to the definitions of our variables of interest. To calculate an ETR, we needed to choose a common measure of profit. When creating a benchmark definition of profit, we wanted to avoid double-counting profits, which would lead us to excessively low estimated ETRs and a downwards-biased consolidated ETR. It is a well-known problem that the BEA data includes profit variables (such as "net profits") that include profits previously taxed elsewhere, such as equity income from foreign affiliates. Any measured ETRs using such measures could be heavily downwards-biased by double counting, and any changes in the ETRs over time could be due to changes in the double counting. Second, we wanted to be able to observe the profit measure in both subsidiaries and parent firms across time and in different tax jurisdictions. Third, we wanted the profit measure to come as close to a "meaningful" tax base as possible. This point will always be a matter for discussion, because there is no clear consensus on what constitutes a "meaningful" tax base. However, since we mainly wished to analyse changes over time and across countries, we primarily needed a constant benchmark from which to measure deviations. This can be readily done using the BEA data set, since its definitions of profits are defined centrally by the BEA and do not vary in any way – e.g. do not include any country-specific definitions of profits or deductions.

To address these challenges as efficiently as possible, we base our benchmark profit measure on the profit-type return category from the overview tables in the BEA, similarly to Wright and Zucman (2018). We then subtract net interest paid since this is usually deductible from taxable profits. Profit-type return in BEA is explained as: "an economic accounting measure of profits from current production". It is gross of taxes and all capital gains/losses as well as income from equity investments. We are thus certain that these profits are not counted twice. Our measures of profits and taxes are highly correlated with other operationalisations of profits and taxes using other databases (Garcia-Bernardo et al., 2021a, b). Our profit measure assumes that no capital gains or equity income is taxable and that all interest expenses are deductible. The measure will be imperfect to the degree that firms are in fact taxed on certain equity investments (in such cases we overestimate the tax rates) and where thin capitalisation rules are binding (in such cases we underestimate the tax rates). On a consolidated scale, however, the tax rates will vary only

as a function of changes in the location of profits, in the tax rates themselves, or in the valid deductions from taxable profits. If a country does not consider parts of this benchmark tax base to be taxable, we could see those as "deductions" from the benchmark tax base. This enables us to examine what share of profits is deducted in each country, as well as whether the tax base has been broadening or narrowing in each country over time.

In addition to a consistent profit measure, we need a suitable measure for taxes paid. Here, we use the only information available in the BEA: "US income taxes paid" and "Foreign income taxes paid". In addition to taxes paid on corporate income in a given year, "US income taxes paid" includes deferred taxes and taxes on repatriated profits. It thus includes all tax liabilities *accrued* in that period either upon earning or repatriating profits. Repatriation tax is a tax on foreign profits, which means that dividing by the US tax base artificially increases the domestic tax rate. On the other hand, the money is levied by the USA and does not reflect taxation imposed by a foreign country. It is, to our knowledge, not possible to disentangle this repatriation tax from income tax in the BEA, which leaves us with little choice but to accept it as part of what we consider as US income tax.

Whenever possible, we consider the average of three consecutive years rather than single years since losses in one year can be used as deductions in the following year. In the results presented below, the base period is thus 2004–2006 and the end period is 2014–2016, consistently for both BEA and Orbis. For the BEA data, the use of consecutive years' data in this way is only possible from 2004 onwards, because prior to 2004 the necessary data in the BEA were only included in the 5-year benchmark surveys. Overall, throughout this paper, we use 2005 to refer to the 2004–2006 period and 2015 to refer to the 2014–2016 period.

In terms of sector composition, the BEA data contain information for sectors of foreign affiliates and for sectors of US parent companies. Therefore, the BEA data enable us, similarly to Janský (2020), to identify the sectors of MNC affiliates, but not the sectors of their US parent companies. Sectors of US parent companies are available only for US parent companies themselves, not their foreign affiliates. Therefore, using the data available, we are only able to identify what sector the MNCs' foreign affiliates operate in, knowing that these are likely affiliates of MNCs whose US parent companies are in different sectors.

2.2 Data on EU MNCs: Orbis

Describing EU MNCs is more challenging than describing their US counterparts, since no central statistics office collects and publishes the data required. In order to approximate the data required for such a comparison, we aggregate data from the Orbis micro-database.

Orbis is a proprietary database created by Bureau van Dijk, a subsidiary of Moody's. It contains information on over 300 million public and private firms worldwide from a variety of country-specific data suppliers. The observational unit for MNCs is entity-year, where an entity can be either a consolidated MNC, or an unconsolidated account of a subsidiary belonging to an MNC. Our original

data set contains information on 13,330 MNCs at the consolidated level. We purposely choose to restrict the sample in order to maintain a balanced panel and as such directly study the reduction in ETRs at the MNC level. MNCs were removed if they had no observable activity abroad, accrued losses throughout the sample period, had less than a half of their consolidated profits observable (parent and subsidiaries), or had fewer than 10 observations in the 2004–2016 period (see Appendix "Data Selection in Orbis" for a more detailed description of the data work in Orbis). This results in our final data set, which contains financial information on 2633 EU MNCs including 15,386 country-level observations and 145,095 country-year observations. We have sufficient data for 23 of the 28 EU member states as of 2019. Compared with the original data set, we include 30% of the profits and 33% of the taxes. As we explain in Appendix "Data Selection in Orbis", we also create less restrictive data samples and use them as robustness checks.

To make the Orbis data comparable to the BEA data, we aggregate various categories of financial information. The consolidated accounts are already observed and need not be changed. We do, however, want to describe what share of the consolidated profits are reported, where and what taxes are paid on it. This means summing up all subsidiary activities by country, which has three limitations in Orbis. Firstly, a well-known problem with using Orbis for this purpose is that the sum of subsidiary activity often exceeds the consolidated activity of the group, due to joint ventures and partial ownership of subsidiaries. If all subsidiaries were owned 100% by their so-called ultimate owner (or MNC), the sum of unconsolidated accounts should in theory equal the consolidated accounts. Otherwise, the consolidated accounts are incompatible with unconsolidated accounts without further work. We solve this by correcting each subsidiary's financial information to include only the share which is owned by the ultimate owner in question (MNC).

The second limitation of Orbis is the lack of completeness at the unconsolidated level. In order to fully analyse the ETRs of EU MNCs, we created a fictitious category, "unobserved", calculated as the difference between the consolidated profits (taxes) and the sum of profits (taxes) at the unconsolidated level. While this group may contain financial information from a diverse set of countries, it allows us to understand how unobserved profits and taxes affect changes in ETRs.

The third limitation of Orbis is the inclusion of equity income from foreign subsidiaries in the parents' unconsolidated profit accounts. This inevitably leads to double counting, since equity income is also booked as profit in the subsidiary, but the taxes are only booked once. To correct for this, we study the operating profits when looking at EU firms; these are gross of taxes and financial profits. Leaving out financial profits enables us to avoid double-counting profits and to obtain realistic ETRs. If we had included financial profits, the result of including the equity income would be a decrease in our effective domestic tax rate estimate to 13% in the EU. While avoiding double counting in this manner is thus a necessity, it potentially introduces new problems: our ETR estimates will likely be inflated for any MNCs for which financial profits constitute a significant share of their consolidated profits. However, the consistency of our results in our robustness checks indicates that our results are not due to systematic bias or the outcome of our use of operating profits data.

The use of consolidated or global ETRs lends two main advantages over studying the unconsolidated (or local) ETR. Firstly, they are the most relevant tax rate from the perspective of the MNCs, since this is ultimately what they hope to minimise through tax planning, and also the most relevant from the perspective of global public finances, since it more accurately describes the tax revenue received. Secondly, they are conceptually sound: the denominator – the global consolidated profits of an MNC – is well defined relative to the country-specific profit definition that is often used to measure unconsolidated ETRs and which might differ across countries, e.g. due to different ways of accounting for equity and interest income.

For both US and EU MNCs, our data sources provide information on the basis of financial accounting rather than on the basis of tax accounting. The data thus provide information on what companies paid in taxes according to financial accounting rather than what they really paid and reported as such to a relevant tax authority. Tax and accounting literature on this topic is available, including a review of research in accounting for income taxes by Graham et al. (2012). Book–tax conformity is a measure of the scale of alignment between tax and financial reporting, which has implications for MNCs (Hanlon & Maydew, 2009). With both BEA and Orbis only capable of providing financial reporting data and with information based on tax accounting missing, we implicitly consider the former to be correlated with the latter and we are thus left with a potential bias in data used for calculating tax, but one which we cannot quantify or control using the available data.

For statutory corporate income tax rates, we use the OECD Tax Database's calculated average top statutory tax rate both for the USA and for all other countries.

2.3 Trends in the Taxation of Domestic and Foreign Corporate Profits

A common trend in corporate taxation has emerged in recent years in both the USA and the EU: MNCs based in both regions have been paying tax at *similar and decreasing* effective rates on both their domestic and foreign profits between 2005 and 2015.

First, looking at the aggregate numbers, we observe that US MNCs paid an average ETR of 25.2% in the 2015 period, which can be decomposed into an ETR of 28.5% on domestic profits and 18.7% on foreign profits (Table 1). EU MNCs had ETRs of 22.4% on average, decomposed into 23.9% on domestic profits, 20.3% on

Table 1 Summary of changes in effective tax rates (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

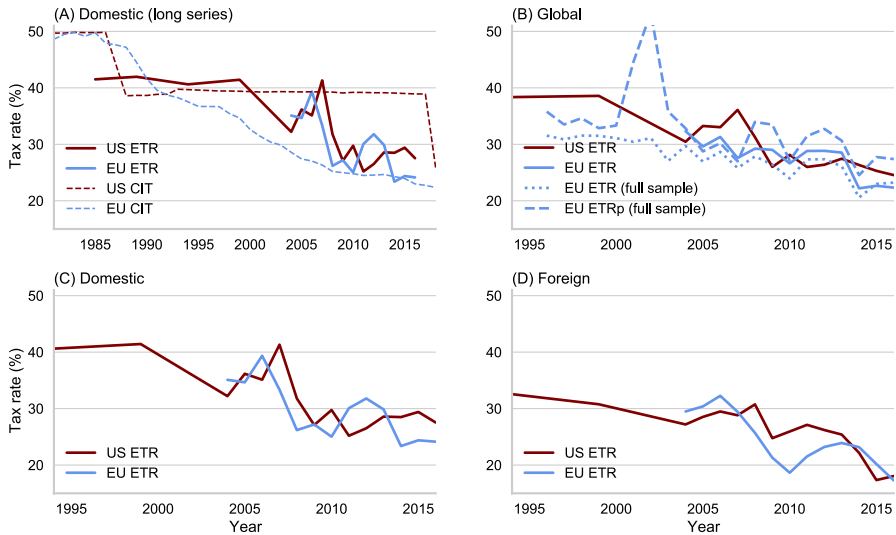|	US MNCs			EU MNCs		
	2005	2015	Difference	2005	2015	Difference
Total	32.3	25.2	7.1	31.1	22.4	8.7
Domestic taxation	34.6	28.5	6.1	36.6	23.9	12.7
Foreign taxation	28.3	18.7	9.6	30.9	20.3	10.6
Unobserved profits				23.8	19.9	

Fig. 1 Corporate income tax rates in the USA and the EU. *Notes* For US (dark red) and EU (light blue) MNCs. (**A**) Domestic tax rates from 1980 to 2016, showing the corresponding domestic statutory tax rates (dashed lines). (**B**) Consolidated tax rates. For EU MNCs, the tax rates of the full sample using consolidated accounts is visualised, using operating profits (dotted) and total profits (dashed) as the denominator of the tax rates. (**C**) Domestic tax rates. (**D**) Foreign tax rates. *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

foreign profits, and 19.9% on unobserved profits. These numbers lead us to three preliminary conclusions: first, that MNCs paid substantially more taxes on average than is listed in examples of offshore leaks such as the Paradise Papers (ICIJ, 2017), but also substantially less than the relevant statutory corporate tax rates; second, that US MNCs were subject to higher ETRs at home than abroad; third, that EU and US MNCs faced similar ETRs; and finally, looking at trends since 2005, we see that ETRs have declined by 8.7 ppts for EU based MNCs and by 7.1 ppts for their US counterparts.

