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$$\frac{n!}{(n-1)!} p^{m-1} (1-p)^{n-m} = p \sum_{\ell=0}^{n-1} \frac{\ell+1}{n} \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell}$$
$$= p \frac{n-1}{n} \sum_{\ell=0}^{n-1} \left[ \frac{\ell}{n-1} + \frac{1}{n-1} \right] \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p^2 \frac{n-1}{n} +$$

$$\frac{\ell!}{(n-1)!} p^{m-1} (1-p)^{n-m} = p \sum_{\ell=0}^{n-1} \frac{\ell+1}{n} \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p \frac{n-1}{n} \sum_{\ell=0}^{n-1} \left[ \frac{\ell}{n-1} + \frac{1}{n-1} \right] \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p^2 \frac{n-1}{n} +$$

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**Bibliographic information:**

Garcia-Bernardo J., Jansky P. and Tørsløv T. (2019): "Decomposing Multinational Corporations' Declining Effective Tax Rates" IES Working Papers 39/2019. IES FSV. Charles University.

This paper can be downloaded at: <http://ies.fsv.cuni.cz>

# Decomposing Multinational Corporations' Declining Effective Tax Rates

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December 2019

## **Abstract:**

We develop a new methodology to decompose the observed decline in multinational corporations' (MNCs') effective tax rates into profit shifting to tax havens and several other components. We apply this methodology to the best available data for MNCs headquartered in the US – 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 profit shifting directly explains only 30% and 5% of the 7 and 9 percentage point declines in effective tax rates for US and EU MNCs, respectively. At the same time, we note that profit shifting might explain more of the decline indirectly, through its effects on domestic taxation, i.e. taxation of MNCs in their home country; this is responsible for more than 50% of the overall decline in effective tax rates for both US and EU MNCs. 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 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. Overall, while we confirm that profit shifting is increasing in scale, we also highlight that it may have even more prominent indirect effects.

**JEL:** F21, F23, H25, H26

**Keywords:** Effective tax rates; multinational corporations; foreign direct investment; profit shifting

**Acknowledgements:** We thank Annette Alstadsæter, Ronald B. Davies, Niels Johannesen, Claus Thustrup Kreiner, Caroline Schimanski, Peter Birch Sørensen and Ludvig Wier for their helpful comments on an earlier version of this paper. Javier Garcia-Bernando has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement number 638946). Petr Janský gratefully acknowledges support from the Czech Science Foundation (P403/18-21011S). To ensure transparency and replicability, and in line with open science practices, our entire database and code can be found on the website of the Open Science Framework (<https://osf.io/nu42h>).

# 1 Introduction

In the past few 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 to tax havens is \$600-\$1100 bn. every year, according to some of the latest studies (e.g. OECD, 2015; Clausing, 2016; Tørsløv, Wier, and Zucman, 2018; Janský and Palanský, 2019). This corresponds to around 10% of global profits or 40% of all MNCs' non-headquarter-profits being shifted to tax havens without a corresponding shift in the location of assets, employees or turnover.

Increases in profit shifting 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 and declining ETRs – occurring concurrently over the past few decades. And it is thus not yet clear how much of that observed decline in ETRs can be explained by the increased profit shifting and how much 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 ask the question of what is 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 that MNCs pay 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, or indeed by an increase in profit shifting or few other minor factors 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 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. Even the best available data at our disposal lack the needed detail to distinguish between these different reasons for reduced tax bases, but otherwise the data do allow for a detailed decomposition.

Specifically, we decompose the decline in MNCs' ETRs into eight components. A decline in ETR could occur due to changes in domestic taxation, either through reductions in the domestic statutory rates (first component) or thanks to a reduced domestic tax base (second). Similarly, there could be changes in foreign taxation either in terms of the foreign statutory rates (third) or foreign tax bases (fourth). Another component is the possibility of changes in profit shifting (fifth), defined as a change in the location of foreign profits that results in lower taxation. Also, let us note that in the decomposition, profit shifting includes genuine movement of activities as well as artificial shifting of profits since we do not attempt to separate these two practices given the limitations of the data. The other, final three components, which turn out to be mostly of minor importance, are: globalisation (sixth), which captures any increases in foreign profits at the cost of domestic profits; residual (seventh), 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 (eighth), 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 as well as a group (i.e. the EU), analysing the influence of individual host (foreign) countries, and into account changes in sectoral compositions.

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

First, we show that profit shifting is on the rise, but it is far from being directly responsible for all of the observed decline in MNCs' ETRs. Looking at the trends in ETRs since 2005, we see that the overall ETRs have declined by 7.1 ppts for US MNCs and by 8.7 ppts for their EU. We estimate that between 2005 and 2015 increased profit shifting to tax havens directly explained only 30% of the decline in ETRs for US MNCs and 5% for EU MNCs. However, profit shifting may have explained more of the observed decline in ETRs indirectly, through its 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 US. 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 US. The remainder is explained by reductions in statutory tax rates abroad (1.5 ppts), and by profit shifting towards foreign affiliates with lower taxation (2.1 ppts). This means that 30% of the decrease in the US MNCs' ETRs since 2004 is directly linked to profit shifting. The bulk of the reduction in ETRs can be explained by US MNCs paying less tax on the profits they earned in the US, despite the statutory tax rates remaining constant during this period. Moreover, we find in an additional sectoral decomposition analysis that MNCs' sector composition changes explain slightly more than a half of the observed decline in US MNCs ETRs, primarily as a result of increasing importance of the finance and insurance sector, which might indicate a real sectoral shift or profit shifting. This identified importance of sectoral changes for declines in US MNCs' ETRs is in line 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 more recent analysis by Janský (forthcoming) showing industry heterogeneity in tax havens with BEA data for US MNCs.

Third, when applying the framework to the EU MNCs in 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 0.8 ppts and changes in foreign tax bases 0.9 ppts. Changes in unobserved profits account for 1.3 ppts. Similar to what we observed for US MNCs, profit shifting only directly explains a minority of the observed change in ETRs (0.4 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 neither across individual EU member states nor across host countries EU MNCs invest in. Also, taking into account changing sectoral composition over time does not explain much of decline in ETRs in terms of domestic taxation and actually is increasing foreign taxation for EU MNCs.

