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The Costs of Tax Havens: Evidence from Industry-Level Data

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Abstract:
Multinational enterprises make use of tax havens to avoid paying corporate income taxes and this costs hundreds billion USD in lost government revenue worldwide according to an increasing number of recent studies. None of those studies assigns these costs to industries. I aim to shed more light on this gap by using some of the best available industry-level US data to determine to what extent the location of the MNEs' profit is aligned with the location of their economic activities. My first finding is that the most important tax havens for US multinational enterprises are the Netherlands, Ireland and Luxembourg (all EU member states). Second, I systematically identify the specific industries in specific tax havens responsible for the costs, which should be useful information for tax authorities aiming to reduce tax avoidance. Finally, I argue that the current data are not detailed enough to provide a reliable industry breakdown of the costs, but the prospect of combining input-output tables with forthcoming country-by-country data seems more promising.

JEL: F21, F23, H25, H26, H87
Keywords: Multinational enterprises; foreign direct investment; tax havens; industry-level data

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1 Introduction

Corporate income taxes are an important source of government revenues in both developing and developed countries. These revenues are reduced when multinational enterprises (MNEs) make use of tax havens to avoid paying taxes. Artificial and deliberate shifting of paper profits to tax havens has negative implications for the original country's institutional and governance strength, perceptions of fairness among its tax payers, and the amount of private finance in its economy, as well as on the government revenues it has available for public expenditures. Nine existing cross-country studies have recently estimated the associated annual global revenue losses as totalling between 100 and 600 billion dollars, but none of these studies have provided a breakdown of these losses by industry.

To help bridge this this gap, I aim to find out which industries are more prone to use tax havens and what the industry breakdown of government revenue losses due to tax havens is, worldwide. Having such a breakdown of tax losses due to tax havens by industry would paint a more detailed picture of how tax havens are affecting economies than the total dollar losses presented so far. Knowing which industries are prone to use tax havens is important for policy makers and should make any policy efforts more focused. Importantly, knowing in which specific combinations of industries and tax havens their countries' companies tax avoidance is concentrated could enable tax authorities, such as the US Internal Revenue Service, to be more efficient in their anti-avoidance efforts. Last, but not least, a breakdown of revenue losses due to tax havens by industry might support future research, especially in combination with other detailed industry-level data such as harmonised national input-output tables.

To establish which industries are responsible for the costs of tax havens, I estimate new industry-level results using information from the Bureau of Economic Analysis (BEA) survey of MNEs headquartered in the United States (US) with foreign affiliates located worldwide. I begin by estimating to what extent these MNEs' locations of (gross) profit (the sum of net income and income taxes) and of economic activity are aligned. To approximate economic activity, I use a range of indicators of which the preferred one is a combination of tangible assets, sales, number of employees and their compensation. In short, this informs us whether the MNEs' profits are reported in the same location(s) as where they do business. For some countries I find that MNEs report systematically lower profits than they should if their profits were proportional to their share of economic activity there. These countries include Brazil, Canada and the US, which is the dominant country in the data since all the MNEs I study are headquartered in the US.

On the aggregate level, I find that around a quarter more profit should be reported in the US than it is currently, for its share to be equivalent to the MNEs' share of economic activity in the US. I find that, coincidentally, about the same amount of profit that is missing from the US is reported in the following tax havens where the MNEs have no corresponding economic activity: the Netherlands, Ireland, Luxembourg, Switzerland, Bermuda, Singapore and the group of four British Overseas Territories in the Caribbean that includes the British Virgin Islands, the Cayman Islands, Montserrat and the Turks and Caicos Islands. The MNEs have more profit located in these tax havens than they do economic activity. These results are consistent with the existing literature on the topic - that the US, and other countries, lose revenue due to tax avoidance, and that the above-named tax havens, including European Union (EU) member states, enable MNEs to avoid taxes.

I examine which industries are most responsible for this tax avoidance by using data that enable me to identify the industries of the MNEs' affiliates located in tax havens, which they likely use as tax avoidance tools. Of the 15 industries in the data, I find that the category entitled 'Other industries' (from now on referred to simply as Other industries), which is dominated by 'management of nonbank companies and enterprises', is responsible for a large share of profits in the tax havens without corresponding economic activity. The interpretation of this finding is not straightforward and I discuss it below. Furthermore, I find similar patterns on a smaller scale for e.g. finance in the Caribbean United Kingdom Islands, manufacturing in Ireland and wholesale trade in Switzerland.

I structure the remainder of this paper as follows: in section 2 I describe the methodology and the data; in section 3 I present the results; in section 4 I conclude, with a discussion of future research and policy recommendations.

2 Literature review

More and more studies are emerging that estimate global government revenue losses due to tax havens or investigate which industries are more prone to tax avoidance via tax havens. In this review I provide a brief overview of the studies that have estimated revenue losses due to tax havens, to date, and then provide a few examples of literature examining the role of tax havens at the industry level. As far as I know, no study has yet combined these two issues, i.e. provided a breakdown of tax-haven-related revenue losses by industry. Indeed, in a recent review paper, IMF's Beer, De Mooij, & Liu (2018, p. 28) lament that there is 'limited insight into the systematic variation in tax avoidance across countries, sectors, firms and time'. I focus on the industry dimension here, filling this gap by estimating new industry-level results using worldwide information on MNEs headquartered in the US.

There have been numerous estimates of the revenue costs of profit shifting to tax havens for various countries, but rather few of them provide industry-specific results. Table 1 summarises the existing estimates of international corporate tax avoidance, profit shifting and associated tax revenue losses. As far as I know, the industry breakdown of the tax losses is not known and no studies have yet provided industry-level revenue estimates for many countries. Indeed, such a breakdown is impossible for most of the studies estimating revenue losses, due to methodological or data-related limitations. Exceptionally, the research methodology and BEA data used by Cobham & Janský (2019) can be adapted to estimate industry-specific results and I do so in this paper. The BEA data were highlighted by OECD (2015b) as among current best practices and have been used recently by Blonigen et al. (2014), Stewart (2014), Clausing (2012), Sullivan (2004), Zucman (2014), International Monetary Fund (2014), Keightley and Stupak (2015), Clausing (2016) and Wright & Zucman (2018).

Table 1. Summary of estimates of government revenue losses due to tax havens

	Country-level detail	Industry-level detail
Cross-country (for many countries globally)	IMF (2014), OECD (2015b), UNCTAD (2015), Crivelli et al. (2016), Clausing (2016), Tørsløv, Wier, & Zucman (2018), Cobham & Janský (2018), Janský & Palanský (2019), Cobham & Janský (2019)	- (As far as I know, no study exists so far.)
Country-specific (for one country, or several countries within a particular region)	Several studies. For example, Huizinga & Laeven (2008) and EPRS (2015) for Europe and Clausing (2009) and Zucman (2014) for the US.	Studies for specific industries, but without revenue estimates, include Johannesen & Larsen (2016) and Bouvatier, Capelle-blancard, Delatte (2017).

Source: Author.

Of the existing research in this area, a paper by Barrios & d'Andria (2016) probably has the closest ambitions to ours in this paper; they use cross-country Orbis data to study industry heterogeneity in profit shifting. They do not fit into Table 1, because they do not focus on revenue estimates, but they do show that profit shifting elasticities have a strong industry-specific component. They find that the variance of the estimated coefficients across industries is large. Several other existing studies have also highlighted industry heterogeneity. Some of these, such as Crivelli et al. (2016) or Johansson et al. (2017), discuss industries primarily in order to exclude them from their final data sample, while Fuest & Riedel (2012) use industry dummies in their estimation and Heckemeyer & Overesch (2017) use dummy variables in their meta regression whenever industry fixed effects are included. There have been several industry-specific studies on profit shifting – for example, Beer & Loeprick (2017) for the gas and oil industry or Bouvatier, Capelle-blancard, & Delatte (2017) for banks. Although these provide insights into specific industries, they do not enable any comparison across industries from which we could observe which industries are most affected by profit shifting.