Over the course of the past 4 decades, the average statutory tax rate on corporate profits has more than halved worldwide. This downward trend in corporate taxation is observed in virtually every country in the world. Figure 1A describes the pattern of falling statutory tax rates in the EU and the USA. The EU time series falls incrementally throughout this period, whereas the US corporate tax rate falls in two major jumps: in 1988 and 2018. Figure 1A also illustrates the difference between statutory and effective tax rates in the USA. The taxes actually paid on domestic profits by US firms (non-MNCs and MNCs) began to fall long before the second statutory tax rate reduction in 2018, and, since the last financial crisis, the US ETRs have been closer to the EU's average statutory tax rate than the average statutory rate in the USA.

The consolidated ETRs on profits encompass all tax policy tools into one easily measured fraction: the fraction of profits ultimately paid in taxes. Figure 1B shows the ETR paid by US MNCs, derived from the BEA, and the ETRs of EU MNCs,

derived from the Orbis database, both for our study sample (Sect. 2), and the full sample at the consolidated level derived from Orbis – using both operating profits (EU ETR) and total profits (EU ETRp). Both rates fall at roughly the same speed and at similar levels; this is true not only for consolidated ETRs (Fig. 1B), but also for both ETRs on domestic (Fig. 1C) and foreign (Fig. 1D) profits.

Figure 1 shows that the ETRs for EU and US MNCs have been falling at similar speeds. Figure 1A suggests that the continual decrease in statutory tax rates in the EU probably drove some changes in the domestic profits of EU MNCs and in the foreign profits of both EU and US MNCs. It is, however, not possible to uncover the original drivers of this process without further analysis – e.g. whether the trend is the outcome of changes in statutory tax rates, changes in tax bases, or increased profits in tax havens. In this paper, we develop a decomposition framework to systematically analyse the contribution of these different effects, which we present in the next section.

3 The Decomposition of Consolidated Effective Tax Rates

In this section, we provide a theoretical framework for the decomposition of consolidated ETRs, which enables us to further analyse some of the trends we described in the previous section. We first describe the main decomposition and then turn to explaining decomposition at the host country and sector levels.

3.1 General Framework

We define the consolidated ETR as the corporate income taxes an MNC pays worldwide, divided by their worldwide (consolidated) profits. An MNC's consolidated ETR is by definition the average of the ETRs paid in its various countries of operation, weighted by the share of profits in each country. When carrying this decomposition across the time dimension, we can describe the changes in the consolidated tax rate vis-à-vis the changes in each ETR as well as the changes in the profit share of each country. Furthermore, we differentiate whether the ETR changes are driven by statutory rate changes or changes in deviations from the statutory tax rates.

Equation (1) states that the consolidated ETR is the average of the ETRs paid abroad and domestically, weighted according to the profits reported in each country:

$$\tau_C = \underbrace{\omega_D \tau_D}_{\text{Domestic}} + \underbrace{\omega_F \tau_F}_{\text{Foreign}} + \underbrace{\omega_U \tau_U}_{\text{Unobserved}} , \tag{1}$$

where τ_C denotes the consolidated ETR for all MNCs headquartered in a given country, ω_D is the share of profits that are reported domestically, ω_U is the share of profits that have unobserved sources (in the Orbis database) and τ_D, τ_F and τ_U are the ETRs paid on those respective profits. This leaves us with three components, which can be analysed separately over time.

A generic difference between periods can be formulated as below:

$$\Delta\tau_C = \underbrace{\omega_D\Delta\tau_D}_{\text{Domestic taxation}} + \underbrace{\omega_F\Delta\tau_F}_{\text{Foreign taxation}} + \underbrace{\Delta\omega_D\left(\tau_D - \tau_F\right)}_{\text{Globalisation}}$$
$$+ \underbrace{\Delta\omega_D\left(\Delta\tau_D - \Delta\tau_F\right)}_{\text{Residual}} + \underbrace{\omega'_U\tau'_U - \omega_U\tau_U - \Delta\omega_U\tau'_F}_{\text{Unobserved profits}}$$

(2)

Here, Δ is the shorthand notation for the change in the variable between periods. The "domestic taxation" effect denotes the initial weight of the domestic component times the change in the domestic tax rate. In other words, the change in consolidated tax rate due to domestic tax changes had the profit distribution been constant through the period. The "foreign taxation" effect does the same for the foreign component. The "globalisation" effect adds the effect of changes in weights between the periods; moving profits abroad yields the tax rate change "$\tau_F - \tau_D$", assuming no changes in rates ($\Delta\omega_D$ denotes profits moved the other way, domestically, hence the sign difference). The fourth term, "residual", accounts for the fact that rates do change at the same time as the weights. For the case of EU MNCs, we need to account for changes in the ETRs on the profits unobserved in the data. Since it is not illuminating to separate changes in base from changes in tax rates, we add a generic term accounting for the entire variation: $\omega'_U\tau'_U - \omega_U\tau_U$, where the apostrophe marks the period 2. The extra term, $-\Delta\omega_U\tau'_F$, arises from a residual term ($\Delta_F + \Delta_D$), which is zero for US MNCs since $\omega_F = \left(1 - \omega_D\right)$, and is $\Delta\omega_F + \Delta\omega_D = -\Delta\omega_U$ for EU MNCs. This change is multiplied by the ETR for foreign profits in the second period, which we denote with τ'_F.

Having decomposed the change in consolidated ETRs into foreign and domestic tax effects, we can then further decompose these components into the effects of statutory tax changes and effects caused by deviations from the statutory tax rates. The domestic tax rate can be written as:

$$\tau_D = \underbrace{s_D}_{\text{Statutory rate (domestic)}} + \underbrace{\left(\tau_D - s_D\right)}_{\text{Deviation from statutory rate (domestic)}}$$

(3)

where S_D is the statutory tax rate at home and τ_D as before is the ETR actually paid. The ETR equals the statutory tax rate minus any deviations from the statutory tax rate. Since this is purely an identity exercise of the tax rate, not including weights at all, the difference over time can simply be written as:

$$\Delta\tau_D = \underbrace{\Delta s_D}_{\text{Domestic statutory rate}} + \underbrace{\left(\Delta\tau_D - \Delta s_D\right)}_{\text{Domestic tax base}}$$

(4)

where domestic statutory rate depicts the change in domestic statutory rates over time. We put the change in deviation from statutory rates under the label "domestic tax base" since these deviations likely stem from changes to the tax base.

The foreign taxation consists of many different countries, each with a weight, statutory rate and effective rate. The following equation states that the foreign tax rate is the weighted average of all the N countries denoted $i \in \{F_1, F_2, \ldots, F_N\}$.

$$\tau_F = \sum_{i=1}^{N} \omega_{Fi} \tau_{Fi}, \tag{5}$$

where $\sum_{i=1}^{N} \omega_{Fi} = 1$.

Similar to the domestic case, we decompose this into the statutory rate and deviations from this:

$$\tau_F = \sum_{i=1}^{N} \left(\underbrace{\omega_{Fi} s_{Fi}}_{\text{Statutory rates (foreign)}} + \underbrace{\omega_{Fi}(\tau_{Fi} - s_{Fi})}_{\text{Deviations from statutory rates (foreign)}} \right) \tag{6}$$

Analogous to Eq. (2), the following gives us the changes in the above equation between periods:

$$\Delta \tau_F = \sum_{i=1}^{N} \left(\underbrace{\underbrace{\omega_{Fi} \Delta s_{Fi}}_{\text{Foreign statutory rate}} + \underbrace{\omega_{Fi}(\Delta \tau_{Fi} - \Delta s_{Fi})}_{\text{Foreign tax base}} +}_{\text{Foreign tax rates and bases}} \underbrace{\Delta \omega_{Fi} \tau'_{Fi}}_{\text{Foreign profit distribution}} \right) \tag{7}$$

This equation states that the change in the foreign part of the consolidated ETR can be decomposed into three terms, weighted across all foreign countries. The first term, foreign statutory rate, denotes the change in average weighted statutory tax rates, keeping the weights across countries constant. The second term, foreign tax base, is the change in deviations from the statutory tax rate between the periods (again keeping weights constant across countries). These two first terms correspond to changes in foreign tax rates and bases. The third term – the "foreign profit distribution" effect – is the change in the consolidated ETR if the ETRs in each country remained as in period 2, but the weights (tax base) moved between countries. Since $\sum_{i=1}^{N} \omega_{Fi} = 1$ still holds in period 2, we must also have that $\sum_{i=1}^{N} \Delta \omega_{Fi} = 0$. Any changes here thus come from the tax base moving between differently taxed jurisdictions.

Overall, we decomposed the change in ETRs into eight components: two related to domestic taxation (domestic statutory rate, domestic tax base), three related to foreign taxation (foreign statutory rate, foreign tax base, foreign profit distribution) and three others (globalisation, residual, unobserved profits).

3.2 Decomposition by Home Country

In terms of the home country level, below we present results of estimating the above decomposition for one headquarter country such as the US or an individual EU member states as well as aggregately for a group of home countries, the EU.

In addition to the main decomposition described so far, we can also differentiate between various host countries, including tax havens, and we can also estimate the effect of sectoral compositions, which we now discuss in turn.

3.3 Decomposition by Host Country

The decrease in foreign ETRs over time can be mapped at the host country level. To facilitate the interpretation of the results, we slightly adapt Eq. (7) as:

$$\Delta \tau_F = \sum_{i=1}^{N} \left(\underbrace{\omega_{Fi} \Delta \tau_{Fi}}_{\text{Foreign tax rates and bases}} + \underbrace{\Delta \omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})}_{\text{Foreign profit distribution}} \right), \tag{8}$$

where $\overline{\tau'_F}$ is the mean tax in period 2. Since $\Delta \omega_{Fi} = 0$, we have that $\Delta \omega_{Fi} k = 0$, where k can be any constant. By using τ'_F, we can assess whether profits have increased in countries that have below or above average ETRs. This facilitates the interpretation of the results, since countries that gain profits ($\Delta \omega_{Fi} > 0$) and have a below-average tax rate ($\tau'_{Fi} - \overline{\tau'_F}) < 0$ will have a negative contribution to the tax rate.

3.4 Decomposition by Tax Haven

The above analysis at the host country level can be adapted to understand if the changes in foreign profit components are created by *increased profits in tax havens*. In order to assess this question, we analyse the contribution of tax havens to the three components of Eq. (8).

We first clarify the definition of tax havens. Following Reurink and Garcia-Bernardo (2020) and Garcia-Bernardo and Janský (2021), we define tax havens in two groups: tax coordination centres (Ireland, the Netherlands, Singapore, Hong Kong, Switzerland) and profit centres (Luxembourg, Bermuda, Barbados, the Cayman Islands and the British Virgin Islands (included in BEA as "UK Caribbean", together with several other countries), The Bahamas (included in BEA as "Other Central America"), Malta, Jersey, Isle of Man and Gibraltar (included in BEA as "Other Europe"), Mauritius, and Puerto Rico. Coordination centres include tax havens that are also used for management and other coordination activities, while profit centres include small island states used mainly to book profits. This distinction allows us to more finely understand which type of tax havens is gaining prominence.

First, in the foreign tax rate and base components (combined here into one), $\sum_{i=1}^{N} \left(\omega_{Fi} \Delta \tau_{Fi} \right)$, only those countries that reduced their tax rates ($\Delta \tau_{Fi} < 0$) contribute to the decrease in ETRs. Amongst those countries, we look at the contribution of each group $\sum_{i \in CC \& \Delta \tau_{Fi} < 0}^{N} \left(\omega_{Fi} \Delta \tau_{Fi} \right)$, $\sum_{i \in PC \& \Delta \tau_{Fi} < 0}^{N} \left(\omega_{Fi} \Delta \tau_{Fi} \right)$, and $\sum_{i \in OC \& \Delta \tau_{Fi} < 0}^{N} \left(\omega_{Fi} \Delta \tau_{Fi} \right)$, *res*pectively, for coordination centres (CC), profit centres (CC) and other countries (OC).