Our findings are consistent with tax competition between countries. When trying to compete for MNCs' operations and profits, countries generally use two categories of tax incentive tools: reductions in their statutory tax rates (usually thought to be important for the intensive margin of tax competition), or increased permitted deductions to the tax base (usually thought important for the extensive margin of tax competition). Using data on OECD-countries, Devereux and Sørensen (2006) find that during the '80s and '90s the effective *marginal* tax rate on profits (important for intensive margin decisions) only fell towards the end of the period, whereas the effective *average* taxation fell throughout the period. In

our results, we observe two different patterns in our two groups of EU MNEs and US MNEs. The EU member states have reduced EU MNCs' tax payments by lowering their statutory tax rates rapidly since the '90s while broadening the tax bases only moderately, therefore likely reducing both the average *and* marginal ETRs. The US, conversely, refrained from any statutory tax changes until 2018 and instead reduced the average ETR for its MNCs by allowing firms – on average – to pay considerably lower taxes on their corporate profits despite a constant statutory rate.

While the reductions in statutory tax rates and tax bases are not *directly* caused by profit- or activity-shifting, such tax policies are likely affected by tax competition and these ETR reductions could thus *indirectly* be driven by profit-shifting (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. In this extreme case, the optimal tax rate would be 0% and there would be no *direct* revenue loss due to profit-shifting. One could, however, argue that profit-shifting generates 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, Lockwood, and Redoano (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 through profit- and activity-shifting.

When we show that profit shifting in itself can explain at most 30% of US MNCs' ETRs' reduction, this does not rule out that the remaining reduction in ETRs is the result of strategic spillovers, or strategic tax cuts as a response to profit shifting. 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, de Mooij, and Keen, (2016) find that losses through strategic spillovers are likely three times higher than direct losses due to profit shifting. 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 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) or those proposed by the OECD (2019) and the IMF (De Mooij, Liu, & Prihardini, 2019).

Our paper informs two different areas of economic literature: the literature on backward-looking ETRs for firms, and the literature on profit shifting and tax competition. Much of the literature on backward-looking effective taxation, which are ETRs estimated from data on firms as we in this paper, for example, is based on a method presented by Desai, Foley, and Hines (2004), who used the US Bureau of Economic Analysis (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 so-called forward-looking ETRs, which model a rate for hypothetical companies on the basis of the existing legislation often using a method developed by Devereux and Griffith (2003a) and used by several other papers including Spengel et al. (2014) and Hanappi (2018). Having access to the affiliate-level micro-data behind the BEA, they are 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 Stewart (2014), Clausing (2016), Cobham and Janský (2019), Wright and Zucman (2018), Tørsløv et al. (2018) or Garcia-Bernardo, Janský, and Tørsløv (2019), among others. Whereas most of these papers only study foreign affiliates, in this paper we additionally include data on the parent country, the US, 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 it has previously been used to estimate ETRs. Egger, Loretz, Pfaffermayr, and Winner (2009b), Egger, Eggert, & Winner (2010), and Garcia-Bernardo, Janský, and Tørsløv (forthcoming), 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, used recently by Thomsen and Watrin (2018) in a rare paper that estimates ETRs for both the US and the EU, but it does not provide information on the location of subsidiaries. We therefore use Orbis to create a data set on 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 MNC activity along with the US in our analysis, which has not previously been done with these two data sources to our knowledge.

The paper also relates to a vast 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), Johannesen, Tørsløv, and Wier (2017) and Wier and Reynolds (2018). The profit shifting literature has primarily been interested in the practice of shifting profits without moving real activity, and has either estimated the elasticity of corporate profits or the amount of profits moved. While the purpose of this paper is to analyse *changes* in corporate taxation, a back-of-the-envelope-calculation of the profit-shifting *magnitude* in our data puts the "excess" amount of profits located in tax havens in line with other studies at a minimum of \$150-200 bn. for US firms alone (see appendix section 5). Our analysis does not find any evidence to suggest that there is less profit shifting than previous papers have found. We do, however, find that profit shifting 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 through the *direct* effects of increased profit shifting.

The literature on tax competition covers both competition over tangible capital and competition over reported profits and profit shifting (see e.g. Slemrod and Wilson, 2009; Hong and Smart, 2010; Johannesen, 2010; and the application in Keen and Konrad, 2012, of the model by Kanbur and 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 profit- and activity-shifting with the effects of changes in how countries tax profits domestically. While we do not isolate the effect of profit shifting, as defined in the literature, we identify an upper bound for its effect on ETRs over time. We find that strategic spillovers potentially affect ETRs 2 and 15 times *more* than the upper bound of direct profit shifting effects for US and EU MNCs, respectively. 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 profit shifting directly.

The rest of the paper continues as follows: section 2 introduces the data used in our analyses, first BEA for US MNCs and then Orbis for EU MNCs, and describes the basic descriptive statistics on ETRs over time, section 3 provides a formal framework for the decomposition of the ETR, section 4 presents and discusses the results of the applied decomposition, and section 5 concludes.

## 2 Data description

### Data on US MNCs: BEA – Foreign affiliate statistics

In order to describe US MNCs' ETRs, we use the BEA's "Activities of US Multinational Enterprises" dataset. It provides worldwide information on the profits and taxes paid by US MNCs and is freely available at the BEA website, from which we used, in particular, the tables "US parent companies" and "Majority-owned foreign affiliates". This data has been published since the 1950s, annually since 1982. Every 5 years a benchmark survey has been carried out, which includes every US MNC and much richer data. 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.

It is important to note that due to the aggregation of the data, it is impossible to balance the "panel" of firms, in order to determine what differences are driven by changes in the sample over time. We define an MNCs 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 US seems quite constant over time, it could be affected by the properties of firms entering and exiting the data. Both firms that are newly active abroad and those closing their foreign activities are likely to have a high share of activity in the US. 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.

