Do multinationals' unrelated party revenues respond to corporate income taxation? Evidence and implications for policy simulations

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Abstract

Large multinational companies' tax planning practices and increased corporate income tax competition have attracted a growing attention from researchers and policy-makers. On the academic side, over the 2000s, the literature seems to have shifted focus from real responses onto the elasticity of pre-tax income to taxation and profit shifting schemes. On the policy side, reforms of the global tax system have been proposed that anchor taxing rights over firms' profits to the location of final customers. In this context, we ask whether multinational companies organize extra-group transactions for tax planning purposes and we investigate the implications of this response for reform simulations. Leveraging country-by-country report statistics, we share descriptive evidence of the phenomenon and estimate a tax semi-elasticity of -1.85 for unrelated party revenues, subject to various cave-ats. We also propose an adjustment of revenue variables to approximate a distribution of sales reflecting the final destination of the transactions. The adjusted database, which gives a reduced weight to low-tax sales platforms and displays greater consistency with market size indicators, is made available for future research.

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1 Introduction

Since the 1980s, increased economic integration has exacerbated the tax competition for multinational companies' investments, spurring countries to offer lower tax rates and / or broader tax base deductions.[1] This constitutes a potential narrative for the strong decrease in the global average statutory corporate tax rate between 1985 and 2020, from 49% to 23.5%.[2] In the United States (US), the effective average tax rate (EATR) on corporate profits went down from close to 50% in the 1950s to 17% in 2018; within the European Union (EU), the EATR has declined from 30% to around 20% over the last two decades.[3] In addition, several large-scale profit shifting mechanisms have provided multinational companies with opportunities to book their taxable income in low-tax jurisdictions where they maintain little or no real economic activity. Such practices have also become a key determinant of the effective taxation of corporate profits globally and have been widely documented in the literature.[4]

In the wake of such trends and in reaction to the digitalisation of economic activities that facilitates the disconnection of profits and value creation, two main developments have guided the following study.

On the academic side, researchers have refined our understanding of multinational companies' aggressive tax planning practices, with a growing focus on profit shifting over the last few years. Over the 2000s, the focus of empirical works seems to have shifted from multinational companies' real responses to taxation (e.g., location decisions or investment) onto the elasticity of pre-tax profits to corporate income tax rates, often controlling for real economic activity so as to highlight pure "paper" operations. As a consequence of this shift in the literature, Beer, Mooij, and Liu (2020) stress in conclusion to their review that "there is little attention in the literature on the interaction between profit shifting and the reallocation of real activities by MNCs". Recently, Laffitte and Toubal (2022) have provided a new framework to study the phenomenon by disaggregating profit shifting into two movements: the concentration of sales in low-tax jurisdictions on the one hand and the concentration of expenses in high-tax countries on the other hand. Investigating the former, they have put revenues under the spotlight again by showing that US multinationals organize their global presence around sales platforms in response to taxation and by quantifying the weight of sales shifting practices in total profit shifting. In their main analysis, they explain the foreign sales ratio (i.e. the ratio of sales directed to any other country to total sales) as a function of the statutory corporate income tax rate. Since they include both unrelated party and related party revenues, their analysis indifferently encompasses both traditional profit shifting schemes based on intra-group transactions and some forms of real responses.

On the policy side, several proposals for reforms of the international corporate income tax system aim at reconnecting taxation and value creation. In October 2021, 136 countries and jurisdictions agreed on the "two-pillar solution to address the tax challenges arising from the digitalisation of the economy". Pillar One typically consists in allocating part of the taxing rights over the profits of large and very profitable multinational companies to their "market jurisdictions", where goods and services are consumed or used. Other proposals pursue a similar objective like the "Minimum Effective Tax Rate (METR)" of Cobham et al. (2022), the European Commission's Common Consolidated Tax Base (CCCTB, 2016) or, more generally, formulary apportionment approaches. In their "unilateral implementation scenario", Baraké et al. (2021a) also examine the allocation of some of the gains from a global minimum tax on corporate profits based on firms' revenues. All have in common that they use the location of multinational companies' customers to distribute the taxes raised. Simulating such reforms has then raised the question of the potential disconnection between the accounting-based treatment of revenues in available macroeconomic databases and the destination-based distribution required for apportionment. Even with statistics that isolate extra-group transactions, the possibility for multinational companies to operate sales remotely, from neighbouring countries where they have

1. See for instance Flamant, Godar, and Richard (2021) for an empirical investigation of the evolution of corporate income tax (and personal income tax) competition within the EU.

2. Average statutory corporate income tax rate weighted by GDP, based on the OECD's Corporate Tax Statistics and cited by Clausing, Saez, and Zucman (2020) or Janeba and Schjelderup (2022).

3. See Piketty, Saez, and Zucman (2018) for the US and Spengel et al. (2020) for the EU. The EATR corresponds to the average rate at which pre-tax profits are actually taxed and it is computed, in the simplest approach, as the ratio of taxes paid to total income. It may differ from the statutory tax rate (i.e., the headline rate imposed by the law on taxable income) due to the progressivity of corporate income taxation, to tax base deductions (e.g., deductible financing expenses) or to various tax credits.

4. See for instance Heckemeyer and Overesch (2017) or Beer, Mooij, and Liu (2020) for related literature reviews. More studies are covered in Section 2.

set up an affiliate, is likely to bias the revenue estimates. Motivated by simple descriptive statistics, we propose to further investigate the economic factors that drive a wedge between customers' location and the observed distribution of multinational companies' revenues.

From these starting points, we ask the following question: do multinational companies' unrelated party revenues respond to corporate income taxation? What are the implications for policy simulation?

We rely on country-by-country report statistics. Released so far for four financial years (from 2016 to 2019) by the Internal Revenue Service (IRS) and for two financial years (2016 and 2017) by the OECD, these datasets provide information on the domestic and foreign activities of multinational companies, respectively headquartered in the US or in a broader set of *headquarter countries*.[5] For each tax jurisdiction where they are active, country-by-country report statistics display their aggregated revenues, pre-tax profits, corporate income taxes paid and accrued, number of employees, among other variables. In particular, for the financial year 2017, country-by-country report statistics cover 38 headquarter countries and over 150 *affiliate countries*.[6] While several documents and studies have highlighted weaknesses associated with these data, revenue variables make them particularly appropriate for our study.[7]

First, in country-by-country report statistics, revenue variables encompass a broad range of transactions. They "include revenues from sales of inventory and properties, services, royalties, interest, premiums and any other amounts", while excluding intra-firm dividends and remaining therefore free from potential double-counting issues. Second, they are split into three different variables: *unrelated party revenues* correspond to "transactions with independent parties" (i.e., involving partner entities that are not part of the multinational group); *related party revenues* correspond to "transactions with associated enterprises" (i.e., involving partner entities that are part of the multinational group); total revenues correspond to the sum of the two other variables. Country-by-country report statistics importantly allow to distinguish unaffiliated or affiliated transactions. Third, revenues are associated with the affiliate country where the subsidiary registering the sales in its financial accounts has its tax residence, instead of final customers' location. Revenue variables thus reflect multinational companies' potential tax planning margins. Consider the example of a US multinational company providing cloud services. The group has a unique foreign affiliate in Ireland, from which services are operated and sold to customers all over Europe. The Irish affiliate registers in its financial accounts the revenues from sales not only to Irish customers, but also to those located in Germany, France, the Netherlands, etc. Similarly, if the affiliate indeed resides in Ireland for tax purposes, the country-by-country report of the multinational will attribute 100% of the revenues generated in Europe to Ireland. The ultimate destination of the transactions and thus customers' location are not observed.

Figure 1: Illustrating schema

Note: This schema illustrates the example of the cloud service company, headquartered in the US and operating its European sales via a foreign affiliate in Ireland. As transactions accrue to the latter's revenue in its financial accounts, country-by-country report statistics do not provide any information on the location of the ultimate users of the services (e.g., France).

5. By headquarter countries, we designate the jurisdictions where multinational groups' ultimate parent entities (i.e., entities at the top of their respective ownership structure) are located. In country-by-country report statistics, headquarter countries are identified based on the tax residence of the ultimate parent entity.

6. By affiliate countries, we designate the partner jurisdictions where multinational groups' subsidiaries are located. In country-by-country report statistics, affiliate countries are identified based on the tax residence of the subsidiaries. For instance, the total revenues associated with, say, France in the US country-by-country report statistics correspond to the sum of the revenues of large US multinational companies' affiliates residing in France for tax purposes.

7. See Section 2 for a discussion of the existing literature leveraging country-by-country report statistics.

Leveraging these characteristics of country-by-country report statistics, we analyse whether multinational companies' unrelated party revenues respond to corporate income taxation and if so, to which extent. Through a descriptive investigation of the data, we evidence the disproportionate weight of some tax havens within the set of affiliate countries. Typically, in 2017, they account for 27% of US multinational companies' foreign unrelated party revenues and for less than 6% of the final consumption expenditures in the corresponding sample. We also measure the semi-elasticity of unrelated party revenues to effective or statutory corporate income tax rates. In our benchmark specification, which relies on cross-country comparisons, we find a semi-elasticity of -1.85 to the statutory corporate income tax rate. Said otherwise, when the headline rate increases by 1 percentage point in an affiliate country, the unrelated party revenues booked there by US multinational companies decreases by 1.85%. Whether this effect is driven by the direct effect of corporate income taxation or rather signals the broader impact of affiliate countries' tax environment is however less clear. Indeed, introducing the tax haven status into the set of regressors reduces the magnitude and significance of the statutory rate effect, while tax havens are associated with four-time larger revenues holding all controls constant. The specific effect of corporate income taxation further displays a limited robustness to alternative specifications. We conclude that tax environment characteristics, among which corporate income taxation, influence the organisational choices of multinational companies (e.g., location of foreign affiliates or billing of unaffiliated transactions), but this tax planning margin remains secondary relatively to intra-group profit shifting schemes.

Furthermore, while it is a key requirement to investigate multinational companies' tax planning, the fact that revenue variables are based on the accounting treatment of sales makes them incompatible with simulations of apportionment reforms. Typically, the draft nexus and revenue sourcing rules released by the OECD in February 2022 (see OECD (2022)) provide detailed guidelines for measuring sales as per their final destination under Pillar One Amount A. Similarly, when discussing the potential revenue effects of their METR proposal, Cobham et al. (2022) underline this limitation of country-by-country report statistics as "sales revenues are attributed to the recipient entity, and do not reflect the sourcing rules developed for Pillar One". As shown in the analysis of revenue responses to taxation, this divergence is likely to create substantial biases in favour of multinational companies' - possibly low-tax - sales platforms. Therefore, we develop an adjusted mapping of country-by-country revenue variables for the US and 14 other headquarter countries. The adjusted variables aim at reflecting the location of ultimate consumers or users, rather than the jurisdictions where transactions are registered for financial reporting purposes. Adjusting the IRS' 2017 country-by-country report statistics, tax havens' share of US multinationals' foreign unrelated party revenues is reduced from 27% to 18%. The "corrected" distribution of sales is substantially more in line with proxies for market size than pre-adjustment variables, considering both US multinationals and the extended sample. The following paper and the associated appendix delineate the methodology behind this adjustment, which crucially relies on the Bureau of Economic Analysis (BEA)'s statistics on the activities of US multinational companies. We also illustrate the potential use of the adjusted variables for policy simulations.[8]

Section 2 presents the different strands of the literature upon which this study is built and to which it contributes. Section 3 then describes the data at hand, including country-by-country report statistics and the data sources mobilised in our proposed adjustment. The empirical analysis of Section 4 examines whether and the extent to which multinational companies' unrelated party revenues respond to corporate income taxation. Section 5 develops the proposed adjustment of country-by-country revenue variables and illustrates its potential use for policy simulations. Section 6 concludes.

2 Literature

This study contributes to three main strands of the literature, on which we successively elaborate. First, by investigating whether and how multinational companies' unrelated party revenues respond to corporate income taxation, we contribute to empirical research on corporate tax avoidance. Second, this work adds to the body of works that have mobilised country-by-country report statistics and assessed their reliability. Third, we build upon simulations of proposed reforms of the global corporate income tax system and develop

8. All code files and outputs are available online. The central GitHub repository can be found through this link: https://github.com/pechouc/destination-based-sales.

a new database to foster further work in this direction.

2.1 Empirical literature on corporate tax avoidance

This study first relates to the empirical literature on corporate tax avoidance. While focus is generally set on profit shifting practices, Laffitte and Toubal (2022) have put other indicators under the spotlight again and aimed at quantifying sales shifting. In Section 4, we further explore whether and how multinational companies exploit the organisation of extra-group sales as a corporate income tax planning margin.

In the empirical literature on multinationals' tax planning schemes, researchers generally focus on profit shifting. For instance, many studies have identified how lower tax rates make some jurisdictions particularly attractive for multinational companies and drive the amount of pre-tax profits booked there upwards. Controlling for multinationals' real economic activity, which is especially feasible with firm-level data, benchmark analyses have identified a semi-elasticity of profits with respect to tax rate differentials of about -0.8 to -1 (Dharmapala (2014), Heckemeyer and Overesch (2017), Johansson et al. (2017), Beer, Mooij, and Liu (2020)). In other words, holding everything else constant, a one-percentage-point reduction in the tax rate of a jurisdiction with respect to others is associated with a 0.8% to 1% increase in the pre-tax profits booked by multinationals in this jurisdiction. Several studies have also mobilized firm-level information to identify profit shifting mechanisms or, in another body of work, exploited macroeconomic data to estimate the global scale of profit shifting and the associated tax revenue losses.[9]

Earlier studies had lent attention to the response of other indicators, reflecting in particular multinationals' real economic activity, to corporate income taxation. For instance, Grubert and Mutti (1991) showed that the higher the statutory tax rate of a jurisdiction, the less fixed capital US multinational companies would register there. Grubert and Mutti (2000) and Altshuler, Grubert, and Newlon (2000) further explored this relationship to highlight the influence of countries' trade policy or by refining the estimation with first-difference specifications. Mooij and Ederveen (2003) provided a survey of the empirical literature on the links between corporate income taxation and multinationals' foreign direct investment (FDI): their meta-analysis yielded a median semi-elasticity of FDI to the tax rate of about -3.3. Although Mutti and Ohrn (2019) updated these findings and confirmed the sensitivity of US multinationals' location decisions to taxation, as highlighted above, focus moved from multinationals' real responses onto profit shifting.

The shift operated in the literature from real indicators to pre-tax profits may be explained by the relative magnitude of the effects. Indeed, using a sample ranging from 1996 to 2004, Grubert (2012) shows that the rise in the foreign share of US multinationals' worldwide income is mainly the result of a change in the domestic versus foreign profitability margins, rather than that of a shift in sales. Despite such results, Laffitte and Toubal (2022) have put revenues under the spotlight again by showing that US multinationals organize their global presence around sales platforms in response to taxation and by quantifying the weight of sales shifting practices in total profit shifting. In their main analysis, they explain the foreign sales ratio (i.e. the ratio of sales directed to any other country to total sales) as a function of the statutory corporate income tax rate. Since they include both unrelated party and related party revenues, they account for traditional profit shifting schemes, as well as for some real responses to taxation.

In Section 4, we focus on the sensitivity of multinational companies' unrelated party revenues to taxation. Doing so, we specifically isolate extra-group transactions from related party revenues, that key profit shifting mechanisms aim at manipulating (e.g., debt shifting, transfer mispricing, strategic location of intangible assets, etc.). Potential responses of unrelated party revenues to taxation are thus more likely to reflect real adjustments from multinational companies: the latter would not only react through the accounting distribution of their pre-tax profits, but also through the actual organisation of production, sales and marketing activities or exports.[10]

9. One can refer for instance to Laffitte and Toubal (2022) who compile lists of studies relevant for both of these questions.

10. Note however that recent works have underlined how blurry the distinction between multinational companies' real and "nominal" responses to corporate income taxation can be. In particular, Laffitte and Toubal (2022) document the contract manufacturing practices of Apple, which allow the group to disconnect the physical movement of goods from extra-group financial transactions. The company concentrates European sales in its Irish affiliates (including unrelated party revenues), while this affects in no way the location of productive activities.

2.2 Uses and assessments of country-by-country report statistics

Recently made available, country-by-country report statistics have rapidly appeared as a valuable data source to investigate multinationals' tax planning practices. In this work, we highlight what revenue variables reflect in the data and examine the consequences of this definition for the study of corporate tax avoidance.

The anonymized and aggregated country-by-country report statistics released by the IRS and the OECD (see IRS (2016-2019) and OECD (2016-2017)) have been mobilised to answer several questions. For instance, Garcia-Bernando, Janský, and Tørsløv (2021) estimate the effective tax rates faced globally by US multinational companies from different data sources, including country-by-country report statistics, and examine how they determine the pre-tax profits reported. Garcia-Bernardo and Janský (2022) use these data to estimate the global scale of multinationals' profit shifting practices. Country-by-country data have also been used to assess the revenue potential of global minimum taxes (OECD (2020), Clausing, Saez, and Zucman (2020), Baraké et al. (2021a)) or to evaluate reforms (Garcia-Bernardo, Janský, and Zucman (2022)).[11]

Although researchers have already used these statistics for diverse purposes, important limitations have been identified. First, some profits are double-counted. On the one hand, profits assigned to "stateless entities" (which are particularly large in the case of US multinationals) are often also counted elsewhere (either under US domestic profits, or in a non-US jurisdiction). Most studies using aggregated country-by-country report statistics therefore drop stateless entities entirely. On the other hand, intra-firm dividends may give rise to double-counting: these payments can inflate profits before tax and artificially reduce effective tax rates as they are generally subject to no or light taxation (Horst and Curatolo (2020)).[12] Second, the coverage of the OECD's data remains limited in terms of sample period (only two income years, 2016 and 2017), headquarter countries (28 in 2016 and 38 in 2017) and affiliate countries. Indeed, the degree of detail of the bilateral breakdown can vary significantly from a parent jurisdiction to another (Garcia-Bernando, Janský, and Tørsløv (2021)). Third, as underlined by Baraké et al. (2021b), some observations display excessive profitability margins or large fluctuations in profits between years, which may indicate additional inconsistencies in the data.[13]

However, little attention has been given so far to revenue variables ("unrelated party revenues", "related party revenues" and "total revenues"). When they describe the limitations of the data used to model their METR proposal, Cobham et al. (2022) explain that the turnover matrix compiled by the OECD (2020) presents two main shortcomings: not only does it include intra-group sales which are a key tool for multinational companies to shift their profits to low-tax jurisdictions, but extra-group sales also reflect the location of the payment recipient, instead of customers' location. This turnover matrix is primarily based on country-by-country report statistics. Indeed, in these data, revenue variables reflect the tax residence of the subsidiaries that register transactions in their financial accounts, not the ultimate destination of sales.

We contribute to the literature using country-by-country report statistics by evidencing the related distortions. We also propose a methodology to adjust revenue variables, approximating the ultimate destination of multinational companies' sales.

2.3 Simulations of reforms of the corporate income tax system

Furthermore, in developing a destination-based adjustment of country-by-country revenue variables and in illustrating its use, we contribute to the literature on simulations of global corporate income tax reforms. More specifically, we add to the body of works that estimate the revenue effects of specific proposals, that allocate taxing rights or revenues based on sales.

11. In addition to this literature, several researchers have gained access to firm-level country-by-country reports: Fuest, Hugger, and Neumeier (2022) study the reports of German firms and Bratta, Santomartino, and Acciari (2021) could access this information for all the multinationals in the scope of these reporting rules that have at least one affiliate in Italy. As some multinational companies have voluntarily started to release their reports online, a few studies have also mobilized those. See Baraké et al. (2021a), who use them to test the robustness of their revenue gain estimates, as well as Faccio et al. (2021) for a more comprehensive exploration and assessment of these data.

12. When a multinational from country A owns an affiliate in country B that itself owns an affiliate in country C, dividends paid by C to B are not counted as part of B's revenue, but they are sometimes counted as part of B's profit. This problem has been documented more or less extensively by a few tax administrations focusing on domestic observations. Baraké et al. (2021b) discuss the issue and basic adjustments in more details.

13. Other potential limitations are covered in the related disclaimer maintained by the OECD (see OECD (2021)).

First, the OECD (2020) develops a methodology to evaluate the revenue effects of Pillar One. The proposal, which has been substantially overhauled by the OECD / G20 Inclusive Framework since then, specifically targeted two types of activities at the time: "Automated Digital Services" (ADS) and "Consumer Facing Businesses" (CFB). In-scope multinational companies were identified based on existing industry classifications and on consolidated financial accounts from the ORBIS database (so as to apply the turnover threshold). Still relying on consolidated financial accounts, they estimate global amounts of residual profits for various turnover and profitability thresholds.[14] From there, although the revenue sourcing rules for Pillar One do not necessarily focus on the location of customers (e.g., for online advertising services), the analysis required a destination-based distribution of in-scope multinational companies' sales. For CFB firms, the authors used the Analytical AMNE database of the OECD (see OECD (2016)) and took as a proxy for the destination-based sales into a jurisdiction the turnover booked by relevant multinational companies in this country minus the exports registered there. This proxy does not net out intra-group transactions and does not account for remote sales.[15] For ADS companies, sales are proxied with the number of Internet users in each country while taking into account consumption differentials.

Second, Cobham et al. (2022) develop the "Minimum Effective Tax Rate" (METR). In a way, this proposal can be seen as a combination of the global minimum tax approach and the allocation of taxing rights to market jurisdictions. It consists in identifying multinational companies' non-effectively taxed profits (NETs), aggregating them at the group level and allocating them across jurisdictions based on the distribution of real economic activity indicators. These include sales, which should be based on the location of customers as per Pillar One revenue-sourcing rules, and the simulation of revenue effects thus requires a destination-based mapping of revenues. As a proxy, the authors rely on the "turnover matrix" built in OECD (2020). However, they acknowledge the substantial limitations of this approach as (i) matrices focus on multinational companies's subsidiaries that record positive profits, (ii) they include both affiliated and unaffiliated sales (intra-group transactions being heavily distorted by tax planning practices) and (iii) they reflect the location of recipient entities instead of the final destination of transactions.

Third, Baraké et al. (2021a) simulate the revenue effects of a global minimum corporate income tax and present a "unilateral scenario" in which one country collects a top-up tax on its own multinational companies, as well as on foreign firms. In theory, the taxes collected from foreign firms are determined by destination-based sales. In practice, in the estimation of potential revenue gains, they are allocated based on the distribution of unrelated party revenues in country-by-country report statistics. For instance, if US multinational companies book 5% of their unrelated party revenues in France, France can collect 5% of the top-up taxes due by these US firms on their undertaxed profits. Estimates are thus subject to the type of biases that we have mentioned so far.

Examples from the literature on corporate income tax reform simulations highlight the need for an adjusted mapping of multinational companies' sales, which would reflect the final destination of the transactions (i.e., the location of customers). We propose such an adjustment for country-by-country revenue variables, making the benchmark database and a fully flexible Python package readily available for future research.

3 Data

3.1 Country-by-country report statistics

3.1.1 General remarks

This study first relies on aggregated and anonymized country-by-country report statistics. Released so far for four financial years (from 2016 to 2019) by the IRS and for two financial years (2016 and 2017) by the OECD, these datasets provide information on the domestic and foreign activities of multinational companies, respectively headquartered in the US or in a broader set of headquarter countries. For each tax jurisdiction where they are active, country-by-country data display their aggregated revenues, pre-tax profits, corporate income taxes paid and accrued, among other variables.

14. Several percentage shares of residual profits reallocated to market jurisdictions were also considered in the estimates of revenue effects.

15. Consider the example seen previously of the US multinational company with a foreign affiliate in Ireland, which registers sales to French customers. With such a methodology, sales to remote consumers or users are subtracted from the Irish revenues, which reduces Ireland's share of reallocated taxing rights, but the corresponding sales are not attributed to their final destination.

In particular, the dataset comprises three revenue variables: "unrelated party revenues", which correspond to transactions between subsidiaries of the reporting multinational company and unaffiliated partners; "related party revenues", associated with intra-group transactions; "total revenues" (i.e., the sum of the two other variables). In country-by-country report statistics, the notion of revenues encompasses a wide scope of transactions. The definition provided by the OECD, in charge of supervising their collection globally, is the following: "revenues should include revenues from sales of inventory and properties, services, royalties, interest, premiums and any other amounts". Besides, dividends paid by affiliated corporations are excluded.[16]

Several studies have underlined the limitations of country-by-country report statistics.[17] When focusing on revenues, three shortcomings should be taken into account:

- Stateless entities. Aggregated and anonymized country-by-country report statistics include "stateless" entities, which are especially important for US firms. These correspond to affiliates of multinational companies whose tax jurisdiction could not be properly established for various possible reasons. Importantly, they may lead to double-counting in the revenue variables and therefore, following most of the studies that have resorted to country-by-country report statistics (OECD (2020), Garcia-Bernardo and Janský (2022) or Clausing, Saez, and Zucman (2020)), we exclude stateless entities from our analysis.

- Aggregation levels and taxpayer confidentiality. For a given pair of headquarter and affiliate countries, the number of active multinational companies may be so low that aggregated country-by-country reports would breach taxpayers' confidentiality. Most tax administrations, including the IRS, therefore gather affiliate countries with a too low number of reporting entities, typically at the continental level. This introduces observations such as "Other Europe" or "Other Africa". In the OECD's country-by-country report statistics, the granularity of bilateral breakdowns is very heterogeneous across headquarter countries; we explain how we approach this issue in more details below.

- Voluntary and mandatory reporting. For the financial year 2016, the reporting of country-by-country report statistics by in-scope multinational companies was not yet mandatory. As noticed by the OECD (2020), from the 2016 to the 2017 US country-by-country data, the number of reporting companies increased by roughly 40%. Our benchmark results are presented for the financial year 2017 and they are therefore preserved from this limitation. The latter might however affect our results for the financial year 2016 in Appendix B.6.

3.1.2 The IRS' country-by-country report statistics

Country-by-country reporting has been mandatory for US multinational companies with a consolidated turnover of more than 850 million USD since 2017. Based on the firm-level reports of in-scope multinationals, the IRS produces and releases aggregated and anonymized data (see IRS (2016-2019)). For the financial year 2017, the US country-by-country report statistics relied on the reporting of 1,575 multinational companies, with 180,370 entities globally. Excluding "Stateless entities", which account for 3.8% of US multinational enterprises' total revenues worldwide, as well as intermediary totals, the preprocessed dataset provides information for 145 unique affiliate countries. This includes the US themselves, the revenues registered domestically by US multinational companies representing 67% of the global total. Among affiliate *countries*, there are 4 continental aggregates ("Other Africa", "Other Europe", "Other Americas" and "Other Asia and Oceania") that together account for less than 0.1% of the total revenues booked abroad.

3.1.3 The OECD's bilateral country-by-country report statistics

We then consider the OECD's aggregated and anonymized country-by-country report statistics, which cover 38 headquarter countries for the 2017 income year (see OECD (2016-2017)). We however restrict our attention to a subset of headquarter countries. We first exclude the 4 headquarter countries that only report a split of the country-by-country variables between domestic and foreign activities (all activities abroad

16. Importantly, due to the exclusion of intra-group dividends, revenues should be free from the double-counting identified for profit before tax in the literature (see Horst and Curatolo (2020) or Baraké et al. (2021b) on dividend double-counting).

17. The OECD's dedicated disclaimer also covers various issues associated with these data (see OECD (2021)).

being aggregated into a "Foreign jurisdictions total"). Our empirical analysis could then be applied to the remaining 34 headquarter countries but it would be more or less relevant depending on the detail of the bilateral breakdown reported by each parent. Typically, some reporters only provide a continental breakdown. Therefore, we focus on the 15 headquarter countries that report at least 60 unique affiliate countries in their country-by-country reports. Table 1 presents the list of these headquarter countries, as well as their respective number of affiliate countries.