Second, in the foreign profit distribution component, $\sum_{i=1}^{N} \left(\Delta \omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F}) \right)$, two types of countries can contribute to the decrease in ETRs: those whose weight

increased ($\Delta\omega_{Fi} > 0$) and have a tax rate below the average ($(\tau'_{Fi} - \overline{\tau'_F}) < 0$), and those whose weight decreased and have a tax rate above the average. Since we are interested in understanding foreign profit distribution increases, we focus only on the first group – one could think of the second group as the countries that lost weight due to profit increases in the first group. Similarly to the previous case on tax bases and rates, we calculate $\sum_{i=1}^{N} \left(\Delta\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F}) \right)$ for coordination centres, profit centres and other countries.

In addition, the "globalisation" (6) and the "residual" (7) components might capture the role of tax havens. Increased profits in tax havens could impact these two terms by reducing the share of domestic profits. As a consequence, we are going to observe the share of domestic profits as well as the scale of these components. Finally, the component "unobserved profits" (8) could also reflect the role of tax havens, but we are unable to quantify it due to, by definition, the lack of any further information.

3.5 Decomposition by Sector

The decrease in ETRs can be also mapped at the sector level. For both the BEA data set and the Orbis data set, we have information on each firm's main industrial sector, for both the domestic tax base and the aggregated tax base. Similar to the decomposition by host country, we can decompose the decrease in ETRs into effects of sector composition and the rest as:

$$\Delta\tau = \sum_{s=1}^{M} \left(\underbrace{\omega_s \Delta\tau_s}_{\text{Taxation except sector composition}} + \underbrace{\Delta\omega_s \left(\tau'_s - \overline{\tau'_F} \right)}_{\text{Sector composition}} \right), \qquad (9)$$

where $\Delta\tau$ is the decrease in ETRs due to foreign or domestic taxation, ω_s is the weight of sector s and τ'_s is the ETR for firms in that sector in the second period. With the decomposition framework outlined, we now turn to discussing its estimates in the same order.

4 Results and Discussion

4.1 General Results

By applying the framework, we set out above, the BEA and Orbis data sets can be used to decompose changes in ETRs for US and EU MNCs over time. In practice, we can and do decompose the change in US and EU MNC tax rates using a handful of calculated variables. We need the consolidated tax rate in both periods, the foreign and domestic ETRs of both periods, the share of profits at home in both periods and the counterfactual foreign tax rates with weights as in the first period but rates

as in the second, and vice versa. The entire code we use in these calculations and the associated non-proprietary data can be found online at the Open Science Framework website (https://osf.io/nu42h). Our data do not only enable us to decompose the domestic and foreign components of the ETR as indicated in Table 1, but also to provide more detailed decompositions, for example, into the foreign component to see which countries contribute most to changes in MNCs' ETRs, as outlined in the framework in Sect. 3.

The main results of our decomposition are given in Table 2. Its first column, Table 2.I, shows the change in the ETR at which US MNCs paid between 2005 and 2015, decomposed according to our framework. (A more detailed calculation of the results in Table 2 is included in Table 7 in the Appendix.) The total reduction by 7.1 ppts, from 32.3 to 25.2%, is explained almost equally by domestic changes (3.9%) and changes in foreign tax rates and bases (3.5%). Since the statutory tax rate in the USA changed very little in this period, almost all the domestic variation is explained by firms paying a lower effective rate than the statutory rate on average. We show that this is not likely to be explained by the rise of S-corps in Sect. 1 of the Appendix, since the decline in ETRs for non-S-Corp domestic US firms was similar to what we see for the domestic part of US MNCs. Furthermore, we can explain the 3.5 ppts drop due to foreign ETRs mostly by a larger share of the tax base being located in lower tax countries (2.1%, or 29% of the 7.1 ppt reduction) and partly (1.6%) by falling statutory tax rates across the board, counteracted by a slight broadening of the base.

To enable a closer comparison with the results on EU firms discussed below, Table 2.II shows the results of the decomposition for US MNCs including net interest paid. This paints a picture of the US firms paying less than the statutory tax rate on their domestic profits, on average, while countries throughout the rest of the

Table 2 Decomposition of the decrease in effective tax rates over time (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

	I: US (05-15)	II: US* (05-15)	III: EU* (05-15)	IV: US (94-04)	V: US (94-99)
Effective tax rate 2005	32.3	32.8	31.1 (28.9, 32.9)	38.3	38.3
Effective tax rate 2015	25.2	26.2	22.4 (18.5, 28.4)	32.3	38.2
Difference	− 7.1	− 6.7	− 8.7 (− 11.8, − 3.1)	− 6.0	− 0.0
(1 + 2) Domestic taxation	− 3.9	− 3.6	− 5.9 (− 8.5, − 3.0)	− 4.3	0.6
1 Domestic statutory tax rate	− 0.2	− 0.2	− 3.4 (− 4.6, − 2.4)	0.4	0.2
2 Domestic tax base	− 3.7	− 3.4	− 2.5 (− 5.1, 0.1)	− 4.7	0.4
(3 + 4) Foreign tax rates and bases	− 1.5	− 1.1	− 1.6 (− 2.3, − 0.1)	− 0.5	0.5
3 Foreign statutory tax rate	− 1.6	− 1.4	− 0.8 (− 1.0, − 0.4)	− 1.4	− 0.3
4 Foreign tax base	0.1	0.3	− 0.9 (− 1.4, 0.5)	0.8	1.0
5 Foreign profit distribution	− 2.1	− 2.3	− 0.4 (− 1.3, 0.0)	− 0.7	− 1.1
6 Globalisation	0.2	0.2	0.7 (− 0.1, 2.2)	− 0.7	0.1
7 Residual	0.1	0.2	− 0.2 (− 2.1, 0.9)	0.2	0.0
8 Unobserved profits			− 1.3 (− 3.6, 3.1)		

world continue to lower their statutory tax rates. Any shifting of profits between individual states in the USA, and any usage of the special tax rules in Puerto Rico would also be included in the "domestic tax effect"; our decomposition does not single these effects out. (The case of Puerto Rico is described in more detail in the Appendix to Tørsløv et al., 2020; Grubert & Slemrod, 1998, or Mata & Guimarães, 2019.) Increased role of tax havens, including traditional profit shifting between countries, could be present in component 5 as well as potentially 3, 4, 6, 7 and 8 (as discussed in Sects. 3.4 and 4.4), whereas domestic reactions to tax competition will be caught in components 1 and 2, and potentially 7. It is important to note that the reductions in ETRs seen in the table could easily be a reaction to tax havens. Had the US not allowed firms to pay taxes at ETRs below the statutory rate on average, the result might simply have been an erosion of the US tax base.

For EU MNCs, we show the decomposition results on the basis of Orbis in Table 2.III. We include confidence intervals that we calculate using 1000 bootstrapping samples. The 8.7 ppt reduction in the ETRs for EU MNCs is explained by various forces. Changes in statutory tax rates at home explain 3.4 ppts of the decrease and changes in tax base explain a further 2.5 ppts. Changes in foreign taxation account for 2 ppts of the decline; this is explained in similar parts by foreign statutory tax rates (0.8 ppts), foreign tax bases (0.9 ppts) and partly also by foreign profit distribution (0.4 ppts, or 5% of the 8.7 ppt reduction). These forces are complemented by changes in the amount of profits unobserved in the data and the tax rate applicable to them. 35% of profits are in unobserved locations in Orbis in period 1; this reduces to 9% in period 2 (Table 6). This reflects an increase in the data quality in Orbis in recent years and contributes to a decrease in the observed ETR of 1.3 ppts. When we consider only the profits whose locations *are* observed in Orbis, however, the pattern is similar to that from the USA: domestic changes dominate foreign changes, since the domestic base is approximately two times larger than the foreign base (Table 6). We find that domestic taxation components are 2 and 15 times larger than foreign profit distribution component for US and EU MNCs (2.1 vs. 3.9 and 0.4 vs. 5.9), respectively. However, for EU MNCs, the change in domestic taxation is driven by both statutory rate changes and changes in the tax base.

For US MNCs, where we use BEA data, we have information starting in 1994 (remaining two columns in Table 2). Table 2.IV shows the same decomposition but for the period from 1994 (data from the benchmark survey) until 2005. In this period, the reduction in effective taxation for US firms was similar (6.0 ppts), but a larger share of that reduction is explained by domestic policy (4.3%). In fact, almost 80% of the reduction in ETRs in this period corresponds to a decrease in the tax base. This might be due to deductions at home or increased use of domestic tax havens such as Puerto Rico. (In this period, the S-corps became more popular and about 5 ppts. of domestic US profits moved from C-corps to S-corps – if this happened in the MNC sector as well, this could explain some of the fall, but to separate this effect properly we would need to have access to a data set splitting US MNCs into S-corps and C-corps.) Furthermore, changes in foreign profits explain 1.1 ppts of the decrease; these are explained by changes in foreign profit distribution (0.7 ppts) and a drop in the statutory rates (1.4 ppts) that was not fully counteracted by base widening (− 0.5 ppts). In this period, the globalisation effect also contributed to the
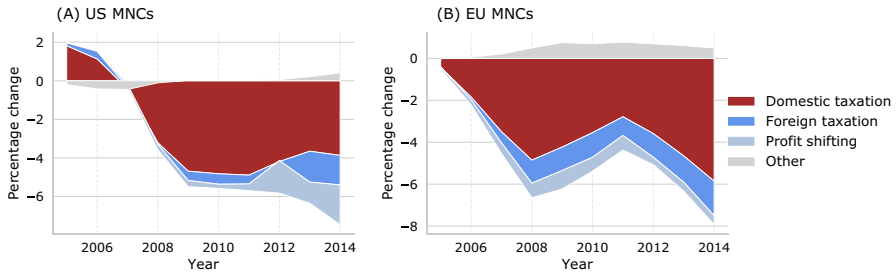
Fig. 2 Evolution of effective tax rates. *Note* The horizontal line at zero marks the tax rate in 2005. *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

decrease in tax rates (0.7%). Finally, Table 2.V shows the results for the period 1994 until 1999 (both sets of data from the benchmark surveys). In this period, there was practically no change in taxation. The domestic tax rate increased slightly, and this was compensated by a decrease in foreign taxation.

We further study the decomposition over individual years rather than between two specific periods to understand whether the changes in ETRs and the components have been gradual or sudden. In Fig. 2 as well as in Table 6, we show that for US MNCs (Fig. 2A), most of the decrease in domestic taxation took place shortly before the financial crisis, and levels then stabilised. The decrease in foreign taxation due to foreign tax rate changes took place more gradually, and particularly in the period between 2010–2012 and 2014–2016. For EU MNCs (Fig. 2B), the decrease in taxation occurred more gradually, decreasing until the period 2008–2010 and then increasing again until 2011. Interestingly, while the decrease due to changes in foreign profit distribution occurred mostly only recently, from 2011 on, for US MNCs, this component declined in importance from around the same time for EU MNCs.

While domestic taxation is directly responsible for more than 50% of the overall decline in ETRs for both US and EU MNCs, foreign taxation might explain some of this decline indirectly. Results of both Table 2 and Fig. 2 show that changes in the domestic taxation of MNCs are responsible for the majority of the decline in the ETR for US MNCs since 1994 and EU MNCs since 2005. A counterfactual world in which ETRs do not change at all is of course highly unlikely. It is possible that changes in domestic taxation are a means of avoiding profit increases in tax havens, in which case we could argue that they are partially driven by tax havens. They are, however, not *directly* due to tax havens.