3 Data

In this section I describe the data, which enable me to estimate indicators of profit and economic activity at the industry-country level for as many countries and industries as possible. I use data from a survey of all US MNE groups, which has been carried out since 1982 by the Bureau of Economic Analysis (BEA) and described by the BEA (2017). I use its 2014 data, which is the latest benchmark survey available (these include more information every five years). I use the financial and operating data for US MNEs that cover the activities of majority-owned foreign affiliates (affiliates) and their US parent companies (parents). While the parents are based in the US, the foreign affiliates are located in a wide range of countries around the globe and the two together thus create a global data set informing us about US-headquartered companies' worldwide business activity. The data contain all the variables needed to apply the methodology (net income, income taxes, tangible assets, sales, employment, compensation of employees). Furthermore, I construct a measure of profit, which adds income taxes on both the foreign affiliates and US parents to the net income; this is my preferred measure of profit, since I am interested in the distribution of declared (taxable) profits. The publicly available data that I use are aggregated at country- and industry-level, although the data are gathered through surveys from individual firms. The use of this aggregated data can lead to biases. For example, unfortunately I cannot control for or even estimate the magnitude of the bias from effective consolidation of underlying profits and losses. Future research should be carried out to address this research question with access to company-level data.

The data pose at least three challenges to the objective of having data that are as detailed as possible at the industry-country-level. First, each affiliate in the data is classified according to the country in which the largest percentage of its sales (or income, for holding companies) is located, with the exception of oil-related industries, which are classified in their country of incorporation (BEA, 2017). Second, the data enable me to identify the industries of MNE affiliates in tax havens that are likely used as tools by the MNEs, but not the industries of their US parent companies (which are available for US parent companies themselves, but not their foreign affiliates) that are likely ultimately responsible for the losses due to tax haven use. So, using the data available, I am only able to identify what industry the MNEs' foreign affiliates located in tax havens operate in, knowing that these are likely used to the benefit of MNEs whose US parent companies are in different industries. Third, I mostly prefer the most detailed country disaggregation, with up to 56 countries (and 8 other country groups, classified by geography) and 15 different industry categories, rather than the more detailed industry classification with around 80 industry groups, which cannot be combined with the information about the MNE affiliates. Table A1 in the Appendix presents basic information about the US MNEs' activities by by the affiliate's industry (for all countries except the US) or the parent company's industry (only for the US parent companies themselves).

Other industry is an intriguing industry category, because in the BEA data it includes information for holding companies. Holding companies form a quantitatively substantial part of the BEA data. Wright & Zucman (2018) report that more than half of US MNEs' investment abroad is intermediated through holding companies and the BEA data contain information only about the industries and countries of affiliates with which US parent companies have *direct* transactions and positions. It follows that holding companies and therefore the Other industry category are bound to play an important role in our data analysis. Another notable characteristic of the BEA survey data related to holding companies is that it tends to overestimate MNEs' profits; this issue has been discussed, for example, by Clausing (2016). Profits that pass through MNEs' affiliates in different countries might be counted more than once in the BEA survey data. Hines (2010) argues that a sizable fraction of the income reported in tax havens is in fact income earned by other foreign affiliates that US parents invest indirectly through tax haven operations. Unfortunately, it is not possible to account accurately for this potential double-counting in the BEA survey data. An alternative would be to use the balance of payments data, in which profits are consolidated and counted only once, but this has two key drawbacks. First, the balance of payments data does not contain country- and industry-level information for taxes and other indicators of economic

activity, which are necessary for our envisaged analysis. Second, as Zucman (2014) discusses, it does not contain the real source of profits but only the location of the holding companies involved in tax planning. In comparison, the BEA survey data is more likely to reveal the real source of profits as well as the location of the holding and thus risks double-counting.

4 Methodology

The methodological approach I apply here builds on Cobham & Janský (2019). Their preferred measure of misaligned profit reflects, in effect, how much taxable profit is in the wrong place and presents one straightforward way of estimating how to 'better align rights to tax with economic activity' (OECD 2013: 11). I estimate this as the (negative) excess profits recorded in countries where there is not concomitant economic activity; or, equivalently, the (positive) missing profits from countries with economic activity. I estimate an MNE's misaligned profit in country *c* in a given year as:

$$Misaligned\ profit_c = Share\ of\ economic\ activity_c * Total\ global\ profit - Profit_c$$

where profit is gross profit (the sum of net income and income taxes), total global profit is the sum of profit across all countries. The share of economic activity is estimated using a range of indicator values for the given country divided by each indicator's global total. As indicators of economic activity, I adopt the formula proposed by European Commission (2016) for the Common Consolidated Corporate Tax Base (CCCTB), which is weighted one-third tangible assets, one-third sales, and one-third split equally between compensation costs and (number of) employees. Additionally, as a robustness check and to increase coverage of countries when some of the information is not available for all countries, I provide results for indicators of economic activity other than this preferred CCCTB combination – namely five individual indicators of sales, tangible assets, total assets, employment and compensation. Similarly, since for a number of countries there is no information available about taxes, and thus about profit, I estimate what I call misaligned net income. I estimate this in the same way as misaligned profit, except that I use net income in place of profit in the equation.

Ultimately, I measure what can be termed misalignment of location between profits and economic activity, as approximated by the various indicators described: if the result is negative, I call this excess profits (since alignment would require its removal); if the result is positive, I call this missing profits. However, with the current data and methodology, neither Cobham & Janský (2019) nor I are able to attribute the observed extent of misalignment to particular reasons. Similar research should in future decompose the scale of misalignment to pinpoint the causal reasons for it, including profit shifting or the higher capital intensity of operations in certain countries or industries.

While I am interested in the estimated scale of misaligned profit, I focus primarily on the industry breakdown of the misaligned profits and its potential implications for government revenues. I estimate the misaligned profit at the country-industry level in the following modification of the equation above for MNEs in industry *i* in country *c*:

$$Misaligned\ profit_{ci} = Share\ of\ economic\ activity_{ci} * Total\ global\ profit_i - Profit_{ci}$$

From both the country- and country-industry-level misaligned profit estimates, we are able to derive rough estimates of what these might imply for government revenues. The additional information I need for this is the tax rate; when available, I use effective rather than statutory tax rates because they better reflect what an MNE could be expected to pay in taxes if it was to report more profit in the relevant country. In line with other existing research (Clausing, 2016; Stewart, 2014), I estimate average effective tax rates at the country level as the ratio of income tax to (gross) profit (and use these for both country- as well as country-industry-level estimates). I then multiply the estimated misaligned profit with these estimated average effective tax rates. When the estimated average effective tax rates turn out to be negative or are not available, for example because there is no tax information in the data, I use statutory corporate income tax rates collected by KPMG (2018) instead so as to keep the countries in question in the results.

5 Results

In this section, before reporting industry-level estimates, I first present the estimates of misaligned profit by country, for all industries combined. Figure 1 presents estimates of misalignment between profit and economic activity for all industries put together, excluding the US in order to better present the differences among the other countries. From Figure 1, I can see that the full set of data for both foreign affiliates and US parents and for all the variables needed for the estimation of the profit misalignment (net income, income taxes, tangible assets, sales, employment, compensation of employees) for the group of all industries is available for 36 individual countries out of the 58 individual countries for which I have some data (additionally, I show the results for one specific group of countries - United Kingdom Islands, Caribbean – which includes the British Virgin Islands, the Cayman Islands, Montserrat and the Turks and Caicos Islands). In describing the results, I focus on the CCCTB combined indicator of economic activity, but there are five other indicators that can also reveal misalignment of profits with economic activity.