Another note 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 have large losses, the total taxable profits will be low and this will inflate the tax rate. On average, however, this should be offset by the firms that made losses in previous years and deduct these in their current profit base. There is of course the one-sided risk of firms never using their accrued deductions, 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 some important choices with regard to the definitions of our variables of interest. To calculate an ETR we have to choose a common measure of profit. When creating a benchmark definition of profit, we want 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 which were already 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 want to be able to observe the profit measure in both subsidiaries and parent firms across time and in different tax jurisdictions. Third, we want 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 about what constitutes a "meaningful" tax base. However, since we mainly want to analyse changes over time and across countries, we primarily need a constant benchmark from which we can measure deviations. This can readily be done from the BEA dataset, 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 well as we can, 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 operationalizations of profits and taxes using other databases (Garcia-Bernardo et al., 2019). 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 look at what share of profits are 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 good 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 that 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 US 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.

When we can, 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 was only included in the five-yearly benchmark surveys. Overall, throughout this paper, we use 2005 to refer to the period 2004-2006, and 2015 to refer to the period 2014-2016.

In terms of sector composition, the BEA data contains information for sectors of foreign affiliates and for sectors of US parent companies. Therefore, the BEA data enables us, similarly to Janský (forthcoming), 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. So, 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.

### **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 either be a consolidated MNC, or an unconsolidated account of a subsidiary belonging to an MNC. Our original dataset 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 of ETRs at the MNC-level. MNCs were removed if they did not have any observable activity abroad, made losses throughout the sample period, did not have at least 50% of their consolidated profits observable in (parent + subsidiaries), or did not have at least 10 observations in the 2004-2016 period (see appendix section 3 for a more detailed description of the data work in Orbis). This results in our final dataset containing financial information on 2,633 EU MNCs including 15,386 country-level observations and 145,095 country-year observations. We have sufficient data for 23 out of the 28 EU member states as of 2019. Compared with the original dataset, we include 30% of the profits and 33% of the taxes. As we explain in appendix section 3, 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 two 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 that equity income from foreign subsidiaries is included in the parents’ unconsolidated profit accounts. This inevitably leads to double counting, since they are also booked as profits 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 our effective domestic tax rate estimate to 13% in the EU. Avoiding double counting this way is thus a necessity, but it introduces possible new problems: our estimate of ETR will likely be inflated for any MNCs for whom financial profits constitute a significant share of their total profits. However, the consistency of our results in our robustness checks indicates that our results are not due to systematic bias or to our use of operating profits data.

Using the consolidated or global ETR lends two main advantages over studying the unconsolidated (or local) ETR. Firstly, it is 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, it is conceptually sound: the denominator – 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, for example, due to different ways of accounting for equity and interest income.

For statutory corporate income tax rates, we use the OECD Tax Database’s calculated average top-statutory tax rate both for the US and countries in the rest of the world.

## Trends in the taxation of domestic and foreign corporate profits

A common trend in corporate taxation has emerged over recent years in both the US 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 of all, looking at the aggregate numbers, we observe that US MNCs paid an average ETR in the period 2015 of 25.2%, 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 foreign profits, and 19.9% on unobserved profits. Three conclusions can already be reached from these numbers. Firstly, that MNCs pay substantially more taxes on average than in the examples from the offshore leaks such as Paradise Papers (ICIJ, 2017), but also substantially less than they would if they paid at the relevant statutory corporate tax rates. Secondly, that US MNCs are subject to higher ETRs at home than abroad. Thirdly, that EU- and US MNCs face similar ETRs. Finally, looking at the trends since 2004, we see that the ETRs have declined by 8.7 pts for EU based MNCs and by 7.1 pts for their US counterparts.

**Table 1: Summary of effective tax rates' changes (%)**

	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	

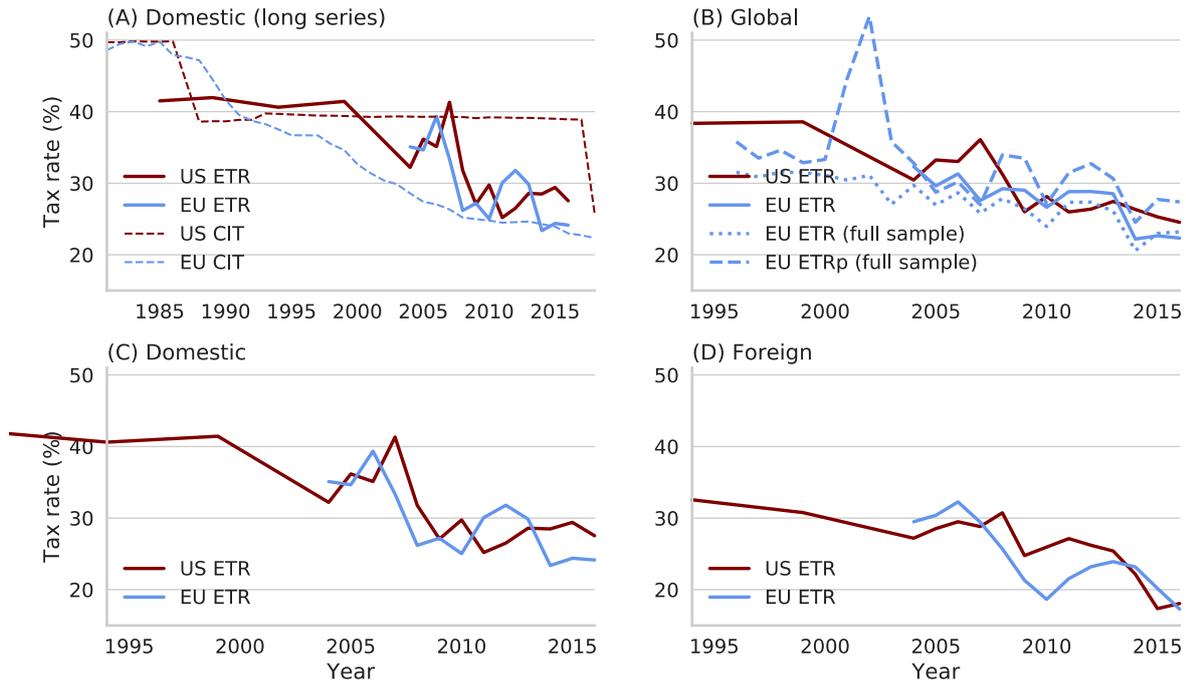
*Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.*

Over the past four 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 US. The EU time-series falls incrementally over the 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 in the US. 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 US.