In addition to the possibility of tax havens indirectly affecting domestic taxation component of declining MNCs' ETRs' decomposition, tax havens might also indirectly affect the taxation of non-MNCs in a similar way. In a way, Table 2 only shows us only a part of the picture, because the taxation of non-MNCs can also be affected by changes in the effective taxation of domestic profits. In the period between 2004 and 2016, non-MNCs in the USA experienced a similar reduction in effective taxation as we have observed for MNCs, which aligns well with the ETR shown in Fig. 1. Table 5 shows the development of the ETRs for all non-S-Corp US firms, both MNCs and non-MNCs. This is by definition more driven by the US

profits than the results in Table 2, which were only for MNCs. Since we exclude S-corps, this analysis excludes 20% of the profits made by US MNCs (as detailed in Table 5 in the Appendix), much as unobserved profits account for 10% of the profits in our EU MNC sample. However, where we know the total effective taxation of the unobserved profits in Orbis, we do not know how much (extra dividend) taxes S-corps pay effectively. This should be investigated when better data become available, since this is another key part of the effective taxation picture. Table 5 shows that the slightly smaller tax reduction of 6.6 ppts is even more dominated by US profits, and only 1.1% pt. of the reduction is due to profits moving between foreign countries. Since including domestic firms increases the weight of the domestic component of the decomposition, the importance of components that are not directly linked to tax havens increases.

4.2 Decomposition by Home Country

We now decompose ETRs of EU MNCs by individual EU home country and present these more granular results in addition to the aggregate results for the EU as a whole presented so far. For this analysis, we focused on the nine countries with the largest MNCs (by profits). Our sample selection in Orbis is restrictive and retains only MNCs for which we have information, at the subsidiary level, about the majority of the total profits and taxes (Sect. 3 and Appendix "Data Selection in Orbis"). This enables us to calculate the point estimates more accurately, at the expense of larger confidence intervals. Nonetheless, the decomposition by home country shows a similar pattern to that found in our decomposition for all EU MNCs. The decrease in effective taxation is confirmed in all these countries except France and Sweden (Table 9 in the Appendix) and is driven by a decrease in statutory tax rates, both on domestic and on foreign profits. An increase in foreign profit distribution component is only confirmed for two countries, Germany and Spain, although the sign is generally negative for the Netherlands, Denmark, Finland and Sweden, and these results are confirmed in our robustness check using different Orbis sample (Tables 10, 11).

4.3 Decomposition by Host Country

Next, we ask which countries contribute the most to the decrease in foreign taxation (equation 8). This can be decomposed into changes in foreign tax rates and bases ($\underline{\omega}_{Fi}\Delta\tau_{Fi}$) and foreign profit distribution ($\Delta\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})$). As explained in Sect. 3, τ'_F corresponds to the average tax rate in period 2 and facilitates the interpretation by giving a negative weight to countries where the weight increases and the ETR is below the average foreign ETR. We visualise the two components in Fig. 3.

We find evidence of more substantial sectoral shifts for US MNCs than for EU MNCs. Figure 3A, C shows the change in ETRs ($\omega_{Fi}\Delta\tau_{Fi}$), plotting the weight of the country (ω_{Fi}) against the change in taxation ($\Delta\tau_{Fi}$). Figure 3B, D shows the foreign profit distribution effect ($\underline{\Delta}\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})$), plotting the taxation in the country relative to the average ($\tau'_{Fi} - \overline{\tau'_F}$) against the change in weight ($\Delta\omega_{Fi}$). Figure 3A shows for US MNCs that the countries with the highest weight have generally decreased
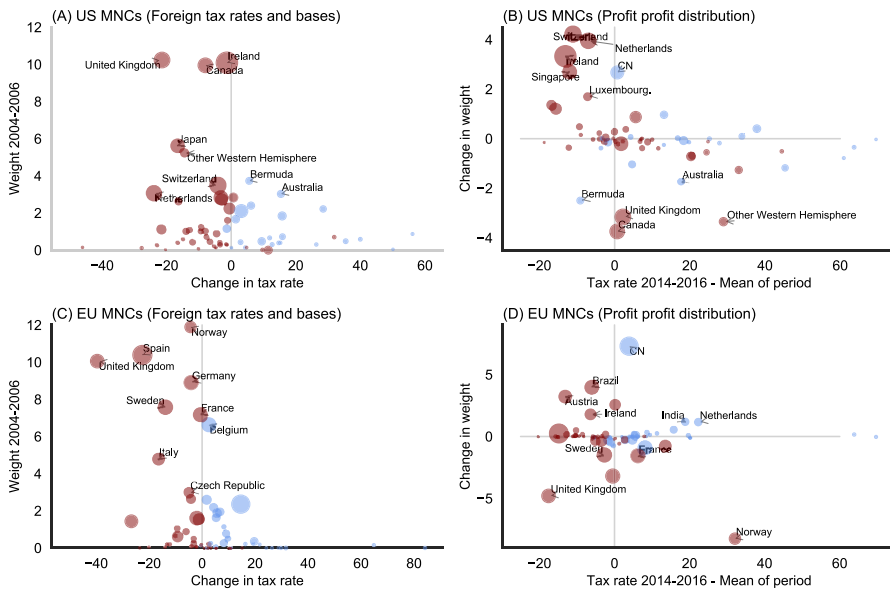
Fig. 3 Different countries' contributions to the decrease in foreign taxation. *Notes* Different countries' contributions to the decrease in ETRs for US MNCs (**A**, **B**) and EU MNCs (**C**, **D**). Countries with a negative (positive) contribution to foreign tax rates are displayed in red (light blue). The decrease in ETRs due to foreign tax rates and bases is mapped in (**A**, **C**), while the decrease in ETRs due to foreign profit distribution is in (**B**, **D**). Note the lack of a clear pattern in (**D**), which reflects the lack of any substantial effect from foreign profit distribution on the decrease in taxation for EU MNCs. *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

their ETR, particularly the UK, Canada, Japan and the Netherlands. Figure 3B shows for US MNCs that the countries with the lowest tax rates have generally increased in weight, particularly Switzerland, the Netherlands, Ireland, Singapore and the UK Caribbean islands. Conversely, the countries with the highest tax rates have generally decreased in weight, e.g. Australia, Norway and France. For EU MNCs, we observe that particular countries contributed strongly to the observed decrease in ETRs (Fig. 3C, D), particularly the UK, Spain, Norway, Sweden, France, Germany and Italy (Fig. 3C). As expected given the low value of the foreign profit distribution component to the decrease in ETRs, we do not see a clear pattern in Fig. 3D. While Norway is an outlier with a high tax rate, only Austria, Brazil and Ireland combine both a below-average tax rate and an increase in weight larger than 1 ppt.

4.4 Decomposition by Tax Haven

We now present our estimates on how much of the decline in ETRs is due to tax havens. There are six components that might capture the role of tax havens: the "foreign statutory tax rate" (3), the "foreign tax base" (4), the "foreign profit distribution" (5), the "globalisation" (6), the "residual" (7) and the "unobserved profits" (8). While unobserved profits could be in tax havens, we are unable to determine it due

to the profits being, by definition, unobserved. The impact of both the residual and the globalisation components depends on the changes in the share of domestic profits. Increased profits in tax havens could impact these two terms by reducing the share of domestic profits. However, we observe that the share of domestic profits has remained constant for US MNCs and increased for EU MNCs at the expense of the share of unobserved profits (Table 6). As such, the impact of these two components is small (between − 0.2 and 0.7 ppts, see Table 2), and we can expect the impact of tax havens to be small.

The three foreign profit components are potentially, however, more impacted by tax havens: foreign tax base, foreign tax rate and foreign profit distribution. We decompose each of the three components based on the type of countries impacting them. In particular, we focus on three types: coordination centres (tax havens that are also used for management and other coordination activities), profit centres (small states used primarily to book profits) and other countries. An extended description is written in Sect. 3.4. We find that 97% of the *changes in foreign profit distribution* of US MNCs are due to increased profits towards tax havens (Table 3). The majority of it (71%) is due to coordination centres and is reflected in Fig. 3B as a cluster of countries (Switzerland, Netherlands, Ireland and Singapore) with much lower tax rates than the average and large profit share gains. This is in contrast with EU MNCs, for which tax havens only account for 12% of the changes in foreign profit distribution – although the lack of data in Orbis on tax havens (e.g. Tørsløv et al., 2020; Garcia-Bernardo et al., 2020) could indicate that the effect of tax havens is reflected in the component "unobserved profits". In the case of changes in *foreign tax bases and rates*, other countries account for the majority of the decline (78–99%), both for changes in statutory tax rates and for changes in tax bases (Table 3). This is expected given that tax rates in tax havens were already low in 2005.

The increase in profits in tax havens by US MNCs raises two questions. First, why has been the share of corporate profits in relation to value-added increasing in recent decades? (see, e.g. Fuest et al., 2020). Consistently with the literature, we find that the growth of corporate profits has outpaced the decrease in ETRs. Between 2005 and 2015, domestic profits of US MNCs increased by 90% and taxes paid by 57%. In the same period, the GDP of the USA increased by 38%. Second, what is the origin of the profits in tax havens? The increase in profits in tax havens could be associated with increased profit shifting, or it could be related to new profits created by an increase in real economic activity in tax havens. In order to partially disentangle this question, we look at the profitability of US MNCs in tax havens (Fig. 9). Profit shifting would be characterised by an increase in profits without a corresponding increase in economic activity. We find that profits in coordination centres increased from an average of USD 72 billion in 2005 to USD 189 billion in 2015 (a 164% increase), while the number of employees increased from USD 664 to 808 thousand (22% increase) – i.e. the profit per employee increased from USD 108,000 to 233,000. Similarly, profits in profit centres increased from USD 38 to 57 billion (a 50% increase), while employees increased from USD 60 to 84 thousand (40% increase) – i.e. the profit per employee increased from USD 633,000 to 677,000. Profits in other foreign countries increased from USD 220 to 303 billion (38% increase), while employees increased from USD 9.7 to 12.9 million (33% increase) – i.e. the profit

Table 3 Effect of tax havens on the decrease in foreign effective tax rates (%). *Source:* Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	USA (05-15)			EU (05-15)		
	Coordination centres	Profit centres	Other countries	Coordination centres	Profit centres	Other countries
(3 + 4) Foreign tax rates and bases	14.2%	3.3%	82.5%	0.2%	–	99.8%
3 Foreign statutory tax rate	9.7%	0.8%	89.6%	0.4%	–	99.6%
4 Foreign tax base	16.2%	5.4%	78.3%	0.3%	–	99.7%
5 Foreign profit distribution	71.1%	25.5%	3.4%	12.0%	–	88.0%

per employee increased slightly from 22,700 to 23,500 (2.5% increase). In line with the literature (e.g. Tørsløv et al., 2020), the rapid increase in profits in coordination centres without a corresponding increase in employees indicates that profit shifting may be the cause of the increase in profits in tax havens.

While the reductions in statutory tax rates and tax bases are not *directly* caused by tax havens, such tax policies are likely affected by tax competition and these ETR reductions could thus *indirectly* be driven by tax havens (Haufler & Schjelderup, 2000; Keen and Konrad, 2012). To illustrate this, think of a world where the elasticity of capital with regard to profit taxation approaches infinity due to extreme profit shifting to tax havens. In this extreme case, the optimal tax rate would be 0% and there would be no *direct* revenue loss due to tax havens. One could, however, argue that tax havens generate a revenue loss *indirectly* through limiting the use of corporate taxation. This thought experiment is used by IMF (2014) in order to illustrate that the observed revenue loss is only part of the losses generated by tax competition. If all effective tax reductions were just the result of changing opinions on how to generate tax revenue – unaffected by outside pressure – this indirect loss would be zero. If, however, some share of effective tax reductions are a reaction to increasing tax competition, the indirect effects this generates should be carefully considered. Devereux et al. (2008), focusing on OECD countries, show that a statutory tax rate reduction of 1 ppt in other countries is on average associated with a statutory rate decrease of 0.7 ppts in the home country. This suggests that countries currently react rather strongly to tax competition. IMF (2014) calls this the "strategic spillover" and underlines the importance of the losses generated by this as comparable to those observed due to tax havens.