Figure 1 highlights that – regardless of the measure used – misaligned profit is always positive for certain countries: the US, Brazil and France, while it is consistently negative for a number of other countries, including Luxembourg and the Netherlands. This implies that for profit to be more closely aligned with economic activity, more profit should be reported in the US, Brazil and France and less profit in Luxembourg and the Netherlands. The latter countries, in which the reported profit is consistently higher than economic activity, are behaving as tax havens in the sense that these countries have likely attracted paper profit that ought to be reported elsewhere. I will refer to the biggest among them as 'tax havens' and the method applied here enables their ex post empirical identification, in contrast with most other existing research, which requires their ex ante definition.

I find that about the same amount of profit as is missing from the US is reported in the tax havens with no corresponding economic activity – 478 billion US dollars in total across the Netherlands, Ireland, Luxembourg, Switzerland, Singapore, and Caribbean United Kingdom Islands (the group of four British Overseas Territories in the Caribbean that includes British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands). Additionally, Figure A1 in the Appendix reports estimated misaligned net income, and the misaligned net income for Bermuda (for which no gross profit information is available) is 80 billion US dollars (for the seven tax havens combined, this figure is 564 billion US dollars, while missing net income for the US is estimated at 465 billion US dollars). Altogether, I thus identify seven important tax havens for US MNEs, broadly confirming the findings presented in previous papers by Zucman (2014) and Cobham & Janský (2019).

In terms of the industries most responsible for these amounts, Figure 2 shows the same estimation of misaligned profit as Figure 1, but this time by industry. The results in Figure 2 are affected by data being not available for many of the industry-country-level observations and that is also partly why I can only identify a few industries as responsible for profit misalignment in the tax havens. Among the industries, I identify the category Other industries as the industry with the most misaligned profit on the side of the US, but there is no corresponding information for tax havens for this industry category due to data omissions. From the available data, as seen in Figure 2, I find highest misaligned profits for the following specific combinations of tax havens and industries: finance and insurance in the Caribbean United Kingdom Islands and, to a smaller extent, in Luxembourg and the Netherlands; manufacturing (chemicals in particular) and the information industry in Ireland; and wholesale trade in Switzerland.

The hypothetical revenue implications of the misaligned profits presented in Figure 2 are included in Table A2 in the Appendix. The results presented are illustrative estimates only and should be interpreted with caution. Again, because some information about tax – and thus gross profit – is missing in the data, I only provide estimates for a subsample of countries. The patterns are similar to what we saw in Figure 2: the hypothetical revenue implications of the estimated misaligned profits suggest that the US is losing almost 100 billion US dollars, which is in line with estimates by Cobham & Janský (2019) and Clausing (2016), while the tax havens identified above, along with a few other countries, seem to be gaining most. The Other industries category seems to be the most important among the industries, as it was in Figure 2 for the US. By multiplying the estimated misaligned profit with the average effective tax rate applied, we can estimate the effects of those tax rates; let me discuss two that stand out. First, some countries' high tax rates highlight the scale of misaligned profit: this is the case for India and Italy, which have above average tax rates according to the data. Second, we can clearly see the paradox of tax havens –

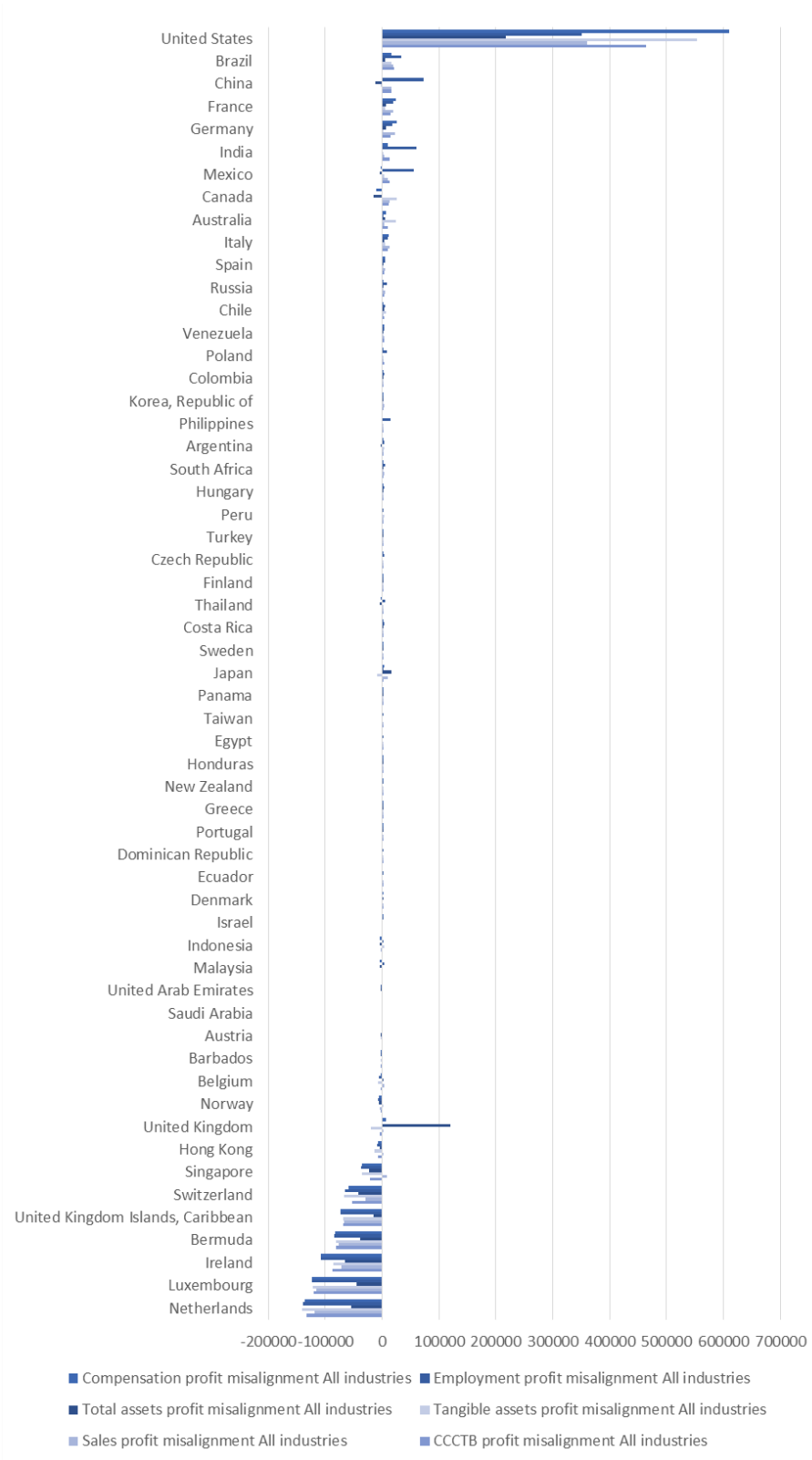
the costs to other countries from profit misalignment in favour of tax havens are much higher than the additional revenues the tax havens receive thanks to that misalignment. This is because the tax havens usually tax companies' profits at lower rates than they would be taxed at in the other countries and this logically leads to lower revenues. While misaligned profit is symmetrical by definition in the sense that what is excess profit in tax havens is missing profit in other countries, and therefore the sum of misaligned profit across all countries is zero, this is not true when it comes to the revenue effects of profit misalignment. The tax havens obviously do have higher revenue from excess reported profits than if the reported profits were proportionate to the companies' economic activity located within them, but other countries' revenues are even further reduced due to the corresponding missing reported profit.