The consolidated ETR on profits encompasses 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 (section 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 change in the domestic profits of EU MNCs, and in 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 changes in statutory tax rates, changes in tax bases, or increased profit shifting to low-tax jurisdictions gave rise to the trend. In this paper we develop a decomposition framework to systematically analyse the contribution of these different effects, which we present in the next section.

**Figure 1: Corporate income tax rates in the US and the EU**



Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: For US (dark red) and EU (light blue) MNCs. (A) Domestic tax rate from 1980 to 2016, showing the corresponding domestic statutory tax rates (dashed lines). (B) Consolidated tax rate. For EU MNCs, the tax rate of the full sample using consolidated accounts is visualized, using operating profits (dotted) and total profits (dashed) as the denominator of the tax rate. (C) Domestic tax rate (D) Foreign tax rate.

### 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.

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:

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

where  $\tau_C$  denotes the consolidated ETR for all MNCs headquartered in a given country,  $\omega_D$  is the share of profits that are reported domestically,  $\omega_U$  is the share of profits that have unobserved sources (in the Orbis database) and  $\tau_D$ ,  $\tau_F$  and  $\tau_U$  are the domestic and foreign ETRs paid on those profits. This leaves us with three components, which can be analysed separately over time.

A generic difference between periods can be formulated as below:

$$(2) \Delta\tau_C = \underbrace{\omega_D \Delta\tau_D}_{\text{Domestic taxation}} + \underbrace{\omega_F \Delta\tau_F}_{\text{Foreign taxation}} + \underbrace{\Delta\omega_D (\tau_D - \tau_F)}_{\text{Globalisation}} + \underbrace{\Delta\omega_D (\Delta\tau_D - \Delta\tau_F)}_{\text{Residual}} + \underbrace{\omega'_U \tau'_U - \omega_U \tau_U - \Delta\omega_U \tau'_F}_{\text{Unobserved profits}}$$

Here,  $\Delta$  is the short hand 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 – “home” – 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 ( $\Delta\omega_F + \Delta\omega_D$ ), which is zero for US MNCs since  $\omega_F = (1 - \omega_D)$ , 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  $\tau'_F$ .

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:

$$(3) \tau_D = \underbrace{S_D}_{\text{Statutory rate (domestic)}} + \underbrace{(\tau_D - S_D)}_{\text{Deviation from statutory rate (domestic)}}$$

where  $S_D$  is the statutory tax rate at home, and  $\tau_D$  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:

$$(4) \Delta\tau_D = \underbrace{\Delta S_D}_{\text{Domestic statutory rate}} + \underbrace{(\Delta\tau_D - \Delta S_D)}_{\text{Domestic tax base}}$$

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 equation below states that the foreign tax rate is the weighted average of all the  $N$  countries denoted  $i \in \{F_1, F_2, \dots, F_N\}$ .

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

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

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

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

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

$$(7) \quad \Delta\tau_F = \sum_{i=1}^N \left( \underbrace{\frac{\omega_{Fi}\Delta S_{Fi}}{\text{Foreign statutory rate}} + \frac{\omega_{Fi}(\Delta\tau_{Fi} - \Delta S_{Fi})}{\text{Foreign tax base}}}_{\text{Foreign taxation}} + \frac{\Delta\omega_{Fi}\tau'_{Fi}}{\text{Profit shifting}} \right)$$

This equation states that the change in the foreign component 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 taxation. The third term – the “profit shifting” 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, profit shifting), and three others (globalisation, residual, unobserved profits). In terms of the home country level, below we present results of estimating this 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 and we can also estimate the effect of sectoral compositions, which we now discuss in turn.

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 equation (7) as:

$$(8) \quad \Delta\tau_F = \sum_{i=1}^N \left( \underbrace{\frac{\omega_{Fi}\Delta\tau_{Fi}}{\text{Foreign taxation}}}_{\text{Foreign taxation}} + \frac{\Delta\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})}{\text{Profit shifting}} \right),$$

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  $\tau'_F$ , we can assess whether profits have been shifted to 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.

The decrease in ETRs can be also mapped at the sector level. For both the BEA dataset and the Orbis dataset, 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:

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

where  $\Delta\tau$  is the decrease in ETRs due to foreign or domestic taxation,  $\omega_s$  is the weight of sector  $s$  and  $\tau'_s$  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

By applying the framework we set out above, the BEA and Orbis datasets 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 above, 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 section 3.

The main results of our decomposition are 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 A3 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 taxation (3.5%). Since the statutory tax rate in the US 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 section 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 30% 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.

**Table 2: Decomposition of the decrease in effective tax rates over time (%)**

	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
Domestic taxation (1 + 2)	-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
Foreign taxation (3 + 4)	-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 Profit shifting	-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)		

*Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.*

To enable a closer comparison to 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 world continue to lower their statutory tax rates. Any profit-shifting between individual states in the US, 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., 2018). Traditional profit shifting between

countries is shown in component 5 (and possibly also 6 and 7), 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 profit shifting going (component 5). 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 equal parts by changes in foreign statutory tax rates (0.8 ppts), change in foreign bases (0.9 ppts), and profit shifting (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 A2). 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 US: domestic changes dominate foreign changes, since the domestic base is approximately two times larger than the foreign base (Table A2). We find that domestic taxation components (which can be considered as strategic spillovers) are 2 and 15 times larger than profit shifting 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.