Table 1: Headquarter countries with sufficient affiliate country breakdowns

Headquarter country	Number of affiliate countries
Japan	198
India	163
Germany	159
United States	145
South Africa	138
China	124
Switzerland	120
Spain	119
Denmark	114
Italy	109
Bermuda	99
Mexico	96
Luxembourg	90
France	89
Australia	80

Note: This table shows the 15 headquarter countries retained in our empirical analysis and for the extension of the destination-based adjustment beyond US multinational companies. The table also shows the number of unique affiliate countries in their respective aggregated country-by-country reports, stateless entities being excluded. Data come from the OECD's country-by-country report statistics.

For the financial year 2017, the country-by-country report statistics restricted to these 15 headquarter countries relied on the reporting of over 4,000 multinational companies, with roughly 525,000 entities globally. Excluding "Stateless entities", which account for 1.5% of total revenues worldwide, as well as intermediary totals, the dataset provides information for 221 unique affiliate countries. This includes the headquarter countries themselves, the revenues registered domestically representing 62% of the global total. Among the unique affiliate *countries*, there are also 4 continental aggregates ("Other Africa", "Other Europe", "Other Americas" and "Other Asia and Oceania") that account for 0.6% of the total revenues booked abroad.

3.2 Other data sources

3.2.1 Empirical investigation

First, we investigate whether multinational companies' unrelated party revenues respond to corporate income taxation. The main tax variable that we consider is the statutory corporate income tax rate. Statutory tax rates are sourced in the OECD's Corporate Tax Statistics (OECD (2016-2019c)), complemented with the Tax Foundation's dataset (Bray (2021)). Effective tax rates (average and marginal) are also used as regressors in alternative specifications. They are taken from the OECD's Corporate Tax Statistics (OECD (2016-2019b)) and from the CBT Tax Database (Oxford University Centre for Business Taxation (2017)). Effective tax rate series are extended based on statutory rates, using a methodology similar to that of Bratta, Santomartino, and Acciari (2021).

Second, our three main control variables are the size of the affiliate country's economy, its foreign market access and the distance from the headquarter country to the affiliate country. The latter accounts for the cost of setting up a local affiliate. Gross Domestic Product (GDP) data come from the World Economic Outlook database (IMF (2022)). Foreign market access is estimated as per Laffitte and Toubal (2022)'s and

Head and Mayer (2013)'s methodology, based on the bilateral trade series of the BACI database (Gaulier and Zignago (2010)) and on gravity variables from the gravity database of the CEPII (Head and Mayer (2013)). Distance measures are taken from the gravity database of the CEPII. In Appendix A.1, we replace the foreign market access variable by the logarithm of each affiliate country's "Logistics Performance Index" (or LPI), as defined by the World Bank (2018). More precisely, we focus on the international LPI, aggregated over 2012-2018 editions. Available for 167 jurisdictions, this index evaluates countries on six dimensions of trade. We consider the overall score, which encompasses all the different criteria.

Third, we add a variety of secondary control variables. Most of them (contiguity, common language dummies, colonial relationships and regional trade agreements) directly come from the CEPII gravity database. Affiliate countries' remoteness is measured following the suggestion of Head (2003), also based on the CEPII gravity database. For affiliate countries's tax environment, we identify tax havens based on two alternative lists: the one gathered by Hines and Rice (1994) and the one compiled by Tørsløv, Wier, and Zucman (2018). Data on tax treaties were scraped on the website of the Exchange of Information database (OECD (n.a.)). Consumption tax rates (including value-added taxes, sales taxes, etc.) are taken from the "Tax Summaries" of PwC (see PwC (2022)). In Appendix A.1, we also control for affiliate countries' mean wage in logarithmic form. These are sourced from the statistics of the International Labour Organization (ILO) on wages, more precisely from series on the "Average monthly earnings of employees by sex and economic activity" (see ILO (n.a.)).[18]

Eventually, for descriptive statistics, Gross National Income (GNI) series are sourced from the World Bank's and the OECD's National Accounts Statistics (World Bank and OECD (2016-2019)), while data on consumption expenditures are provided by the United Nations Conference on Trade and Development (UNCTAD, see UNCTAD (2016-2019)).

3.2.2 Proposed destination-based adjustment

First, we leverage data provided by the Bureau of Economic Analysis (BEA) on the worldwide activities of US multinational companies (see BEA (2016-2019a)). These statistics compiled since 1977 give an annual overview of the finances (balance sheet details, aggregated income statements...) and operations (destination of goods and services supplied, employee compensation, capital expenditures...) of US multinational companies and their foreign affiliates.

In particular, we focus on the BEA's revised statistics from 2016 to 2018 and preliminary statistics for 2019 related to the majority-owned affiliates of US multinationals.[19] Tables II.E1 to II.E17 provide detailed information on the "goods and services supplied" by US multinationals. These can be assimilated to sales but their scope is narrower than that of revenue variables in country-by-country data. The precise definitions of goods and services supplied can be found in Appendix B.1.1. For 75 affiliate country (of which 18 regional aggregates) where they operate, Table II.E2 allows to split the sales registered by the majority-owned affiliates of US multinational companies based on their ultimate destinations. Total goods and services supplied are first provided in millions of current USD. They are then split between sales to the US and sales to non-US countries. The latter amount is again distributed between sales to the host country (where the affiliate is active) and sales to any other country. Eventually, all aggregates are split between sales to affiliated companies and sales to unrelated parties. The schema in Appendix B.1.2 illustrates this sequence of disaggregations.

These data allow to shed light on the issue mentioned above for country-by-country report statistics. The total goods and services registered by the majority-owned affiliates of US multinational enterprises in a given jurisdiction are not all directed to the host country. On average in 2017, 59% of the goods and services supplied are attributed to the host country, with respectively 12% and 29% of sales directed to the US and to any other country. The ratio of goods and services supplied to the host country to total goods and services supplied strongly varies from an affiliate country to another: the minimum is of 6% for Barbados and the maximum is of 96% for Venezuela. These differences highlight the use by US multinational companies of

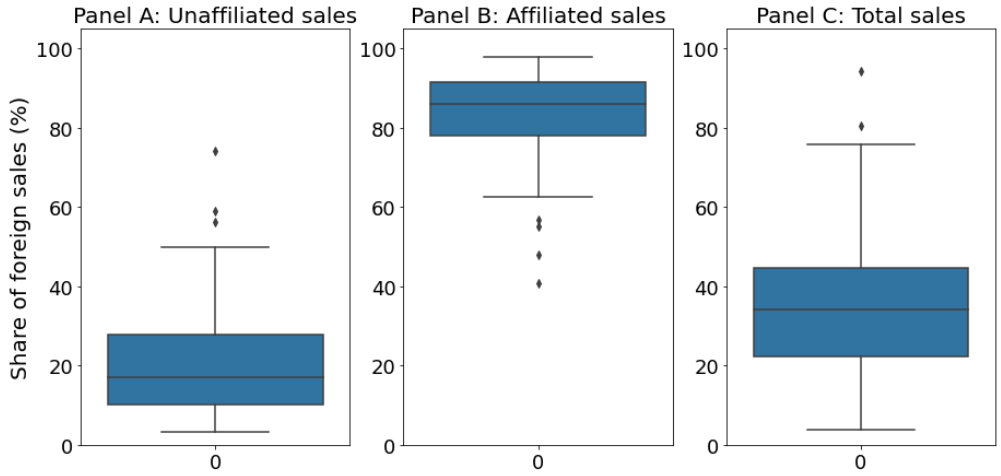
18. The preparation of these data is very simple for now and should likely be refined. We consider average earnings over the whole set of economic activities in current USD. Missing values are imputed with the average over time observed in the database for the corresponding country.

19. Most of the descriptive statistics of the following paragraphs are presented for the 2017 income year to align them with the latest income year available in the OECD's country-by-country report statistics.

certain countries as platforms, where only a limited share of sales is actually directed to the local market.[20] The right panel of Figure 2 shows the distribution of the shares of foreign sales observed over the set of affiliate countries, which can be as low as 4% (Venezuela) or as high as 94% (Barbados).

For most affiliate countries, the BEA's data also allow to distinguish sales to affiliated and to unaffiliated entities. On average, related party sales account for 30% of the total revenues. Here too, the global average hides substantial heterogeneity: 57% of the sales registered in Barbados are associated with intra-group transactions, while it is the case for only 7% of the sales recorded in Chile. The left and center panels of Figure 2 shows the distribution of the foreign sales ratio across affiliate countries, while focusing on unaffiliated sales and on affiliated sales respectively. Quite strikingly, extra-group transactions are much more concentrated in the local jurisdiction (median foreign sales ratio of less than 20%) than intra-group transactions (median foreign sales ratio above 85%).

Figure 2: Distribution of the share of foreign sales by US multinational companies, per type of transactions



Note: This figure is based on the BEA's data on the worldwide activities of US multinational companies (see BEA (2016-2019a)). It shows the distribution of the share of foreign sales observed across affiliate countries recorded in these statistics. The share of foreign sales is defined, for each affiliate country, as the ratio of the sum of sales directed to the US and sales directed to any third country to total sales. The left and center panels distinguish sales to affiliated and to unaffiliated parties. We focus on the 2017 income year.

Furthermore, our proposed adjustment relies on bilateral trade statistics. More precisely, we combine the UN Comtrade database for merchandise flows (see United Nations (2016-2019)) and the Balanced Trade in Services (BaTIS) dataset for service flows (see OECD-WTO (2016-2019) and Liberatore and Wettstein (2021)). The latter analytical statistics were designed so as to correct for recurrent asymmetries in international trade data. Important considerations regarding the choice of trade statistics are detailed in Appendix B.2. More details are also provided about how we prepare and combine the two datasets.

On the one hand, the UN Comtrade database constitutes the reference statistical source for customs-based merchandise trade flows (see United Nations (2016-2019)). These data follow the United Nations (2011) standard and reflect the physical cross-border movement of goods. We download the relevant data from the UN Comtrade online portal.[21] For the year 2017, focusing on imports, the resulting dataset involves 234 unique partners and 169 unique reporters while, on average, each reporter is associated with 167 partners.

On the other hand, BaTIS data cover 206 reporting countries, from 2005 to 2019. For each pair of reporting and affiliate countries, several information are available. First, one can choose between the exports from the reporting country to the partner country and imports by the former from the latter. Second, several values are proposed: the reported amount, additional estimates and a "final balanced value" that aims at

20. Laffitte and Toubal (2022) define the "foreign sales ratio" as the ratio of the foreign sales (to the US or to any other country) to the total sales registered in a given jurisdiction: this variable then constitutes the key objective of their empirical analysis.

21. The process followed to collect these data is described in details in this online repository: https://github.com/pechouc/comtrade_data_selection.

correcting for bilateral asymmetries. Last, these data are available for a wide range of service categories. All amounts are presented in current USD. For the year 2017, considering exports, final balanced values and commercial services, the dataset covers 201 unique partner countries. On average, each reporting country is associated with 200 destinations.[22]

Eventually, we mobilise a series of auxiliary data sources:

- As an alternative to the UN Comtrade database on merchandise flows, the code for the adjustment allows to use the OECD's Balanced International Merchandise Trade Statistics (BIMTS, see OECD (2016-2019a) and Fortanier and Sarrazin (2016)). BIMTS cover over 160 reporting countries. For each of these, the dataset provides its "Balanced Trade Value", i.e. its exports corrected for bilateral asymmetries, to a variety of partner countries in current USD. Data are available for 12 years, from 2007 to 2018, and a wide variety of commodity categories. In 2017, focusing only on the total of all commodities, the dataset covers 162 unique partners and on average, each reporting country is associated with 135 destinations;

- As an alternative to the UN Comtrade and BaTIS databases specific to the US, the code for the adjustment also allows to use the US International Transactions Accounts (ITAs) maintained by the BEA. In particular, the current account in these quarterly statistics theoretically records the exports of goods and services from US residents to non-residents based on changes in ownership. On the data portal of the BEA, we focus on Table 1.5 "U.S. International Trade in Goods and Services by Area and Country" (see BEA (2016-2019b)). From 1999 to 2020, it provides several indicators that break down by sector and nature of transactions the US exports and imports of goods and services to and from 90 partners. The latter include 18 continental aggregates or regional organizations and 72 countries (UK Caribbean Islands being aggregated as a single partner country). Appendix B.2.2 provides a more detailed discussion of the strengths and weaknesses of these data for the purpose of our computations;

- In the extension of our adjustment to non-US multinational companies, we mobilize the OECD's Analytical AMNE database, compiled by Cadestin et al. (2018). In particular, we focus on the information that these statistics provide on the activities of domestically-owned companies.[23] These data cover a sample of 60 countries from 2005 to 2016 and include estimations of the gross output, gross value-added, exports and imports of domestically-owned firms. Importantly, they allow to distinguish the domestic branches of multinational companies and purely local firms. In the absence of more recent data, we concentrate on 2016 figures and assume that they remain valid for the following years.

4 Do unrelated party revenues respond to corporate taxation?

4.1 Descriptive statistics

4.1.1 US country-by-country report statistics

We start by exploring the basic geographical distribution of US multinational companies' sales based on the country-by-country report statistics of the IRS. Among the variables provided, we mainly focus on "unrelated party revenues", which cover sales and transactions operated with unaffiliated entities.

From 2016 to 2019, the continental breakdown of US multinational companies' unrelated party revenues is rather stable. Foreign subsidiaries account for around 27% of the total and the bulk of foreign unrelated party revenues is registered in Europe (roughly 46%), while Asia-Pacific countries (between 32% and 34%) form the second largest continental partner. The continental distribution of unrelated party revenues however hides

22. In the work of Liberatore and Wettstein (2021), the most extreme differences between reported trade values and final balanced values are observed for Bermuda. The balanced exports of services of Bermuda are 41 times larger than its reported exports, meaning that other countries register much larger imports of services from Bermuda than Bermuda does in its exports. Similarly, the balanced imports of services of Bermuda are 18 times larger than its reported imports, meaning that other countries register much larger exports of services to Bermuda that Bermuda does in its imports. To some extent, the same appears for the Cayman Islands and Barbados. For these countries, we therefore rely on the values reported by their partners: for their exports, we take partner countries' reported imports from Bermuda, the Cayman Islands and Barbados and their imports correspond to partner countries' reported exports.

23. See OECD (2016) and, more specifically, the file "analytical_amne_domesticMNEs.xlsx" that can be downloaded from the OECD's website.

noticeable country-level specificities. Table 2 shows the 20 largest affiliate countries for US multinational companies based on the IRS' 2017 country-by-country report statistics, ranked according to unrelated party revenues.

Table 2: Top twenty largest affiliate countries

Affiliate country	UPR (USD billion)	Share of foreign UPR (%)
United Kingdom	486.7	12.2
Canada	372.9	9.4
Ireland	245.0	6.1
China	239.5	6.0
Germany	217.5	5.5
Japan	209.1	5.2
Singapore	207.3	5.2
Switzerland	180.6	4.5
Brazil	147.1	3.7
France	146.5	3.7
Mexico	129.5	3.3
Australia	122.9	3.1
Netherlands	121.5	3.0
Hong Kong	112.6	2.8
Italy	84.4	2.1
Belgium	64.4	1.6
India	58.1	1.5
Spain	56.5	1.4
Korea	54.7	1.4
Russia	43.8	1.1

Note: This table presents the 20 most important affiliate countries for US multinational companies. This ranking is based on the unrelated party revenues booked by US multinational enterprises in each of these jurisdictions. Revenues are presented in absolute amounts (expressed in 2017 billion USD) and as a share of US multinational companies' total foreign unrelated party revenues (expressed in percentage). All figures are based on the IRS' 2017 country-by-country report statistics. "UPR" stands for unrelated party revenues.

Two long-term commercial partners of the US, the United Kingdom and Canada, come respectively first and second. Major industrialized economies (e.g. Germany, Japan, France), the largest emerging countries (China, Brazil, India) or members of the North American Free Trade Agreement (NAFTA; Canada mentioned above and Mexico) appear among this top twenty. But the position of smaller economies, such as Ireland, Singapore or Switzerland that respectively rank third, seventh and eighth, may be more surprising.

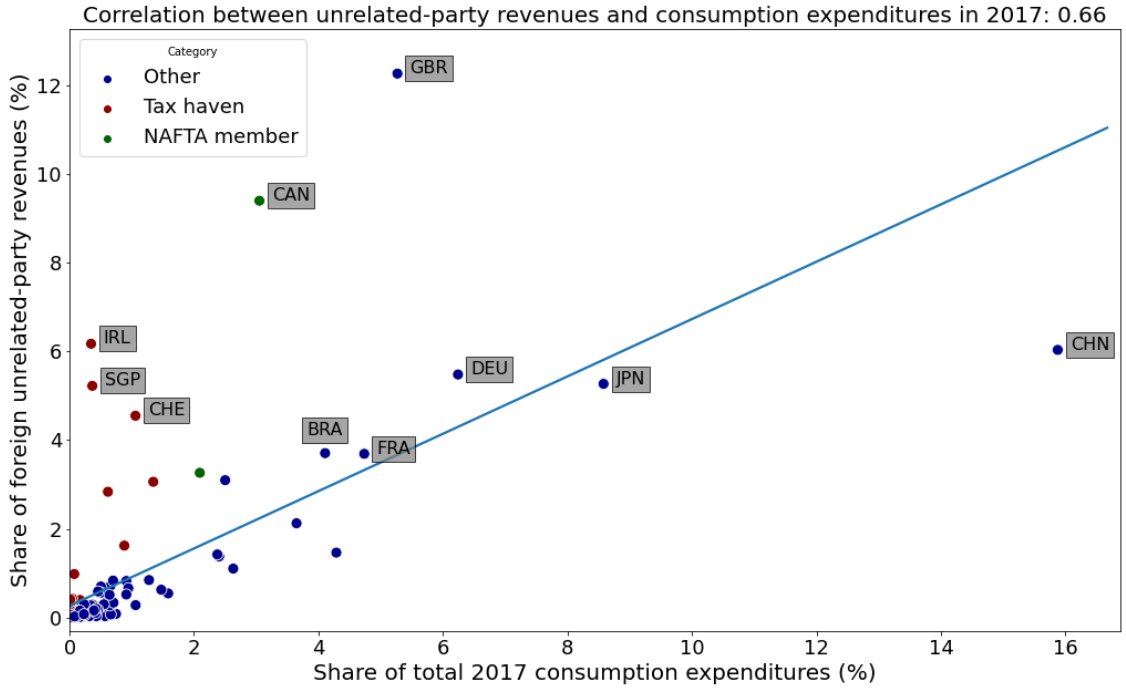
To further investigate this puzzle, we add a notion of local market size or aggregate demand. Figure 3 relates each country's share of US multinationals' foreign unrelated party revenues with its share of the final consumption expenditures observed in the sample. This variable serves as a proxy for the final destination of sales in the draft nexus and revenue sourcing rules released by the OECD for Pillar One Amount A in February 2022.[24] Countries' position on the x-axis is determined by their share of final consumption expenditures, while their position on the y-axis is given by their share of foreign unrelated party revenues. Without any attempt at the estimation of a rigorous model, the regression line underlines the expected relationship between both variables. With a correlation of 0.66, a high share of global final consumption expenditures is generally associated with a high share of US multinational companies' unrelated party revenues.

A number of countries, the dots located well above the regression line, display a share of unrelated party revenues that is disproportionately large relative to their share of final consumption expenditures. Highlighted by the color of these dots, two main groups appear: close commercial partners of the US (with NAFTA members in green and the UK at the very top of the graph) and tax havens, based on the

24. We exclude 10 countries for which we have no data on 2017 final consumption expenditures. These affiliate countries account for 0.4% of US multinational companies' total unrelated party revenues, such that their exclusion affects the computation of "Shares of foreign unrelated party revenues (%)" in the y axis only marginally.

classification of Tørsløv, Wier, and Zucman (2018).

Figure 3: Relationship between affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures



Note: This figure presents the relationship between affiliate countries' share of US multinational companies' foreign unrelated party revenues and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other affiliate countries. The trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics, final consumption expenditures from the UNCTAD data portal.

On the one hand, the three jurisdictions mentioned above (Ireland, Singapore and Switzerland) appear well above the regression line, as well as Hong-Kong and the Netherlands. These five countries are listed as tax havens in Tørsløv, Wier, and Zucman (2018). While Ireland and Singapore respectively account for 6.2% and 5.2% of the worldwide unaffiliated sales of US multinational companies based on country-by-country report statistics, both countries only represent 0.3-0.4% of the final consumption expenditures observed in the sample. Similarly, Switzerland represents 4.5% of total revenues and 1.1% of the final consumption expenditures. Importantly, such a discrepancy is not observed for all tax havens: the ones that stand out are the among the largest economies of the list and are geographically close to US multinational enterprises' key markets. On the other hand, apart from specific commercial partners (e.g. the United Kingdom, Canada, Mexico or Australia), the main industrialized countries (e.g. Germany, Japan, France or Italy) display a higher share of consumption expenditures than of unrelated party revenues. So do most emerging economies like China, with 15.9% of total consumption expenditures for only 6.0% of unaffiliated sales, or India.

As explained previously, in country-by-country report statistics, the three revenue variables are based on the tax jurisdiction of the affiliate that registers the transactions in its income statement. They do not necessarily reflect the ultimate destination of the goods or the country of residence of the ultimate service beneficiary. Therefore, we can potentially interpret the disconnection between the distribution of unrelated party revenues and local market size as revealing the use by US multinational companies of some affiliate countries as platforms, from which substantial sales are operated remotely. Since this disconnection is particularly strong for low-tax jurisdictions, descriptive statistics suggest that the organisation of extra-group transactions around sales platforms provide firms with a tax planning opportunity. Indeed, the 41 tax

havens listed in Tørsløv, Wier, and Zucman (2018) and the UK Caribbean Islands account for 27% of all unrelated party revenues registered abroad by US multinationals and for less than 6% of final consumption expenditures.

4.1.2 Including other headquarter countries

Considering now the OECD's country-by-country report statistics, restricted to the 15 headquarter countries that provide a sufficiently granular breakdown (see Table 1), we investigate whether some affiliate countries still display a disproportionate concentration of extra-group sales relatively to the size of their domestic market. Table 3 shows the 20 largest affiliate countries based on unrelated party revenues.

Table 3: Top twenty largest affiliate countries, including non-US multinationals

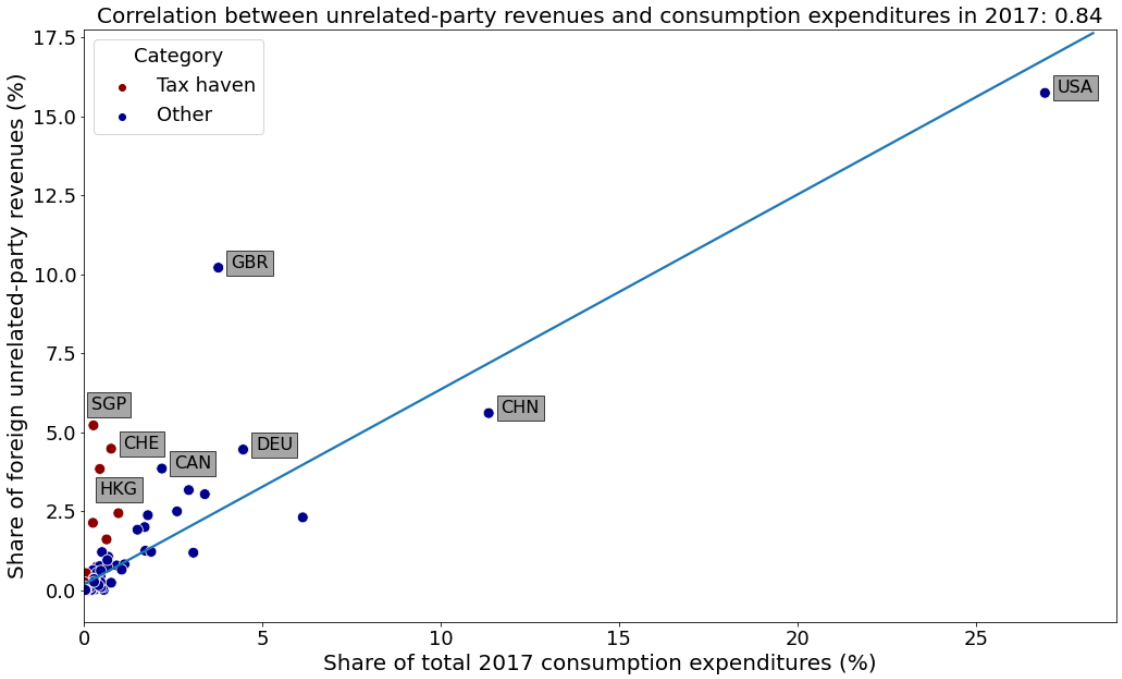
Affiliate country	UPR (USD billion)	Share of foreign UPR (%)
United States	2,142.1	15.6
United Kingdom	1,389.5	10.1
China	763.1	5.6
Singapore	710.3	5.2
Switzerland	609.9	4.4
Germany	606.2	4.4
Canada	524.3	3.8
Hong Kong	522.5	3.8
Brazil	431.6	3.1
France	413.8	3.0
Italy	339.8	2.5
Netherlands	332.0	2.4
Australia	323.4	2.4
Japan	314.0	2.3
Ireland	290.4	2.1
Spain	272.1	2.0
Mexico	261.0	1.9
Belgium	219.1	1.6
Korea	170.3	1.2
Russia	165.9	1.2

Note: This table presents the 20 most important affiliate countries for US and non-US multinational companies. This ranking is based on the unrelated party revenues booked by foreign multinational enterprises in each of these jurisdictions. Revenues are presented in absolute amounts (expressed in 2017 billion USD) and as a share of multinational companies' total foreign unrelated party revenues (expressed in percentage). All figures are based on the OECD's 2017 country-by-country report statistics. "UPR" stands for unrelated party revenues.

The phenomenon is somewhat mitigated, but we can draw similar observations as from Table 2. While Ireland drops in the ranking compared with Table 2 (from 3$^{\text{rd}}$ with 6% of foreign unrelated party revenues to 15$^{\text{th}}$ with 2%), a few small, low-tax jursidictions still concentrate large shares of foreign unrelated party revenues. The importance of Singapore, Switzerland and Hong Kong (with the Netherlands and Belgium to a lesser extent) in the distribution of extra-group sales seems disproportionate with respect to the size of their respective markets. Typically, with 5.2% of foreign unrelated party revenues, Singapore comes close to China, the second largest economy in the sample, which is attributed 5.6% of extra-group transactions. Switzerland and Hong Kong both rank higher than large industrialised or emerging economies such as Brazil, France or Japan.

Figure 4 illustrates the relationship between the distribution of foreign unrelated party revenues and final consumption expenditures for all affiliate countries in the sample.

Figure 4: Relationship between all affiliate countries' shares of foreign unrelated party revenues and final consumption expenditures, including non-US multinationals



Note: This figure presents the relationship between affiliate countries' share of multinational companies' foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Here too, the line of best fit underlines the expected positive correlation between affiliate countries' share of foreign unrelated party revenues and their share of the final consumption expenditures observed in the sample. We retrieve patterns comparable to Figure 3 with a few countries standing above the regression line and showing therefore a disproportionate concentration of multinationals' extra-group sales relatively to the size of their domestic market. Many of these, indicated by the red dots on the left end of the graph, are listed as tax havens by Tørsløv, Wier, and Zucman (2018). This may indicate that the use of low-tax jurisdictions as sales platforms is not specific to US multinational companies, such tax planning practices being employed by the firms headquartered in the 15 countries retained.[25] However, the higher correlation between extra-group sales and the macroeconomic indicator (0.84 vs. 0.66 when focusing on US multinationals) may point to a lower intensity of non-US firms' tax planning practices.