When we show that tax havens in themselves can explain at most 29% of US MNCs' ETRs' reduction during the past few decades, this means that up to 71% of that reduction could potentially be due to strategic spillovers. This ratio is not far from the extent identified in the previous literature on the levels of strategic vs. base spillovers. In what they call a highly speculative calculation based on country-level data, Crivelli et al. (2016) find that losses through strategic spillovers are likely three times higher than direct losses due to tax havens. The results of our paper are based on MNCs alone; including non-MNCs could reveal that revenue losses due to strategic spillover are in fact a substantially larger share of all revenue losses. This is because when countries make reductions in their domestic tax rates in order to compete for profits and investments; those reductions affect non-MNCs as well as MNCs. This should be considered carefully when weighing the merits of the current international tax system against new proposals. Such proposals include most prominently Pillar One and Pillar Two proposals by the OECD (2019) for taxing the digital economy that are being agreed by more than 100 governments worldwide in 2021 as well as the destination taxation proposed by Auerbach et al. (2017), or various implementations of formulary apportionment, such as the Common Consolidated Corporate Tax Base (CCCTB) proposed by the European Commission (2016) and studied e.g. by Mardan & Stimmelmayr (2018) or those proposed by the IMF (De Mooij et al., 2019).

It is thus clear from the results we have presented that the decline in ETRs caused by reactions to tax competition – the strategic spillover – potentially represents an

important cost within the current tax system that is often overseen in the debate. Tax havens might be responsible for lower taxation of both MNCs and non-MNCs. We hypothesise but are not able to test this with the current data that not only are ETRs lowered through tax havens directly, but the tax base of MNCs and non-MNCs that remains in the country is, in reaction to tax havens, then taxed at a lower rate than would be the case, had tax havens not existed.

4.5 Decomposition by Sector

Finally, we investigate whether the observed decrease in ETRs could be due to changes in the sectoral composition of the studied MNCs. We find that this is indeed partly the case for US MNCs, but much less so for EU MNCs (Table 4). For US MNCs, changes in the weight of different sectors account for 3.7 ppts out of the 6.8 ppts reduction in effective taxation, primarily as a result of changes in the Finance and Insurance sectors (Fig. 4A, B). When we consider only changes in foreign taxation, sectoral changes can account for 7.7 ppts out of the 10.7 ppts decrease. This is due to an increase in the financial, real estate and pharmaceutical sectors (which face low tax rates abroad) and a decrease in the petroleum and coal products and mining sectors (which usually face resource taxes) (Fig. 4C, D). In the light of these results, we can say that only half of the 3.7 ppts decrease in the ETR on the domestic tax base of US MNCs is attributable to real changes in tax base. For the changes related to the foreign base, only one-third of the 3.5 ppts decrease is attributable to changes in statutory tax rates and in the base shifted between foreign

Table 4 Summary of effective tax rates' sectoral decomposition (%). *Source*: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	US MNCs			EU MNCs		
	2005	2015	Difference	2005	2015	Difference
Domestic taxation	33.5	26.7	− 6.8	37.4	24.7	− 12.6
Taxation except sector composition	33.5	30.4	− 3.1	37.4	26.1	− 11.3
Sectoral change	30.4	26.7	− 3.7	26.1	24.7	− 1.4
Foreign taxation	27.1	16.4	− 10.7	31.4	21.2	− 10.3
Taxation except sector composition	27.1	24.1	− 3.0	31.4	13.9	− 17.5
Sectoral change	24.1	16.4	− 7.7	13.9	21.2	7.3
Unobserved profits				23.5	28.0	4.5
Taxation except sector composition				23.5	17.3	− 6.2
Sectoral change				17.3	28.0	10.7

Note that the numbers in Table 4 do not match exactly with those in Table 2. This is due to some sectors, including some major ones such as "Mining", having negative profits or taxation. Excluding those sectors would distort the comparison with the rest of the analysis. Instead, we set the profits and taxes of those sectors to zero. For US MNCs, this was done for US mining companies in the domestic sector. For EU MNCs, sector "P" (education) was set to zero for the domestic taxation, sectors "P", "D" (electricity) and "J" (IT) for the foreign taxation, and sectors "P", "D","J", "M" (professional),"G" (wholesale and retail trade), and "E" (water supply) for the unobserved profits.
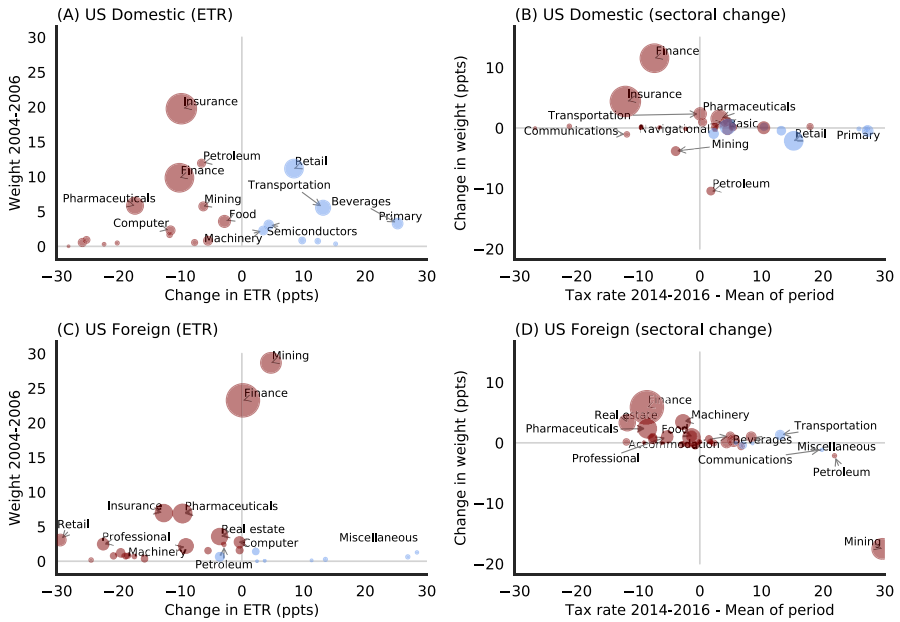
Fig. 4 Sectoral changes in taxation for US MNCs. *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

countries. Given the limitations of the data, we are unable to differentiate whether what we observe is a real change in sectors or an increase in the financialisation of MNCs.

For EU MNCs, the sectoral decomposition indicates that most of the decline in ETRs cannot be explained by change in the sectoral composition (only − 1.4 ppts out of − 12.6 ppts for domestic taxation), and for foreign taxation the sectoral change is positive at 7.3 ppts and might thus actually lead to underestimating that the decline in ETRs had the sectoral composition stayed unchanged. In order to check the robustness of this result for EU MNCs, we replicate the analysis keeping only manufacturing MNCs, and the results are maintained (Table 8).

5 Conclusion

This paper shows that while tax havens are important, declines in ETRs might be dominated in magnitude by the strategic spillovers of tax competition. From the point of view of a country's tax revenue authority, tax competition likely causes more revenue loss indirectly through countries' policy reactions, than directly due to tax havens. Using data from the BEA and Orbis, we have shown that the decline in ETRs for US and EU MNCs since the mid-2000s has been driven mainly by the lowering of statutory tax rates, and only to a much lesser degree by increasing profits in tax havens. We add to the country-level IMF (2014) analysis by showing that revenue losses due to

strategic spillovers are potentially twice as large as losses due to profit shifting directly for US MNCs.

One of this paper's key contributions is that it presents an EU data set comparable to the US BEA data on MNCs. This has enabled us to examine the similarities and differences between US and EU MNCs. We show that both groups of MNCs have paid tax on their consolidated profits at similar effective rates since 2005 and that those rates have declined markedly in that period. While both rates fell somewhat as a result of profits being moved to lower taxed subsidiaries, the lowering of ETRs are, in both cases, primarily explained by domestic taxation and statutory tax rate reductions abroad. For the US MNCs, the ETRs increasingly fell below the statutory rate. For the EU MNCs, most of the decline was explained by falling statutory tax rates at home.

We show that reductions in statutory rates have been the key driver of declining effective tax rates in the EU, whereas tax havens are more important in the USA. One possible interpretation of these findings is that EU countries managed to reduce the increase in profits in tax havens (at least relatively to the USA) by pre-emptively reducing statutory rates. From the point of view of the USA, which did not reduce its statutory rates, US MNCs achieved ETRs comparable to EU MNCs by increasing profits in low-tax jurisdictions. An alternative possible explanation is that US MNCs were increasingly able to shift profits between EU countries and into tax havens (through, e.g. the Directive 2003/49/EC, which eliminated withholding tax rates on intra-group royalty and interest payment within the EU), while EU MNCs faced higher domestic constraints to do so. Furthermore, until better time series for MNCs become available, we cannot fully rule out what share of the actual trends remains unobserved due to data limitations. A case in point is the existence and scale of the explicitly estimated unobserved profits in the Orbis data for EU MNCs. At least some of these unobserved profits are likely to be profits in low-tax jurisdictions, which could explain part of the observed difference in tax haven effects between US and EU MNCs. Future research could investigate the reasons why US MNCs managed to increase the share of profits in tax havens while EU MNCs did not.

The large indirect cost of tax havens is likely the largest cost associated with current international tax rules. When analysing only the direct revenue costs of tax havens, one is potentially ignoring the majority of the problem. An analysis of changes in strategic spillover effects is crucial when evaluating the current tax system against other potential systems, such as the CCCTB and the destination cash flow tax. Or, perhaps most importantly, a global minimum corporate income tax as part of the OECD's 2019 Pillar Two proposals for taxing the digital economy that are being agreed in 2021.

On behalf of all authors, the corresponding author states that no conflict of interest exists.

Appendix

US Firms and the Effect of S-corps on Effective Tax Rates

S-corps constitute an important factor in the average effective taxation of US firms. These are important because they do not pay any corporate income taxes,
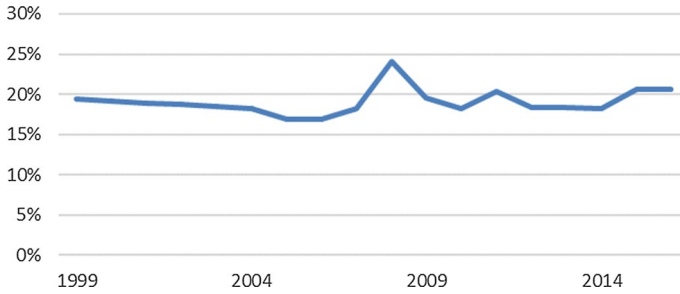
Fig. 5 The share of US profits earned in S-corporations. *Source* Authors on the basis of the IRS data (Statistics of Income)
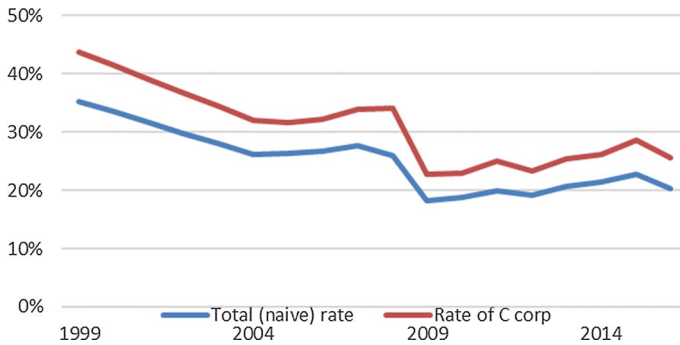

Fig. 6 The average effective tax rate on all US profits with and without S-corps. *Source* Authors on the basis of the US national accounts data

but instead pay higher dividend taxation. In other words, the same taxes *are* paid on the profits, but these are not corporate taxes. Including these corporations in any sample of firms used to calculate ETRs will thus give serious biases towards 0. Unfortunately, the BEA data include these firms in all their statistics, which leaves researchers with a problem.

In order to say something about the magnitude of the use of S-corps, we use the IRS "Source of Income" data, following the lead set by Wright and Zucman (2018). This, together with national accounts data from BEA, shows that the share of US domestic profits that are made in S-corps was fairly constant between 2004 and 2016 at about 20%. The level is shown in Fig. 5.