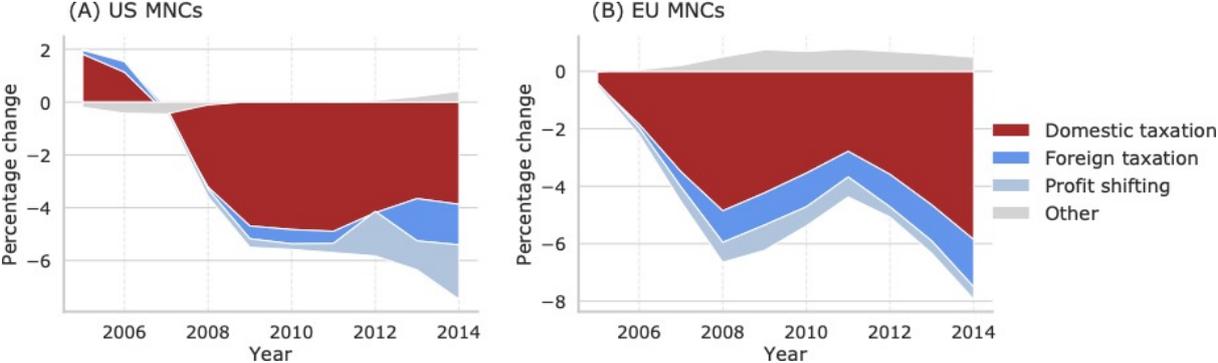
For US MNCs we have BEA data stretching further in the past than the 2005-2015 period and the remaining two columns in Table 2 show the results. Table 2.IV shows the same decomposition but for the period from 1994 (data from the benchmark survey) until 2005. In this period, the reduction in effective 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 did become 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 equally by profits being moved to lower tax locations (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 globalization effect also contributed to the decrease in tax rates (0.7%). Finally, Table 2.V shows 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 has been gradual sudden. In Figure 2 as well as in Table A2, 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 stabilized. The decrease in foreign taxation due to profit shifting and foreign tax rate changes took place more gradually, and particularly in the period between 2010-12 and 2014-16. For EU MNCs (Fig. 2B), the decrease in taxation occurred more gradually, decreasing until the period 2008-10 and then increasing again until 2011.

While domestic taxation is directly responsible for more than 50% of the overall decline in ETRs for both US and EU MNCs, profit shifting might explain some of this decline indirectly. Results of both

Table 2 and Figure 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 2004. 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 increases in profit shifting, in which case we could argue that they are partially driven by profit shifting practices. They are, however, not *directly* due to profit shifting.

**Figure 2: Evolution of effective tax rates**



Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Note: The horizontal line at zero marks the tax rate in 2005.

In addition to the possibility of profit shifting indirectly affecting domestic taxation component of declining MNCs’ ETRs’ decomposition, profit shifting might also indirectly affect the taxation of non-MNCs in a similar way. In a way, Table 2 only shows us 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 US experienced a similar reduction in effective taxation as we have observed for MNCs, which aligns well with the ETR shown in Figure 1. Table A1 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 A1 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 becomes available, since this is another key part of the effective taxation picture. Table A1 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 profit shifting increase.

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. Higher levels of profit shifting 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 profit shifting directly, but the tax base of MNCs and non-MNCs that remains in the country is, in reaction to profit shifting, then taxed at a lower rate than would be the case, had profit shifting not existed.

**Decomposition by home country**

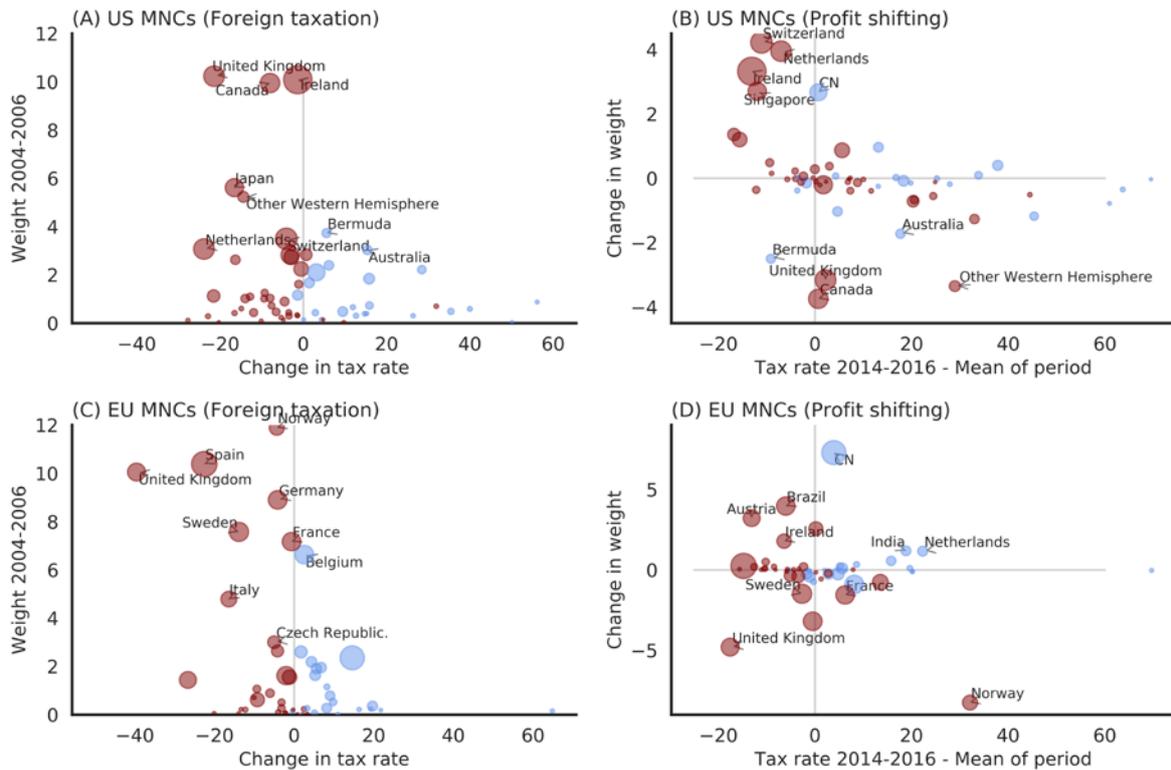
We now decompose ETRs of EU MNCs by individual EU home country and present these more granular results in addition to the aggregate results for the EU as a whole presented so far. For this analysis, we focused on the nine countries with the largest MNCs (by profits). Our sample selection in Orbis is

restrictive, and retains only MNCs for which we have information, at the subsidiary-level, about the majority of the total profits and taxes (section 3 and appendix section 3). 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 A5 in the Appendix), and is driven by a decrease in statutory tax rates, both on domestic and foreign profits. An increase in profit shifting 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 A6 and A7).