Three limitations associated with these computations should however be underlined. First, the coverage of headquarter countries is limited and rather biased towards Europe: out of 15 headquarter countries retained, 7 are Western European economies whereas there are only 3 Asian countries. Aggregating the revenues that their multinationals record may thus yield a distorted view of the global importance of each affiliate country. Beyond continental representativeness, for instance, Canada strongly benefits from the inclusion of the two other NAFTA members (the US and Mexico) in the restricted sample. Second, all the headquarter countries retained do not provide the same granularity in their bilateral breakdowns. Although it is less likely when focusing on the 20 largest affiliate countries as in Table 3, some countries can sometimes be "hidden" in aggregate partners which are not considered here. Third, the correlations presented in Figures 3 and 4 may not be directly comparable due to the presence of the US among the affiliate countries in the latter. Indeed, with 16% of foreign unrelated party revenues and 27% of the final consumption expenditures observed in the sample, the US is given a large weight when computing the correlation of the two series: with China,

25. As detailed in Section B.5.4, these observations are robust to the exclusion of the US from the set of headquarter countries.

it heavily drives down the slope of the line of best fit and as these two large affiliate countries are located close to the regression curve, correlation is mechanically inflated. Excluding the US from the set of affiliate countries, we find a correlation of 0.69 between affiliate countries' shares of foreign unrelated party revenues and final consumption expenditures. For these three reasons, the results presented in this section should be considered as indicative.

4.2 Econometric modelling

4.2.1 Methodology

In the following, we wish to test more rigorously whether the distribution of multinationals' unrelated party revenues depends on corporate income taxation. We derive our econometric model from an adaptation of the Melitz (2003)-Chaney (2005) model in which (i) firms' profits are subject to a linear corporate income tax rate and (ii) preferences are quasi-linear between the differentiated good and the numeraire. Solving for the general equilibrium of the model yields the following gravity equation for the aggregate extra-group sales between i and j (see Chouc (2022)):[26]

$$X_{i,j} = \lambda \frac{L_i L_j}{L} f_{i,j}^{-(\frac{\gamma}{\sigma-1}-1)} \theta_j^{\gamma}$$

Where $X_{i,j}$ corresponds to aggregate extra-group sales between headquarter country i and destination country j, λ is a constant determined by the parameters of the model, L_i and L_j corresponds to the population of both countries, $f_{i,j}$ denotes the fixed cost for setting up a foreign affiliate in j if the multinational is headquartered in i and θ_j is a multilateral resistance term which indicates j's remoteness from the rest of the world. One may notice that the linear corporate income tax rate is absent from this gravity equation, which is the result of two counter-vailing effects that perfectly offset each other.[27] This can be seen as the null hypothesis for the rest of the analysis. In logarithmic form, this expression gives:

$$ln(X_{i,j}) = ln(\lambda) - ln(L) + ln(L_i) + ln(L_j) - (\frac{\gamma}{\sigma-1} - 1) ln(f_{i,j}) + \gamma ln(\theta_j)$$

Our benchmark specification derives from this logarithmic expression of the initial gravity equation. Importantly, the model considered precludes by assumption the use of export platforms or so-called "multinational production" (see Footnote 26). Such practices by multinational companies have been widely documented in the trade literature or more recently by Laffitte and Toubal (2022) in relation with corporate income taxation. We follow the same methodology as the latter to integrate into our specification a proxy for affiliate countries' foreign market access (i.e., the degree to which they may provide multinational companies with a facilitated access to neghbouring markets), in logarithmic form. Also accounting for taxation, this gives the following specification:

$$\begin{aligned} ln(X_{i,j,t}) = {} & \beta_0 + \beta_1 Tax_{j,t} + \beta_2 ln(GDP_{i,t}) + \beta_3 ln(GDP_{j,t}) \\ & + \beta_4 ln(FMA_{j,t}) + \beta_5 ln(Dist_{i,j}) + G_{i,j,t}\gamma + FE_{i,t} + \varepsilon_{i,j,t} \end{aligned}$$

26. For more details, one can refer to the third chapter of Chouc (2022). Importantly, this framework consists in a reinterpretation of the standard model: instead of exporting from their headquarter country, firms enter foreign markets by setting up a local affiliate (which involves a fixed cost determined bilaterally, similar to the fixed export cost in the benchmark model) and by producing locally. Sales, profits and corporate income taxes are then recorded or paid in the foreign jurisdiction. Like in Chaney (2005), firms draw their productivity from a Pareto distribution and once drawn, the value of this random variable is assumed to be the same across all production sites. This model excludes by assumption export platforms or multinational production. This notably differs from Arkolakis et al. (2018), who extend the conventional Melitz (2003)-Chaney (2005) with multinational production and achieve tractability by dropping fixed costs for setting up foreign affiliates. For an integration of corporate income taxation in the latter framework, see Wang (2020).

27. This result is derived and described more extensively in Chouc (2022). On the one hand, corporate income taxes weigh negatively on the after-tax profits that multinational companies compare with the fixed entry cost: this generates a negative extensive margin effect and as less firms enter the foreign market, bilateral sales are reduced. On the other hand, once a firm enters a foreign market, the higher the local corporate income tax rate is, the lower the number of competitors that sell other varieties of the differentiated good in that market and the higher the market share that the entrant can capture: this intensive margin effect, which involves that firm-level bilateral sales increase in the affiliate country's tax rate conditional on entry, perfectly offsets the extensive margin effect. This mainly illustrative result likely depends on the quasi-linearity of preferences and on the assumption that corporate income tax revenues are exclusively spent on the non-differentiated numeraire good.

$X_{i,j,t}$ is the dependent variable, that enters the model in logarithmic form. In most cases, it corresponds to the unrelated party revenues (UPR) observed in country-by-country report statistics. We also consider alternative targets: the number of multinationals active in the affiliate country (# MNEs), related party revenues (RPR) or profits before tax (PBT). For all of these variables, i designates the headquarter country of the multinational groups, j stands for the affiliate country where the affiliates have their tax residence, and t is the year index.

First, we test whether corporate income tax variables, that depend on affiliate country j and year t, can affect the dependent variable. In most estimations, β_1 is the key parameter of interest. Note that $Tax_{j,t}$ can designate various measures of the affiliate country's tax rate on corporate income. The statutory rate, the Effective Average Tax Rate (EATR) and the Effective Marginal Tax Rate (EMTR) are obtained from various databases and effective tax rate series are extended to the whole set of affiliate countries with the same methodology as in Bratta, Santomartino, and Acciari (2021).[28] As a way to account for the timing of multinational companies' location and organisation decisions, we consider the lagged statutory tax rate as an additional independent variable. Eventually, for each affiliate country and year, we also compute effective tax rates directly from the positive-profit sub-sample of country-by-country report statistics. We take the ratio of income taxes paid ("CbCR ETR (cash)") or income taxes accrued ("CbCR ETR (accrued)") to profits before tax. To limit endogeneity issues, we add them to the set of regressors with a one-year lag.

The dependent variable is then assumed to depend on the Gross Domestic Product (GDP) of the headquarter country and that of the affiliate country, which correspond to country sizes in the initial gravity equation. We add the Foreign Market Access (FMA) of the affiliate country. These two variables are indexed with respect to affiliate country j and year t. As we expect large and well-connected countries to be more attractive for multinational firms, we expect positive estimates for the corresponding coefficients β_2, β_3 and β_4. The dependent variable is also assumed to depend on the distance (Distance) between headquarter and affiliate countries, that may be seen as a proxy for the fixed cost of establishing a foreign affiliate. The higher the distance between both countries, the higher this cost is expected to be and the lower aggregate revenues or profits would be: we therefore expect β_5 to be negative.

We add several gravity variables as controls. These include the logarithm of the simple remoteness measure proposed by Head (2003), which stands for $ln(\theta_j)$.[29] Bilateral controls also complement distance as a proxy for the fixed market entry cost ($f_{i,j}$ in the initial equation) and variables specific to the affiliate country are associated with its degree of remoteness θ_j. In that regard, $G_{i,j,t}$ covers: a variable equal to 1 if and only if the observation is domestic, that is if and only if i and j are the same; an indicator variable for contiguity between i and j; common language dummies; a binary variable indicating the existence of a colonial relationship between i and j after 1945; a dummy for country j's EU membership; an indicator variable for the existence of a regional trade agreement including i and j.

Eventually, $FE_{i,k,t}$ stands for a set of standalone or interacted headquarter country and time fixed effects introduced or not depending on the sample considered.

4.2.2 Results

We mainly mobilize the IRS' aggregated tabulations of country-by-country reports, available for four income years from 2016 to 2019, and therefore focus on large US multinational companies. We are looking for the determinants of unrelated party revenues and in particular, for the effect of the corporate tax rate on their distribution. Benchmark results are presented in Table 4.

28. Data sources: OECD (2016-2019c) and Bray (2021) for statutory tax rates; OECD (2016-2019b) and Oxford University Centre for Business Taxation (2017) for effective tax rates.

29. An alternative treatment of the multilateral resistance term θ_j would consist in adding affiliate country fixed effects to the specification. Most of our results abstract from those, but Table 12 in Appendix A.1 presents results with the IRS' country-by-country report statistics treated like panel data (within estimator with country and year fixed effects).

Table 4: Influence of various corporate income tax rate measures on unrelated party revenues

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)	(5) ln(UPR)	(6) ln(UPR)
Statutory tax rate	-0.0185**					
	(0.011)					
EATR		-0.0141*				
		(0.057)				
EMTR			-0.00871**			
			(0.047)			
Lagged statutory tax rate				-0.0156**		
				(0.033)		
Lagged CbCR ETR (cash)					-0.0188***	
					(0.002)	
Lagged CbCR ETR (accrued)						-0.0148**
						(0.032)
ln(GDP) - WOE	1.196***	1.190***	1.170***	1.191***	1.226***	1.208***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	0.292***	0.294***	0.288***	0.291***	0.237	0.240
	(0.004)	(0.003)	(0.004)	(0.004)	(0.107)	(0.107)
ln(Distance)	-0.489***	-0.466***	-0.429***	-0.483***	-0.137	-0.172
	(0.002)	(0.003)	(0.006)	(0.002)	(0.501)	(0.383)
Constant	-6.409	-7.064	-8.646*	-6.866	-12.74*	-13.07*
	(0.221)	(0.178)	(0.090)	(0.188)	(0.058)	(0.055)
Gravity control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	508	508	508	508	256	256
R-squared	0.837	0.837	0.836	0.837	0.846	0.845
Adj. R-squared	0.832	0.832	0.831	0.832	0.837	0.836

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents the results of the benchmark specification, using the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues, "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook, "EATR" for the Effective Average Tax Rate and "EMTR" for the Effective Marginal Tax Rate. Effective tax rates are also computed based on the positive-profit sub-sample of the IRS' country-by-country report statistics for each affiliate country and year ("Lagged CbCR ETR (cash)" and "Lagged CbCR ETR (accrued)", respectively using income taxes paid on a cash basis and income taxes accrued). They are included with a one-year lag in the set of regressors to limit endogeneity issues.

In Column 1, while controlling for GDP, foreign market access, distance, the full set of gravity variables and year fixed effects, we find a statistically significant relationship between the statutory tax rate and unrelated party revenues. The coefficient associated with the statutory corporate income tax rate is negative: the higher the statutory tax rate of the affiliate country, the lower the unrelated party revenues booked there by US multinationals. More precisely, we find a semi-elasticity of unrelated party revenues to the statutory tax rate of -1.85 (coefficient of -0.0185). Said otherwise, when an affiliate country's statutory tax rate is

raised by 1 percentage point, the unrelated party revenues booked there by US multinationals are expected to drop by around 1.85% (they are multiplied by $e^{-0.0185} = 0.982$).

This result is relatively robust to the use of alternative measures of the affiliate country's corporate income tax rate or to the introduction of a one-year lag. Except for the Effective Marginal Tax Rate (EMTR, Column 3), point estimates for β_1 are consistently comprised between -0.014 and -0.019, which corresponds to a semi-elasticity range of -1.4 to -1.9. Most coefficients are statistically significant at the 95% confidence level and even the coefficient associated with the Effective Average Tax Rate (EATR) is estimated rather precisely (p-value of 0.057). The effect of the lagged cash effective tax rate computed from the positive-profit sub-sample of country-by-country report statistics ("Lagged CbCR ETR (cash)", Column 5) is strongly significant.

The signs of the coefficients associated with affiliate country's GDP and foreign market access are consistent with our expectations. The two coefficients are relatively stable across estimations, respectively around 1.2 and 0.29. Extra-group sales increase with GDP and foreign market access: for instance, when an affiliate country's GDP increases by 1% holding everything else constant, unrelated party revenues are expected to increase by 1.2%. The effect of GDP is systematically strongly significant, while that of foreign market access is strongly significant in Columns 1 to 4 and loses significance when including the effective tax rates computed from country-by-country data (Columns 5 and 6).[30]

The results for distance are comparable to those obtained for foreign market access. In the first columns (current statutory tax rate, EATR, EMTR and lagged statutory tax rate), the associated coefficient is negative and strongly significant. Point estimates are rather consistent, between -0.43 and -0.49, meaning that a 1% increase in distance between the affiliate country considered and the US is associated with a reduction in unrelated party revenues by around 0.45%. However, when we consider the effective tax rates computed directly from country-by-country report statistics, this coefficient comes closer to -0.15 and loses any statistical significance. Interpreting this change does not seem straightforward, but it may raise questions regarding the endogeneity of these two tax variables.

More generally, the tax environment of the affiliate country seems to play a significant role in the distribution of unrelated party revenues. In Table 5, we introduce additional variables describing affiliate countries' tax environment. In Column 2, we first examine the effect of tax information exchange agreements and double taxation conventions on the distribution of unrelated party revenues. We compare our estimates and their interpretation with the central results of Laffitte and Toubal (2022), who also study the effect of the broader tax environment on US multinationals' foreign to total sales ratio. First, the variable indicating whether a Tax Information Exchange Agreement (TIEA) was enforced between the US and the affiliate country is associated with a large, positive and strongly significant coefficient. This differs from the observations of Laffitte and Toubal (2022), who obtain a negative relationship between the existence of a treaty of information exchange and the foreign sales ratio. Second, we find no statistically significant effect of the enforcement of a Double Taxation Convention (DTC) between the US and the affiliate country on the unrelated party revenues booked there. Laffitte and Toubal (2022) also obtain such a result, the existence of a DTC having no effect on the foreign to total sales ratio: they relate this finding to an earlier study by Blonigen and Davies (2004), who do not identify any robust impact of double taxation agreements on FDI. Third, the coefficient associated with the number of DTCs enforced by the affiliate country is positive, but it is smaller than the estimate for the enforcement of a TIEA and it is imprecisely estimated. Again, this result may be reconciled with the findings of Laffitte and Toubal (2022), who interpret this regressor as controlling for treaty shopping opportunities. Additionally, the reduced magnitude of the coefficient associated with the statutory corporate income tax rate (from a semi-elasticity of -1.9 based on Column 1 to -1.7 based on Column 2) may indicate that, without controlling for them, the marginal effect initially estimated indirectly reflects other characteristics of the affiliate country's environment.

30. Note that we do not control for the headquarter country's GDP. Indeed, as we focus here on the IRS' country-by-country report statistics, we would only control for the US GDP, introducing variations only along the time dimension in redundance with year fixed effects.

Table 5: Influence of the affiliate country's tax environment on unrelated party revenues

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)
Statutory tax rate	-0.0185**	-0.0171**	-0.0134**	-0.00985
	(0.011)	(0.016)	(0.028)	(0.109)
TWZ tax haven classification			1.647***	
			(0.000)	
H&R tax haven classification				1.439***
				(0.000)
TIEA enforced		1.147***	0.481***	0.943***
		(0.000)	(0.002)	(0.000)
DTC enforced		-0.0540	-0.00766	-0.0761
		(0.715)	(0.953)	(0.559)
# DTC enforced / 100		0.578	0.549*	0.795**
		(0.144)	(0.088)	(0.014)
ln(GDP) - WOE	1.196***	1.148***	1.247***	1.212***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	0.292***	0.349***	0.239***	0.293***
	(0.004)	(0.000)	(0.006)	(0.001)
ln(Distance)	-0.489***	-0.0921	-0.193	-0.117
	(0.002)	(0.548)	(0.111)	(0.361)
Constant	-6.409	-8.064	-1.214	-1.663
	(0.221)	(0.153)	(0.788)	(0.715)
Gravity control variables	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	508	508	508	508
R-squared	0.837	0.852	0.883	0.875
Adj. R-squared	0.832	0.847	0.878	0.871

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents the results of an alternative specification, with additional variables describing affiliate countries' tax environment. We first introduce dummy variables indicating classification as a tax haven, either by TWZ / Tørsløv, Wier, and Zucman (2018) or by H&R / Hines and Rice (1994). Other dummy variables indicate whether the affiliate country has signed a Tax Information Exchange Agreement (TIEA) or a Double Taxation Convention (DTC) with the US. Eventually, "# DTC signed / 100" corresponds to the number of DTCs signed by the affiliate country, scaled by 100. We use again the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues and "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook.

When introducing a dummy for the classification of the affiliate country as a tax haven, be it based on the list by Hines and Rice (1994) or by Tørsløv, Wier, and Zucman (2018), the statutory tax rate seems to lose part or most of its explanatory power. In Column 3, with the classification by Tørsløv, Wier, and Zucman (2018), the coefficient comes closer to 0 (-0.0134) and is less precisely estimated; in Column 4, with the classification by Hines and Rice (1994), the coefficient is not significantly different from 0. Tax haven classification on the contrary is associated with a very large, positive and strongly statistically significant

effect on unrelated party revenues.[31] For a given statutory corporate income tax rate, holding GDP, the foreign market access, distance and all the other gravity control variables constant, unrelated party revenues are more than 4 times higher in a tax haven than in a non-haven jurisdiction ($exp(1.5) = 4.5$). This result underlines the disproportionate weight of some low-tax sales platforms in the mapping of US multinational companies' sales and suggests that an affiliate country's tax haven status encompasses a broader set of attractiveness factors. Consistently with this idea, considering the classification of Tørsløv, Wier, and Zucman (2018) in Column 3 in particular, the effect of the enforcement of a TIEA is reduced significantly (from a coefficient of 1.147 to 0.481).

Table 6: Effects of the statutory corporate tax rate and consumption tax rate on various dependent variables

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(RPR)	(4) ln(RPR)	(5) ln(# MNEs)	(6) ln(PBT)
Statutory tax rate	-0.0185**	-0.0136	-0.0460***	-0.0430***	-0.0128***	-0.0423***
	(0.011)	(0.110)	(0.000)	(0.002)	(0.003)	(0.001)
Consumption tax rate		-0.0471***		-0.00681		
		(0.000)		(0.728)		
ln(GDP) - WOE	1.196***	1.232***	1.161***	1.197***	0.601***	1.061***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	0.292***	0.184*	0.235	0.181	0.0313	0.217
	(0.004)	(0.062)	(0.223)	(0.352)	(0.579)	(0.173)
ln(Distance)	-0.489***	-0.448***	-0.893***	-0.655**	-0.323***	-0.875***
	(0.002)	(0.007)	(0.000)	(0.027)	(0.000)	(0.001)
Constant	-6.409	-7.839	-2.495	-5.678	-8.853***	-4.712
	(0.221)	(0.117)	(0.772)	(0.512)	(0.001)	(0.535)
Gravity control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	508	474	500	467	509	461
R-squared	0.837	0.855	0.673	0.684	0.808	0.663
Adj. R-squared	0.832	0.850	0.663	0.673	0.802	0.652

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents the results of the benchmark specification with the statutory corporate income tax rate as tax-related regressor, but varying the dependent variable. We also introduce a measure of the consumption tax rate (e.g., standard value-added tax rate or average sales tax rate depending on affiliate countries' indirect tax systems). We use again the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues, "# MNEs" for the number of multinational companies active in a given jurisdiction (as recorded in country-by-country report statistics), "RPR" for related party revenues, "PBT" for profits before tax and "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook.

From there, Table 6 does two things. First, as the statutory tax rate may signal other characteristics of the local tax environment not directly related to corporate income taxation, we control for affiliate countries'

31. Laffitte and Toubal (2022) raise a somewhat similar observation when studying the determinants of the foreign to total sales ratio of US multinational companies. In their benchmark specification, increasing the statutory tax rate by 1 percentage point is expected to reduce the foreign to total sales ratio by about 0.57 percentage point, this effect being statistically significant at the 95% confidence level. When the tax haven dummy variable is introduced, the coefficient comes closer to zero (from -0.570 to -0.277) and its degree of statistical significance is reduced. On the contrary, the tax haven classification indicator is associated with a positive coefficient, statistically significant at the 99% confidence level. However, in our case, contrarily to Laffitte and Toubal (2022), it is of a completely different order of magnitude than the coefficient associated with the statutory tax rate.

consumption tax rates (considering Value-Added Taxes (VAT), sales taxes, etc.). Second, we consider other dependent variables than the unrelated party revenues, respectively related party revenues, the number of US multinational companies active in the affiliate country and profits before tax.

First, in Column 2, we find that controlling for consumption tax rates reduces the magnitude and significance of the coefficient associated with the statutory tax rate. The semi-elasticity to corporate income taxation is reduced (in absolute terms) from -1.9 to -1.4 and it is not significant at conventional confidence levels anymore (p-value of 0.11). The consumption tax rate is associated with a substantially larger effect, since the corresponding semi-elasticity is of -4.7: when the VAT rate increases by 1 percentage point in an affiliate country while holding everything else constant, the unrelated party revenues booked there by US multinational companies are expected to decline by close to 5%. The estimate is strongly significant. This observation again corroborates the idea that part of the effect associated with the statutory rate in our benchmark specification is in fact related to other features of the local tax environment.

Second, we find that the relative influence of the statutory tax rate, the consumption tax rate and the foreign market access is quite different for unrelated party and related party revenues (Columns 3 and 4). Intra-group sales are less sensitive to foreign market access than extra-group sales, both in terms of magnitude and statistical significance of the coefficient, but they react more to corporate income taxation. Indeed, the magnitude of the corresponding semi-elasticity is much larger: between -4.3 and -4.6 for related party revenues and between -1.4 and -1.9 for unrelated party revenues. This is consistent with the notion that multinational companies' profit shifting is mainly operated via related party transactions, organised specifically in response to corporate income tax rates. Besides, the local consumption tax rate does not seem to affect related party revenues, which may not be surprising with regard to Figure 2: affiliated sales in the BEA's statistics largely consist of foreign transactions (median foreign sales ratio above 85%) and these are not subject to local VAT or sales taxes.

Third, we find that the number of multinationals active in a jurisdiction decreases with its statutory corporate income tax rate, this relationship being strongly statistically significant.[32] With -0.013 in Column 5 versus -0.0185 in Column 1, the corresponding coefficient is also of a smaller magnitude than the effect on unrelated party revenues. This difference may indicate that the latter is driven not only by the extensive margin (less multinationals entering an affiliate country would imply lower unrelated party revenues being booked there), but also by an intensive margin (conditional on entry, multinationals would tend to record lower unrelated party revenues in a relatively high-tax jurisdiction).

Eventually, profits before tax display a semi-elasticity to the statutory corporate income tax rate that is comparable to that obtained for related party revenues.[33]

32. This result is consistent with the theoretical framework mentioned above and derived from Melitz (2003)-Chaney (2005). Indeed, in this model, corporate income taxes weigh negatively on unrelated party revenues through an extensive margin effect: the higher the local corporate income tax rate in country j, the less firms find it profitable to incur the fixed cost for setting up a foreign affiliate there.

33. We estimate a large semi-elasticity of profits before tax to the statutory corporate income tax rate, around -4.2. This result means that when an affiliate country's statutory tax rate is raised by 1 percentage point, the pre-tax profits booked there by US multinationals are expected to drop by 4.2% (more precisely, they are multiplied by $e^{-0.0423} = 0.959$). For several reasons, this estimate cannot be directly compared with the benchmark -0.8 or -1 semi-elasticity of pre-tax profits to corporate income tax rate differentials identified so far in the literature. We investigate these reasons based on the meta-analysis of Beer, Mooij, and Liu (2020), who find a benchmark semi-elasticity of -0.974 (Beer, Mooij, and Liu (2020) instead discuss semi-elasticities in absolute values; we align their findings with our own results by considering negative semi-elasticities, but the interpretation is fundamentally the same). First, as they aim at estimating the magnitude of multinationals' profit shifting behaviour, these estimates are obtained by controlling for the local real economic activity of the firm. We do not control for economic activity indicators in the same way, as we wish to include multinationals' real responses to taxation in our estimates. In Beer, Mooij, and Liu (2020)'s preferred specification (cf. Table 2), the absence of controls for real economic activity is associated with a positive and strongly significant coefficient of 0.454: we should thus compare our result to a semi-elasticity of at least $-(0.974 + 0.454) = -1.428$. Second, such surveys and meta-analyses have often underlined the larger semi-elasticities estimated on aggregated data rather than firm-level samples (the latter being usually considered as superior to study and size profit shifting). Still based on the Table 2 of Beer, Mooij, and Liu (2020), we should also account for the absence of firm and country fixed effects and for the use of macro-level data: this gives a benchmark semi-elasticity of $-(1.428 - 0.211 + 0.472 + 1.082 + 0.354) = -3.125$. Our own estimate thus comes closer to the benchmark order of magnitude. Third, Beer, Mooij, and Liu (2020) identify a positive effect of time on estimated semi-elasticities: for instance, they find that a value of around -1.5 would apply in 2015, versus -1 in their benchmark. Our sample being very recent, from 2016 to 2019, time may also play a role in explaining the large semi-elasticity that we estimate. Fourth, we focus on US multinational companies, which may be particularly tax aggressive, while literature surveys include non-US headquarter countries.

Overall, these results suggest that US multinational companies' unrelated party revenues respond to affiliate countries' tax environment. Firms tend to organise in such a way that they register more of their extra-group sales in relatively lower-tax countries (especially in tax havens listed by Tørsløv, Wier, and Zucman (2018) or Hines and Rice (1994)) and less in the higher-tax ones. However, whether benchmark estimates unravel a direct effect of corporate income taxation or signal other mechanisms is less clear. And these results come with further cave-ats.

First, Table 6 shows that the response of unrelated party revenues to corporate income taxation is of limited magnitude. On the one hand, Column 2 yields a non-significant semi-elasticity of -1.4 while it is of -4.7 for the consumption tax rate: firms' adjustment of unrelated party revenues appears as three times stronger with respect to VAT or sales taxes than to taxes on corporate income. On the other hand, Columns 3, 4 and 6 highlight the large effect of affiliate countries' corporate income tax rate on US multinational companies' related party revenues and pre-tax profits. The resulting semi-elasticity of these two dependent variables to corporate income taxes is estimated around -4.3, which is between 2 and 3 times larger in absolute values than for unrelated party revenues. This result hints at the fact that intra-group transactions remain firms' primary tax planning instrument in response to corporate income taxation.

Second, as explained above, Column 5 in Table 6 suggests that a negative extensive margin effect is at play, a higher corporate income tax rate reducing the number of entering multinational companies. To preserve taxpayers' confidentiality, when only a small number of US firms are present there, the IRS aggregates certain affiliate countries into continental partners. Therefore, the extensive margin mechanism may involve some form of endogenous selection into the sample, which could in turn bias our estimates. Specific estimation procedures may be required to abstract from this potential selection bias.

Third, these results are moderately robust to alternative specifications.