In addition, we can investigate the industry composition of net income in the selected tax havens from the BEA data. For the Netherlands and Bermuda, the vast majority – more than four fifths (84 and 83%) – of that net income was reported in 'Other industries', as shown in Figure 3. This industry category was also responsible for about a half of the net income reported in the Caribbean Islands and Singapore; there is no information available for Ireland, Luxembourg or Switzerland. Moreover, like Figure 2, Figure 3 confirms the importance of specific industries in individual tax havens. Manufacturing is important in Ireland, wholesale trade in Switzerland, and finance and insurance in the Caribbean United Kingdom Islands in particular and to a lesser degree also in other tax havens.

Other industries is identified as the most important industry category in the data and I thus discuss additional information about it from the BEA data. Since this information is only available for continents and the US, I discuss it for the US and all other countries combined across continents together. First, Other industries accounts for 51% of net income of US headquartered MNEs overall (47% for US parents and 54% for their foreign affiliates). Second, while for the US there are several large categories within Other industries (e.g. utilities; transportation and warehousing), for all other countries Other industries are dominated by 'Management of nonbank companies and enterprises': this subcategory accounts for 91% of Other industries. Third, according to the BEA, data for nonbank holding companies are included in this 'Management of nonbank companies and enterprises' subcategory, for which the BEA data provides a breakdown in terms of employees and total assets. 'Holding companies, except bank holding companies' has a lower number of employees than 'Corporate, subsidiary, and regional management offices' (5.8 versus 14.5 thousand), but a much higher share of total assets (almost all of them). The total assets of foreign affiliates' holding companies almost a third of the total assets of all foreign affiliates and more than a fifth of the total assets of all US parents and their foreign affiliates combined. Holding companies are therefore important in terms of their total assets and are highly likely to be responsible for almost all the net income reported in the 'Other industries' category. Recently, Wright & Zucman (2018) note and overcome this limitation of the BEA data by combining it with the IRS corporate income tax returns and this might be a promising avenue for future research on the industries responsible for the costs of tax havens.

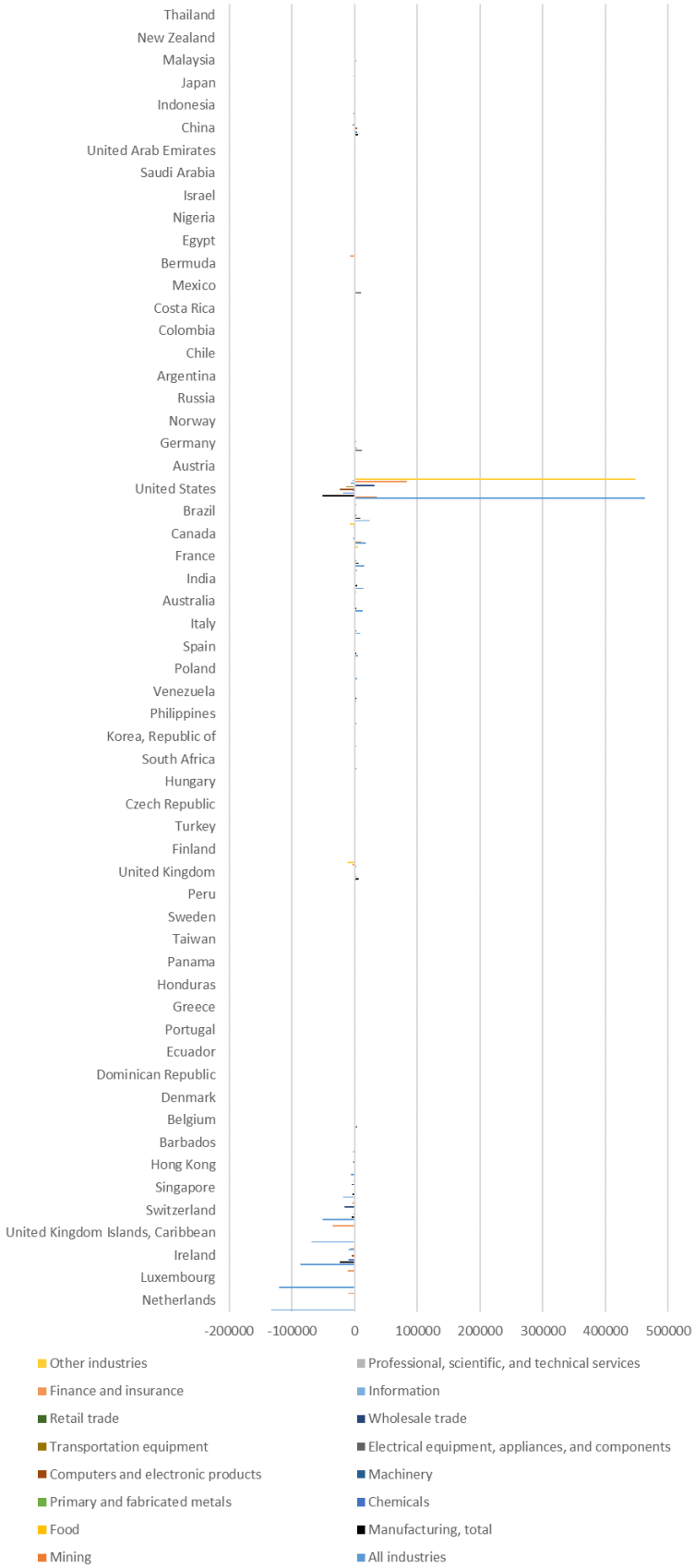
To ascertain which industries are responsible for the costs of tax havens, I draw on another data source that also comes from the BEA. It is a separate data series on the US direct investment position abroad on historical-cost basis, cross-classified by countries and industries, and used here for 2014 to be consistent with the other results. The seven tax havens account for slightly over 50% of worldwide foreign direct investment in 2014 (2582 billion US dollars out of the total of 5109 billion US dollars); the Netherlands and Luxembourg are the most important tax havens (jointly accounting for 1350 billion US dollars) and this confirms the importance of these countries for US MNEs. The slightly different industry classification in this data source explicitly distinguishes holding companies (nonbank) from other industries. In Figure 4 I present the country-by-industry foreign direct positions for the seven tax havens. These confirm the importance of holding companiesfor Luxembourg and the Netherlands, in particular, as well as the importance of finance for the Caribbean United Kingdom Islands and a few other specific industries for other tax havens. Overall, it shows that the two data sources, the BEA survey of MNEs used throughout this paper and this other data source on foreign direct investment positions used only for Figure 4, are broadly consistent and point towards the same industries being responsible.

Figure 1. Misalignment between profit and economic activity (CCCTB) for all industries together (million US dollars)