When considering the US national accounts data, presented in Fig. 6, we find that the effective tax rate of the whole domestic corporate sector fell from 26 to 20% between 2004 and 2016, while these numbers increase to 32–26%, respectively, when removing S-corps. The ETR is thus approximately 6 ppts higher when we only consider firms that pay their taxes as corporate taxes. In either case, the reduction over the period corresponds well with the 6.1% ppt decrease in domestic taxation of MNCs that we identified from the BEA data and show in the main tables of this paper. This points towards US MNCs getting just about

Table 5 Decomposition of the decline in US firms consolidated tax rates 2005–2015 with domestic corporations included (%). *Source*: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	%	% of total difference
Effective tax rate 2005	31.3	
Effective tax rate 2015	24.7	
Difference	− 6.6	100.0
Domestic taxation (1 + 2)	− 4.2	63.2
1 Domestic statutory tax rate	− 0.2	3.5
2 Domestic tax base	− 4.0	59.7
Foreign tax rates and bases (3 + 4)	− 1.0	14.7
3 Foreign statutory tax rate	− 1.3	19.6
4 Foreign tax base	0.3	− 5.0
5 Foreign profit distribution	− 1.1	16.4
6 Globalisation	− 0.2	2.6
7 Residual	− 0.2	3.2

Data on domestic corporate profits are obtained from the national accounts from BEA, data on MNC's profits are from the BEA's MNC survey, and data on profits of S-corps are from the IRS's SOI-database on corporate taxation

the same effective tax reductions on their profits reported in the USA as US non-MNCs get. S-corporations are unlikely to have caused the downwards trend in the domestic taxation of profits booked in the USA between 2004 and 2016, although the ETR each year will seem low if they are not accounted for (Table 5).

The Main Decomposition of Effective Tax Rates

See Tables 6 and 7.

Data Selection in Orbis

We collected financial and ownership information from the Orbis database. Orbis collects information on over 300 million public and private firms worldwide from a variety of country data providers. We extracted company ownership data from the Orbis database (http://orbis.bvdinfo.com) in March 2018. For each available entity, we extracted its country, taxes paid, profit (loss) before taxes and EBIT for each available year. For each global ultimate owner (parent firm which owns at least 50% of a company directly or indirectly and is not itself owned by any other firm), we extracted the consolidated taxation, profits, EBIT (aggregated for the entire firm) for each available year, and the list of subsidiaries (entities owned at least 50% by the global ultimate owner) for the entire range of the data: 2007–2017. We then matched each entity to the corresponding global ultimate owner. If the owner was not known at the time of the financial information, the closest available year was used.

Table 6 The basic decomposition components over time (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

Year	US MNCs						EU MNCs							
	Domestic taxation			Foreign taxation			Domestic taxation			Foreign taxation			Unobserved profits	
	Weight	Effective taxation	Statutory rate	Weight	Effective taxation	Statutory rate	Weight	Effective taxation	Statutory rate	Weight	Effective taxation	Statutory rate	Weight	Effective taxation
2004–2006	63.1	34.6	39.3	36.9	28.3	29.0	46.3	36.6	33.1	19.1	30.9	30.2	34.6	23.8
2005–2007	60.8	37.5	39.3	39.2	28.7	28.7	45.9	35.6	32.4	20.0	30.6	29.8	34.1	20.2
2006–2008	57.1	36.4	39.3	42.9	29.4	28.9	47.8	32.6	31.3	20.8	29.0	28.9	31.4	24.3
2007–2009	54.2	34.0	39.2	45.8	28.5	28.5	52.0	29.0	30.3	22.8	25.5	28.1	25.2	30.3
2008–2010	54.2	29.5	39.2	45.8	27.5	28.0	57.0	26.1	29.2	26.3	21.6	27.1	16.7	46.5
2009–2011	57.2	27.2	39.2	42.8	26.3	27.4	56.9	27.4	28.7	29.2	20.5	27.0	13.9	47.3
2010–2012	58.6	27.0	39.2	41.4	26.4	27.2	55.5	28.9	28.3	30.0	21.2	26.9	14.5	39.7
2011–2013	60.9	26.9	39.1	39.1	26.2	27.1	55.7	30.6	27.8	29.0	22.8	26.7	15.3	33.5
2012–2014	63.5	28.0	39.1	36.5	24.0	25.9	58.0	28.8	27.4	28.7	23.4	26.4	13.3	26.0
2013–2015	65.5	28.8	39.0	34.5	21.0	24.2	59.3	26.5	27.0	31.2	22.5	26.4	9.5	23.7
2014–2016	66.8	28.5	39.0	33.2	18.7	22.7	58.3	23.9	25.9	32.8	20.3	26.2	8.9	19.9

Table 7 Decomposition of the decrease in effective tax rates over time – summary of the calculations (rates in %). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	I: US (04-14)	II: US* (04-14)	III: EU* (04-14)	IV: US (94-04)	V: US (94-99)
Domestic taxation (1 + 2)	− 3.9 = 0.63 (28.5 – 34.6)	− 3.6 = 0.65 (28.7 – 34.3)	− 5.9 = 0.46 (23.9 – 36.6)	− 4.3 = 0.72 (34.6 – 40.6)	0.6 = 0.72 (41.4 – 40.6)
1 Domestic statutory tax rate	− 0.2 = 0.63 (39.0 – 39.3)	− 0.2 = 0.65 (39.0 – 39.3)	− 3.4 = 0.46 (25.9 – 33.1)	0.4 = 0.72 (39.3 – 38.7)	0.2 = 0.72 (39.0 – 38.7)
2 Domestic tax base	− 3.7 = 0.63 (− 10.5 – − 4.7)	− 3.4 = 0.65 (− 10.3 – − 5.0)	− 2.5 = 0.46 (− 1.9 – 3.4)	− 4.7 = 0.72 (− 4.7 – 1.9)	0.4 = 0.72 (2.4 – 1.9)
Foreign tax rates and bases (3 + 4)	− 1.5 = 0.37 (24.1 – 28.3)	− 1.1 = 0.35 (27.1 – 30.2)	− 1.6 = 0.19 (22.2 – 30.9)	− 0.5 = 0.28 (30.3 – 32.2)	0.5 = 0.28 (34.0 – 32.2)
3 Foreign statutory tax rate	− 1.6 = 0.37 (24.5 – 29.0)	− 1.4 = 0.35 (25.6 – 29.6)	− 0.8 = 0.19 (26.0 – 30.2)	− 1.4 = 0.28 (30.6 – 35.5)	− 0.3 = 0.28 (34.3 – 35.5)
4 Foreign tax base	0.1 = 0.37 (− 0.4 – − 0.7)	0.3 = 0.35 (1.5 – 0.6)	− 0.9 = 0.19 (− 3.8 – 0.7)	0.8 = 0.28 (− 0.3 – − 3.3)	1.0 = 0.28 (0.4 – − 3.3)
5 Foreign profit distribution	− 2.1 = 0.37 (18.7 – 33.9)	− 2.3 = 0.35 (20.6 – 36.8)	− 0.4 = 0.19 (20.3 – 33.1)	− 0.7 = 0.28 (28.3 – 34.9)	− 1.1 = 0.28 (29.5 – 36.1)
6 Globalisation	0.2	0.2	0.7	− 0.7	0.1
7 Residual	0.1	0.2	− 0.2	0.2	0.0
8 Unobserved profits	0.0	− 0.0	− 1.3	0.0	0.0

For each cell, both the final result and the calculation used to obtain it are shown.

For each of the 46,423 global ultimate owners with consolidated accounts, we filtered those outside the EU 21 (the member states of the EU in 2004), where data quality is low (Garcia-Bernardo et al., 2017), to reach 28273 firms, and removed the state-owned enterprises as in Babic et al. (2019) to reach 27,054 firms; we kept those 27,054 firms that were either public or private limited companies. We then removed firms that had either negative profits (19,861 remaining) or fewer than five observations (12,192 remaining). Out of the 28 EU member states as of 2019, we are left with data relating to 23 member states.

For each of the 12,192 global ultimate owners, we aggregated the financial information on all its active subsidiaries (excluding the categories "branch" and "foreign company") by country. In order to account for partial ownership, we first scaled each financial variable by the ownership stake ("total ownership" variable in Orbis) when this information was available and used the average total ownership (87.7%) for subsidiaries where this information was not available. In the aggregation process, we removed subsidiaries for which information on profits or taxation was not available.

We then removed global ultimate owners for which we could not account at least 50% of their operating profits and taxes at the unconsolidated level, and those for which we accounted for more than 120% (for example because we did not have subsidiaries with losses). This reduced the sample to 5,159 companies. Then, to achieve a more balanced panel, we removed global ultimate owners for which we did not have at least 10 years of data (in the period 2004–2014), which further reduced the sample to 2653 companies. Finally, we removed 20 companies for which the effective tax rate was above 60% for the entire period as outliers. The final data set contained 145,095 country-year observations for those 2633 companies.

In addition, we created two robustness checks. One in which the threshold was set to five observations, which produced a set containing 5119 global ultimate owners and 214,599 country-year observations; and one where only combinations of country global ultimate owner with positive profits and taxes were combined, containing 2633 companies and 100,060 observations.

Additional Decompositions with Orbis

See Tables 8, 9, 10 and 11.

Back-of-the-Envelope Calculation of Misreported Profits

Following the method presented in Tørsløv et al. (2018), profit shifting can be proxied by the misalignment between profits and activity measured in terms of the wage bill. They calculate a macro indicator for profit shifting, π, dividing the profits earned by the wage bill in different sectors of different countries. In this section, we do a back-of-the-envelope version of this: we compare the ratio between profits and wage bill within all US MNCs, aggregated, and analyse where profits are in excess and where they are missing. However, we do so comparing very rough groups of countries, and thus likely underestimating the profits shifted. To illustrate the method, two time series are introduced in Figs. 7 and 8.

Table 8 Robustness tests for Orbis (%). *Source*: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	Manufacturing sample	Larger sample	Only positive
Effective tax rate 2005	30.4 (26.6, 33.2)	30.9 (28.8, 32.6)	32.1 (29.1, 35.6)
Effective tax rate 2015	21.6 (18.5, 25.8)	22.5 (19.5, 27.8)	23.3 (21.0, 26.4)
Difference	− 8.7 (− 12.3, − 2.3)	− 8.5 (− 10.9, − 3.7)	− 8.8 (− 10.8, − 6.4)
Domestic taxation (1 + 2)	− 5.6 (− 7.8, − 2.6)	− 5.9 (− 7.9, − 3.5)	− 5.1 (− 6.6, − 3.4)
1 Domestic statutory tax rate	− 1.7 (− 2.9, − 0.7)	− 3.3 (− 4.4, − 2.4)	− 3.6 (− 4.7, − 2.7)
2 Domestic tax base	− 3.9 (− 5.8, − 1.0)	− 2.5 (− 4.5, − 0.2)	− 1.5 (− 3.5, 0.5)
Foreign tax rates and bases (3 + 4)	− 1.2 (− 2.2, − 0.4)	− 1.8 (− 2.5, − 0.4)	− 1.8 (− 2.6, − 0.8)
3 Foreign statutory tax rate	− 0.9 (− 1.5, − 0.6)	− 0.8 (− 1.0, − 0.5)	− 0.8 (− 1.1, − 0.6)
4 Foreign tax base	− 0.3 (− 0.8, 0.5)	− 1.0 (− 1.6, 0.3)	− 1.0 (− 1.6, − 0.1)
5 Foreign profit distribution	− 0.2 (− 1.3, 0.3)	− 0.3 (− 1.0, 0.1)	− 0.5 (− 1.4, 0.0)
6 Globalisation	1.9 (− 0.1, 4.4)	0.7 (− 0.1, 2.0)	0.0 (− 0.4, 0.7)
7 Residual	− 1.6 (− 4.3, 0.1)	− 0.3 (− 2.0, 0.7)	0.0 (− 0.5, 0.3)
8 Unobserved profits	− 2.0 (− 4.4, 3.3)	− 1.0 (− 3.2, 3.0)	− 1.6 (− 2.8, − 0.2)

Figure 7 shows the amount of wages paid in the domestic and foreign affiliates of US MNCs, split into the effective taxation of the countries. It shows that in the categories we could name "low-tax countries" that have a tax rate below 15%, there is almost no personnel at all. The tax rate by which the countries have been split is kept constant across the period to avoid countries shifting between the groups.