- *Adjusting the model with the logarithm of the retention rate.* In the theoretical model derived from Melitz (2003) and Chaney (2005), the corporate income tax rate enters firms' program as $(1 - tax_j)$, that is as the retention or net-of-tax rate of the affiliate country (see Chouc (2022)). It is therefore more rigorous to include the logarithm of the retention rate in the set of regressors, rather than the plain tax rate. In Table 9 of Appendix A.1, we adjust the initial results to reflect more closely the theoretical framework. For most measures of the tax rate, the new estimates are quite consistent with our initial results. We find a statistically significant positive effect for the regressor computed from the statutory tax rate: the estimated elasticity of 1.345 indicates that holding everything else constant, a 1% increase in the retention rate of any given affiliate country increases by around 1.3% the unrelated party revenues booked there by US multinational companies. Similarly to Table 4, the respective effects of the EATR and of the lagged statutory rate are of lesser magnitude and statistical significance. However, results differ significantly for the effective tax rates computed from country-by-country report statistics. While the effect associated with the cash-based rate is less precisely estimated than before (from a 99% to a 95% confidence level), the point estimate of the accrual-based rate is of a completely different magnitude, reaching 2.2 versus 1.0 to 1.3 for the other regressors. This instability and the fact that the effect of foreign market access or distance disappears in Columns 4 and 5 may again question the reliability of these tax rate measures.[34]

- *Alternative measure of foreign market access.* In our benchmark results, we control for affiliate countries' access to foreign markets as in Laffitte and Toubal (2022). In an alternative specification, in Table 10 of Appendix A.1, we use the Logistics Performance Index (LPI) of the World Bank (2018). More precisely, we consider the logarithm of affiliate countries' overall International LPI score, aggregated across several survey waves: this indicator encompasses various dimensions of trade, with areas for policy regulations (customs, infrastructure, quality of logistics services) and performance outcomes (timeliness, ease of arranging shipments, tracking and tracing). Clearly, most of the initial results are not robust to this alternative control. In Column 1, the coefficient associated with the logarithm of the retention rate computed from the statutory corporate income tax rate is reduced from around 1.3 to less than 0.9 and is not significant at any conventional level of confidence. Similarly, in Columns 2 and

34. Reassuringly, comparing Tables 4 and 9, the point estimates for the main control variables are very robust to the different forms under which we integrate the tax variable. Using the logarithm of the retention rate is more closely consistent with our model, but semi-elasticities are directly comparable to existing estimates in the literature, hence this choice of presentation for benchmark results.

3, the estimates associated with the EATR and the lagged statutory tax rate lose any statistical significance. The only significant effects are obtained with the effective tax rates computed directly from the positive-profits sub-sample of country-by-country report statistics but, here too, effect magnitude is largely reduced. On the other hand, across all specifications, the LPI score is associated with a large positive effect on unrelated party revenues: the elasticity varies from 4.3 to 4.8 and it is systematically estimated with high precision. From there, two remarks are in order. First, some of the dimensions encompassed by the LPI score directly relate to policy inputs and these levers of attractiveness for foreign businesses may correlate significantly with relatively favourable tax environments: for instance, among the 25 countries with the higest aggregated LPI scores, 8 are classified as tax havens by Tørsløv, Wier, and Zucman (2018). Second, the financing of the facilities and of the administration that this score assesses may be endogenous to affiliate countries' tax collection capacities and thereby to tax rate measures. Decomposing the LPI score along its different dimensions (which, taken separately, affect our estimates for the effect of corporate income taxation very heterogeneously) or isolating some of the questions that constitute the LPI surveys may allow to further investigate these effects.

- *Introducing wages.* Eventually, we propose to include the logarithm of mean daily earnings in the set of regressors, based on ILO (n.a.). Indeed, in our theoretical framework that derives from Chaney (2005), wages are all equalized to 1 due to the numeraire good assumed to be produced with constant returns to scale in all countries. We may suspect on the contrary that wage differentials affect firms' location decisions, having thus an effect on the distribution of unrelated party revenues. As shown in Table 11 of Appendix A.1, integrating this new control strongly affects our initial results and in Columns 1 to 3, the estimated effect of corporate income taxation simply loses any statistical significance. Here also, potential effects come from the effective tax rates observed in country-by-country report statistics, as the cash-based and the accrual-based regressors are respectively associated with elasticities of 1.1 and 2.0 (95% and 99% confidence level).

- *Introducing affiliate country fixed effects.* The only effects that remain significant at conventional confidence levels across these alternative specifications are associated with the effective tax rates computed from country-by-country report statistics. Table 12 in Appendix A.1 goes further and introduces affiliate country fixed effects. These fixed effects thus encompass time-invariant characteristics like the measure of remoteness, the tax haven status or the aggregated Logistics Performance Index included in Table 10. This provides a more rigorous assessment of the effect of corporate income taxation on US multinational companies' unrelated party revenues. The effects of the current statutory rate, the EATR and the lagged statutory rate (which enter the model as log retention rates) have lost any statistical significance. Besides, we find a small positive elasticity of unrelated party revenues to the retention rates computed from country-by-country report statistics: 0.1 for the lagged cash-based effective tax rate and 0.4 for the lagged accrual-based rate. Both are unprecisely estimated with p-values between 0.05 and 0.06.

These robustness checks and alternative specifications qualify our initial results. While the aggregated country-by-country reports of US multinational companies evidence the importance of affiliate countries' tax environment in shaping the distribution of unrelated party revenues, the direct effect of corporate income taxation is less clear. In our benchmark model, the statutory and effective tax rates may in fact signal other affiliate country characteristics that are actually driving attractiveness for foreign firms' extra-group sales. More robust mechanisms seem at play when considering the effective tax rates computed from the positive-profit sub-sample, but they may not be as reliable as a pure policy instrument like the statutory tax rate. On the one hand, these effective tax rates could be seen as our "ideal" tax measure, because they are specific to the activities of large US multinational companies. In some jurisdictions, the taxation of major foreign firms depends less on the headline rate than on idiosyncratic arrangements from which different companies may or may not benefit. As these effective tax rates reflect the taxes that are actually paid or accrued, they may be closer to the perceptions driving firms' location decisions. In that sense, Figure 7 in Appendix A.1 shows that these two measures of the tax rate discriminate particularly well the jurisdictions classified as tax havens by Tørsløv, Wier, and Zucman (2018). On the other hand, effective tax rates computed from country-by-country reports are fundamentally endogenous to multinational companies' tax planning behaviour, which questions their use for the estimation of "causal" effects (even with the one-year lag that we

systematically apply). In addition, they may be distorted by the potential inclusion of intra-firm dividends in pre-tax profits (see Horst and Curatolo (2020) or Baraké et al. (2021b)).

5 Destination-based adjustment of revenue variables

As explained in the introduction and as identified by Cobham et al. (2022), the geographical distribution of revenues in country-by-country report statistics does not correspond to the final destination of the goods and services sold, but instead reflects the accounting treatment of the transactions of multinationals' subsidiaries.

This definition involves substantial departure from a destination-based distribution because countries differ in their attractivity for multinational companies when those look to set up foreign affiliates. The trade literature has underlined how countries may become "export platforms" from which multinationals operate a part of their transactions remotely, often with neighboring countries. Laffitte and Toubal (2022) add to this body of works by stressing the role of corporate income taxation in the choice of these platforms, as well as the possibly severe disconnection between the accounting treatment of transactions and the physical movements of goods or services. The literature thus suggests that using country-by-country report statistics to simulate reforms of the global corporate income tax system relying on some kind of sales apportionment would likely overestimate the revenue gains of export platforms and, somewhat ironically, tax havens.

In Section 4, descriptive statistics do highlight the disproportionate weight of small, low-tax jurisdictions and econometric analyses provide some evidence for a response of unrelated party revenues to tax environment characteristics. We now propose an adjustment of country-by-country revenue variables, that could be used to approximate a destination-based distribution of sales and simulate the desired reforms.

5.1 Methodology

In this section, we broadly present the methodology used to adjust the revenue variables in country-by-country report statistics, based on the ultimate destination of the sales. More details can be found in the appendix, to which we refer when relevant. We first describe the methodology employed for US country-by-country report statistics and then present the tentative extension to other headquarter countries.

5.1.1 Splitting revenues intro three types of sales

The first step consists in splitting each of the three revenue variables ("unrelated party revenues", "related party revenues" and "total revenues") in three different amounts: sales directed to the affiliate country, sales directed to the US and sales directed to any other country.

We start by reorganizing the BEA data on the destination of the goods and services supplied by the majority-owned affiliates of US multinational firms, following the schema of Appendix B.1.3. For each affiliate country present in this dataset, we then have: the totals of sales to affiliated partners, to unaffiliated partners and to all partners, split across three types of final destination. We can compute the relative share of each type of destination (the US, the affiliate country or any other country) in unaffiliated, affiliated and total sales.

Excluding US-US sales, 86 affiliate countries in the IRS' data are absent from BEA statistics, accounting for 4% of all foreign total revenues. Plus, for some countries, the BEA data are incomplete and do not allow to properly split unaffiliated and affiliated sales based on their destination. For these, we impute mean shares computed at the level of the corresponding continents (Africa, Americas, Asia-Pacific and Europe).

Appendix B.1.4 gives a detailed example of these computations for one of the affiliate countries present in both IRS and BEA datasets.

5.1.2 Already attributed sales

Combining the three revenue variables of the IRS' country-by-country report statistics with the relative shares computed from BEA data, we obtain a split of unrelated party revenues, related party revenues and

total revenues in three types of ultimate destination: the US, the affiliate country and any other country.[35] Unrelated party revenues, related party revenues and total revenues directed to the US or to the affiliate country are associated with their ultimate destination. They can already be considered as destination-based sales.

5.1.3 Distributing sales to third countries

We use trade statistics to distribute the sales that are not directed towards the US, nor towards the affiliate country. The selection and preparation of trade data are presented in Appendix B.2.

For each affiliate country in the IRS' country-by-country report statistics, we have a distribution of its exports or a proxy for it. Two remarks are in order. First, we eliminate the US from export destinations: the sales that are ultimately directed to the US have already been attributed using BEA data. Second, for each reporting country, we eliminate from the distribution of exports the destinations that represent less than 0.5% of total transactions. We indeed assume that US multinationals are not likely to operate such niche operations and rather attribute them to domestic firms.

We use this distribution to approximate the ultimate destinations of unattributed sales. For instance for France, unrelated party sales to other countries amount to 21.2 billion USD in 2017. As Germany represents 15% of French exports, we conclude that US multinationals register 3.2 billion USD of sales via their French subsidiaries that are ultimately directed to Germany.

5.1.4 The case of US-US sales

So far, we have estimated a destination-based mapping of the sales registered by US multinationals via their subsidiaries in foreign affiliate countries. BEA data allowed to split each revenue variable of the IRS' country-by-country report statistics in three categories and unallocated sales were distributed thanks to trade statistics.

However, Table II.E2 of the BEA's data on the activities of US multinationals does not allow to distribute the revenues registered by US multinationals directly in the US, which may actually be associated with exports and be ultimately directed to other, foreign countries. Instead, we use Table I.O1 that describes the sales of US parents based on their destination and type for each sector of activity. Without allowing to distinguish between unrelated party and related party revenues ("U.S. persons" are not split between intra- and extra-group transactions), we find that 12% of total US-US sales are directed to another country in 2017.

We can therefore split the three US-US revenue variables between local operations and exports. The former are already associated with their ultimate destination and consistently with the methodology detailed above, we use trade statistics to distribute the latter. Besides, we exclude destinations that represent less than 0.5% of US exports, the absence of such a restriction producing disproportionate adjustments for small economies.

5.1.5 Tentative extension to non-US multinationals

As explained in Section 3.1.3, in the OECD's country-by-country report statistics, the granularity of bilateral breakdowns strongly varies among the 38 headquarter countries. Excluding those that only provide a split between domestic and foreign activities, we could apply our methodology to the remaining 34 headquarter countries. Based on continental averages, we can split the revenues attributed to aggregate partners and distribute them to hypothetical destinations, but this involves substantial approximation. Therefore, in the benchmark extension of the computations to non-US multinationals, we focus on the 15 headquarter countries that report at least 60 unique affiliate countries in their country-by-country reports. They are listed above, in Table 1, with their respective number of affiliate countries.

We now describe the methodology used to adjust the revenue variables reported by the 14 non-US headquarter countries. We start by splitting the revenue variables into local and foreign sales. This differs from the adjustment of US multinational companies' revenues, as the BEA's data allowed to distinguish

35. From then on, the total revenue columns do not match the sum of the corresponding unrelated party and related party revenue columns. It is the case in the original country-by-country report statistics of the IRS, but we have computed from BEA data and applied different percentages to distribute each of the three revenue variables.

three types of transactions: local sales, sales directed to the US and sales directed to any other country. We extrapolate the information provided by the BEA, assuming that the split between local and foreign sales observed for US multinationals also holds for non-US companies. For instance, in 2017, 71% of the total sales of goods and services registered in France by US multinationals were associated with local transactions, while 4% were directed to the US and 25% to a third country. From there, we assume that the total revenues booked by, say, German multinationals in France are split between 71% of local sales and 29% (4% + 25%) of foreign sales. As for the adjustment of US revenue variables, using the BEA's data, we can apply different shares for unrelated party, related party and total revenues.

We apply a specific methodology for the domestic observations and mobilize the Analytical AMNE database of the OECD (see OECD (2016) and Cadestin et al. (2018)). Taking the example of Spain, these data suggest that the split observed in the BEA's data, which attributes 38% of the revenues booked in Spain by Spanish multinational companies to foreign destinations, could under-estimate the importance of domestic sales. Indeed, exports only account for 18% of the local gross output of Spanish multinationals in 2016 according to the Analytical AMNE database. We therefore split domestic revenues based on these statistics rather than by applying the local sales percentages of US multinational companies. This however comes with limitations: we have only one split for unrelated party, related party and total revenues; the latest statistics in the Analytical AMNE database correspond to the 2016 income year, while we take 2017 as benchmark in country-by-country report statistics.

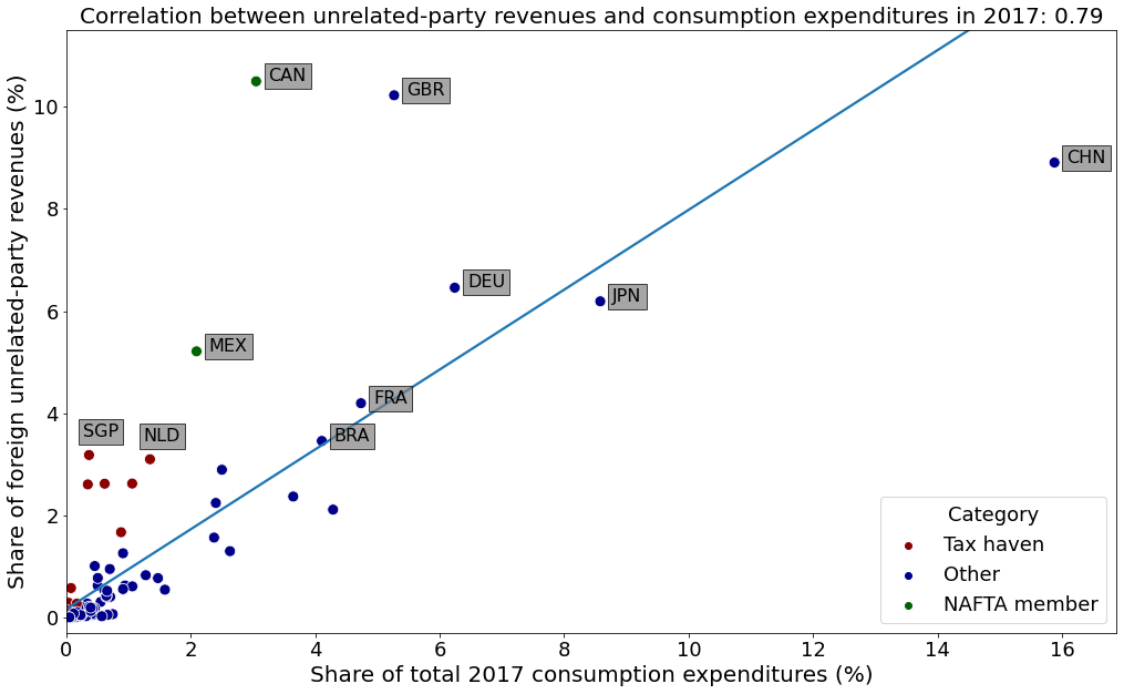
From there, local sales are already associated with their final destination and sales generated abroad are allocated to their approximated final destinations using the same trade statistics as for US multinational companies' revenues.

5.2 Brief assessment

Section B.4 of the Appendix provides a detailed assessment of our proposed adjustment. Building upon the descriptive statistics of Section 4.1, we mainly evaluate its effect on the weight of low-tax sales platforms and the extent to which it improves the consistency of unrelated party revenues with market size indicators. We briefly summarize these results in the following.

First, we consider the impact of the adjustment on US multinational companies' largest affiliate countries. Compared with Table 2, the highest-ranking countries have been recomposed, especially in favor of NAFTA members (Canada moving from second to first, Mexico from eleventh to sixth), the largest economy of the sample (China moving from fourth to third) or France (from tenth to seventh). Oppositely, smaller low-tax jurisdictions like Ireland, Switzerland and Singapore then display revenue shares that are more in line with the size of their economies. Figure 5 illustrates this evolution for all affiliate countries. The correlation between unrelated party revenues and final consumption expenditures has increased substantially: before the adjustment, it was of 0.66 and it reaches 0.79 after the destination-based adjustment.

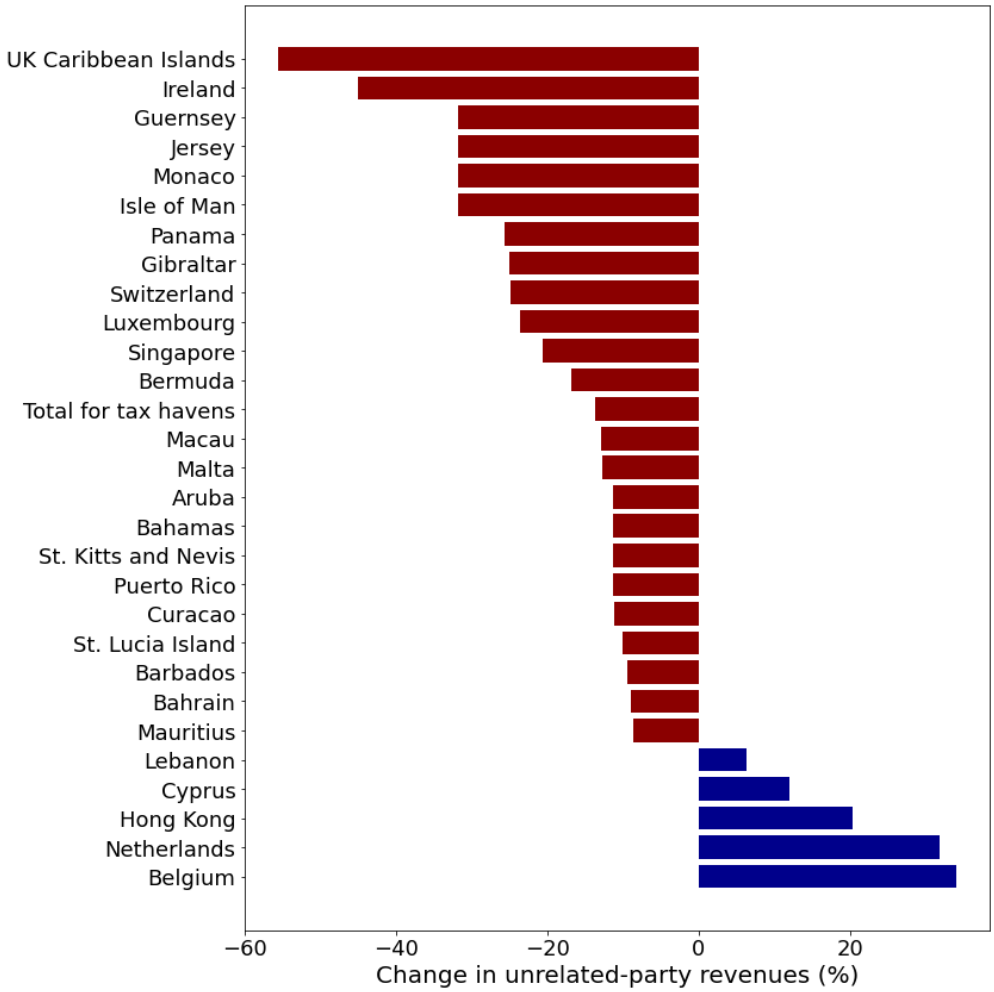
Figure 5: Post-adjustment relationship between all affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures



Note: This figure presents the relationship between destination countries' share of US multinational companies' adjusted foreign unrelated party revenues and their share of final consumption expenditures. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Second, except for one non-haven country, all of the ten largest losers from the adjustment are listed as tax havens by Tørsløv, Wier, and Zucman (2018). Focusing more specifically on the evolution of these jurisdictions, we find that their aggregate weight moves from 27% of foreign unrelated party revenues in the IRS' country-by-country report statistics to 18% in the adjusted mapping of sales. Most of the tax havens listed by Tørsløv, Wier, and Zucman (2018) in our sample (24 out of 29) see their unrelated party revenues decrease, as seen in Figure 6. These results, which are broadly robust to the inclusion of non-US multinationals, corroborate the idea that the adjustment operates a re-balancing of extra-group sales from potentially low-tax sales platforms to other, larger economies where ultimate consumers and users are more likely to be found.

Figure 6: Change in tax havens' unrelated party revenues



Note: This figure presents the percentage change in unrelated party revenues implied by our destination-based adjustment for the tax havens listed by Tørsløv, Wier, and Zucman (2018). For each tax haven, it is computed as the ratio of the difference between adjusted and non-adjusted unrelated party revenues to non-adjusted unrelated party revenues. The aggregated evolution of all tax haven unrelated party revenues is also presented as the "Total for tax havens". Red bars indicate a decrease in unrelated party revenues, while blue bars indicate an increase.

In Section B.4.6 of the Appendix, we discuss the potential limitations of the destination-based adjustment, while Sections B.5 and B.6 provide various robustness checks.

5.3 Example of policy simulation

We illustrate how the adjusted mapping of multinationals' sales can be used to simulate proposed reforms of the international corporate income tax system. Several proposals indeed involve an apportionment of multinationals' income or of their so-called "tax deficit" based on the distribution of their extra-group sales.[36] For instance, in the two-pillar proposal fostered by the OECD, Pillar One allocates a part of in-scope multinationals' tax base to their "market jurisdictions" (i.e., to the tax jurisdictions where their customers are located or where value creation occurs). Full formulary apportionment proposals go further and distribute the entire taxing rights, generally based on a combination of payroll costs, tangible assets

36. In Clausing, Saez, and Zucman (2020), the "tax deficit" of a multinational company is defined as the difference between the amount of corporate income taxes that the group would pay under a global minimum tax rate and the amount that it actually pays.

and destination-based extra-group sales. We can also mention the Minimum Effective Tax Rate (METR) proposal of Cobham et al. (2022) who propose to first determine multinational companies' non-effectively-taxed profits and then, to allocate these additional tax bases across countries based on the distribution of their destination-based sales.

We first explain some of the issues that are likely to arise when using non-adjusted and adjusted mappings of the country-by-country revenue variables to simulate such reforms. We then give practical insights on the impact of the sales mapping adjustment for simulations of sales apportionment proposals.

5.3.1 Preliminary remarks

The main difficulty for these simulations lies in that they rely on several, distinct computations that may not be available for the same sets of countries. To ensure the comparability of the revenue gain estimates across countries, methodologies often require additional assumptions that may hinder the accuracy of the results.

From Baraké et al. (2021a) and Baraké et al. (2021b), tax deficit estimates are available for around 80 countries. They either report aggregated country-by-country statistics via the OECD for 2017 or they are included in the results of Tørsløv, Wier, and Zucman (2018), who provide estimates of profits booked in tax havens by the multinational companies headquartered in a broad set of jurisdictions. The proposal simulated below involves distributing these tax deficits based on the distribution of multinationals' unrelated party revenues. But the non-adjusted and adjusted sales mappings are based on country-by-country report statistics and as such, they are only available for a limited set of countries. Using these mappings of sales, we can only distribute the tax deficits of at most 34 jurisdictions. We do cover the most important headquarter countries and thus most of the total tax deficit, but assumptions would be required to impute the tax deficits of countries for which we lack a sales mapping.

Furthermore, among the 34 jurisdictions for which we can deduce a destination-based mapping of multinationals' sales, many countries only provide a limited country-by-country breakdown. Some even only report a continental split of the revenue variables. Not only does this make the adjusted sales mapping less precise, but this also limits the usability of the non-adjusted statistics. Having determined an estimate for the tax deficit of the Isle of Man, if we only know how its multinationals' sales are distributed across continents, how can we allocate the corresponding revenues to the right taxing jurisdictions? The main objective of Baraké et al. (2021a) was to provide revenue gain estimates for EU Member-States, so that they could deal with this issue with rough but simple imputations. In the following, we instead (i) distribute only the tax deficits of countries that report a sufficiently detailed bilateral breakdown in their country-by-country statistics and (ii) focus on the outcome for the affiliate countries that are explicitly included in the reports of all these parent countries.

Eventually, we only have tax deficit estimates for some of the affiliate countries on which we focus in our revenue gain estimates. Because domestic sales generally represent a substantial share of multinationals' total revenues, taxing jurisdictions are expected to collect a large portion of their own tax deficit. The revenue gains of countries for which we lack a tax deficit estimate are therefore likely to be underestimated relatively to countries for which we have such an estimate. To compare all jurisdictions on an equal footing, we discuss the revenues that are estimated to be collected from foreign multinational companies.

5.3.2 Full sales apportionment of tax deficits

To illustrate the possibilities offered by the adjustment of country-by-country revenue variables, we simulate the tax revenues from a full apportionment of multinationals' tax deficits based on extra-group sales. Contrarily to the "unilateral scenario" of Baraké et al. (2021a), countries are not assumed to collect the entirety of their own tax deficit. If France only accounts for, say, 60% of the unrelated party revenues of French multinational companies, then France only collects 60% of its tax deficit and the rest is shared across the other market jurisdictions served by these firms.

Methodological considerations. First, we only distribute the tax deficits of countries for which we have satisfying non-adjusted and adjusted sales mappings. As in the benchmark extension of our destination-based adjustment to non-US multinationals, we restrict the set of parent countries to the 15 jurisdictions

that report at least 60 unique affiliate countries in their aggregated country-by-country reports. Table 7 lists these countries and shows their respective tax deficits. They gather a total tax deficit of 115.2 billion USD, versus a full sample total of 180.3 billion USD based on the estimates of Baraké et al. (2021b), hence a 64% "coverage rate".

Table 7: Restricted set of headquarter countries and associated 2017 tax deficit estimates as per Baraké et al. (2021b)

Headquarter country	Tax deficit to be allocated (billion USD)
Australia	1.8
Bermuda	1.3
China	6.3
Denmark	1.8
France	4.0
Germany	13.4
India	0.6
Italy	3.1
Japan	6.0
Luxembourg	6.0
Mexico	0.4
South Africa	3.0
Spain	5.4
Switzerland	3.6
United States	58.5

Note: This table presents the 15 headquarter countries retained based on the granularity of the bilateral breakdown of their aggregated country-by-country report statistics, as well as their tax deficits as per the latest estimates of Baraké et al. (2021b). Those are presented for the income year 2017 and a 15% minimum rate, in current billion USD.