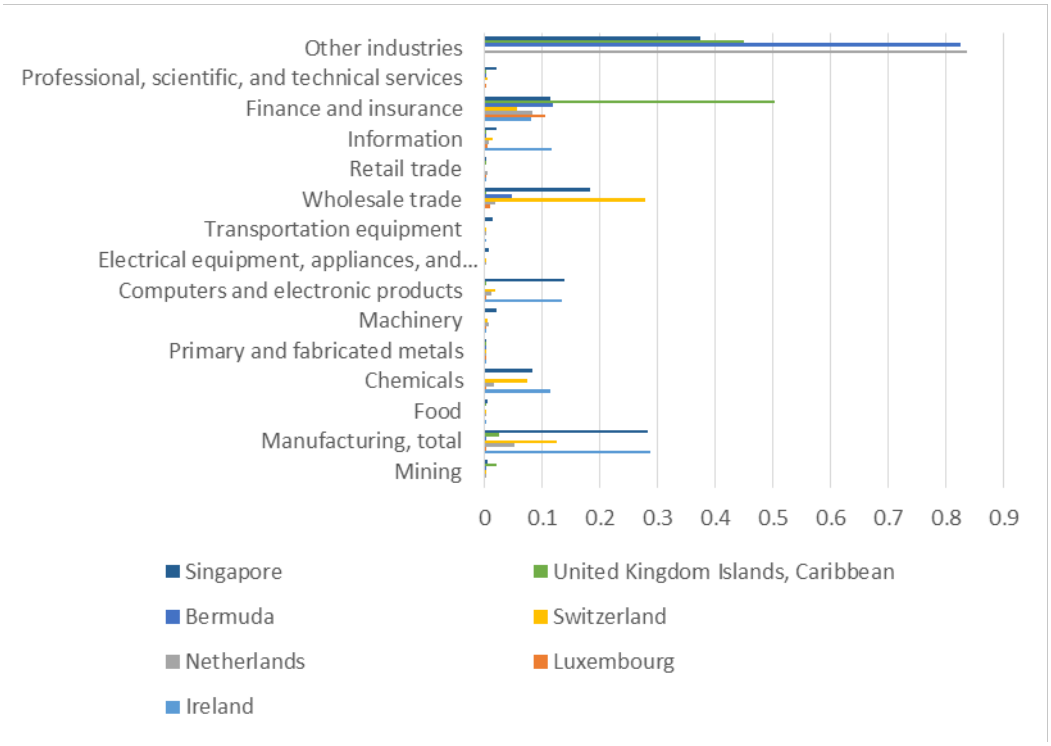
Source: Author

Figure 2. Misalignment between profit and economic activity (CCCTB) for all industries individually (million US dollars)



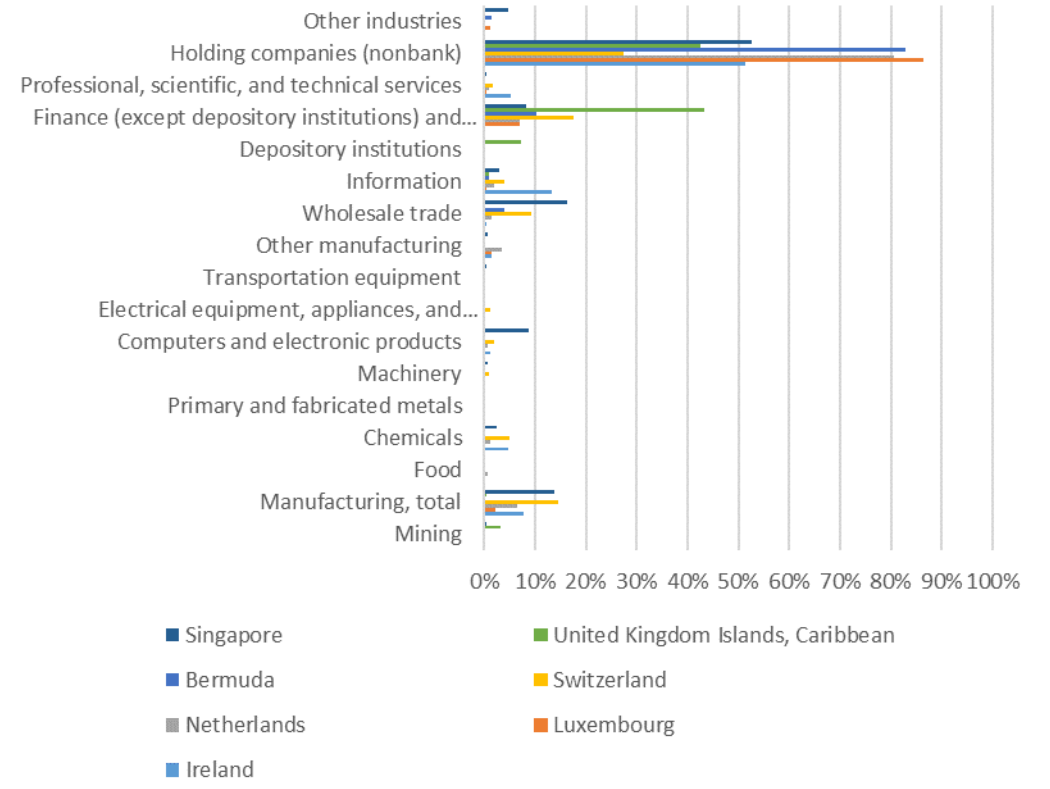
Source: Author

Figure 3. Industry breakdown of net income reported in the most prominent tax havens (as a share of net income reported across all industries in the given tax haven)



Source: Author.

Figure 4. Industry breakdown of foreign direct investment position reported in the most prominent tax havens (as a share of the position across all industries in the given tax haven)



Source: Author.

6 Conclusion

Existing studies have estimated the annual global revenue losses associated with profit shifting to tax havens to be between 100 and 600 billion dollars, but none of them has yet provided an industry breakdown of these losses. I fill this gap by investigating the industry breakdown of government revenue losses due to tax havens worldwide. I find that more than a quarter more profit should be reported in the US for it to match MNEs' shares of economic activity in the US. Meanwhile, about the same amount of profit is reported without any corresponding economic activity in the most prominent tax havens: the Netherlands, Ireland, Luxembourg, Switzerland, Bermuda, Singapore, and the Caribbean United Kingdom Islands. I identify that the category 'Other industries' appears to be the most active in international corporate tax avoidance through tax havens. Also, industries taking advantage of profit shifting to tax havens likely include finance in the Caribbean United Kingdom Islands, manufacturing in Ireland and wholesale trade in Switzerland. These and similar results should form a natural input into tax avoidance-related risk analyses carried out by governments.

Policy makers and tax authorities, such as the US IRS, should use these sorts of industry-country level findings to focus policy and tax enforcement efforts more closely on the countries and industries that are currently responsible for government revenue losses. A first step would be to ensure that data enabling a correct and more precise categorisation of the relevant industries is made more available and accessible. The implications for policy from the results I have presented are unfortunately limited by the fact that the industries in the data are classified for the individual affiliates rather than for the overall MNE or its US parent, and also because holding companies might distort the results. Another limitation is that data is missing for many countries and industries due to confidentiality. A third important limitation is that the 'Other industries' category is dominated by holding companies, which might lead to double counting of profit and that in the case of holding companies, the real industries of the affiliates in question remain unknown. Still, I believe that the industries I have identified here as playing a key role can serve as a basis for an increased policy focus in the identified tax havens on the part of the partner countries. For example, tax authorities in the US and other countries that are affected by profit shifting to tax havens could focus their tax enforcement efforts on the particular country and industry intersections that I have identified as likely responsible for the revenue they are foregoing.

The data sets currently available, including the one I have used here, are not detailed enough to provide a complete industry breakdown of the use of tax havens. At the same time, the limitations serve as a reminder that further research is needed. One particularly promising area of future research is the use of input-output tables in combination with combination other data, to estimate the industry breakdown. The expected results of this and other future research should in turn lead to more specific policy recommendations. Indeed, future research is bound to sharpen these recommendations, especially if it systematically identifies not only the industries that make the most use of tax havens, as I did here, but also the industries that benefit from using tax havens to the largest detriment of other countries' government revenues. Perhaps the country-by-country reporting data for big MNEs that is currently being collected by OECD and governments worldwide could enable the identification not only of industries, but also of specific companies responsible for tax avoidance via tax havens.