Figure 8 shows the distribution of profits reported, using the same categories of countries. Here, the low-tax countries are very clearly an important factor for US MNCs. It is also remarkable how little profits there are compared to the wage bill in the domestic market.

The back-of-the-envelope calculation goes as follows (and is shown in Table 12 for 2015): calculate π in a category of countries based on their effective taxation, and compare with the average π of the US MNCs. If it is much higher than the average, the difference between the average and the measured π is a rough estimate of the scale of inward shifting. Like this, just by looking at the very lowest taxed countries, we obtain a number close to those presented in the existing literature, at $189 bn from US MNCs alone (for a recent discussion of the estimates and associated BEA data challenges see, for example, Zucman, 2014; Clausing, 2020, Blouin and Robinson, 2020). An important note to bear in mind in this extremely simple calculation is that the BEA data do not always show exactly which countries' profits and wages are in. Often, tens of countries are lumped together into one large group, such as "Other western hemisphere", including all Caribbean islands not explicitly mentioned. If havens are lumped together with larger non-haven countries, the average tax rate across the group might fall above 15%, which would take them completely out of the equation in this little calculation.

Table 9 Decomposition by home country (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

	Germany	Spain	UK	Italy	France	Denmark	Finland	The Netherlands	Sweden
Effective tax rate 2005	36.0 (30.7, 40.0)	29.7 (26.9, 31.6)	33.1 (29.4, 37.3)	32.2 (31.0, 37.8)	43.3 (24.0, 48.6)	42.8 (23.6, 60.4)	26.9 (22.3, 28.3)	30.2 (25.9, 33.3)	26.3 (24.4, 28.2)
Effective tax rate 2015	27.0 (22.6, 30.1)	20.2 (10.7, 23.4)	21.2 (16.5, 26.1)	23.4 (20.1, 33.2)	47.4 (26.0, 74.7)	22.0 (19.8, 25.8)	19.4 (17.6, 22.9)	23.9 (18.5, 26.8)	25.9 (23.0, 27.7)
Difference	− 9.0 (− 16.1, − 1.5)	− 9.5 (− 19.3, − 6.0)	− 11.9 (− 17.8, − 7.2)	− 8.9 (− 11.1, − 2.4)	4.1 (− 1.9, 25.8)	− 20.9 (− 39.9, − 0.9)	− 7.5 (− 9.7, − 1.3)	− 6.3 (− 11.9, − 1.3)	− 0.4 (− 3.6, 1.5)
Domestic taxation (1 + 2)	− 6.5 (− 9.9, − 2.3)	− 5.2 (− 18.7, 3.1)	− 8.6 (− 13.0, − 4.9)	− 2.5 (− 7.6, − 0.5)	9.1 (− 3.1, 24.0)	− 22.3 (− 38.7, − 3.5)	− 2.5 (− 3.9, 0.5)	− 1.8 (− 3.3, − 1.0)	− 2.5 (− 4.7, − 0.0)
1 Domestic statutory tax rate	− 2.1 (− 3.5, − 0.9)	− 8.2 (− 8.4, − 5.5)	− 3.7 (− 6.1, − 2.8)	− 4.7 (− 5.1, − 3.9)	1.2 (0.9, 1.8)	− 3.8 (− 4.4, − 2.7)	− 1.9 (− 3.3, − 1.5)	− 1.3 (− 2.2, − 0.8)	− 2.3 (− 2.8, − 1.7)
2 Domestic tax base	− 4.4 (− 7.4, − 0.3)	3.0 (− 12.8, 11.4)	− 4.9 (− 8.4, 0.0)	2.1 (− 3.3, 3.7)	8.0 (− 4.8, 23.1)	− 18.5 (− 35.0, 0.6)	− 0.6 (− 2.3, 3.7)	− 0.5 (− 1.3, 0.1)	− 0.2 (− 2.6, 2.3)
Foreign taxation (3 + 4)	− 0.9 (− 2.2, 3.9)	0.6 (− 0.1, 1.9)	− 0.9 (− 2.6, 1.2)	− 2.1 (− 4.6, 0.5)	− 1.2 (− 1.9, 3.8)	− 0.3 (− 1.1, 2.4)	− 0.3 (− 1.8, 0.6)	1.9 (− 5.5, 10.5)	− 0.6 (− 2.7, 1.6)
3 Foreign statutory tax rate	− 1.1 (− 1.6, − 0.7)	− 0.2 (− 0.2, 0.1)	− 0.7 (− 1.5, − 0.2)	− 0.8 (− 1.5, − 0.2)	− 0.5 (− 1.4, − 0.3)	− 1.3 (− 2.4, − 0.7)	− 0.6 (− 0.8, − 0.4)	− 2.1 (− 3.3, − 0.8)	− 0.7 (− 1.3, − 0.6)
4 Foreign tax base	0.2 (− 0.9, 5.1)	0.8 (− 0.1, 2.1)	− 0.2 (− 1.2, 2.0)	− 1.2 (− 3.0, 0.9)	− 2.0 (− 2.7, 5.2)	1.0 (− 0.2, 4.7)	0.3 (− 1.2, 1.2)	4.0 (− 3.0, 12.8)	0.2 (− 1.6, 2.7)
5 Foreign profit distribution	− 1.8 (− 6.7, − 0.6)	− 1.0 (− 2.3, − 0.2)	0.3 (− 1.3, 0.6)	0.1 (− 0.5, 0.4)	0.9 (− 6.5, 2.4)	− 0.5 (− 3.9, 0.1)	− 0.1 (− 1.0, 0.3)	− 2.9 (− 8.4, 0.6)	− 0.7 (− 3.1, 0.1)
6 Globalisation	2.6 (− 2.7, 10.6)	− 4.3 (− 6.3, 0.7)	4.3 (0.0, 8.2)	− 0.9 (− 1.6, 1.7)	0.8 (− 1.2, 2.7)	− 1.5 (− 6.4, 5.6)	− 0.0 (− 0.6, 1.1)	− 0.0 (− 0.6, 0.4)	0.2 (− 0.2, 1.1)
7 Residual	− 1.5 (− 6.7, 1.5)	0.9 (− 2.9, 2.6)	− 4.6 (− 9.4, − 0.0)	− 1.3 (− 3.3, 0.3)	− 2.2 (− 4.2, 3.3)	1.7 (− 6.6, 7.5)	− 0.2 (− 1.7, 1.0)	0.0 (− 0.5, 0.8)	0.1 (− 0.6, 0.6)
8 Unobserved profits	− 1.0 (− 5.6, 4.7)	− 0.6 (− 3.2, 2.6)	− 2.4 (− 4.7, − 0.4)	− 2.1 (− 3.3, 2.7)	1.0 (− 2.6, 10.8)	1.8 (− 1.3, 6.0)	− 4.5 (− 6.4, 0.5)	− 3.9 (− 7.8, 3.6)	2.7 (− 0.0, 5.2)

The two numbers indicate the 95% confidence intervals of 1000 bootstrap samples. Italicised values are statistically significant.

Table 10 Robustness tests for Orbis for the home country analysis with a larger sample (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

	Germany	Spain	UK	Italy	France	Denmark	Finland	The Netherlands	Sweden
Effective tax rate 2005	35.5 (30.6, 39.2)	29.2 (26.9, 30.7)	32.6 (29.1, 36.4)	32.6 (31.3, 37.2)	42.8 (25.1, 48.2)	42.2 (25.8, 55.6)	26.8 (22.3, 28.3)	32.9 (27.3, 35.6)	26.8 (24.8, 28.6)
Effective tax rate 2015	27.0 (23.7, 30.3)	20.3 (10.9, 23.0)	20.6 (16.3, 25.5)	24.2 (21.1, 33.3)	45.0 (25.2, 70.1)	22.4 (20.5, 26.5)	19.4 (17.5, 22.5)	23.6 (19.8, 27.4)	25.7 (23.0, 27.4)
Difference	− 8.6 (− 14.4, − 1.4)	− 8.9 (− 18.2, − 6.0)	− 12.1 (− 17.3, − 7.7)	− 8.4 (− 10.5, − 2.2)	2.2 (− 3.3, 21.7)	− 19.8 (− 34.5, − 1.1)	− 7.4 (− 10.0, − 1.4)	− 9.2 (− 14.3, − 1.9)	− 1.2 (− 4.3, 0.7)
Domestic taxation (1 + 2)	− 6.0 (− 9.0, − 2.0)	− 5.0 (− 17.9, 3.0)	− 8.6 (− 12.5, − 5.6)	− 3.4 (− 7.5, − 1.5)	7.3 (− 3.6, 21.3)	− 20.9 (− 34.1, − 5.6)	− 2.0 (− 3.7, 0.5)	− 1.6 (− 3.1, − 0.8)	− 2.9 (− 4.8, − 0.5)
1 Domestic statutory tax rate	− 2.3 (− 3.7, − 1.0)	− 8.3 (− 8.5, − 5.6)	− 3.7 (− 5.8, − 2.8)	− 4.7 (− 5.1, − 4.0)	1.2 (1.0, 1.8)	− 3.9 (− 4.4, − 3.0)	− 2.0 (− 3.5, − 1.6)	− 1.0 (− 1.9, − 0.5)	− 2.5 (− 2.9, − 1.8)
2 Domestic tax base	− 3.7 (− 6.5, 0.5)	3.3 (− 12.0, 11.1)	− 4.9 (− 7.9, − 1.1)	1.3 (− 3.3, 2.9)	6.1 (− 5.3, 20.3)	**− 16.9 (− 30.2, − 2.0)**	0.1 (− 2.1, 3.7)	**− 0.6 (− 1.4, − 0.2)**	− 0.4 (− 2.5, 1.9)
Foreign tax rates and bases (3 + 4)	− 0.9 (− 2.2, 4.1)	1.0 (− 0.1, 1.9)	− 0.8 (− 2.4, 1.6)	− 1.8 (− 4.1, 0.6)	− 1.5 (− 2.1, 2.8)	**− 0.9 (− 1.8, 1.0)**	− 0.3 (− 1.7, 0.6)	− 7.5 (− 13.9, 2.7)	− 0.8 (− 2.6, 1.2)
3 Foreign statutory tax rate	− 1.0 (− 1.6, − 0.7)	− 0.2 (− 0.2, 0.0)	− 0.6 (− 1.4, − 0.2)	− 0.8 (− 1.4, − 0.2)	− 0.5 (− 1.4, − 0.4)	− 1.2 (− 2.0, − 0.7)	− 0.6 (− 0.8, − 0.4)	− 4.5 (− 6.9, − 1.6)	− 0.8 (− 1.2, − 0.6)
4 Foreign tax base	0.1 (− 1.0, 5.3)	1.1 (− 0.0, 2.1)	− 0.2 (− 1.2, 2.1)	− 1.0 (− 2.7, 1.0)	− 2.2 (− 2.9, 4.1)	0.4 (− 0.9, 2.7)	0.3 (− 1.1, 1.3)	− 3.0 (− 7.3, 5.5)	0.0 (− 1.5, 2.3)
5 Foreign profit distribution	− 1.7 (− 6.5, − 0.5)	− 1.4 (− 2.4, − 0.1)	0.1 (− 2.3, 0.5)	0.0 (− 0.6, 0.3)	0.7 (− 5.2, 2.0)	− 0.3 (− 2.3, 0.2)	− 0.1 (− 1.0, 0.2)	1.9 (− 3.2, 4.1)	− 0.4 (− 2.5, 0.2)
6 Globalisation	2.1 (− 2.5, 8.4)	− 3.9 (− 5.9, 0.6)	4.6 (0.9, 8.0)	− 0.6 (− 1.2, 2.2)	1.0 (− 0.5, 2.6)	− 1.9 (− 5.6, 2.2)	− 0.0 (− 0.9, 0.9)	0.0 (− 0.4, 0.5)	0.2 (− 0.2, 1.1)

Table 10 (continued)