Second, we also focus on a restricted set of countries when estimating the revenue effects of the full sales apportionment reform. We focus on the countries that are reported as affiliate countries in all of the 15 aggregated country-by-country reports. Indeed, we know that these countries are never integrated to regional aggregates and we have, for each parent, their exact amount of unrelated party revenues: we do not need to make assumptions about how sales attributed to aggregate partners are distributed, which may reduce the accuracy of the estimates and limit comparability across taxing jurisdictions. We obtain a set of 46 countries, out of which 6 are classified as tax havens by Tørsløv, Wier, and Zucman (2018).

Third, in the resulting table, we show the revenues collected specifically from foreign multinational companies. These two columns allow to compare the revenue gains of the different taxing jurisdictions. Otherwise, because of the importance of domestic sales for most multinational companies, the countries whose tax deficits are being distributed would be expected to collect a substantial share of their own tax deficit and their revenue gains would mechanically be increased relatively to the other countries.

Results. Table 8 presents the results from these computations.

Table 8: Revenue gains collected from foreign multinationals under a full apportionment of tax deficits

Taxing country	Using unadj. UPR (m. USD)	Using adj. UPR (m. USD)	Discrepancy (%)
Argentina	427.0	459.7	7.7
Australia	1,086.6	1,250.0	15.0
Austria	459.2	594.6	29.5
Brazil	1,541.4	1,699.6	10.3
Bulgaria	38.9	32.6	-16.3
Canada	1,978.0	2,847.1	43.9
Chile	349.8	324.1	-7.3
China	2,296.0	4,024.9	75.3
Colombia	268.3	284.7	6.1
Czech Rep.	324.9	351.6	8.2
Denmark	148.6	200.8	35.1
Egypt	73.0	79.9	9.5
Finland	153.1	171.5	12.0
France	1,816.8	2,456.3	35.2
Germany	2,252.7	3,200.6	42.1
Hungary	179.3	181.0	0.9
India	511.5	961.6	88.0
Indonesia	304.9	378.7	24.2
Italy	1,272.5	1,670.1	31.2
Japan	1,203.0	1,967.8	63.6
Korea	444.0	870.2	96.0
Malaysia	219.1	357.5	63.1
Mexico	1,028.0	1,705.6	65.9
Morocco	40.7	56.8	39.6
Norway	238.7	279.2	17.0
Philippines	112.8	190.0	68.5
Poland	560.1	663.1	18.4
Portugal	197.7	233.1	17.9
Romania	183.3	182.0	-0.7
Russia	586.3	819.4	39.7
Slovakia	110.4	109.5	-0.8
South Africa	306.7	304.1	-0.8
Spain	947.7	1,127.6	19.0
Sweden	383.2	497.3	29.8
Taiwan	274.9	498.6	81.3
Thailand	326.2	459.3	40.8
Turkey	321.5	471.8	46.8
UAE	261.2	474.9	81.8
UK	4,958.7	5,080.6	2.5
United States	6,410.2	6,847.6	6.8
Non-havens	34,596.8	44,365.3	28.2
Belgium	699.1	873.8	25.0
Hong Kong	1,161.5	1,349.0	16.1
Ireland	1,145.2	761.3	-33.5
Luxembourg	277.4	244.7	-11.8
Singapore	2,305.7	1,587.2	-31.2
Switzerland	3,028.1	1,743.1	-42.4
Tax havens	8,617.1	6,559.1	-23.9
Full sample	43,213.9	50,924.4	17.8

Note: This table presents the revenues collecting by each taxing country from foreign multinationals under a full sales apportionment of tax deficits. The first column, "Using unadj. UPR (bn. USD)", is obtained by using the non-adjusted country-by-country statistics of the OECD and the second column, "Using adj. UPR (bn. USD)", is obtained by using our adjusted sales mapping for the restricted set of headquarter countries (15 parents). Revenue gain estimates are presented in current million USD for the income year 2017 and the change due to our destination-based adjustment of country-by-country revenue variables is expressed in percentage. "UPR" stands for unrelated party revenues.

As explained above, for comparability purposes, we show the detailed estimates per taxing country only for the revenues collected from foreign multinational companies. Including countries' collection of their own multinationals' tax deficits, the full sample of jurisdictions on which we focus in Table 8 gathers revenue gains of 111.3 billion USD and 110.9 billion USD, using respectively the non-adjusted country-by-country report statistics and the adjusted revenue variables. Said otherwise, our restricted set of taxing jurisdictions covers most of the total tax deficit (115.2 billion USD) being allocated. Revenues collected from foreign multinationals represent between 39% and 46% of the total depending on the sales mapping considered.

Before the adjustment of unrelated party revenues, the total tax revenues collected from foreign multinationals amount to 43.2 billion USD. After the adjustment, the corresponding total is of 50.9 billion USD. The aggregate increase (+18%) may be explained by the composition of the group of collecting countries on which we focus (which could benefit more than others from the adjustment), but also by the lower importance that the adjusted mapping of extra-group sales gives to domestic transactions. With the adjusted mapping of unrelated party revenues, headquarter countries generally account for a lower share of their multinational companies' extra-group sales and more taxes are collected from foreign firms.[37]

Based on the raw distribution of unrelated party revenues, 8.6 billion USD accrue to the 6 tax havens in the set of interest and they capture 20% of the total. With 6.6 billion USD accruing to these jurisdictions after the adjustment, their estimated revenue gains are reduced by 24% on average and they capture 13% of the tax revenues from foreign multinationals. Their share has thus gone down significantly with our proposed adjustment of country-by-country revenue variables. This shift in favor of the non-havens in the sample could be expected as tax havens were already identified as the biggest "losers" from our adjustment.

6 Conclusion

In this work, we first leverage the OECD's and IRS' aggregated country-by-country report statistics to assess whether the distribution of multinational companies' unrelated party revenues is affected by corporate income taxation. Simple descriptives highlight the concentration of unrelated-party sales in tax havens (27% of the foreign total in US data, 21% when including other headquarter countries), which is disproportionate relatively to the size of local markets (less than 6% of final consumption expenditures). From there, our econometric model is based on a simplified theoretical framework that shuts off the mechanisms potentially disconnecting extra-group sales and customers' location, to which we add a measure of foreign market access as in Laffitte and Toubal (2022) and corporate income tax rates. Controlling for affiliate countries' size and foreign market access, as well as for various gravity variables, we find a semi-elasticity of unrelated-party revenues to the local statutory corporate income tax rate of -1.85 (i.e., a one percentage point increase in the tax rate is associated with a 1.85% reduction in extra-group sales). However, further results suggest that part of the measured elasticity actually reflects other dimensions of affiliate countries' tax environment, including consumption taxation which appears as an important driver for the distribution of unrelated party revenues. Besides, the elasticity of related party revenues or pre-tax profits to corporate income taxation displays both a higher magnitude and a stronger statistical significance, indicating that intra-group transactions constitute multinational companies' primary tax planning lever. Overall, we find some evidence that firms' location decisions and organisation extra-group sales are affected by jurisdictions' tax environment and additional work remains to establish the robustness of these findings.

Taxation or, more generally, the economic factors that drive a wedge between the observed distribution of multinational companies' sales and the location of their customers make the simulation of the revenue effects of some proposed reforms particularly difficult. As described in Section 2.3, several studies have already faced the limitations of available statistics, having to rely on mappings of firms' revenues biased towards - possibly low-tax - sales platforms. Therefore, we propose an adjustment of the revenue variables in country-by-country report statistics that aims at approximating a destination-based distribution (i.e., at reflecting customers' location). The "corrected" distribution of sales is more in line with proxies for market size than pre-adjustment variables, considering alternatively US multinationals or the extended sample. Illustrating the use of adjusted variables, we allocate the top-up taxes estimated by Baraké et al. (2021b) as

37. Considering the 2017 data for the 15 headquarter countries that record a sufficient number of affiliate countries, domestic observations concentrate 65% of total unrelated party revenues. With the adjusted distributions of unrelated party revenues, the share of domestic transactions in the total is reduced to 55%.

per Pillar Two based on firms' unrelated party revenues: introducing the adjustment, tax havens' share of the additional taxes from foreign multinationals is reduced from 20% to 13%, their absolute revenue gains being cut by close to a quarter. The database is readily available online, as well as a fully flexible Python package allowing to manipulate the various parameters of the adjustment. In the short to medium term, we wish to draw attention to this adjusted database, as a way to collect feedback and improve upon the current limitations of the computations.

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A Appendix to the quantitative analysis

A.1 Econometric modelling

Table 9: Initial results with the logarithm of the retention rate instead of the plain tax rate

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)	(5) ln(UPR)
ln(Retention rate) - Statutory	1.345**				
	(0.021)				
ln(Retention rate) - EATR		0.996*			
		(0.081)			
ln(Retention rate) - Statutory, lagged			1.120*		
			(0.052)		
ln(Retention rate) - Lagged CbCR ETR, cash				1.085**	
				(0.045)	
ln(Retention rate) - Lagged CbCR ETR, accrued					2.238***
					(0.000)
ln(GDP) - WOE	1.194***	1.188***	1.190***	1.215***	1.243***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	0.292***	0.293***	0.290***	0.244	0.279*
	(0.004)	(0.004)	(0.004)	(0.107)	(0.056)
ln(Distance)	-0.488***	-0.463***	-0.481***	-0.132	-0.214
	(0.002)	(0.003)	(0.002)	(0.518)	(0.269)
Constant	-6.610	-7.321	-7.063	-13.60**	-10.33
	(0.207)	(0.163)	(0.177)	(0.049)	(0.121)
Gravity control variables	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	508	508	508	255	254
R-squared	0.837	0.836	0.837	0.842	0.857
Adj. R-squared	0.832	0.831	0.832	0.832	0.849

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table adjusts the benchmark specification by considering the logarithm of retention rates (i.e., $log(1 - \text{tax rate})$) instead of plain tax rates in the set of regressors. We use the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues, "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook and "EATR" for the Effective Average Tax Rate. Effective tax rates are also computed based on the positive-profit sub-sample of the IRS' country-by-country report statistics for each affiliate country and year ("Lagged CbCR ETR (cash)" and "Lagged CbCR ETR (accrued)", respectively using income taxes paid on a cash basis and income taxes accrued). They are included with a one-year lag in the set of regressors to limit endogeneity issues.

Table 10: Review of initial results with the Logistics Performance Index as foreign market access proxy

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)	(5) ln(UPR)
ln(Retention rate) - Statutory	0.892				
	(0.134)				
ln(Retention rate) - EATR		0.754			
		(0.160)			
ln(Retention rate) - Statutory, lagged			0.817		
			(0.165)		
ln(Retention rate) - Lagged CbCR ETR, cash				0.729***	
				(0.004)	
ln(Retention rate) - Lagged CbCR ETR, accrued					1.522***
					(0.000)
ln(GDP) - WOE	1.037***	1.033***	1.036***	0.989***	1.021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Logistics Performance Index)	4.302***	4.355***	4.313***	4.825***	4.444***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Distance)	-0.369***	-0.360***	-0.368***	-0.327*	-0.362**
	(0.006)	(0.007)	(0.006)	(0.064)	(0.033)
Constant	-6.864**	-7.012**	-6.969**	-8.874**	-8.396**
	(0.023)	(0.020)	(0.021)	(0.019)	(0.022)
Gravity control variables	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	490	490	490	256	255
R-squared	0.881	0.881	0.881	0.883	0.890
Adj. R-squared	0.877	0.877	0.877	0.876	0.883

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table adjusts the log retention rate specification by introducing an alternative measure of foreign market access. Instead of the one proposed by Laffitte and Toubal (2022) based on Head and Mayer (2013), we use the Logistics Performance Index of the World Bank (2018). We use the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues, "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook and "EATR" for the Effective Average Tax Rate. Effective tax rates are also computed based on the positive-profit sub-sample of the IRS' country-by-country report statistics for each affiliate country and year ("Lagged CbCR ETR (cash)" and "Lagged CbCR ETR (accrued)", respectively using income taxes paid on a cash basis and income taxes accrued). They are included with a one-year lag in the set of regressors to limit endogeneity issues.

Table 11: Review of initial results with the logarithm of mean daily wage in the set of regressors

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)	(5) ln(UPR)
ln(Retention rate) - Statutory	0.718				
	(0.283)				
ln(Retention rate) - EATR		0.492			
		(0.396)			
ln(Retention rate) - Statutory, lagged			0.427		
			(0.519)		
ln(Retention rate) - Lagged CbCR ETR, cash				1.070**	
				(0.036)	
ln(Retention rate) - Lagged CbCR ETR, accrued					2.000***
					(0.000)
ln(GDP) - WOE	1.169***	1.164***	1.161***	1.157***	1.186***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	0.296***	0.296***	0.293***	0.251*	0.294**
	(0.004)	(0.004)	(0.004)	(0.084)	(0.039)
ln(Distance)	-0.188	-0.170	-0.174	-0.192	-0.274
	(0.232)	(0.270)	(0.269)	(0.323)	(0.147)
ln(Mean daily wage)	0.475***	0.477***	0.477***	0.294***	0.246***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Constant	-3.272	-3.670	-3.835	-7.349	-4.931
	(0.534)	(0.485)	(0.464)	(0.279)	(0.454)
Gravity control variables	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	442	442	442	242	241
R-squared	0.876	0.875	0.875	0.869	0.878
Adj. R-squared	0.871	0.871	0.871	0.861	0.870

p-values in parentheses

Using robust standard errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table adjusts the log retention rate specification by introducing the logarithm of mean daily wage into the set of regressors. Data on mean earnings come from ILO (n.a.). We use the IRS' aggregate country-by-country report statistics from 2016 to 2019. Estimation is done via Ordinary Least Squares (OLS); time fixed effects and gravity control variables are systematically included. "UPR" stands for unrelated party revenues, "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook and "EATR" for the Effective Average Tax Rate. Effective tax rates are also computed based on the positive-profit sub-sample of the IRS' country-by-country report statistics for each affiliate country and year ("Lagged CbCR ETR (cash)" and "Lagged CbCR ETR (accrued)", respectively using income taxes paid on a cash basis and income taxes accrued). They are included with a one-year lag in the set of regressors to limit endogeneity issues.

Table 12: Review of initial results with affiliate country fixed effects

	(1) ln(UPR)	(2) ln(UPR)	(3) ln(UPR)	(4) ln(UPR)	(5) ln(UPR)
ln(Retention rate) - Statutory	0.839				
	(0.229)				
ln(Retention rate) - EATR		0.885			
		(0.134)			
ln(Retention rate) - Statutory, lagged			-0.636		
			(0.336)		
ln(Retention rate) - Lagged CbCR ETR, cash				0.100*	
				(0.059)	
ln(Retention rate) - Lagged CbCR ETR, accrued					0.430*
					(0.054)
ln(GDP) - WOE	1.676***	1.679***	1.671***	1.959***	1.729***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Foreign Market Access)	-0.0655	-0.0595	-0.0478	-0.0234	-0.0133
	(0.822)	(0.837)	(0.870)	(0.930)	(0.955)
Constant	-20.81**	-20.87**	-21.02**	-28.38**	-22.24**
	(0.019)	(0.019)	(0.018)	(0.045)	(0.027)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	508	508	508	255	254
R-squared	0.278	0.278	0.276	0.425	0.451
Adj. R-squared	0.269	0.270	0.267	0.414	0.440

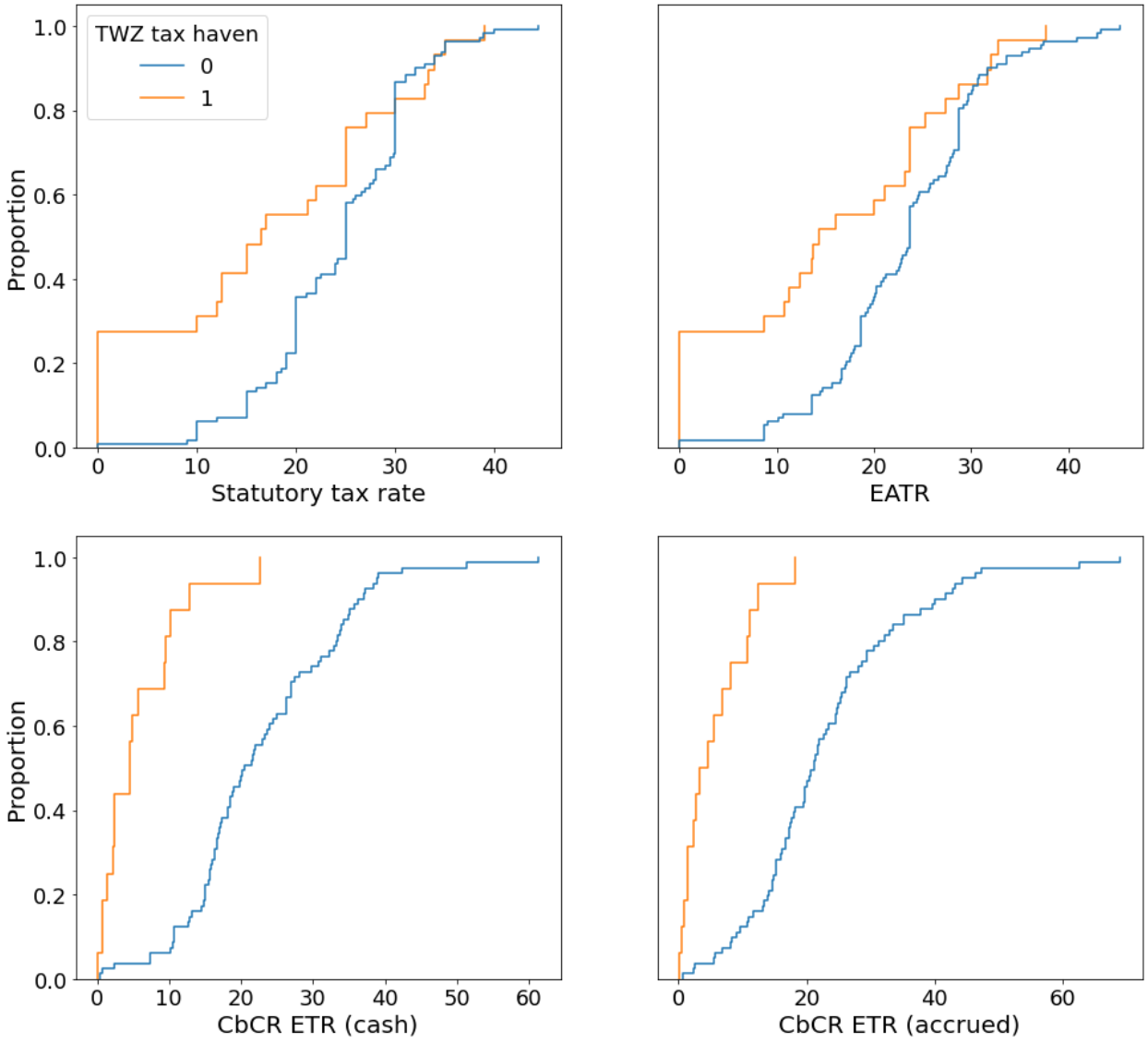
p-values in parentheses

Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: This table adjusts the log retention rate specification by introducing affiliate country fixed effects. We use the IRS' aggregate country-by-country report statistics from 2016 to 2019, treated as an unbalanced panel. We rely on the "within estimator"; year fixed effects are systematically included. "UPR" stands for unrelated party revenues, "ln(GDP) - WOE" for the logarithm of the Gross Domestic Product sourced from the IMF's World Economic Outlook and "EATR" for the Effective Average Tax Rate. Effective tax rates are also computed based on the positive-profit sub-sample of the IRS' country-by-country report statistics for each affiliate country and year ("Lagged CbCR ETR (cash)" and "Lagged CbCR ETR (accrued)", respectively using income taxes paid on a cash basis and income taxes accrued). They are included with a one-year lag in the set of regressors to limit endogeneity issues.

Figure 7: Distribution of the main tax rate measures, distinguishing the tax havens identified by Tørsløv, Wier, and Zucman (2018)



Note: This figure shows the empirical cumulative distribution functions for the main tax rate measures in our econometric analysis, while distinguishing the tax havens identified by Tørsløv, Wier, and Zucman (2018) from other non-haven affiliate countries in the IRS' country-by-country report statistics. Each panel corresponds to a different tax rate measure. The top-left panel corresponds to the statutory corporate income tax rate and the top-right panel to the Effective Average Tax Rate (EATR, including the extension with the methodology proposed by Bratta, Santomartino, and Acciari (2021)). The bottom-left panel corresponds to the cash-based effective tax rate computed from the positive-profit sub-sample of country-by-country report statistics and the bottom-right panel to the accrual-based effective tax rate. All measures are taken in 2017.

B Appendix to the adjustment of revenue variables

B.1 Data on the activities of multinational enterprises

B.1.1 Definitions of the revenue variables

In country-by-country report statistics, the three revenue variables are defined as follows:

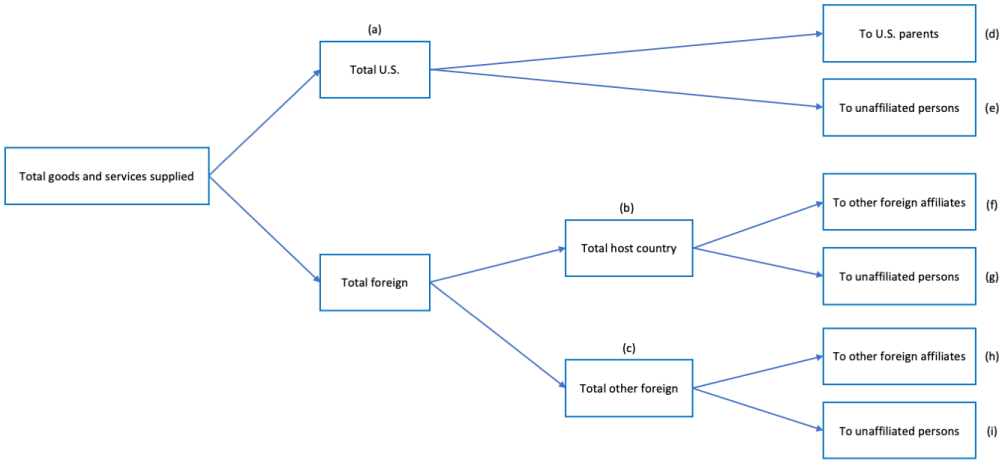
- Unrelated party revenues: "The sum of revenues of all the constituent entities of the MNE group in the relevant tax jurisdiction generated from transactions with independent parties."
- Related party revenues: "The sum of revenues of all the constituent entities of the MNE group in the relevant tax jurisdiction generated from transactions with associated enterprises."
- Total revenues: "Revenues should include revenues from sales of inventory and properties, services, royalties, interest, premiums and any other amounts. Revenues should exclude payments received from other constituent entities that are treated as dividends in the payer's tax jurisdiction. Total revenues should equal the sum of unrelated and related party revenues."

In the BEA's data on the activities of US multinational enterprises, the sales of goods and services are defined as follows:

- Goods supplied: "Goods supplied are generally defined as sales of economic outputs that are tangible. For sales in wholesale and retail trade, goods supplied include only the value of goods resold; they consist of reported sales of goods less BEA's estimate of the value of the distributive services provided by selling, or arranging for the sale of, goods (this estimate is added to reported sales of services to calculate services supplied)."
- Services supplied: "Services supplied are generally defined as sales of economic outputs that are intangible. For sales in insurance, services supplied consist of reported premiums less BEA's estimates of the premiums set aside for expected or 'normal' losses plus a measure of premium supplements, which represent income earned on funds that insurers hold on policyholders' behalf. For sales in banking, services supplied include not only the explicit fees and commissions reported as sales but also BEA's estimate of the value of implicit services provided by banks. (The values subtracted from and added to sales of services in insurance and banking are added to and subtracted from, respectively, reported values of other income.) For sales in wholesale and retail trade, services supplied include BEA's estimate of the value of the distributive services provided by selling, or arranging for the sales of, goods (this estimate is subtracted from reported sales of goods to calculate goods supplied). For industries other than insurance, banking, and wholesale and retail trade, services supplied consist of reported sales of services."

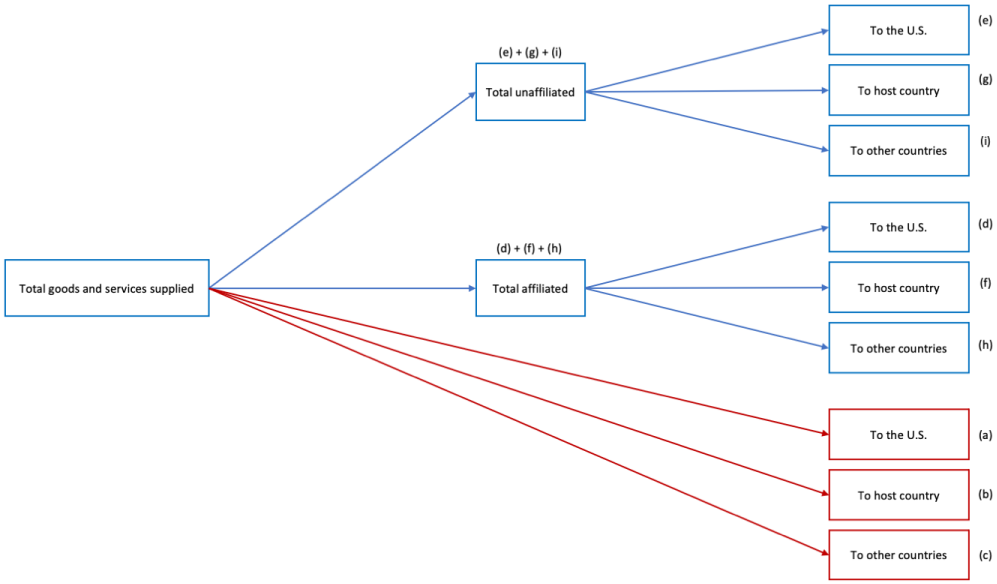
B.1.2 Organization of Table II.E2 in the BEA's data

Figure 8: Disaggregation of the goods and services supplied in Table II.E2 of the BEA's data on the activities of US multinational enterprises



B.1.3 Re-organization of Table II.E2 for the destination-based adjustment

Figure 9: Disaggregation of the goods and services supplied after the re-organization operated in the destination-based adjustment of revenue variables



B.1.4 Illustrating the combination of IRS and BEA data

To illustrate the computations that combine the country-by-country revenue variables and the BEA's statistics, we take the example of France.

Step 1

In the IRS' 2017 country-by-country report statistics, this affiliate country is associated with the following values for revenue variables:

- Unrelated party revenues: 146.5 billion USD;
- Related party revenues: 58.1 billion USD;
- Total revenues: 204.6 billion USD.

Step 2

From the Table II.E2 of the BEA's 2017 data on the activities of US multinationals, we have the following:

- Goods and services supplied to unaffiliated parties amount to 155.3 billion USD. These are distributed as follows:
  - 84% (131.0 billion USD) are directed to France;
  - 1% (1.8 billion USD) are directed to the US;
  - 14% (22.5 billion USD) are directed to other countries.
- Goods and services supplied to affiliated parties amount to 41.5 billion USD. These are distributed as follows:
  - 21% (8.7 billion USD) are directed to France;
  - 13% (5.3 billion USD) are directed to the US;
  - 66% (27.5 billion USD) are directed to other countries.
- Total goods and services supplied amount to 196.7 billion USD. These are distributed as follows among ultimate destination types:
  - 71% (139.8 billion USD) are directed to France;
  - 4% (7.0 billion USD) are directed to the US;
  - 25% (49.9 billion USD) are directed to other countries.