### 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 taxation ( $\omega_{Fi}\Delta\tau_{Fi}$ ) and the profit shifting effect ( $\Delta\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})$ ). As explained in section 3,  $\overline{\tau'_F}$  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 visualize the two components in Figure 3.

**Figure 3: Different countries' contributions to the decrease in foreign taxation and profit shifting**



Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: Different countries' contributions to the decrease in ETRs for US MNCs (A & B) and EU MNCs (C & D). The decrease in ETRs due to foreign taxation is mapped in (A) and (C), while the decrease in ETRs due to profit shifting is in (B) and (D). Note the lack of a clear pattern in (D), which reflects the lack of any substantial effect from increased profit shifting on the decrease of taxation for EU MNCs.

We find evidence of more substantial sectoral shifts for US MNCs than for EU MNCs. Figures 3A and 3C show the change in ETRs ( $\omega_{Fi}\Delta\tau_{Fi}$ ), plotting the weight of the country ( $\omega_{Fi}$ ) against the change in taxation ( $\Delta\tau_{Fi}$ ). Figures 3B and 3D show the profit shifting effect ( $\Delta\omega_{Fi}(\tau'_{Fi} - \overline{\tau'_F})$ ), 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 their ETR, particularly the United Kingdom, 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 U.K. 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 (Figures 3C and 3D), particularly the United Kingdom, Spain, Norway, Sweden, France, Germany and Italy (Fig. 3C). As expected given the low value of the profit shifting component to the decrease in ETRs, we do not see a clear pattern in Figure 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.

### **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. 4AB). 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. 4CD). 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 countries. Given the limitations of the data, we are unable to differentiate whether what we observe is a real change in sectors or profit shifting.

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 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 A4).

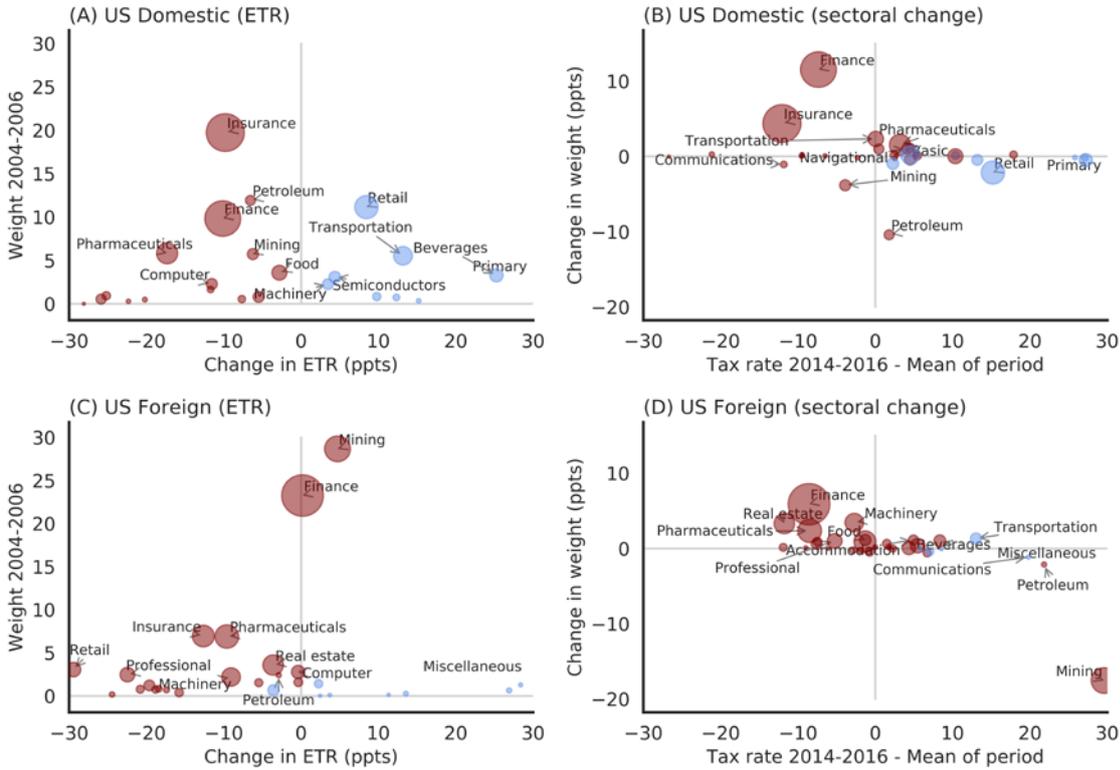
**Table 4: Summary of effective tax rates' sectoral decomposition (%)**

	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 for 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 for 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 for sector composition				23.5	17.3	-6.2
Sectoral change				17.3	28.0	10.7

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: 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.

**Figure 4: Sectoral changes in taxation for US MNCs**



Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

## 5 Conclusion

This paper shows that while profit shifting is 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 the losses caused by the practice of profit shifting directly. Using data from the BEA and Orbis, we have shown that the decline in the ETRs for US- and EU MNCs since the mid-2000's has been driven mainly by the lowering of statutory tax rates, and only to a much lesser degree by shifting profits into countries with lower taxation. We have added to the country-level IMF (2014) analysis by showing that the revenue losses to strategic spillover are potentially 2 and 15 times as large than the losses from profit shifting directly for US and EU MNCs, respectively

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 2004, 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 effective rate declines are, in both cases, primarily explained by domestic taxation and statutory tax rate reductions abroad. For the US MNCs, the ETR increasingly fell below the statutory rate. For the EU MNCs, most of the decline was explained by falling statutory tax rates at home.