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Appendix A

Table A1. US MNEs' activities by parent industry (for the US) or affiliate industry (for all other countries) in millions of US dollars (employment in thousands of employees)

	Net Income		Taxes, income foreign (affiliates) or US (parents)		Profit (sum of net income and taxes)		Sales	
	US	All other countries	US	All other countries	US	All other countries	US	All other countries
All industries	1251664	1166223	331712	133164	1583376	1299387	13000381	6504909
Mining	14237	58256	9320	42463	23557	100719	222477	313884
Manufacturing, total	509458	176474	105994	32803	615452	209277	4945821	2724874
Food	35596	8857	10340		45936		548279	237041
Chemicals	131148	54301	25666	10418	156814	64719	691854	539553
Primary and fabricated metals	6407	3326	2711	915	9118	4241	218272	93125
Machinery	27132	15882	6359	3229	33491	19111	243289	191959
Computers and electronic products	92543	40845	25186	4510	117729	45355	551189	545202
Electrical equipment, appliances, and components	10128	5391	2050	527	12178	5918	113117	57286
Transportation equipment	62025	7727	11878	2659	73903	10386	927605	429916
Wholesale trade	58730	71689	19462	11504	78192	83193	1719546	1532326
Retail trade	50450	13654	26979	3931	77429	17585	1466820	383217
Information	124604	24801	40452	3277	165056	28078	1041298	286427
Finance and insurance	308386	161243	84562	18763	392948	180006	1899838	527930
Professional, scientific, and technical services	68394	31449	9788	4729	78182	36178	424321	280725
Other industries	117406	628656	35157	15694	152563	644350	1280261	455526

	Employment		Compensation		Tangible assets (Net Property, Plant, and Equipment)		Total assets	
	US	All other countries	US	All other countries	US	All other countries	US	All other countries
All industries	27587.2	14052.4	2116998	632546	4290724	1456249	39011574	25178065
Mining	296.6	270.1	34150	23737	387706	489697	704562	1102333
Manufacturing, total	7473.6	5439.2	711254	237856	1271498	441102	7718230	2728260
Food	877.2	483.2	57724	18337	100555	35448	623771	196039
Chemicals	890.3	681.9	112676	45350	217631	103823	1658093	731815
Primary and fabricated metals	462.9	257	37790	11897	55762	29080	254057	118886
Machinery	532.4	505.8	49145	27780	47610	25760	416476	251885
Computers and electronic products	955.1	879.5	111830	32925	83558	59641	963502	456900
Electrical equipment, appliances, and components	278.9	241.3	24702	7471	21114	8448	205817	85563
Transportation equipment	1632.1	1100.9	156242	41281	172077	55591	1416236	252387
Wholesale trade	1815.9	971.4	128975	64152	280070	45495	1394449	1067058
Retail trade	5467.3	1489.6	172381	31808	308088	64191	856457	281928
Information	1998.9	603.6	200378	36778	434188	54842	2245618	510580
Finance and insurance	2849.1	724.5	356401	69654	289740	35362	22627620	9976828
Professional, scientific, and technical services	1650.4	1320.8	170154	76521	68153	23858	704364	450317
Other industries	6035.3	3233.3	343305	92040	1251281	301701	2760274	9060760

Source: Author

Notes: The total of manufacturing is displayed alongside its sub-categories: food; chemicals; primary and fabricated metals; machinery; computers and electronic products; electrical equipment, appliances, and components; transportation equipment.

Table A2. Revenue implications of misalignment between profit and economic activity (CCCTB) for all industries (million US dollars)

	Average effective tax rates	All industries	Mining	Manufacturing, total	Food	Chemicals	Primary and fabricated metals	Machinery	Computers and electronic products	Electrical equipment, appliances, and components	Transportation equipment	Wholesale trade	Retail trade	Information	Finance and insurance	Professional, scientific, and technical services	Other industries
Netherlands	0.027675	-3682		-8		38	-2	-20	17	-11		-23		17	-286	28	
Ireland	0.032236	-2793		-776		-315	0	1	-164		0	53	0	-313	-212		
Switzerland	0.036531	-1880		-194		-89	0		-19	-4	-1	-577		-14	-118	30	
Luxemburg	0.006348	-763		4										-2	-69		
Denmark	0.444155	-697		214		305	-9	6	116				15		82	108	
Singapore	0.038558	-694	6	-128		14	-3	-21	51	-9	-21	-184		21	-107	-6	
United Kingdom Islands, Caribbean	0.0093	-641	-6	-12											-320		
Hong Kong	0.077641	-491		-9		-28		-2	38	3		-128	-18	-15	-66	-30	
Barbados	0.124026	-268		7		1	0							0			
Belgium	0.10874	-172		398		168		22	16	-1	73	-91			-172		
Ecuador	0.125	27	-10	18		2	0					-1			8		
Dominican Republic	0.179266	33	0	14							0	-4					
Portugal	0.175258	84	0	52		18	0	4			7	-16		5	10	3	
United Kingdom	0.094655	138	227	579		216	-17	76	134	8	0	19	163	312	-299	149	-1050
Taiwan	0.145157	152	0	13		59		0	76	1		-15		11	19	2	
Honduras	0.220183	166	0				0	0				1		1			
Sweden	0.151226	198		-87		26	-2	-7	-1	5	12	-47	3	20	25	3	
Greece	0.344569	201	0	76		30						-4	0	3	65	15	57

Czech Republic	0.167939	280	0	149		25	2	6	97	8	16		1			5	
Panama	0.276119	281		40		20	0				0	17		1	35	0	
Finland	0.2	294	0	234		29		15		2		-15		6		17	
Poland	0.117443	442	22	243		50	3	6	27	17	1	15		20	39	21	38
Philippines	0.142857	451		147		24			177			-7	0	106		35	
Peru	0.336374	476	97	23		36		3				9					
Turkey	0.329703	532				167		7	4			20			16		
Korea, Republic of	0.200769	588		396		8	8	-28	184		218	-72	-47	4	28	1	
South Africa	0.254493	631		168		34	-5		12			29		3	10	28	
Hungary	0.385918	653		242		26			32		27	45		-60			
Spain	0.162306	862		495		30		13	90	34	176	18	21	11	99	49	
Venezuela	0.34	1154		929		244		27				110			157	95	
Australia	0.152187	1868	64	377		197		32	84		94	-92	45	-54	19	166	397
Canada	0.11442	1996	1120	-100		-239	40	-94	171	-119	112	-182	187	-14	-253	95	-772
Brazil	0.176911	4267	223	1576		473	-28	123	182		346	166			437	59	
Italy	0.498205	4825	4	1594		834	68	89	343	212	35	278		213	214	130	
France	0.329537	5227	-24	2279		1116	-39	31	525	31	129	-22	163	210	362	225	1783
India	0.357207	5244	31	1359		514	3	76	330	14	284	182		574	258	1271	
US	0.209497	96946	7330	-10796		-3791	12	-464	-4930	14	-2926	6708	-62	-1150	17332	-685	93984
Austria	0.25			154		18	2	-4	50		17	11	-1		1	1	
Germany	0.2958		42	3257		1320	-62	209	471	-113	829	335	-374	528	1	238	
Norway	0.27			-48		12	4			-2	0	17	1	0		37	
Russia	0.2			293		48		25				19			44	15	
Argentina	0.35		-4	247		100		22	8		95	95		62	-113	20	
Chile	0.2			77		113	0	1				10			14	10	
Colombia	0.25			126		16		4	8			52		21	90	20	

Costa Rica	0.3		0	87		58		0						3		26	
Mexico	0.3			3077		469	15		506	122	598	-50	-374	305	14	141	
Bermuda	0									0			0		0		
Egypt	0.25					46				0		-9			-14	3	
Nigeria	0.3						0			0	0		0	1			
Israel	0.265			-175		28								32	-10	132	
Saudi Arabia	0.2			-12						0	0		0	13	0	18	
United Arab Emirates	0.55							17			0					-4	
China	0.25		-73	1312		913	31	-30	1174	21	-352	-960	-111	100	91	365	
Indonesia	0.25		-506	-184		58		13	13			7		2		3	
Japan	0.3564		0	-253		215	-4	135	339	19	7	-433	194	-58	-970	104	
Malaysia	0.25		-389	241		34	-1	-14	640		-13	-41		2	0	28	
New Zealand	0.28			32		23		12	15	-1		-29		29	-53	9	
Thailand	0.2			139		78	-1	7	-73		36						

Source: Author

Appendix B

The existing global estimates of government revenue losses due to tax havens

There are nine existing studies, as far as I know, that provide revenue estimates for many countries; most of these provide results at the country level. Table 2 sums up the following research contributions to estimating the scale of profit shifting for many countries: IMF's Crivelli et al. (2016) and a follow-up study by Cobham & Janský (2018), UNCTAD (2015) and a follow-up study by Janský & Palanský (2019), OECD (2015b), Clausing (2016), Cobham & Janský (2019), IMF (2014), and Tørsløv, Wier, & Zucman (2018). I focus on these studies because most of them have been influential in the policy debate, and all include an answer as to what the scale of profit shifting is and how much tax revenue governments lose, in most cases providing estimates for many countries worldwide. I list these studies in approximate order of the relevance of their estimates (including the most recent study, which is preliminary, as the last).