	Germany	Spain	UK	Italy	France	Denmark	Finland	The Netherlands	Sweden
7 Residual	− 1.0 (− 5.5, 1.3)	0.8 (− 3.0, 2.2)	*− 5.3 (− 9.4, − 0.8)*	− 0.6 (− 2.5, 0.2)	− 2.3 (− 4.0, 2.5)	2.3 (− 2.6, 6.6)	− 0.4 (− 2.1, 1.0)	− 0.1 (− 0.7, 0.7)	0.2 (− 0.5, 0.7)
8 Unobserved profits	− 1.0 (− 5.3, 4.7)	− 0.5 (− 3.1, 2.8)	*− 2.2 (− 4.2, − 0.5)*	− 2.0 (− 3.3, 3.3)	1.2 (− 3.1, 8.7)	1.8 (− 0.9, 7.0)	− 4.7 (− 6.3, 0.4)	− 2.4 (− 5.4, 2.6)	2.3 (− 0.4, 4.7)

Using the larger sample where a threshold of five observations was used (section "Data Selection in Orbis"). Italicised values are statistically significant for both this sample and the study sample. Bold values in the cells are statistically significant in this sample

Table 11 Robustness tests for Orbis for the home country analysis, keeping observations with positive profits and taxes only (%). *Source* Authors on the basis of data from the Bureau of Economic Analysis and Orbis

	Germany	Spain	UK	Italy	France	Denmark	Finland	The Netherlands	Sweden
Effective tax rate 2005	35.5 (28.8, 38.4)	29.2 (27.1, 31.4)	32.6 (28.7, 33.7)	32.6 (31.0, 36.6)	42.8 (24.4, 48.4)	42.2 (24.3, 53.2)	26.8 (23.0, 28.0)	32.9 (25.7, 30.7)	26.8 (25.2, 27.8)
Effective tax rate 2015	27.0 (21.4, 27.7)	20.3 (12.3, 21.6)	20.6 (16.3, 20.9)	24.2 (20.4, 29.5)	45.0 (25.3, 57.7)	22.4 (19.0, 22.5)	19.4 (18.0, 21.6)	23.6 (22.2, 26.2)	25.7 (22.3, 26.7)
Difference	− 8.6 (− 14.9, − 2.7)	− 8.9 (− 18.1, − 7.7)	− 12.1 (− 15.3, − 10.4)	− 8.4 (− 10.8, − 5.0)	2.2 (− 3.1, 9.7)	− 19.8 (− 33.1, − 3.7)	− 7.4 (− 8.5, − 2.9)	− 9.2 (− 7.6, − 1.0)	**− 1.2 (− 3.5, − 0.7)**
Domestic taxation (1 + 2)	− 6.0 (− 8.0, − 0.9)	**− 5.0 (− 16.6, − 1.9)**	− 8.6 (− 10.2, − 6.1)	− 3.4 (− 7.4, − 0.9)	7.3 (− 2.8, 11.8)	− 20.9 (− 32.0, − 3.4)	− 2.0 (− 2.3, 0.1)	− 1.6 (− 2.7, − 0.8)	− 2.9 (− 3.9, − 1.2)
1 Domestic statutory tax rate	− 2.3 (− 3.5, − 1.6)	− 8.3 (− 7.1, − 5.1)	− 3.7 (− 6.2, − 3.0)	− 4.7 (− 5.0, − 3.7)	1.2 (0.9, 1.7)	− 3.9 (− 4.1, − 2.8)	− 2.0 (− 2.1, − 1.5)	− 1.0 (− 2.1, − 0.7)	− 2.5 (− 2.7, − 1.7)
2 Domestic tax base	**− 3.7 (− 4.9, 1.3)**	3.3 (− 11.0, 5.3)	− 4.9 (− 6.2, − 0.5)	1.3 (− 3.4, 3.2)	6.1 (− 4.4, 10.8)	− 16.9 (− 28.0, 0.1)	0.1 (− 0.5, 3.0)	**− 0.6 (− 0.8, − 0.0)**	− 0.4 (− 1.9, 1.1)
Foreign tax rates and bases (3 + 4)	**− 0.9 (− 2.1, − 0.3)**	1.0 (− 0.1, 0.5)	**− 0.8 (− 2.7, − 0.1)**	− 1.8 (− 4.5, 0.5)	**− 1.5 (− 4.7, − 0.1)**	− 0.9 (− 0.8, 1.0)	− 0.3 (− 1.6, 0.3)	− 7.5 (− 5.2, 2.7)	− 0.8 (− 3.1, 0.5)
3 Foreign statutory tax rate	− 1.0 (− 1.4, − 0.7)	− 0.2 (− 0.2, 0.0)	− 0.6 (− 1.3, − 0.2)	− 0.8 (− 1.5, − 0.2)	− 0.5 (− 1.7, − 0.6)	− 1.2 (− 2.0, − 0.7)	− 0.6 (− 0.8, − 0.5)	− 4.5 (− 3.2, − 0.9)	− 0.8 (− 1.4, − 0.6)
4 Foreign tax base	0.1 (− 0.9, 0.6)	1.1 (− 0.1, 0.7)	− 0.2 (− 1.5, 0.1)	− 1.0 (− 3.0, 0.9)	− 2.2 (− 3.2, 0.7)	0.4 (0.3, 2.7)	0.3 (− 0.9, 1.0)	− 3.0 (− 2.4, 4.8)	0.0 (− 1.9, 1.6)
5 Foreign profit distribution	− 1.7 (− 2.5, − 0.4)	− 1.4 (− 0.8, − 0.2)	0.1 (− 0.2, 0.4)	0.0 (− 0.3, 0.3)	**0.7 (− 2.3, − 0.1)**	− 0.3 (− 2.0, 0.1)	− 0.1 (− 0.9, 0.1)	1.9 (− 2.2, 0.1)	− 0.4 (− 1.6, 0.2)
6 Globalisation	2.1 (− 2.8, 2.2)	**− 3.9 (− 5.1, − 0.2)**	4.6 (− 0.0, 3.6)	− 0.6 (− 1.6, 1.1)	1.0 (− 0.5, 1.5)	− 1.9 (− 5.0, 1.5)	− 0.0 (− 0.7, 1.1)	0.0 (− 0.3, 0.4)	0.2 (− 0.2, 0.8)
7 Residual	− 1.0 (− 0.6, 1.8)	0.8 (0.2, 3.3)	**− 5.3 (− 5.2, 0.0)**	− 0.6 (− 3.2, 0.9)	− 2.3 (− 2.7, 1.1)	2.3 (− 1.8, 5.8)	− 0.4 (− 1.2, 0.5)	− 0.1 (− 0.5, 0.4)	0.2 (− 0.4, 0.5)

Table 11 (continued)

	Germany	Spain	UK	Italy	France	Denmark	Finland	The Nether-lands	Sweden
8 Unobserved profits	− 1.0 (− 6.1, 2.7)	− 0.5 (− 2.5, 0.2)	− 2.2 (− 4.6, − 1.9)	− 2.0 (− 2.5, 0.2)	1.2 (− 1.2, 9.7)	1.8 (− 1.8, 1.5)	− 4.7 (− 6.3, − 0.3)	− 2.4 (− 4.3, 3.0)	2.3 (− 0.1, 3.8)

Italicised values are significant for both this sample and the study sample. Bold values are significant in this sample. Bold italic values are significant only in the study sample
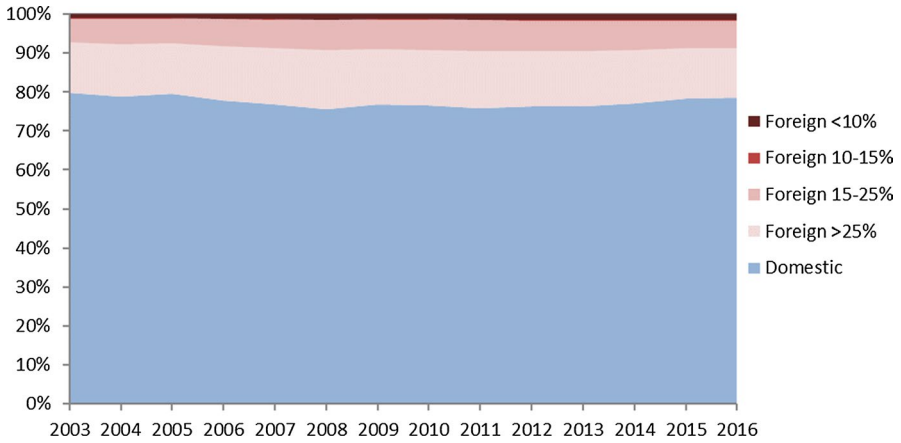
Fig. 7 Wages paid by US MNCs split by estimated effective tax rate abroad. *Source* Authors on the basis of data from the Bureau of Economic Analysis
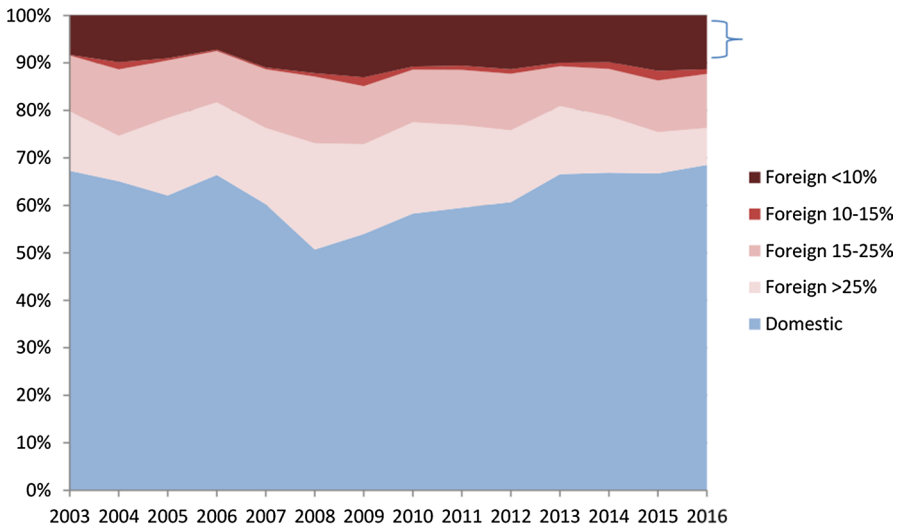
Fig. 8 Profits reported by US MNCs split by estimated effective tax rate abroad. *Source* Authors on the basis of data from the Bureau of Economic Analysis

Table 12 Back-of-the-envelope calculation for 2015. *Source* Authors on the basis of data from the Bureau of Economic Analysis.

	Total	Domestic	Foreign	Foreign < 10%	Foreign 10–15%	Foreign 15–25%	Foreign > 25%
Profits (USD bn)	1551	1024	527	184	32	172	138
Per cent of total profits (%)	100	66	34	12	2	11	9
Wages (USD bn)	2803	2192	612	44	6	197	365
Profit-shifting indicator (%)	55	47	86	419	529	88	38
Amount shifted into countries if benchmark π		– 189		160	29	64	– 64

2015 was chosen to enable comparison of the numbers with Tørsløv et al. (2020), which also has the latest numbers from 2015. The $189 bn is obtained by adding the two rows named "Foreign < 10%" and "Foreign 10–15%". By coincidence, this equals the amount missing from the domestic market on average; no causality implied by this observation

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See Fig. 9.
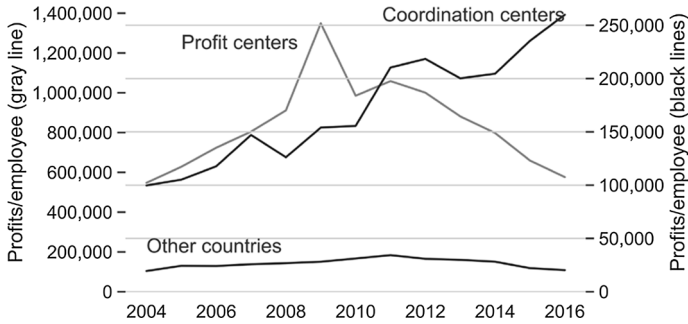
Fig. 9 Profitability of US MNCs (profits to employee ratio) in coordination centres, profit centres and other countries. *Source* Authors on the basis of data from the Bureau of Economic Analysis.

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