The large indirect cost of profit shifting is likely the largest cost associated with current international tax rules. When we analyse only the direct revenue costs of profit shifting, we are potentially ignoring the majority of the problem. Analysis of changes in strategic spillover effects will be crucial when evaluating the current tax system against other potential systems, such as the CCCTB, the destination cash flow tax or a global minimum corporate income tax as part of the OECD's 2019 Pillar Two proposals for taxing the digital economy.

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# Appendix

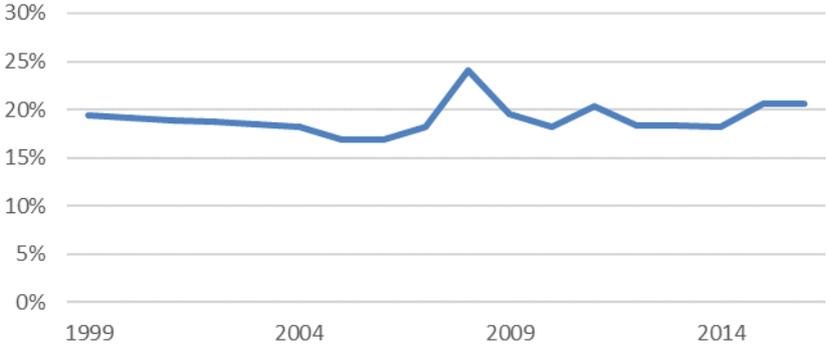
## Section A1: US firms and the effect of S-corps on effective tax rates

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, 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 includes 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 figure A1 below.

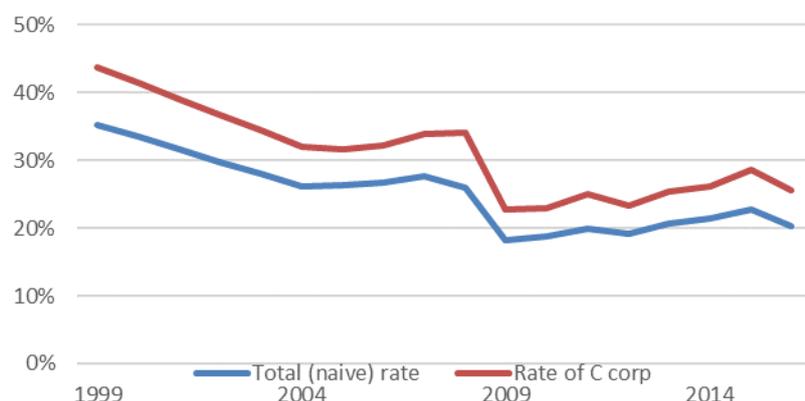
When considering the US national accounts data, presented in figure A2, we find that the effective tax rate of the whole domestic corporate sector fell from 26% to 20% between 2004 and 2016, while these numbers increase to 32% to 26% respectively when removing S-corps. The ETR is thus approximately 6 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 the same effective tax reductions on their profits reported in the US as US non-MNCs get. S-corporations are unlikely to have caused the downwards trend in the domestic taxation of profits booked in the US between 2004 and 2016, although the ETR each year will seem low if they are not accounted for.

**Figure A1: The share of US profits earned in S-corporations**



Source: Authors on the basis of the IRS data (*Statistics of Income*).

**Figure A2: 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.*

**Table A1: Decomposition of the decline in US firms consolidated tax rates 2005-2015 with domestic corporations included (%)**

	%	% 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 taxation (3 + 4)	-1.0	14.7
3 Foreign statutory tax rate	-1.3	19.6
4 Foreign tax base	0.3	-5.0
5 Profit shifting	-1.1	16.4
6 Globalisation	-0.2	2.6
7 Residual	-0.2	3.2

*Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.*

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

## Section A2: The main decomposition of effective tax rates

**Table A2: The basic decomposition components over time (%)**

Year	US MNCs						EU MNCs						Unobserved profits	
	Domestic taxation			Foreign taxation			Domestic taxation			Foreign taxation			Weight	Effective taxation
	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

*Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.*

**Table A3: Decomposition of the decrease in effective tax rates over time - summary of the calculations (rates in %)**

	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 taxation (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 Profit shifting	-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

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

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

### **Section A3: 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 to 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.

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, Fichtner, Takes, & Heemskerk, 2017), to reach 28,273 firms, and removed the state owned enterprises as in Babic, Garcia-Bernardo, and Heemskerk (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 5 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 2,653 companies. Finally, we removed 20 companies for which the effective tax rate was above 60% for the entire period as outliers. The final dataset contained 145,095 country-year observations for those 2,633 companies.

We created two robustness checks. One in which the threshold was set to 5 observations, which produced a set containing 5,119 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 2,633 companies and 100,060 observations.

## Section A4: Additional decompositions with Orbis

**Table A4: Robustness tests for Orbis (%)**

	Manuf. 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 taxation (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 Profit shifting	-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)

*Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.*

**Table A5. Decomposition by home country (%)**

	Germany	Spain	United Kingdom	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 Profit shifting	-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)

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: The two numbers indicate the 95% confidence intervals of 1000 bootstrap samples. Light red are the squares that are statistically significant.

**Table A6: Robustness tests for Orbis for the home-country analysis with a larger sample (%)**

	Germany	Spain	United Kingdom	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 taxation (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)	1.3	-3.0 (-7.3, 5.5)	0.0 (-1.5, 2.3)
5 Profit shifting	-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)
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)

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: Using the larger sample where a threshold of 5 observations was used (section A3). Light red are the squares that are statistically significant for both this sample and the study sample. Dark red are the cells that are statistically significant in this sample.