IMF's Crivelli et al. (2016) estimate losses due to profit shifting related to tax havens by looking at a counterfactual, i.e. if the tax havens' tax rates were no lower than other countries' rates. UNCTAD (2015) estimate tax revenue losses due to tax avoidance schemes that exploit a direct investment relationship on the basis of lower reported rates of return for investment from tax havens. OECD (2015b) combines estimates of revenue losses due to both profit shifting related to tax rate differentials (differences in tax rates across countries) and differences in average effective tax rates for large affiliates of MNEs and domestic companies. Both Clausing (2016) and Cobham & Janský (2017) use data focused on US-headquartered MNEs only, the same data I use here. While Clausing (2016) estimates profit shifting scale from derived semi-elasticities, Cobham & Janský (2019) quantify the extent of misalignment between reported profits and indicators of economic activity. IMF (2014) for the world, and EPRS (2015) with a slightly different methodology for European countries, estimate corporate income tax revenues related to differences in countries' corporate income tax efficiency ratios (using gross and net operating surplus, respectively) relative to the average ratio in the other countries. One of the studies, OECD (2015b), itself argues that given the many uncertainties associated with global estimates of the scale and economic impacts of base erosion and profit shifting (BEPS), no single empirical estimate can be definitive, but the authors add that such estimates are generally of more value for policymakers than extrapolating from more narrow studies involving a limited number of companies or countries. On a similar note, EPRS (2015) observe that most economists concede that estimating aggregate tax revenue losses due to tax avoidance and evasion remains elusive. A recent comprehensive overview of these nine studies is provided by Cobham & Janský (2017).

As far as I know, the industry breakdown of the tax losses discussed in Table 2 is not known and there are no studies that provide industry-level revenue estimates for many countries. Indeed, for most of them, such a breakdown is not possible due to methodological or data-related limitations. The research methodology and data used by Johansson et al. (2017) and Cobham & Janský (2017) could be adapted to estimate industry-specific results. The Orbis data used by Johansson et al. (2017) is not available for free and suffers from a number of biases, which have been highlighted in recent research such as Tørsløv, Wier, & Zucman (2018).

Table A3. Summary of estimates of global profit shifting and associated tax revenue losses

Reference	Annual corporate income tax revenue loss estimates (USD)	Methodology and international corporate tax avoidance estimated	Country-level estimates	Industry-level estimates
IMF's Crivelli et al. (2016)	$400 billion for OECD countries (1% of GDP) and $200 billion for other countries (1.3%).	BEPS related to tax havens by looking at what would happen if the havens' tax rates were not lower.	No	No
Cobham & Janský (2018)	$500 billion globally	Similar to IMF's Crivelli et al. (2016).	Yes	No
UNCTAD (2015)	$200 billion in 2012 globally and $90 billion for lower-income countries, or 8% of CIT.	BEPS through tax avoidance schemes on the basis of lower rates of return for investment from havens.	No	No
Janský & Palanský (2019)	A conservative estimate of $80 billion for a sub-group of countries.	Similar to UNCTAD (2015).	Yes	No
Johansson et al. (2017), OECD (2015b)	$100-240 billion, or 4-10% of global corporate income tax revenues in 2014.	BEPS related to tax rate differentials and differences in average effective tax rates for large affiliates of MNEs and domestic companies.	No	No
Clausing (2016)	$279 billion for a group of selected countries in 2012, 20 % of CIT.	Profit shifting due to tax rate differentials, with the scale estimated from derived semi-elasticities.	Yes	No
Cobham & Janský (2019)	Up to $133 billion for US MNEs in 2012 (profits shifted of up to $660 billion, or almost 1 per cent of world GDP).	The extent of misalignment between the location of US MNEs' economic activity and the location of their profits.	Yes	No
IMF (2014)	5% of CIT in OECD and almost 13% in non-OECD countries in 2012.	Corporate income tax revenues related to differences in countries' corporate income tax efficiency ratios, the spillover effects of profit shifting.	Yes	No
Tørsløv, Wier, & Zucman (2018)	Around 200 billion euros in 2015 (around 12% of CIT). (45% of MNEs' profits shifted, i.e. more than 600 billion euros.)	Profit shifting to tax havens. They argue that relative to their number of employees, firms in tax havens are abnormally profitable. They assume that all profitability in tax havens above the world average reflects inward profit-shifting.	Yes	No

Source: Author.

A brief review of existing industry-level country-specific research

The existing research in this field highlights the fact that tax havens are of varying importance in different industries, and I now briefly review the relevant literature, which is quite voluminous. This should not be considered a comprehensive review, but rather a selection of relevant examples. I examine other empirical studies, without tax revenue losses, but with industry-specific results, even if this was not their focus. Some studies, such as Crivelli et al. (2016) or Johansson et al. (2017), mainly discuss industries from the point of view of excluding certain industries from their final data sample, while Fuest & Riedel (2012) use industry dummies in their estimation but do not provide the detailed results for them. There have been several industry-specific studies on profit shifting – for example, studies on banks using the newly available country-by-country reporting data, including a recent one by Bouvatier, Capelle-blancard, & Delatte (2017) – that provide insights into specific industries but do not enable a comparison across industries from which we could observe which industries are most affected. In their meta regression, Heckemeyer & Overesch (2017) use dummy variables whenever industry fixed effects are included. However, none of this existing empirical research could is informative about how much costs of tax havens various industries may be responsible for.

Over time, the economics literature has got better at identifying MNEs' specific tax avoidance mechanisms, with three main profit shifting channels: debt shifting, location of intangible assets and intellectual property, and strategic transfer pricing. All three are motivated by the MNEs' assumed desire to lower their total tax paid by at least nominally transferring their profits and thus tax bases to jurisdictions where they pay lower taxes, i.e. those with lower effective tax rates. This transfer could be implemented, for example, through often unnecessary loans at high interest rates from one MNE unit located in a tax haven to another profitable unit, to decrease the profit in the latter unit (e.g. from a parent company in the US to an affiliate in Bermuda). Alternatively, intangible assets and intellectual property such as brands or research and development can be stationed artificially at an MNE's subsidiary in a tax haven, to which high service fees are then paid by other parts of the MNE. The third main channel for profit shifting is to inflate or deflate the prices of goods or services that are transferred between the various foreign parts of an MNE in such a way as to minimise the tax burden faced in all the countries involved.

While unnecessary loans at high interest rates can in theory be implemented in any industry, this practice may be easier in industries such as information technology and other mobile and digital industries, when it may not be straightforward to determine where the real economic activity is taking place. Companies with higher intangible assets and intellectual property are likely to use the second profit shifting channel. Therefore, opportunities for tax avoidance might arise more intensively when a large share of assets is intangible, as in, for example, the information technology or research and development-dependent industries (e.g. pharmaceuticals) or MNEs with valuable brands (consumer product companies). The role of intangible assets was described by Lipsey (2010), who used the BEA data to observe that as production comes to depend more on intangible productive assets, MNEs' production locations become increasingly ambiguous because these assets have no clear geographical location, but only a nominal location determined by the MNE's tax or legal strategies. He estimates that, for affiliates in a few tax havens alone, the exaggeration of value added and of sales in those locations amounted in 2005 to about 4 and 10 percent of worldwide affiliate sales, respectively. More recently, Guvenen, Mataloni, Rassier, & Ruhl (2017) identify the scale of profit shifting as being responsible for a part of mismeasurement in official statistics for US GDP and productivity, with large profit shifting adjustments in particular in industries that are intensive in research and development and that are most likely to produce intangible assets that are easy to move across borders. The third channel is likely to be used in industries in which trade plays an important role, and might be visible in the relatively well-accessible and detailed international trade data, especially in commodity trading industries such as mining (Finér & Ylönen, 2017). For a related gas and oil sector, Beer & Loeprick (2017) provide estimates of profit shifting.