Step 3

From there, we deduce the following split for the three revenue variables in the IRS' country-by-country report statistics:

- Unrelated party revenues:
  - $84\% * 146.5 = 123.7$ billion USD are directed to France;
  - $1\% * 146.5 = 1.7$ billion USD are directed to the US;
  - $14\% * 146.5 = 21.2$ billion USD are directed to other countries.
- Related party revenues:
  - $21\% * 58.1 = 12.2$ billion USD are directed to France;
  - $13\% * 58.1 = 7.4$ billion USD are directed to the US;

- $66\% * 58.1 = 38.5$ billion USD are directed to other countries.

- Total revenues:
  - $71\% * 204.6 = 145.4$ billion USD are directed to France;
  - $4\% * 204.6 = 7.3$ billion USD are directed to the US;
  - $25\% * 204.6 = 51.9$ billion USD are directed to other countries.

Other cases

Should France be absent from BEA data, in Step 2, we would instead compute the amounts of goods and services supplied to affiliated, unaffiliated and any party at the European level. We would have similarly computed the destination-based distribution of these three amounts at the continental level. From there, the resulting percentages would have been applied similarly as in Step 3, so as to split the revenue variables of country-by-country report statistics.

B.2 Trade statistics

A key purpose of our research on the revenue variables of country-by-country report statistics is to propose an adjusted geographical breakdown of unrelated party, related party and total revenues that reflects the ultimate destination of the sales, rather than the location of the subsidiaries that register the transactions in their financial accounts. The methodology developed works in two steps: (i) at the country-pair level, revenue variables are split between revenues directed to the affiliate country, to the headquarter country or to any other destination and (ii) the latter are distributed to their (approximative) final destination based on the distribution of the affiliate country's exports of goods and services.

Because of their important role in the adjustment methodology, trade statistics must be selected carefully. The following describes the different databases that were considered, the criteria used to assess them and the combination of sources retained for benchmark computations. Section B.2.1 highlights the main criteria that may differentiate the databases and their influence over the selection process. Sections B.2.2 and B.2.3 present the sources considered for respectively trade in goods and trade in services. Section B.2.4 details the combination of data used in the main computations. Eventually, Section B.2.6 describes the preparation of the selected data.

B.2.1 General considerations

Our use case for trade statistics first requires bilateral data, that show a detailed breakdown of partner countries for each exporting country. Besides, since country-by-country revenue variables cover (among other elements) the sales of both goods and services, we are looking for either a unique source combining merchandise and service flows or different but compatible sources. Third, while trade statistics may often differ based on the sectoral disaggregation that they allow, we only use the total exports of goods and services for now.[38]

From there, Laffitte and Toubal (2022) point at an additional dichotomy in merchandise trade statistics: while data sources based on customs registries define transactions by considering *the physical cross-border movement of goods*, the statistics on the exports of goods from countries' balances of payments measure trade according to *changes in ownership*. Laffitte and Toubal (2022) further underline the impact of this distinction in the case of Apple's contract manufacturing processes. Put in a very schematic manner, let us consider a French consumer buying an iPad in a French store. The good was produced by Apple's manufacturing partner in China but remained, throughout the whole value chain, the property of Apple's Irish subsidiary (as defined in the contract binding Apple and the manufacturing partner). Once assembled, the device was shipped directly from China to France. The good is then treated differently depending on the database considered: customs registries reflect an export from China to France based on the movement of the

38. An industry-by-industry adjustment of US country-by-country reports statistics could be considered. Indeed, the IRS proposes these data for 7 broad groups of sectors and the BEA data on the activities of US multinational enterprises also provide sectoral breakdowns.

product, whereas the Irish balance of payments records an export of merchandise from Ireland to France as the ownership is transferred from Apple Sales International (incorporated in Ireland) to the French consumer.

In US country-by-country report statistics, this sale by Apple would be recorded based on the tax residence of the affiliate that owns the product until it is bought in France and that registers the transaction in its income statement, Apple Sales International. Due to the corporate structure set up by Apple for tax planning purposes, which Laffitte and Toubal (2022) describe based on declarations to the US Senate, the activities of the Irish subsidiary may appear under "Stateless entities". But assuming that it instead accrues to the unrelated party revenues of US multinational companies in Ireland, our aim is to re-attribute an approximately equivalent amount to France. This can only be achieved if the trade statistics used in our adjustment include a corresponding transaction from Ireland to France. More generally, we are looking to approximate a distribution of multinational companies' sales that would be based on the ultimate location of customers. We should ideally favor data sources that measure trade according to changes in ownership, like the exports of goods and services shown in balances of payments.

Eventually, in merchandise trade statistics based on customs registries, imports and exports are not accounted for in the same way, which may lead (among other factors) to bilateral inconsistencies. In the United Nations (2011) framework, that provides the statistical standard for most data sources on trade in merchandise, it is recommended that imports be accounted for on the basis of the country of origin of the goods and that exports be reported on the basis of the country of last known destination at the time of the export. These notions are defined as follows:

- Rules of origin generally include two criteria: "the criterion of goods *wholly produced* (obtained) in a given country, where only one country enters into consideration in attributing origin; the criterion of *substantial transformation*, where two or more countries have taken part in the production of the goods";
- "The country of last known destination is the last country - as far as it is known at the time of exportation - to which goods are to be delivered, irrespective of where they have been initially dispatched to and whether or not, on their way to that last country, they are subject to any commercial transactions or other operations that change their legal status".

In practice, both of these notions present difficulties:

- For imports, the country of origin may be difficult to identify for several reasons. First, and very simply, documentary requirements regarding the origin of the goods vary from a country to another and therefore, the quality of the available information is uneven. Besides, according to United Nations (2011), statistics on trade between the members of a customs union often record imports based on the country of consignment (to which the goods are dispatched from the exporting country), instead of the country of origin;
- For exports, when the good leaves the country where it was initially produced, its ultimate destination is not always known. As such, the country of last known destination reported to customs may not correspond to the place where the good will be consumed or used. This is especially true with the increasing complexity of globalized value chains (e.g., the good may have to follow a series of secondary transformations and the location of the final steps may not be known long in advance) and the optimization of logistic chains (e.g., the last known destination at the time of the export can be a warehouse in Belgium, from which the good will finally be sent to France, Germany or the Netherlands).

Despite these difficulties, the notion of "country of origin" attached to imports is closer to our objective of building a distribution of sales that reflects the final destination of the transactions. Therefore, in the preprocessing of merchandise trade statistics based on customs data, we systematically focus on imports.

B.2.2 Statistical sources on trade in goods

Merchandise trade statistics based on customs registries As illustrated by Laffitte and Toubal (2022) with the case of Apple, trade in goods statistics based on customs registries define transactions according to the cross-border movement of goods. They generally follow the methodology of the United

Nations (2011) under which "as a general guideline, it is recommended that international merchandise trade statistics record all goods which add to or subtract from the stock of material resources of a country **by entering (imports) or leaving (exports) its economic territory**" (page 13). Change of ownership may also be used but "only in exceptional cases when the general guideline is not applicable or not sufficient" (page 13).

Two sources of such merchandise trade statistics are considered for our adjustment of country-by-country revenue variables. First, UN Comtrade data constitute the reference statistical source for customs-based merchandise trade flows (see United Nations (2016-2019)). As such, these data follow the United Nations (2011) standard and reflect the physical cross-border movement of goods. They feature additional information and allow for instance to isolate re-exports or re-imports.[39] We download the relevant data from the UN Comtrade online portal.[40] For the year 2017, focusing on imports, the resulting dataset involves 234 unique partners and 169 unique reporters while, on average, each reporter is associated with 167 partners.

Second, we consider the Balanced International Merchandise Trade Statistics (BIMTS) of the OECD (see OECD (2016-2019a) to access the data and Fortanier and Sarrazin (2016) for the corresponding methodology). Readily accessible on the data portal of the OECD, BIMTS cover more than 160 reporting countries. For each of these, the dataset provides its "Balanced Trade Value", i.e. its exports corrected for bilateral asymmetries, to a variety of partner countries in current USD. Data are available for 12 years, from 2007 to 2018, and for a broad variety of commodity categories. In 2017, focusing only on the total of all commodities, the dataset covers 162 unique partners and on average, each reporting country is associated with 135 destinations.

Merchandise trade statistics as per the balance of payments On the other hand, balances of payments use ownership changes as the primary criterion to define trade flows. The latest and most broadly applied standard for such reporting is the Sixth Edition of the Balance of Payments and International Investment Position Manual (BPM6, International Monetary Fund (2010)). In particular, in the goods and services account, balances of payments include a "general merchandise" field defined as follows: "general merchandise on a balance of payments basis covers **goods whose economic ownership is changed between a resident and a nonresident** and that are not included in the following specific categories: goods under merchanting, nonmonetary gold, and parts of travel, construction, and government goods and services not included elsewhere" (page 151).

The BEA maintains the US International Transactions Accounts (ITAs). In particular, the current account in these quarterly statistics theoretically records the exports of goods and services from US residents to non-residents based on changes in ownership. On the data portal of the BEA, we focus on Table 1.5 "U.S. International Trade in Goods and Services by Area and Country" (see BEA (2016-2019b)). From 1999 to 2020, it provides several indicators that break down by sector and nature of transactions the US exports and imports of goods and services to and from 90 partners. The latter include 18 continental aggregates or regional organizations and 72 destination countries (UK Caribbean Islands being aggregated as a single destination country). The bilateral breakdown of US transactions in these data is thus less granular than in the UN Comtrade database or the BIMTS, but the way trade is defined in principle corresponds more closely to our use case.

In practice, as explained in Bureau of Economic Analysis (2021), the US ITAs are not fully consistent with the BPM6 standards, due in particular to the treatment of "manufacturing services on physical inputs owned by others" (which corresponds to the contract manufacturing operations described by Laffitte and Toubal (2022)). For instance, when US-owned goods leave the US for processing, they are counted as part of exports based on the physical movement of the merchandise; when they are sent back to the US, they appear as imports despite the absence of a change in their ownership. Articles 11.3 to 11.6 describe the issue in more details. Therefore, the ITAs do not yet allow to treat the goods exchanged via contract manufacturing relationships in a way that would be closer to our definition of destination-based sales than what can be

39. Re-exports occur when a country imports foreign goods and then re-exports them to their country of origin; they are included in the country's exports, but United Nations (2011) recommends they be also recorded as a standalone item. Re-imports occur when a country exports goods to a foreign partner and then re-imports them; they are included in the country's imports, but United Nations (2011) recommends they be also recorded as a standalone item.

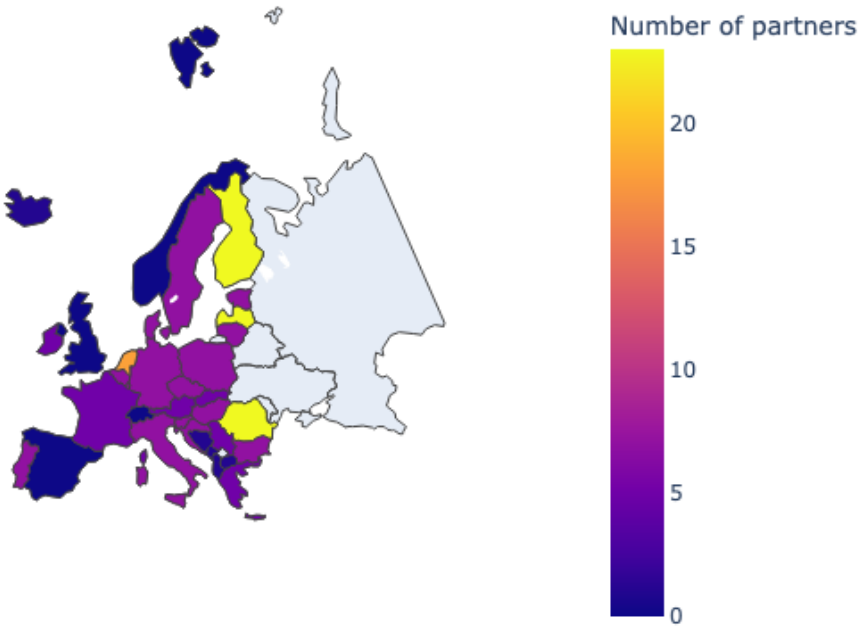
40. The process followed to collect these data is described in details in this online repository: https://github.com/pechouc/comtrade_data_selection.

achieved with customs-based sources.

Bilateral data on the exports of goods as per the balance of payments, that define transactions based on changes in ownership, are limited outside of the US. In its balance of payments annual data, Eurostat provides a limited breakdown of the exports of goods by partner country. Granularity varies depending on the field (e.g., "goods" or "general merchandise on a balance of payments basis") and on the reporting country considered.

- For general merchandise in particular (on which we focus when dealing with US ITAs), only 4 reporting countries display more than 20 partner entities: Cyprus, Finland, Latvia and Romania. The Netherlands is associated with 18 partners and the 33 other reporting countries display 7 partners or less. In most cases, only a distinction between intra-EU and extra-EU exports (or exports to and outside the Euro area) is given. In the above, the number of partner countries is systematically assessed after eliminating missing values. The map in Figure 10 shows the number of partner entities associated to each reporting country, taking 2016 as reference.

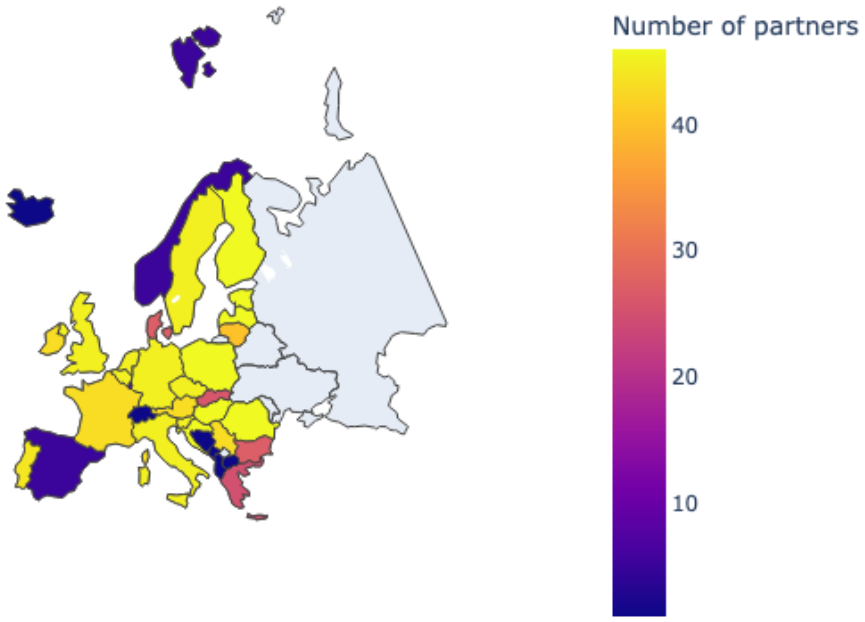
Figure 10: Granularity of the bilateral breakdowns of the "general merchandise on a balance of payments basis" item in Eurostat data per parent country



- Considering the total exports of goods allows for higher granularity. Most EU Member-States display 40 partner countries or more as can be seen in Figure 11 (excluding missing values and again taking 2016 as reference). However, one must keep in mind that the total exports of goods include not only the general merchandise as defined above but also the undesired "net exports of goods under merchanting" (which may lead to negative values in rare cases) and "non-monetary gold". The coverage for these

two sub-fields is similar to that of general merchandise and thus, they cannot be isolated from the total exports of goods.

Figure 11: Granularity of the bilateral breakdowns of the "goods" item in Eurostat data per parent country



To assess whether total exports of goods as per the balance of payments could be used as the trade statistics required by our methodology, we further examine the consistency between general merchandise and total exports of goods data. Indeed, if the two values are close, we could defend the assumption that the distribution of total exports of goods can be used as a proxy for the distribution of the exports of general merchandise, on which we would ideally focus. We do so by comparing the 262 reporting country / partner entity pairs for which they are both available:

- For 30 of them, the numbers are the same, meaning that there are no net exports of goods under merchanting nor exports of non-monetary gold or that both cancel out (as the former can be negative);
- 41 pairs display a strictly larger amount for general merchandise, which may happen if the net exports of goods under merchanting are negative. Total exports of good are then 1.3% smaller than exports of general merchandise on average;
- Eventually, in most cases (191 observations or 73% of the sample), the value for general merchandise is strictly lower than the total exports of goods. For these observations, on average, total exports of goods are 2.9% higher than the exports of general merchandise.

But the weight of the different categories of merchandise exports in the total varies substantially from a reporting country to another. We compute the ratio of total exports of goods to exports of general

merchandise for each reporting country (restricting partners to "EU28" and "EXT_EU28" and summing each variable over the two). Total exports of goods can be larger than general merchandise exports by up to 29.7% in the case of Luxembourg. Sweden, Denmark and Cyprus also display substantial discrepancies of respectively 9.0%, 6.8% and 6.5%. Eventually, 4 other countries (Ireland, Austria, Germany and Belgium) display a discrepancy of more than 3% between the two totals. From these observations, we conclude that although total exports of goods are closely comparable with the exports of general merchandise in most cases, this approximation cannot reasonably apply to several reporting countries.

B.2.3 Statistical sources on trade in services

Contrarily to the exports of goods, the main statistical standards for trade in services are consistent with the definition of trade as per the balance of payments and with the BPM6 standard. More precisely, the 1994 General Agreement on Trade in Services (GATS) defines trade in services as the delivery of a service through one of the following modes of supply:

- Cross-border supply, whenever a service is produced in a country and consumed in another;
- Consumption abroad, which takes place when a service is consumed in the country where it is produced but the consumer or his/her property is abroad at the moment of consumption;
- Commercial presence, which covers cases when the service supplier establishes a foreign presence to deliver the services;
- And presence of natural persons, when an individual is present abroad to deliver the commercial services on behalf of a foreign firm.

The exports of services as they are presented in countries' balance of payments reflect all these modes of supply but the third one. In the second and fourth cases, the service is consumed and produced in the same country but either of the parties involved in the transaction is located abroad. Commercial presence, in which case the legal persons trading are both found in the same country, is instead covered by the Foreign Affiliate Trade Statistics (FATS).

Furthermore, most statistical sources break down the exports of services according to the Extended Balance of Payments Services (EBOPS 2010) classification as defined in BPM6 (see International Monetary Fund (2010)). This classification distinguishes the following 12 categories:

Table 13: Extended Balance of Payments Services (EBOPS 2010) classification

Manufacturing services on physical inputs owned by others
Maintenance and repair services n.i.e.
Transport
Travel
Construction
Insurance and pension services
Financial services
Charges for the use of intellectual property n.i.e.
Telecommunications, computer, and information services
Other business services
Personal, cultural, and recreational services
Government goods and services n.i.e.

Note: "n.i.e." stands for "not included elsewhere".

Our main source of trade in services data is the Balanced Trade in Services (BaTIS) database of the OECD and the WTO (see OECD-WTO (2016-2019) to access the data and Liberatore and Wettstein (2021) for the methodology). The database was first released in 2017 under the BPM5 standard and importantly, it was updated to BPM6 in early 2021. It provides annual data on the exports of services of 202 reporting economies from 2005 to 2019. Exports are broken down according to the 12 main EBOPS categories and the database therefore allows to distinguish commercial services from governmental services. Taking the example of the year 2017, considering exports, final balanced values and commercial services, each reporting country is associated with 200 destinations on average.

In the work of Liberatore and Wettstein (2021), the most extreme differences between reported trade values and final balanced values are observed for Bermuda. The authors explain that "the United States, the Netherlands, Ireland and the United Kingdom report sizeable transactions with Bermuda, most notably in insurance and financial services, which appear to go completely undetected in Bermuda's own data. These issues are most probably linked to the presence of foreign-controlled MNEs and also occur, although at a smaller scale, in countries such as the Cayman Islands and Barbados". The balanced exports of services of Bermuda are 41 times larger than its reported exports, meaning that other countries register much larger imports of services from Bermuda than Bermuda does in its exports. Similarly, the balanced imports of services of Bermuda are 18 times larger than its reported imports, meaning that other countries register much larger exports of services to Bermuda that Bermuda does in its imports. To some extent, the same appears for the Cayman Islands and Barbados. We explain below how we deal with these specific cases.

As a potential alternative for the US, the ITAs prepared and released by the BEA also provide bilateral information on trade in services. However, as the corresponding merchandise trade statistics, they are not entirely consistent with the BPM6 standard, due again to the treatment of contract manufacturing relationships. For instance, when Apple goods are produced abroad by a contract manufacturer, no exchange of merchandise should be recorded based on the change in ownership criterion but a manufacturing service is imported from abroad by Apple. In the Article 12.5 of Bureau of Economic Analysis (2021), the authors explain that "the coverage and presentation of services differ in some ways from BPM6 recommendations. One major gap stems from not yet providing estimates of *manufacturing services on physical inputs owned by others*, a specific form of contract manufacturing. At present, BEA's statistics show 'n.a.' (not available) for this major services component".

B.2.4 Retained benchmark

We retain the following trade statistics for the benchmark destination-based adjustment:

- For merchandise trade statistics, we rely on the UN Comtrade database. We primarily focus on imports, as the associated criterion of the country of origin relates more closely to our purpose of identifying the final destination of the transactions, and we subtract re-imports whenever they are reported. With this selection, we leave aside from the benchmark:
  - Balance of payments statistics. While the bilateral breakdown provided by Eurostat data is too narrow for our computations, the US ITAs could be a reasonable alternative. However, its departures from BPM6 (and thus, from the change in ownership criterion) in the case of contract manufacturing relationships reduces the interest of using these data for our purpose. Because they are based on customs registries, UN Comtrade data share these issues, but their bilateral breakdown is more granular;[41]
  - BIMTS data, which only provide balanced values of trade (that aim at reconciling the gaps between the exports and the imports). Imports indeed correspond more closely to the goal of our adjustment. We illustrate this issue with the specific case of Hong Kong below.
- For trade in services statistics, we use BaTIS data. We focus on balanced values of trade and on commercial services. According to Liberatore and Wettstein (2021), in the case of manufacturing services on physical inputs owned by others, the balanced value is close to the reported exports of

41. That being said, if the ITAs are updated to match the BPM6 standards in the future or if another statistical source ultimately provides trade in merchandise data that are compatible with the change in ownership criterion, this choice may very well be reconsidered.

services as many importing countries do not yet record this item. Besides, in the specific case of Bermuda, the Cayman Islands and Barbados, we rely on the values reported by their partners.

In the benchmark computations, the same data sources are used for the US and for other countries. The code however allows to distinguish the two as the US ITAs may provide a satisfying alternative to the main estimates. In the case of services, the code also allows to exclude certain types of flows based on the EBOPS classification of Figure 13 (which we do not do in the benchmark). For instance, as the "charges for the use of intellectual property" are often used by multinational companies to shift their profits to low-tax jurisdictions, we may want to abstract from them.

B.2.5 Treatment of China - Hong Kong - US trade flows in BIMTS

The treatment of Hong Kong in Fortanier and Sarrazin (2016) illustrates well the reason why the BIMTS balanced value of trade may not correspond to the purpose of our destination-based adjustment. Mainly due its role of interface between China and the rest of the world, 96% of the exports reported by Hong Kong in UN Comtrade data are in fact re-exports. When the ultimate destination country instead registers the country of origin of the goods (most often China) in its imports, substantial asymmetries arise. By combining detailed statistics on these re-exports from the Hong Kong Census Office with UN Comtrade data, Fortanier and Sarrazin (2016) provide the following example:

Figure 12: Extract from the methodological paper associated with BIMTS data

Table 4. Two examples of trade asymmetries between China and the US where re-exports from Hong Kong are important, before and after re-export adjustment ('000 USD, 2011)

	HS 851762*	HS851762 *adjusted*	HS 950490**	HS 950490 *adjusted*
(1) Exports of China to the US	4,975,623	4,975,623	1,627,651	1,627,651
(2) Exports of Hong Kong to the US	2,097,909	2,097,909	715,711	715,711
(3) Of which re-exports originating from China	*1,920,029*	*1,920,029*	*715,467*	*715,467*
(4) Imports of the US from China	9,482,884	7,562,855	2,352,516	1,637,049
(5) Imports of the US from HK	138,023	2,058,052	5,602	721,069
China-US asymmetry (abs)	4,507,261	2,587,232	724,865	9,398
Hong Kong- US asymmetry (abs)	1,959,886	39,857	710,109	5,358

** HS 851762: Machines for the reception, conversion & transmission/regeneration of voice, images/other data*
*** HS 950490: Articles for funfair/table/parlour games (excl. playing cards), incl. pintables*

In the HS 851762 category, Hong Kong registers 2.1 billion USD of exports to the US in 2011 but the vast majority of these correspond to re-exports of goods initially produced in China (Column 1). The US records very small imports of Hong Kong which would indicate that the country of origin (China) was correctly identified. The authors correct for this trade asymmetry by adjusting the US imports, which then reflect much larger imports from Hong Kong on the one hand and much lower imports from China on the other hand (Column 2). They justify this approach as "preserving the role of entrepôts in the value chain, recognizing their important role as a distribution and logistics hubs, whilst also minimizing the need for extra estimations" (indeed, other methods consist in estimating a Hong Kong mark-up on re-exports and re-attributing all remaining trade to the country of origin).

As our purpose is to proxy the final destination of transactions, we would instead consider the opposite adjustment, netting out the intermediary role of Hong Kong. This example illustrates why the balanced value of BIMTS data may not match our objective and highlights the importance of focusing on imports in UN Comtrade data.

B.2.6 Preparation of benchmark trade statistics

We collect UN Comtrade data from the dedicated online portal.[42] We restrict the set of partner entities to individual countries. We then complement the dataset with continent codes ("Africa", "Americas", "Asia-Pacific" and "Europe"). We primarily focus on imports net of re-imports, but we also make use of the available information about exports in some cases. Indeed, there are two main cases in which a pair of origin and destination country may appear in the exports but not in the imports:

- In the first case, the imports do not appear in the data because the destination country does not record any trade statistics in the UN Comtrade database. Let us consider the example of Gabon, which is absent from the database for the years considered. As such, if we focused exclusively on imports to build our mapping of merchandise flows, Gabon would never appear as a destination of exports. For instance, it would be associated with 0 exports of goods from France, while France records exports of merchandise worth 487.7 million USD to Gabon in 2017. To deal with such cases, for countries that do not report any trade data via the UN Comtrade database in the year considered, flows to these destinations are taken based on the exports reported by other countries. With exports too, we net out re-exports.

- In the second case, the destination country does report data via the UN Comtrade database. For instance, Aruba does not record any import from Uruguay in 2017, while Uruguay records non-zero exports to Aruba (2.8 million USD). We cannot determine whether this apparent inconsistency is due to an omission on the Aruba side or Uruguay was not identified as the country of origin of the transaction and thus netted out from imports as per the statistical standard for trade in merchandise. In such cases, we exclusively rely on imports.

For BaTIS data, we also restrict the set of reporters and partners to individual countries. In most cases, we focus on the balanced value of trade (i.e., the value that reconciles exports and imports) and on commercial services. In the specific case of Bermuda, the Cayman Islands and Barbados, we rely on the trade values reported by their partners: for their exports, we take partner countries' reported imports from Bermuda, the Cayman Islands and Barbados and their imports correspond to partner countries' reported exports. We add continent codes as for UN Comtrade data. Eventually, specifically in the BaTIS data, for certain reporting countries, some service exports are not broken down at the destination country level but are presented as directed to the "Rest of the world". We redistribute these amounts to the "Other Europe", "Other Africa", etc. aggregate partners based on continents' relative importance for each reporting country concerned.