**Table A7. Robustness tests for Orbis for the home-country analysis, keeping observations with positive profits and taxes only (%)**

	Germany	Spain	United Kingdom	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 (-3.1, -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 taxation (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)	1.0 (-0.9, 1.0)	-3.0 (-2.4, 4.8)	0.0 (-1.9, 1.6)
5 Profit shifting	-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)
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)

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

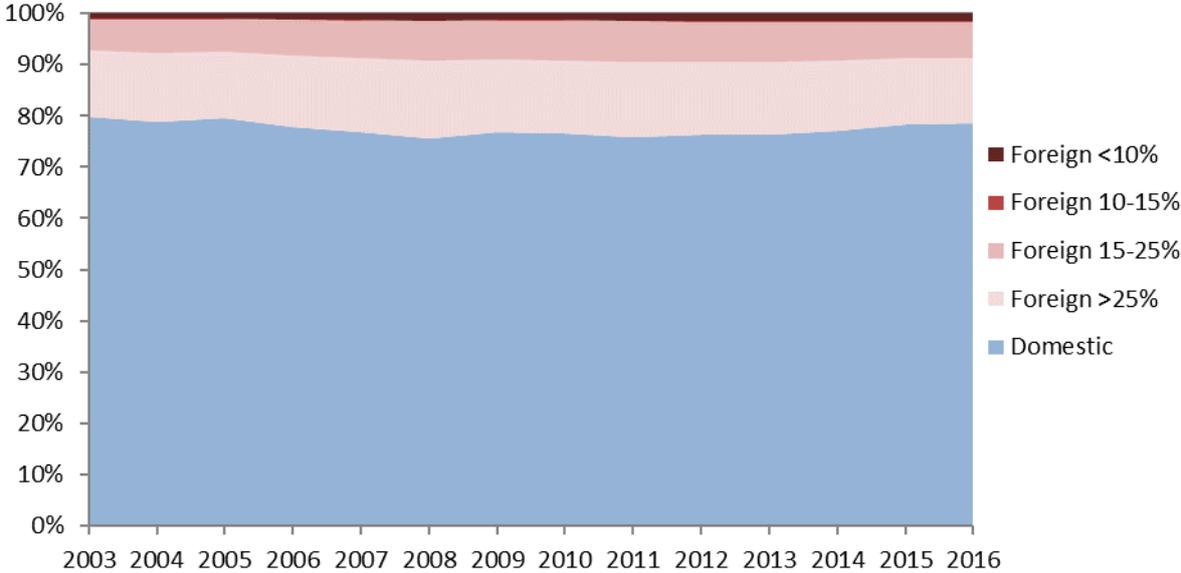
Notes: Light red are the squares that are significant for both this sample and the study sample. Dark red are the cells that are significant in this sample. Lightest blue are cells that are significant only in the study sample.

**Section A5: Back-of-the-envelope calculation of misreported profits**

Following the method presented in Tørsløv, Wier, and Zucman (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,  $\pi$ , 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 figures A3 and A4.

Figure A3 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.

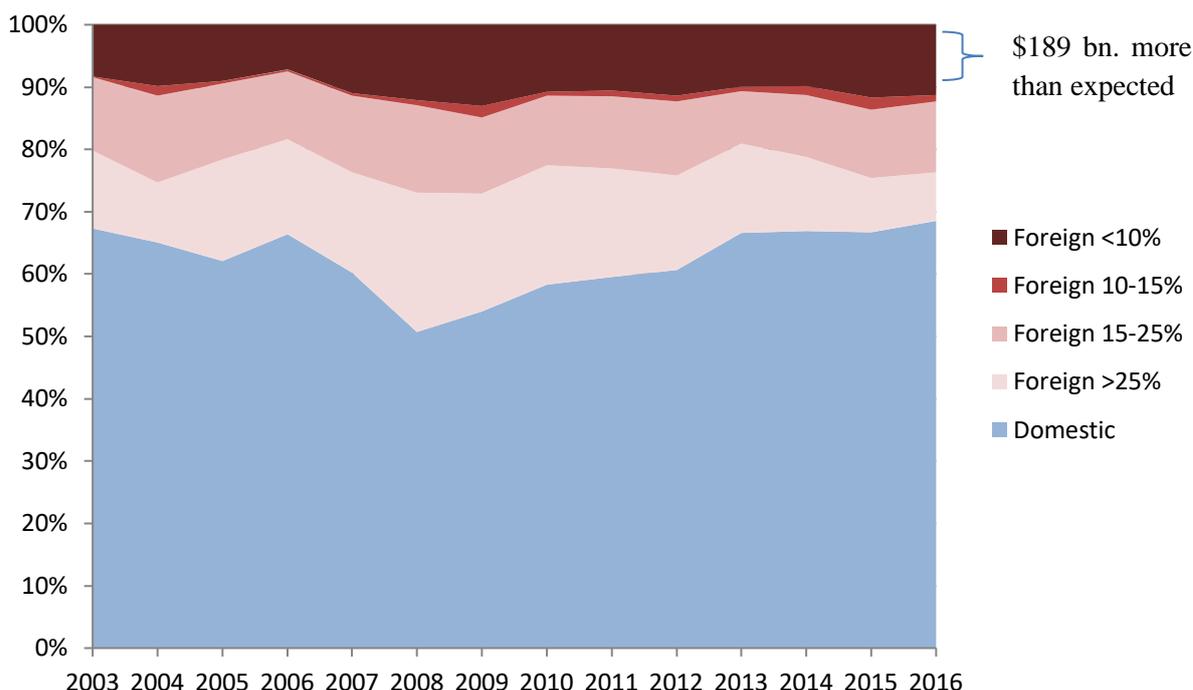
**Figure A3: Wages paid by US MNCs split by estimated effective tax rate abroad**



Source: Authors on the basis of data from the Bureau of Economic Analysis.

Figure A4 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.

**Figure A4: 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.

The back-of-the-envelope-calculation goes as follows (and is shown in table A8 for 2015): Calculate  $\pi$  in a category of countries based on their effective taxation, and compare with the average  $\pi$  of the US MNCs. If it is much higher than the average, the difference between the average and the measured  $\pi$  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, 2019, Blouin and Robinson, 2019). 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 A8: Back of the envelope calculation for 2015**

	Total	Domestic	Foreign	Foreign <10%	Foreign 10-15%	Foreign 15-25%	Foreign >25%
Profits (USD bn.)	1551	1024	527	184	32	172	138
Percent 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 $\pi$		-189		160	29	64	-64

Source: Authors on the basis of data from the Bureau of Economic Analysis.

Note: 2015 was chosen to enable comparison of the numbers with Tørsløv et. al. (2018), 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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