Intensive policy debates on these topics have taken place in a few industries. For example, the OECD's (2015a) base erosion and profit shifting (BEPS) project, which is an intergovernmental effort at decreasing international corporate tax avoidance, has 15 actions, most of them general with respect to industries, with the exception of Action 1: Addressing the Tax Challenges of the Digital Economy. The European Commission has also been very active in that specific industry recently, and organised a

consultation on 'Fair taxation of the digital economy' at the end of 2017. Having reviewed some of the most important studies estimating the global government revenue losses due to tax havens and studies investigating which industries are more prone to tax avoidance via tax havens, I cannot see industry-specific revenue estimates for many countries and I now turn to describing the data that I use to fill in this research gap.

Data sets of MNEs

In this paper I use data from the 2014 survey of all US MNE groups, a survey which has been carried out since 1982 by the Bureau of Economic Analysis (BEA) and is known as the US Direct Investment Abroad survey (USDIA). I draw in this section on a methodology description provided by the Bureau of Economic Analysis (2017) for the 2014 data. The data have been highlighted by OECD (2015b) as some of the current best practices in using available data for BEPS analysis and have been previously used for research. For example, Blonigen et al. (2014) use the confidential, firm-level data to estimate the impact of bilateral tax treaties on US multinational firms' investment behaviour, allowing for treaties' differential effects across industries; Stewart (2014) and Clausing (2012) use the aggregated data to compare effective corporate tax rates, and shares of total foreign income and employment, respectively. Sullivan (2004) uses the BEA data to highlight a dramatic shift of profits to a few jurisdictions, whereas Zucman (2014) employs the same data to show the same. International Monetary Fund (2014) uses the BEA data to identify spillover effects in international taxation. Furthermore, Keightley and Stupak (2015) use the BEA data as one of their data sources to document the large problem of base erosion and profit shifting in the US and elsewhere. Recently, Clausing (2016) uses the BEA aggregate data to study profit shifting, with a focus on the US, and finds that profit shifting likely cost the US government between USD 77 and USD 111 billion in corporate tax revenue in 2012. Even more recently, Wright & Zucman (2018) use the BEA data to show that the US has earned uniquely high returns on its foreign assets because US MNEs have paid low taxes to foreign countries.

There are some other data sets that could be used to answer my main research question, as they include the industry-country-level detail needed to estimate an industry breakdown of the revenue losses for many countries. In most cases, however, these alternative data are either not available or not easily accessible or are not so detailed. Let me briefly discuss three such data sets as examples. Among the not-so-easily accessible are the firm-level BEA survey data (those used here are aggregated) and the MiDi database of the Deutsche Bundesbank on German inbound and outbound foreign direct investment used, for example, by Weichenrieder (2009). These are not publicly available. To access these as a researcher, one needs to be an approved US researcher for the former and an approved researcher willing to access the data in Frankfurt for the latter. Perhaps the most frequently used data set looking at tax havens is Orbis, a firm-level database owned by Bureau van Dijk, which charges for its use. The first important drawback to this dataset is its accessibility – one must pay substantial amounts of money to use it. The second, seen in Cobham and Loretz (2014), is that Orbis lacks substantial amounts of data on firms from developing countries and tax havens. The third is that its coverage of affiliates is poor. In fact, Tørsløv, Wier, & Zucman (2018) show that only a weighted average of 17% of global profits is included in Orbis and for more than a quarter of MNEs there are no profits at all included. In contrast, the BEA survey data used here are publicly available and include most of the detailed information needed to answer the research question (albeit not all, as I describe below). All in all, these alternative data sets could be used to answer the present research question – and future research should indeed make use of them – but after weighing up their pros and cons I have chosen to use the BEA survey data.

Table 3 provides a quick overview of the main data sets on MNEs and other relevant sources. In addition to those discussed above, two types of sources are included – country-by-country reporting data (discussed below) and foreign direct investment and input-output data, which I briefly discuss now. Both of these types of data can be used to study MNEs' activities, but often the data is over aggregated or information on taxes or tax havens is missing. There are two main sources of foreign direct investment data with the ambition of providing global coverage. One is the IMF's Coordinated Direct Investment Survey (CDIS), which contains data at both unilateral and bilateral levels, while the other is the UNCTAD's only unilateral foreign direct investment database, but with a wider coverage of countries, as discussed by UNCTAD (2015). There are a few sources of input-output data with the ambition of providing global coverage. One is the World Input-Output Database (Dietzenbacher, Los, Stehrer,

Timmer, & De Vries, 2013), another is the Global Trade Analysis Project (Steen-Olsen et al., 2016) and other datasets are discussed by Tukker & Dietzenbacher (2013). Overall, these input-output data sets have not been used to answer the research questions of this paper and are promising area of future research. All these data sources differ in terms of their access and data coverage and the type of information they offer.

Table A4. An overview of selected data sets on MNEs and other relevant data sources

	Data access	Description	Coverage
BEA survey aggregate data	Online, free of charge	Country- and country-industry-level data for all US MNEs.	All US-headquartered MNEs; US parents and foreign affiliates
BEA survey firm-level data	US-based restricted access.	Firm-level data for all US MNEs.	All US-headquartered MNEs; US parents and foreign affiliates.
Orbis	Paid access, online.	Firm-level financial and ownership data (very detailed, but problems with completeness – only 17% of global profits are included in Orbis).	Intended global coverage. In reality a good coverage of Europe, not so good coverage of many developing countries and tax havens.
Germany's MiDi	Frankfurt-based access for approved researchers.	The Deutsche Bundesbank houses the Micro database on Direct Investment (MiDi). The data includes profit after tax, but does not include other income statement information, such as taxes or income.	It covers directly or indirectly owned foreign affiliates of German parent companies above a certain size and ownership threshold.
Corporate tax returns data in the United Kingdom (similar data in other countries)	UK-based authorised access	The data from Her Majesty's Revenue and Customs in the UK includes information from corporate tax return forms.	All companies submitting their corporate tax returns in the United Kingdom.
Japan External Trade Organisation	Aggregate information available online	A survey of the Japanese multinational affiliates' operations	Foreign direct investment outflow from Japan.
UNCTAD's and IMF's foreign direct investment data	Online, free of charge.	UNCTAD and IMF are two main sources of foreign direct investment data. In addition to stocks of the investments, not much more detail is provided.	Information for most countries, IMF for around 100 and UNCTAD even more.
Input-output tables	Most of the databases require paid access.	A few input-output databases with various pros and cons (for example, World Input-Output Database and the Global Trade Analysis Project).	Five of the databases have a minimum coverage of 40 countries, some of them around 150 countries.
Country-by-country reporting data on big MNEs	Aggregate data are to be made available in early 2020.	Within the Base Erosion and Profit Shifting project of the OECD governments worldwide have agreed to collect country-by-country reporting data.	All MNEs with consolidated group revenue higher than 750 million Euros.
Country-by-country reporting data for extractive and banking industries	Available online, but not in a consolidated form.	Following the European Union's policies, country-by-country reporting data for extractive and banking industries are being published.	Most banks and finance firms and most firms in the extractive industries (oil, mining, etc.) active in the EU.

Source: Author

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