In another module, we load the two datasets and restrict the set of destinations to the set of affiliate countries in either the IRS' or the OECD's country-by-country report statistics, depending on the use case. Partners that appear in trade statistics but are absent from the set of affiliate countries in country-by-country data are aggregated at the continental level. We then merge the two datasets on each pair of reporting and partner countries. We retain all the country pairs for which we have either merchandise- or service-related information and we replace the resulting missing values with zeros. This process has two main implications, which we illustrate with 2017 as reference year:

- First, it comes down to assuming that the coverage of the two datasets is complete for all the reporting countries that they involve. Let us take the example of France, which is present as a reporting country in both UN Comtrade and BaTIS datasets. Among the partner countries associated with France in the preprocessed UN Comtrade dataset, French exports of merchandise to Gibraltar are of 202.0 million USD. But Gibraltar does not appear among France's partners in the pre-treated BaTIS data. When merging the two datasets, we keep the France-Gibraltar row and replace the service exports by zero, considering that the partner being absent from BaTIS simply means that there are no exports of services from France to Gibraltar.

- Second, several exporting countries are only present in the UN Comtrade extract (35 countries) or in the BaTIS data (2 countries). It is not likely for these countries to exclusively export merchandise or

42. More details on the collection and compilation process are provided in this GitHub repository: https://github.com/pechouc/comtrade_data_selection.

services. Hence, if we were interested in the absolute amounts of exports of these countries, we should find a way to estimate the missing data. In our computations, we solely look for a distribution of these countries' exports, e.g. what percentage of Andorran exports (only in UN Comtrade data) France, the US or Germany represent. In this case, replacing missing values by zeros comes down to assuming that the distribution of observed exports is the same as that of unobserved transactions and thus, as the distribution of these countries' overall exports.

From there, having restricted the set of partner countries to that observed in the IRS' country-by-country report statistics and combined the two datasets, we obtain data on the exports of merchandise and / or services from 236 unique reporting countries to 138 partner countries. We sum merchandise and service exports into a single variable covering all kinds of exports.

There remain a few affiliate countries in the preprocessed country-by-country report statistics for which we lack a distribution of exports. In the specific case of the UK Caribbean Islands, which we aggregate as a single partner in country-by-country data to match BEA statistics on the activities of US multinational enterprises, the distribution of exports is obtained from the trade statistics available for the different jurisdictions composing this group. In all other cases, we impute the missing export distributions based on those observed at the continental level. By doing so, we obtain a distribution of exports, or at least a proxy for it, for all the affiliate countries in country-by-country report statistics.

Eventually, all export distributions are winsorized at the 0.5% level to eliminate the less significant destinations.

B.3 Remarks on the extension to non-US multinationals

In this section, we analyze a few possibly critical issues with the extension of our destination-based adjustment to non-US multinationals. In Section B.3.1, we first assess the existence of a "headquarter country bias" that would not be accounted for with our simplified methodology. In Section B.3.2, we underline another assumption on which the adjustment implicitly relies. However, we only have limited ways of testing or discussing this hypothesis.

B.3.1 Headquarter country bias

In our proposed extension of the destination-based adjustment to non-US multinationals, we extrapolate the BEA's data on the activities of multinational companies to non-US headquarters. We use them to split the revenue variables between local and foreign sales, the latter being obtained by summing the share of sales that are directed to the US and the share of transactions involving any other country. For instance, with this approach, French multinationals are estimated to record in 2017 14.5 billion USD of unrelated party revenues associated with foreign transactions in Singapore. While local sales are associated with their final destination, the revenues generated abroad are allocated based on the distribution of the affiliate country's exports. In particular, because France accounts for 1.4% of the exports of goods and services from Singapore, it is allocated 1.4% of the 14.5 billion USD identified above. A potential issue with this procedure could be that it does not account for the fact that France is the headquarter country of the multinationals considered: it is treated exactly like the US, China or Germany based on the distribution of Singaporean exports.

We use the BEA's data on the activities of US multinational enterprises to assess this issue. The adjustment may be questioned if a strong "headquarter country bias" is observed in the sales percentages of US multinational companies. For each affiliate country, we want to know whether sales to the US represent a disproportionate share of foreign sales (sales to the US plus sales to any third country), compared with the weight of the US in the exports of this country. Said otherwise, do the Singaporean affiliates of US multinational companies sell more in the US than Singapore exports to the US in general? We compare the sales percentages drawn from BEA data and the distribution of each affiliate country's exports from non-winsorized, benchmark trade statistics (UN Comtrade for merchandise and BaTIS for services). We obtain Table 14 for the 20 largest exporters to the US in 2017.

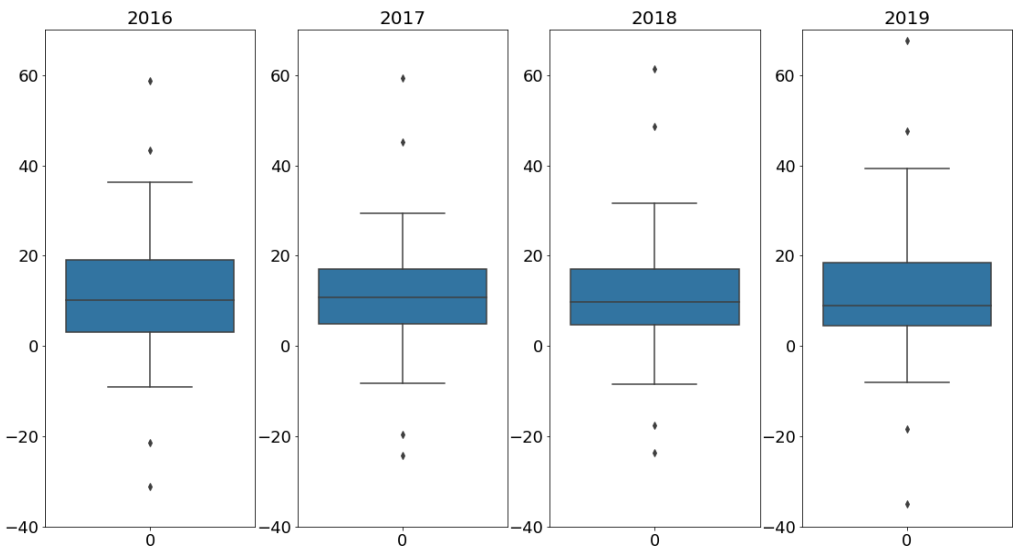
Table 14: Top twenty largest exporters to the US in 2017, with the share of the US in the total foreign sales booked by US multinational companies and in exports

Affiliate country	US share in foreign sales (%)	US share in exports (%)
China	36.3	19.9
Canada	83.2	68.0
Mexico	82.4	70.9
Japan	19.9	18.3
Germany	17.6	9.7
United Kingdom	25.1	16.3
Korea, Republic of	27.3	11.7
India	64.3	19.1
France	12.3	9.7
Ireland	18.7	21.4
Switzerland	13.8	13.7
Italy	30.0	9.8
Taiwan	22.3	10.6
Brazil	22.5	15.9
Malaysia	38.9	12.5
Thailand	31.7	11.6
Singapore	15.4	8.5
Netherlands	16.4	4.9
Israel	60.8	32.2
Belgium	22.8	5.6

Note: This table presents two percentage shares for each of the 20 largest exporters to the US in 2017. The "US share in foreign sales (%)" column is based on BEA data and is obtained as the ratio of total sales to the US to the sum of total sales to the US and to any third country. The "US share in exports (%)" column stands for the weight of the US in each country's total exports (including both merchandise and services). Export percentages are obtained by combining UN Comtrade statistics on trade in goods and BaTIS data for trade in services.

Except for Ireland (and Switzerland to some extent), the share of US sales in the BEA's data is consistently larger than the weight of the US in the country's exports. An extreme case is India: 64% of the foreign sales of goods and services of US multinational companies' affiliates in India are directed to the US, but the US only represents 19% of Indian exports. In Figure 13, we show the distribution of the gaps between both percentage series for the four income years available.

Figure 13: Distribution of the difference between the US share in foreign sales and the US share in exports



Note: For each available income year, this figure presents the distribution of the difference between the share of the US in the total foreign sales booked by US multinational companies in a given affiliate country and the weight of the US in the exports of this country. The share of the US in foreign sales is based on BEA data and is obtained as the ratio of total sales to the US to the sum of total sales to the US and to any third country. Export percentages are obtained by combining UN Comtrade statistics on trade in goods and BaTIS data for trade in services.

Consistently in the four years, the majority of observations display a positive gap, meaning that the share of sales to the US in the BEA's data is higher than the share of the US in the total exports of the country considered. This gap is generally comprised, roughly speaking, between 0 and 20 percentage points.

Coming back to the specific case of India, we also find that the discrepancy (64% vs. 19%) is mostly driven by sales to US parents: it is likely that many US multinational companies have offshored their manufacturing or internal service activities in India. What if we focus on sales of goods and services to unaffiliated entities in the BEA-based percentage? Table 15 follows the structure of the table above, focusing on extra-group transactions in the "US share of foreign sales (%)" column.

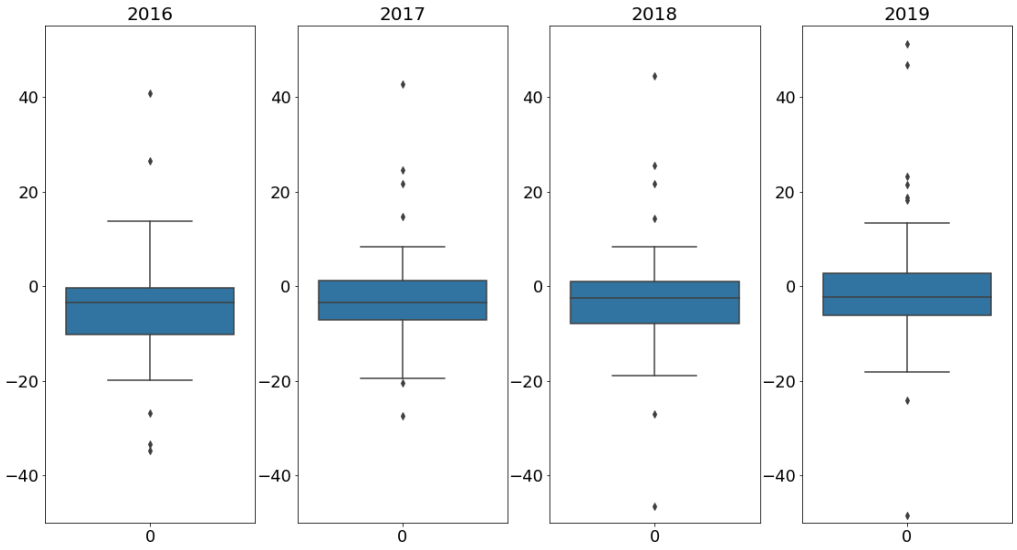
Table 15: Top twenty largest exporters to the US in 2017, with the share of the US in the sales to foreign unaffiliated entities of US multinational companies and in exports

Affiliate country	US share in foreign sales (%)	US share in exports (%)
China	13.3	19.9
Canada	63.4	68.0
Mexico	50.5	70.9
Japan	5.4	18.3
Germany	12.3	9.7
United Kingdom	14.6	16.3
Korea, Republic of	4.5	11.7
India	40.8	19.1
France	7.3	9.7
Ireland	2.0	21.4
Switzerland	7.2	13.7
Italy	16.0	9.8
Taiwan	25.4	10.6
Brazil	8.9	15.9
Malaysia	12.3	12.5
Thailand	5.6	11.6
Singapore	5.2	8.5
Netherlands	6.7	4.9
Israel	26.0	32.2
Belgium	1.5	5.6

Note: This table presents two percentage shares for each of the 20 largest exporters to the US in 2017. The "US share in foreign sales (%)" column is still based on BEA data, but it is now obtained as unrelated party sales to the US divided by the sum of unrelated party sales to the US and to any third country. The "US share in exports (%)" column stands for the weight of the US in each country's total exports (including both merchandise and services). Export percentages are obtained by combining UN Comtrade statistics on trade in goods and BaTIS data for trade in services.

The existence of a headquarter country bias is now much less obvious and on the contrary, the weight of the US in each country's exports is most often larger than the share of the US in the foreign unrelated party sales of local affiliates of US multinational companies. Interestingly, Ireland displays a very large gap (2% vs. 21%) while it used to show balanced figures (19% vs. 21%). This underlines the intense intra-group transactions that US multinational companies operate between their Irish subsidiaries and their headquarter. Figure 14 confirms this observation.

Figure 14: Distribution of the difference between the US share in sales to foreign unaffiliated entities and the US share in exports



Note: For each available income year, this figure presents the distribution of the share of the US in the sales directed to foreign unaffiliated entities and booked by US multinational companies in a given affiliate country, minus the weight of the US in the exports of this country. The share of the US in foreign sales is based on BEA data and is obtained as unaffiliated sales to the US divided by the sum of unaffiliated sales to the US and to any third country. Export percentages are obtained by combining UN Comtrade statistics on trade in goods and BaTIS data for trade in services.

The gaps are now centered closer to 0 percentage point and they are generally negative, down to circa -10 percentage points. Although there exists a headquarter country bias for total sales and there remains substantial heterogeneity even when we focus on third-party transactions, we conclude that our adjustment for unrelated party revenues should be more robust to a possible headquarter country bias than that for total or related party revenues.

B.3.2 Applicability of US multinational companies' domestic sales percentages

With our extended adjustment, when splitting the revenues booked by non-US multinational companies in the US between local and foreign sales, we apply the domestic split between local sales and sales from exports observed for US multinational companies in the US. In 2017, Table I. O1 gives that the 13,439 billion USD sales booked by US parents in the US are split as follows: 88% are directed to the US (or equivalently to the affiliate country) and 12% are directed to any foreign country. This split is stable over the years: for 2016, Table I. O1 also yields 88% vs. 12%; for 2018, we obtain 87% vs. 13%; for 2019, we obtain 88% vs. 12%. In the 2017 adjustment, we therefore assume that 88% of the revenues booked by non-US multinational companies in the US are directed to the US and that the rest corresponds to exports. One may question the "external validity" of this ratio that is computed for the domestic activities of US multinational companies and applied to foreign activities of non-US multinational companies.

The Analytical AMNE database of the OECD allows to challenge this figure (see OECD (2016) and Cadestin et al. (2018)). We use the "Analytical AMNE.xlsx" file downloaded from the OECD's website. The first tab ("GO bilateral"), once restricted to 2016 and the US, indicates that the gross output of foreign-owned firms in the US amounts to 2,590 billion current USD across all industries. The second tab, restricted to 2016, the US and foreign-owned firms, indicates that foreign multinational companies register 436 billion current USD of exports in the US. Taking the ratio of exports to gross output, we get 17%. This ratio can be compared with the 12-13% found above based on BEA data and both seem broadly consistent. However,

Analytical AMNE data are not available after 2016 and we cannot pursue this comparison for the other years in our sample.

B.4 Assessment of the adjustment

B.4.1 Revision of preliminary remarks

In this section, we replicate the results of our descriptive study, based on adjusted country-by-country revenue variables. We thereby underline the effect of our destination-based adjustment, which comforts our interpretation of the decorrelation between the distribution of unadjusted revenue variables and the location of US multinational enterprises' final markets.

Before digging deeper in country-level analyses, Table 16 allows to compare domestic and foreign sales after the destination-based adjustment. It also displays the relative weight of each of the 4 continental aggregates in foreign sales.

Table 16: Evolution of the continental distribution of US multinationals' unrelated party revenues, based on adjusted revenue variables

	2016	2017	2018	2019
Sales to the US (billion USD)	6,943.7	9,413.8	10,013.7	10,435.0
Sales abroad (billion USD)	3,882.0	5,188.3	5,707.2	5,614.7
Of which Europe (%)	39.8	39.1	39.2	39.6
Of which Asia-Pacific (%)	36.2	37.3	38.4	38.0
Of which America (%)	22.6	22.5	21.3	21.4
Of which Africa (%)	1.3	1.1	1.0	1.0

Note: This table presents the absolute amounts of US multinational companies' unrelated party revenues in the US and in foreign jurisdictions. The latter total is obtained by summing unrelated party revenues over all non-US affiliate countries but "Stateless entities" and continental totals. These figures are presented in current billion USD. The distribution of foreign unrelated party revenues among 4 regional aggregates (Europe, Asia-Pacific, America, Africa) is also presented, continents' respective weights being expressed in percentage. All figures are based on adjusted country-by-country report statistics.

These results are relatively stable from a year to another, with a substantial increase in the absolute amounts of unrelated party revenues from 2016 to 2017, explained by country-by-country reporting becoming mandatory for large multinational companies. However, we observe substantial differences with the same table built upon non-adjusted data.

First, in all four years, sales to the US are reduced by slightly more than 10%. This means that the exports now excluded from the unrelated party revenues registered domestically by US multinational enterprises are not fully compensated for by the foreign sales re-attributed to the headquarter country. Mechanically, foreign sales have increased substantially. This represents a jump by roughly 30%.

Second, we observe that the continental distribution of foreign unrelated party revenues has been recomposed. European countries still display the largest concentration of US multinational companies' sales but they have lost 6 to 7 percentage points through the destination-based adjustments. On the contrary, the weights of Asia-Pacific and America have both increased, the former coming closer to Europe over time. This discrepancy underlines the importance of European platform jurisdictions in US multinational firms' global sales network.

B.4.2 New relationship between sales and consumption expenditures

Furthermore, with Table 17, we investigate the effect of our destination-based adjustment at the destination country level. Focusing on 2017 adjusted data, we show the 20 largest destinations for US multinational companies' foreign unrelated party sales. For each of these countries, we display the adjusted revenues in billion USD, the corresponding share of total foreign unrelated party revenues and the country's share of the final consumption expenditures observed in the sample.

Table 17: Relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, based on adjusted revenue variables

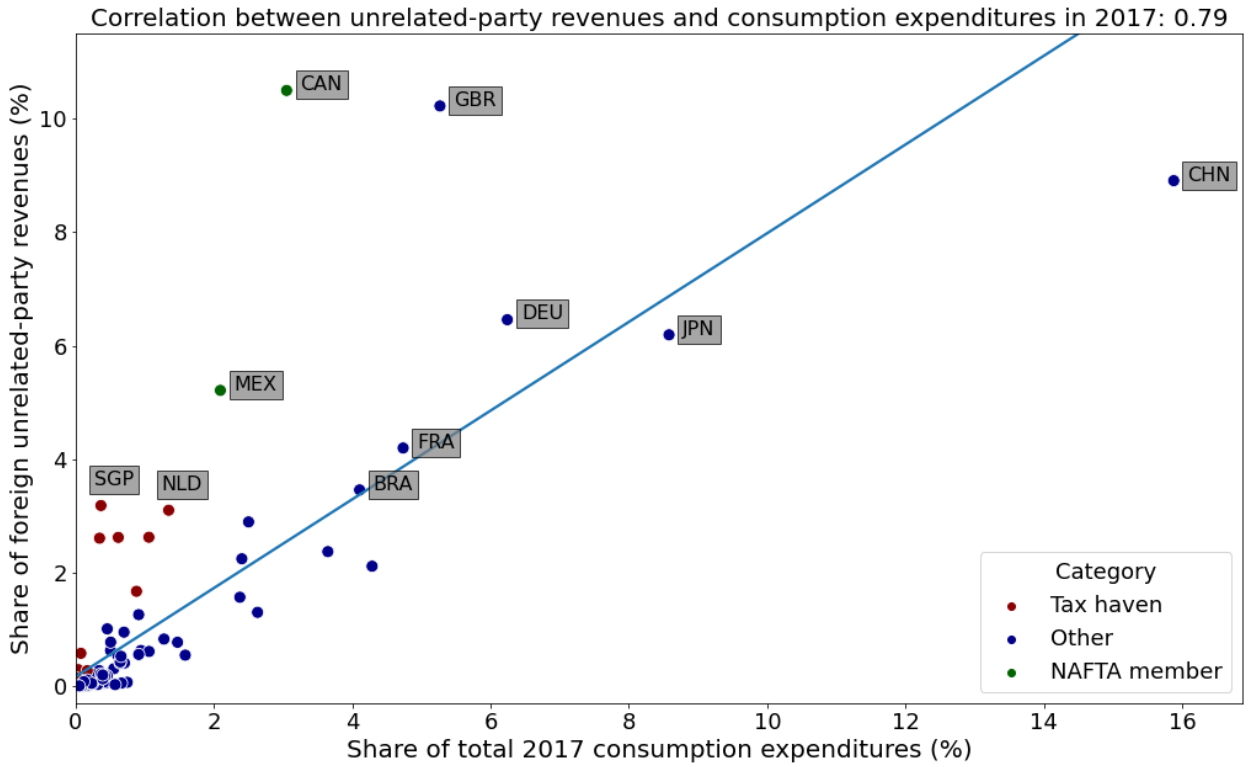
Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
Canada	542.9	10.5	3.1
United Kingdom	528.8	10.2	5.3
China	460.7	8.9	15.9
Germany	334.0	6.5	6.2
Japan	320.2	6.2	8.6
Mexico	269.5	5.2	2.1
France	217.0	4.2	4.7
Brazil	178.8	3.5	4.1
Singapore	164.5	3.2	0.4
Netherlands	160.3	3.1	1.3
Australia	149.6	2.9	2.5
Switzerland	135.6	2.6	1.1
Hong Kong	135.5	2.6	0.6
Ireland	134.8	2.6	0.3
Italy	122.5	2.4	3.6
Korea	116.0	2.2	2.4
India	109.2	2.1	4.3
Belgium	86.3	1.7	0.9
Spain	80.9	1.6	2.4
Russia	67.2	1.3	2.6

Note: This table presents the 20 main destination countries for the US multinational companies, based on adjusted unrelated party revenues. It displays each country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding the US-US observation) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 10.2% of US multinational companies' adjusted foreign unrelated party revenues and 5.3% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

The highest-ranking countries have been recomposed, especially in favor of NAFTA members (Canada moving from second to first, Mexico from eleventh to sixth), the largest economy of the sample (China moving from fourth to third) or France (from tenth to seventh). Oppositely, the most well-known sales platform of US technology multinational companies, Ireland, has tumbled from third to fourteenth: before the adjustment, it represented 6.2% of foreign unrelated party revenues and it only accounts for 2.6% after the destination-based adjustment. In a similar manner, Switzerland has moved from eighth to thirteenth (4.5% of foreign unrelated party revenues before the adjustment vs. 2.6% after) and Singapore from seventh to ninth (5.2% vs. 3.2%). Importantly, the weight of these three countries in the foreign unaffiliated sales of US multinational enterprises is now closer to the size of these economies, as indicated by their share of final consumption expenditures.

Figure 15 further highlights the new relationship between destination countries' share of US multinational enterprises' foreign unrelated party revenues and of final consumption expenditures. The correlation between the two has increased substantially: before the adjustment, it was of 0.66 and it now reaches 0.79 after the destination-based adjustment.

Figure 15: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures



Note: This figure presents the relationship between destinatinaton countries' share of US multinational companies' adjusted foreign unrelated party revenues and their share of final consumption expenditures. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Although a number of tax havens still display a disproportionately high share of unrelated party revenues compared with their weight in final consumption expenditures, the corresponding dots are now grouped closer to the indicative regression line. On the contrary, both NAFTA members (Canada and Mexico) have seen their share of unrelated party revenues increase through the adjustment. We therefore observe a more robust relationship between adjusted unrelated party revenues and our proxy for market size. The United Kingdom, along with major commercial partners of the US, now shows the largest discrepancy between unrelated party revenues and final consumption expenditures. Said otherwise, the destination-based adjustment seems to correct for a substantial part of US multinational companies' relocation of sales to low-tax, platform jurisdictions.

B.4.3 "Winners" and "losers" from the adjustment

To better understand the impact of the adjustment on the distribution of US multinational companies' unrelated party revenues, Tables 18 and 19 respectively show the largest losers and winners from the operation (i.e., the countries whose unrelated party revenues decrease or increase the most).

Table 18: Ten largest "losers" from the adjustment of unrelated party revenues

Destination country	Change in UPR (billion USD)	Change in UPR (%)
Ireland	-110.2	-45.0
Switzerland	-44.9	-24.9
Singapore	-42.8	-20.6
Luxembourg	-9.2	-23.5
United Kingdom Islands, Caribbean	-9.1	-55.6
Peru	-2.9	-30.3
Jersey	-2.3	-31.8
Macau	-2.2	-12.9
Bermuda	-1.9	-16.7
Puerto Rico	-1.8	-11.3

Note: This table is obtained by comparing the unrelated party revenues attributed to each affiliate / destination country respectively in the IRS' country-by-country report statistics and in the adjusted data. The change in revenues is defined as the adjusted revenues minus the non-adjusted revenues. We retain the 10 countries with the lowest change in absolute amounts and the difference is also expressed as a percentage of non-adjusted revenues. "UPR" stands for unrelated party revenues.

Except for Peru, all of the ten largest losers from the adjustment are listed as tax havens by Tørsløv, Wier, and Zucman (2018).[43] In particular, the largest loser from the adjustment of country-by-country revenue variables is Ireland, at which some anecdotal evidence hints as the archetypal example of a low-tax sales platform used by US multinational companies.[44] This 45% decrease might even be an underestimation. On the one hand, based on the BEA's data, only 26% of the unrelated party revenues booked by US multinationals in Ireland are considered as local sales: extra-group sales are thus slashed by 74%. On the other hand, Ireland is attributed additional unrelated party revenues from other affiliate countries that mitigate this cut. Typically, because Ireland represents 4.4% of the total US exports of goods and services in our data, it is allocated 57 billion USD of the unrelated party revenues registered domestically by US multinational companies. Because of the inclusion of intra-group flows in trade statistics, the disproportionate weight of Ireland in the US exports of goods and services may itself be related to the use of this jurisdiction as a sales platform.

Among the "winners" from the adjustment, we mostly find large developed or emerging economies. NAFTA members along the US, Canada and Mexico, respectively rank 2nd and 3rd. This group also gathers rather high-tax jurisdictions: Korea and Mexico, that display the largest relative increases (+112% and +108%), for instance impose corporate income tax rates of 27.5% and 30% respectively. Overall these two rankings comfort the idea that our proposed destination-based adjustment operates a re-balancing from the low-tax sales platforms used by US multinational companies to large, higher-tax economies.

43. UK Caribbean Islands are not classified as such but all the tax jurisdictions that compose this group are considered as tax havens in Tørsløv, Wier, and Zucman (2018).

44. See for instance Laffitte and Toubal (2022) for the analysis of a few multinational companies' tax planning practices.

Table 19: Ten largest "winners" from the adjustment of unrelated party revenues

Destination country	Change in UPR (billion USD)	Change in UPR (%)
China	221.2	92.4
Canada	170.0	45.6
Mexico	140.0	108.1
Germany	116.5	53.6
Japan	111.1	53.1
France	70.5	48.1
Korea	61.3	112.0
India	51.1	87.9
United Kingdom	42.1	8.7
Netherlands	38.8	31.9

Note: This table is obtained by comparing the unrelated party revenues attributed to each affiliate / destination country respectively in the IRS' country-by-country report statistics and in the adjusted data. The change in revenues is defined as the adjusted revenues minus the non-adjusted revenues. We retain the 10 countries with the highest change in absolute amounts and the difference is also expressed as a percentage of non-adjusted revenues. "UPR" stands for unrelated party revenues.

The specific case of the Netherlands, that appears among the largest winners from the adjustment (with a 38.8 billion USD or 31.9% increase) and is classified as a tax haven by Tørsløv, Wier, and Zucman (2018), is particularly interesting to perceive some potential limitations of the adjustment. On the one hand, the BEA's data attribute 65% of the sales of goods and services registered by US multinationals in the Netherlands to local transactions. Although unrelated party revenues are thus cut by almost one third, this reduction is much more limited than the one applied to Ireland for instance (-74% after splitting revenues based on BEA data and -45% eventually). On the other hand, the unrelated party revenues attributed from other affiliate countries to the Netherlands more than offset this reduction, as shown in Table 20.

Table 20: Mapping of unrelated party revenues attributed to the Netherlands following our destination-based adjustment, per affiliate country of origin

Affiliate country	UPR (million USD)	Share of the Netherlands in exports (%)
Netherlands	78,916.3	..
United States	37,761.8	2.9
Ireland	10,855.2	4.7
United Kingdom	7,431.6	7.0
Belgium	4,598.6	16.3
Switzerland	3,508.4	3.0
Germany	3,117.5	7.0
UK Caribbean Islands	2,650.0	31.6
Singapore	2,001.7	1.8
Bermuda	1,474.2	35.9

Note: This table indicates the 10 main affiliate countries from which the post-adjustment unrelated party revenues of US multinational companies in the Netherlands are sourced. The "Share of the Netherlands in exports" column indicates the weight of the Netherlands in the affiliate country's exports based on our retained set of trade statistics. Note that the export percentages actually used in the computations (that exclude the US from the set of destinations) are higher by, say, a few percentage points except for the US itself. It is used to determine the unrelated party revenues eventually allocated to the Netherlands following the methodology of our destination-based adjustment. Adjusted unrelated party revenues are expressed in 2017 million USD in the "UPR (million USD)" column.

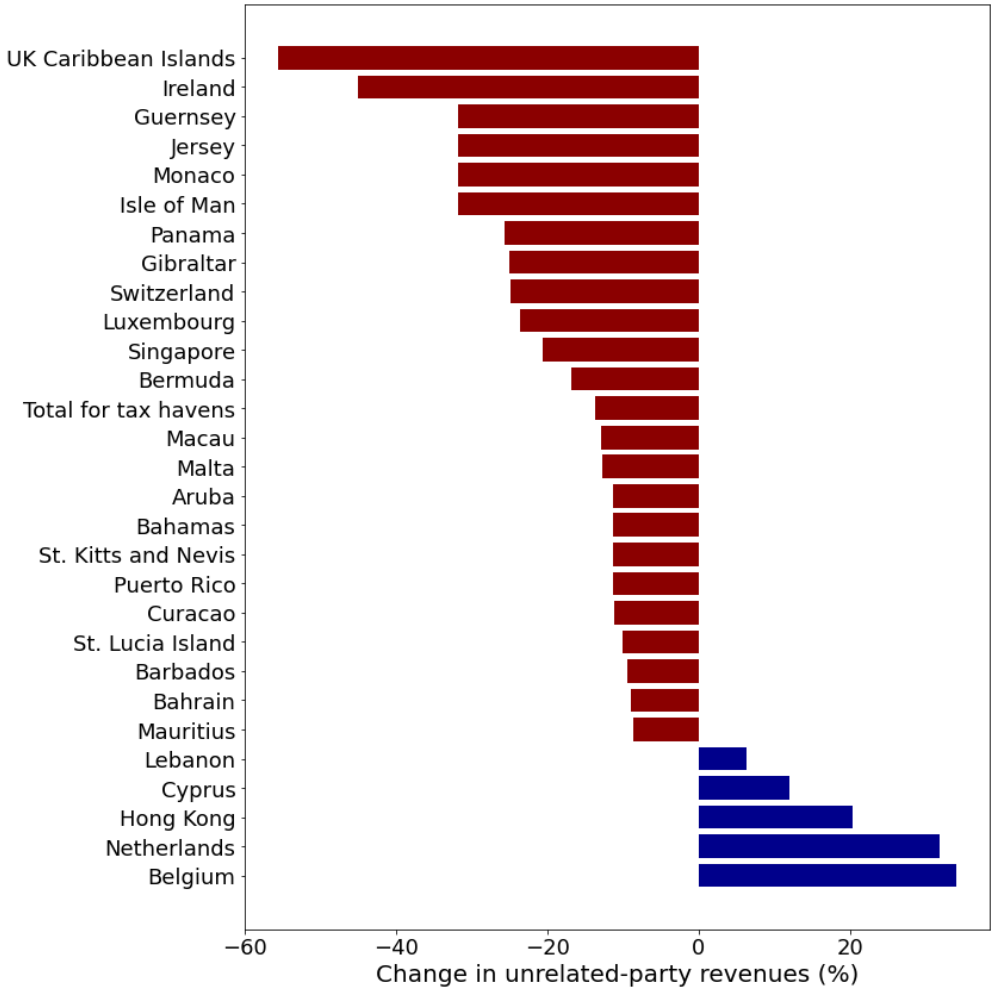
First, the decrease due to the initial split is almost entirely compensated for by the re-direction of US-US sales to the Netherlands. Indeed, according to trade statistics in 2017, the Netherlands accounts for 2.9% of the US exports of merchandise and services and therefore captures 37.8 billion USD from the unrelated party revenues booked domestically by US multinational companies. Second, because of its weight in their exports of goods and services, the Netherlands is attributed large amounts of unrelated party revenues from

some of the other tax havens identified by Tørsløv, Wier, and Zucman (2018) (e.g., Ireland, Belgium or Switzerland). Typically, based on our trade statistics, the Netherlands accounts for more than 30% of the total exports of the UK Caribbean Islands or Bermuda. These results may suggest that the second step of our adjustment (i.e., the attribution of sales directed to any third country) may itself be distorted by the sales platform status of some jurisdictions.

B.4.4 Focus on tax havens

Table 18 spurs us to focus more specifically on the evolution of tax havens. Their aggregate weight moves from 27% of the foreign unrelated party revenues of US multinationals in the IRS' country-by-country report statistics to 18% in the adjusted mapping of sales. Figure 16 shows that most of the tax havens listed by Tørsløv, Wier, and Zucman (2018) in our sample (24 out of 29) see their unrelated party revenues decrease.

Figure 16: Change in tax havens' unrelated party revenues



Note: This figure presents the percentage change in unrelated party revenues implied by our destination-based adjustment for the tax havens listed by Tørsløv, Wier, and Zucman (2018). For each tax haven, it is computed as the ratio of the difference between adjusted and non-adjusted unrelated party revenues to non-adjusted unrelated party revenues. The aggregated evolution of all tax haven unrelated party revenues is also presented as the "Total for tax havens". Red bars indicate a decrease in unrelated party revenues, while blue bars indicate an increase.

Notable exceptions are Belgium, the Netherlands and Hong Kong, as well as Cyprus and Lebanon to a lesser extent. The first three are important hubs for international trade and the sales that they are attributed

from other afiliate countries more than offset the split based on the BEA's data. Typically, Belgium is mainly attributed sales from the US (it accounts for 1.2% of its exports of merchandise and services) or from Ireland (5.8% of exports), while Hong Kong heavily benefits from the US (2.1% of exports) and Singapore (11.9% of exports). We already made a similar observation for the Netherlands.

B.4.5 Including non-US multinationals

We further assess the extension of our destination-based adjustment beyond US multinational companies. Table 21 ranks the 20 largest destination countries based on adjusted extra-group sales, showing their share of the total foreign unrelated party revenues and their share of final consumption expenditures.

Table 21: Post-adjustment relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, including non-US multinationals

Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
United States	2,572.7	14.8	26.9
United Kingdom	1,473.2	8.5	3.8
China	1,406.5	8.1	11.3
Germany	917.3	5.3	4.5
Canada	784.7	4.5	2.2
France	624.0	3.6	3.4
Hong Kong	610.9	3.5	0.4
Japan	551.1	3.2	6.1
Singapore	514.8	3.0	0.3
Brazil	486.1	2.8	2.9
Italy	476.3	2.7	2.6
Mexico	473.1	2.7	1.5
Netherlands	462.5	2.7	1.0
Switzerland	422.1	2.4	0.8
Australia	395.3	2.3	1.8
Korea	361.4	2.1	1.7
Spain	348.4	2.0	1.7
India	309.7	1.8	3.1
Belgium	282.2	1.6	0.6
Russia	255.2	1.5	1.9

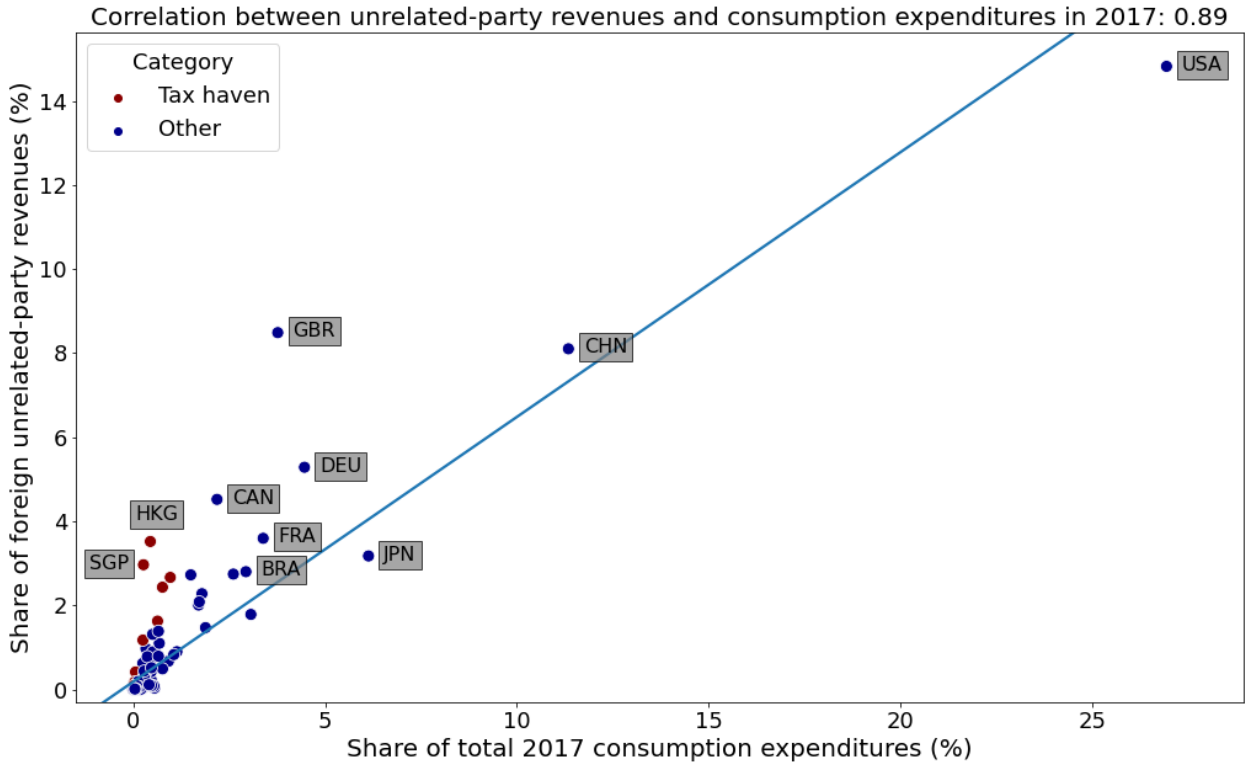
Note: This table presents the 20 main destination countries for multinational companies headquartered in the 15 parent countries considered, based on adjusted unrelated party revenues. It displays each destination country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding domestic observations) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 8.5% of multinational companies' adjusted foreign unrelated party revenues and 3.8% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

The three main affiliate countries (the US, the UK and China) have maintained their positions of Table 2, but their respective weights have moved in different directions. The shares of foreign unrelated party revenues attributed to the US and the UK have decreased (from 15.7% to 14.8% and from 10.2% to 8.5% respectively), whereas China now comes closer to the UK. It concentrates 8.1% of the transactions with foreign unaffiliated parties (vs. 5.6% before the adjustment). Large developed economies seem to benefit from the extended adjustment, with the striking examples of Japan and France (from 14$^{\text{th}}$ with 2.3% to 8$^{\text{th}}$ with 3.2% and from 10$^{\text{th}}$ with 3.0% to 6$^{\text{th}}$ with 3.6% respectively). The weights of Germany and Canada also increase, as these destination countries replace Singapore and Switzerland in the top five. Oppositely and similarly to the outcome of the adjustment for US multinational companies, most of the smaller economies that displayed a disproportionate share of foreign unrelated party revenues lose from the adjustment. While Ireland drops out of the ranking (from the 15$^{\text{th}}$ position initially), Singapore moves from 4$^{\text{th}}$ to 9$^{\text{th}}$ (5.2% vs.

3.0%) and Switzerland from 5th to 14th (4.5% vs. 2.4%). Hong Kong, whose importance remains roughly stable, is a notable exception to this dynamic.

Figure 17 confirms the improved consistency between the distribution of foreign unrelated party revenues and a macroeconomic proxy for market size like the final consumption expenditures. As in the specific case of US multinational companies, the correlation between the two has increased (from 0.84 to 0.89) and tax havens have moved closer to the "normal" relationship, indicated by the regression line.

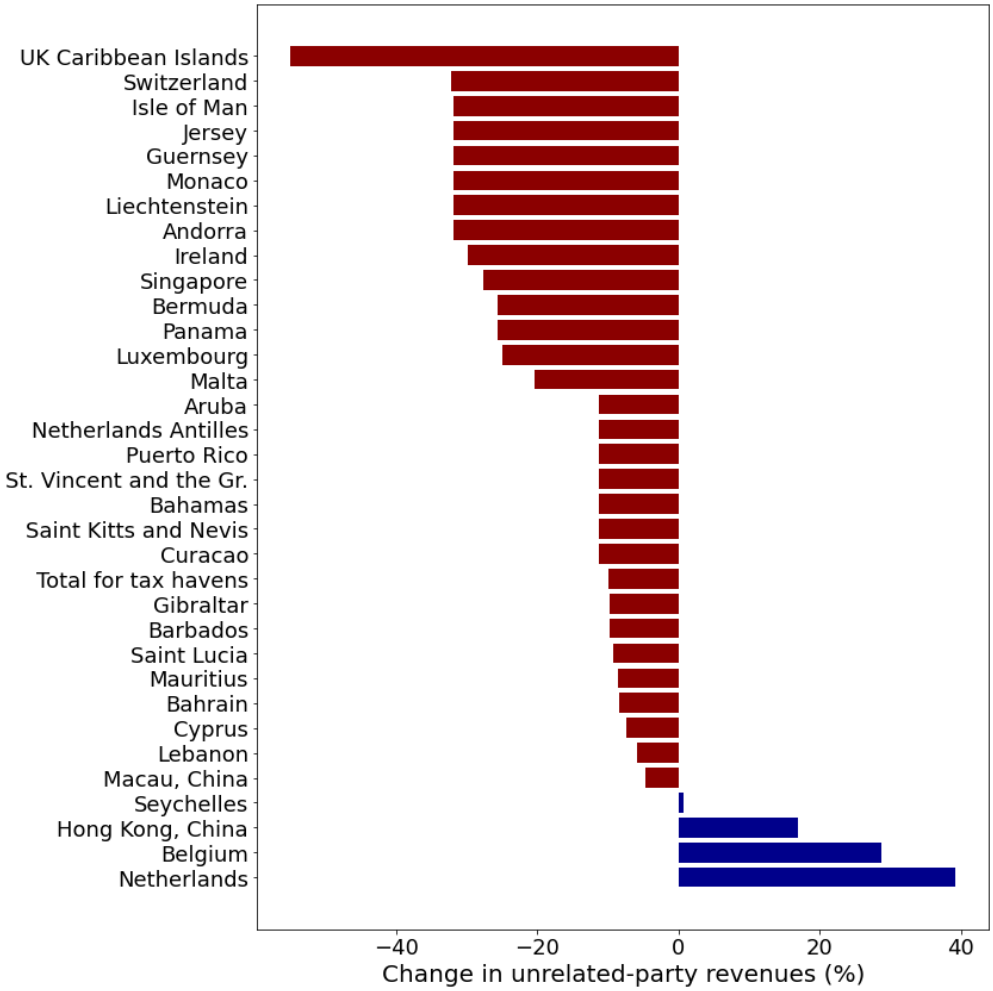
Figure 17: Post-adjustment relationship between destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, including non-US multinationals



Note: This figure presents the relationship between destination countries' share of multinational companies' adjusted foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Eventually, as in the assessment of our adjustment for US multinationals, we can focus more specifically on the evolution of the revenues booked in tax havens. Their aggregate weight moves from 21% of the foreign unrelated party revenues of in-sample multinationals based on non-adjusted country-by-country report statistics to 16% in the adjusted mapping of extra-group sales. Figure 6 shows that most of the tax havens listed by Tørsløv, Wier, and Zucman (2018) in our sample (29 out of 36, including the three jurisdictions not shown) see their unrelated party revenues decrease.

Figure 18: Change in tax havens' unrelated party revenues, including non-US multinationals



Note: This figure presents the percentage change in unrelated party revenues implied by our destination-based adjustment for the tax havens listed by Tørsløv, Wier, and Zucman (2018). For each tax haven, it is computed as the ratio of the difference between adjusted and non-adjusted unrelated party revenues to non-adjusted unrelated party revenues. The aggregated evolution of all tax haven unrelated party revenues is also presented as the "Total for tax havens". Red bars indicate a decrease in unrelated party revenues, while blue bars indicate an increase. The Marshall Islands and Belize are not shown as they respectively display +800% and +192% increases; Antigua and Barbuda is not shown either as it moves from zero to non-zero unrelated party revenues.

This result again corroborates the idea that the adjustment operates a re-balancing of extra-group sales from potentially low-tax sales platforms to other, larger economies where ultimate consumers and users are more likely to be found. Excluding smaller jurisdictions, the increase in the unrelated party revenues observed for Hong Kong, the Netherlands and Belgium (both in the case of US multinationals only and with the extended adjustment) may also hint at the limitations of our methodology.

B.4.6 Potential limitations

While most tax havens are indeed penalized by the destination-based adjustment, some others display an increase in unaffiliated sales from US multinational companies. Importantly, investigating these results highlights some of the potential limitations of our methodology.

First, despite efforts to select the most appropriate data sources, trade statistics might not necessarily reflect the ultimate destination of the merchandise and services supplied. Because they do not distinguish

intra-group and extra-group transactions, they might be somewhat distorted by the aggressive tax planning practices of multinational companies, the sales platforms chosen by US multinational enterprises accounting for an inflated share of exports. Besides, typically in the case of the Netherlands or Hong Kong, the importance of local ports (e.g., Rotterdam, Amsterdam, etc.) and airports (e.g. Schiphol) may also affect trade statistics to some extent. We preclude at least partly such distortions by focusing on imports in merchandise trade data (supposed to identify the country of origin of the goods) and by netting out re-imports, but trade measurements are likely not systematically in line with statistical standards.

Second, and more fundamentally, the eloquent concentration of tax havens in Table 20 (which shows from which affiliate countries the adjusted unrelated party revenues attributed to the Netherlands are sourced) questions the capacity of our methodology to capture the multi-layer sales platform networks organized by US multinational enterprises. If the latter simply used Ireland as a unique intermediary stage before the delivery of the goods and services to the final customer, Irish trade statistics would give more weight to large economies rather than to low-tax jurisdictions and our methodology could efficiently correct for the implied distortion. But in practice, the transactions of large multinationals are organized as complex cross-border schemes that we can only partly unravel via our adjustment.

B.5 Robustness Checks

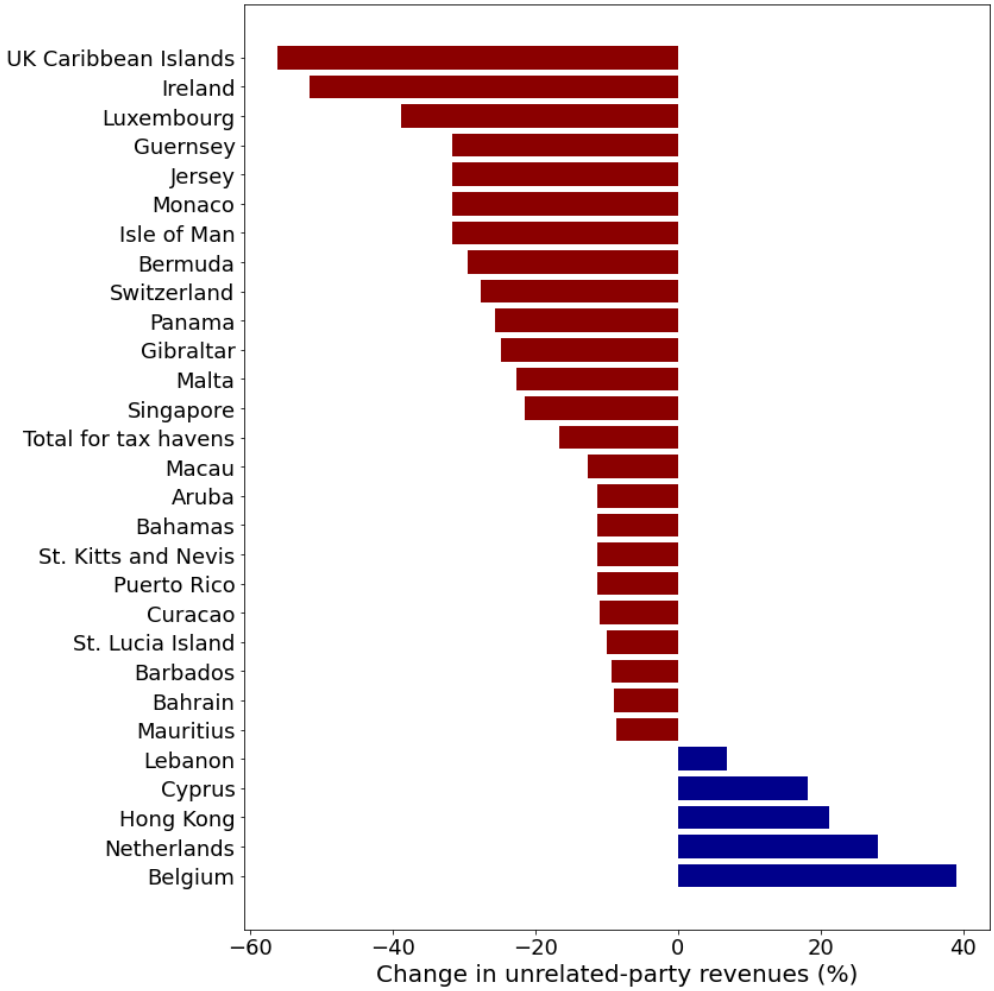
In this section, we present various robustness checks or alternatives to the benchmark computations that highlight strengths and limitations of our proposed adjustment of country-by-country revenue variables. In Section B.5.1, we assess the impact of excluding certain flows of services, known to be manipulated by multinational firms for tax planning purposes, from the trade statistics used in the adjustment. Then, Section B.5.2 underlines how sensitive the results are to the trade statistics winsorizing threshold for a few destination countries. In Section B.5.3, we show that the assessment of the adjustment is robust to the choice of another macroeconomic indicator than final consumption expenditures. Eventually, Section B.5.4 answers a possible concern that the results obtained for the extended sample of headquarter countries could mainly be driven by US multinational companies.

B.5.1 Excluding certain flows of services

In our methodology, trade statistics are used to distribute the sales that are directed from a given affiliate country to any third country (excluding the headquarter country for US multinationals). As these data do not allow to distinguish intra-group and extra-group transactions, they may be endogenous to the profit shifting operations of multinational companies. In particular, certain flows of services involving tax havens might reflect tax planning strategies rather than the location of the actual beneficiaries or users of the services. To mitigate this possibility, we propose to exclude certain flows of services from the trade statistics used in our adjustment. Based on the EBOPS 2010 classification covered by BaTIS data, we net out "insurance and pension services", "financial services" and "charges for the use of intellectual property".

First, looking at the effect of the adjustment on 2017 US country-by-country report statistics, we find that the exclusion of these flows of services marginally raises the correlation between affiliate / destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures. Ex ante any adjustment, this correlation is of 0.66; after the benchmark adjustment, we get to 0.79; with the adjustment excluding certain flows of services, we obtain a correlation of 0.80. Second, the exclusion reduces slightly the weight of tax havens in the adjusted mapping of US multinational companies' unrelated party revenues. Before any adjustment, in the IRS' country-by-country report statistics, the havens listed by Tørsløv, Wier, and Zucman (2018) account for 27% of the unrelated party revenues booked outside of the US. After the adjustment, this share is reduced to 18% without the exclusion of some flows of services and to 17% with this restriction of trade statistics. Third, as shown in Figure 19, the exclusion does not affect the sign of the adjustment for any tax haven, but it accentuates the increase of the unrelated party revenues attributed to Belgium.

Figure 19: Change in tax havens' unrelated party revenues, excluding certain flows of services



Note: This figure presents the percentage change in unrelated party revenues implied by our destination-based adjustment for the tax havens listed by Tørsløv, Wier, and Zucman (2018). For each tax haven, it is computed as the ratio of the difference between adjusted and non-adjusted unrelated party revenues to non-adjusted unrelated party revenues. The aggregated evolution of all tax haven unrelated party revenues is also presented as the "Total for tax havens". Red bars indicate a decrease in unrelated party revenues, while blue bars indicate an increase. The following flows of services are excluded from trade statistics: "insurance and pension services", "financial services" and "charges for the use of intellectual property".

Overall, for the income year 2017, the exclusion of the most sensitive flows of services from trade statistics only has a marginal effect on the outcome of the adjustment. However, this departure from benchmark computations proves more significant for the 2016 income year, with the specific evolution of Bermuda. Initially, in the IRS' 2016 country-by-country report statistics, US multinational companies record 10.3 billion USD of unrelated party revenues in Bermuda. Based on the BEA's statistics, 64% are indeed attributed to Bermuda as local sales and the rest is split between the US and other foreign countries. However, as Bermuda accounts for 0.6% of total US exports in the unrestricted trade statistics, it is attributed a portion of the US-US sales. This 5.8 billion USD addition explains why sales to Bermuda eventually increase by 20% through the adjustment. With the exclusion of the most sensitive flows of services, the weight of Bermuda in US exports decreases substantially. Bermuda then accounts for less than 0.5% of US exports and it is winsorized. Eventually, sales to Bermuda are reduced by 36% through the adjustment.

B.5.2 Sensitivity to the winsorizing threshold

The preprocessing of trade statistics for our adjustment of country-by-country revenue variables also involves winsorizing the smallest destinations from each country's distribution of exports. In the benchmark computations, we exclude the destinations that account for less than 0.5% of the total exports, as we do not expect foreign multinationals to operate such niche operations. However, the choice of this winsorizing threshold is rather arbitrary and for a few small destination countries, results are quite sensitive to its choice.

Typically, appplying a 0.1% winsorizing threshold in the adjustment of US multinational companies' unrelated party revenues generates a dramatic increase in the sales attributed to Lebanon (+623% after the adjustment). In the IRS' 2017 country-by-country report statistics, unrelated party revenues of 249 million USD are recorded in Lebanon and in the trade statistics that we obtain, Lebanon stands for 0.12% of the total US exports of goods and services. With a 0.5% winsorizing threshold, none of the domestic sales of US multinational companies are attributed to Lebanon. With a 0.1% winsorizing threshold, 1,537 million USD of additional unrelated party revenues are allocated, which drives adjusted sales upwards.

Table 22: Mapping of unrelated party revenues attributed to Lebanon following our destination-based adjustment, per affiliate country of origin and with a 0.1% winsorizing threshold

Affiliate country	UPR (million USD)	Share of Lebanon in exports (%)
United States	1537.3	0.12
Lebanon	205.0	..
Greece	35.8	2.65
Egypt	9.3	1.76
Ukraine	8.2	0.88
Jordan	2.7	1.92
Cyprus	2.5	1.19
Kuwait	1.3	0.62
Georgia	0.4	0.91
Senegal	0.1	0.66

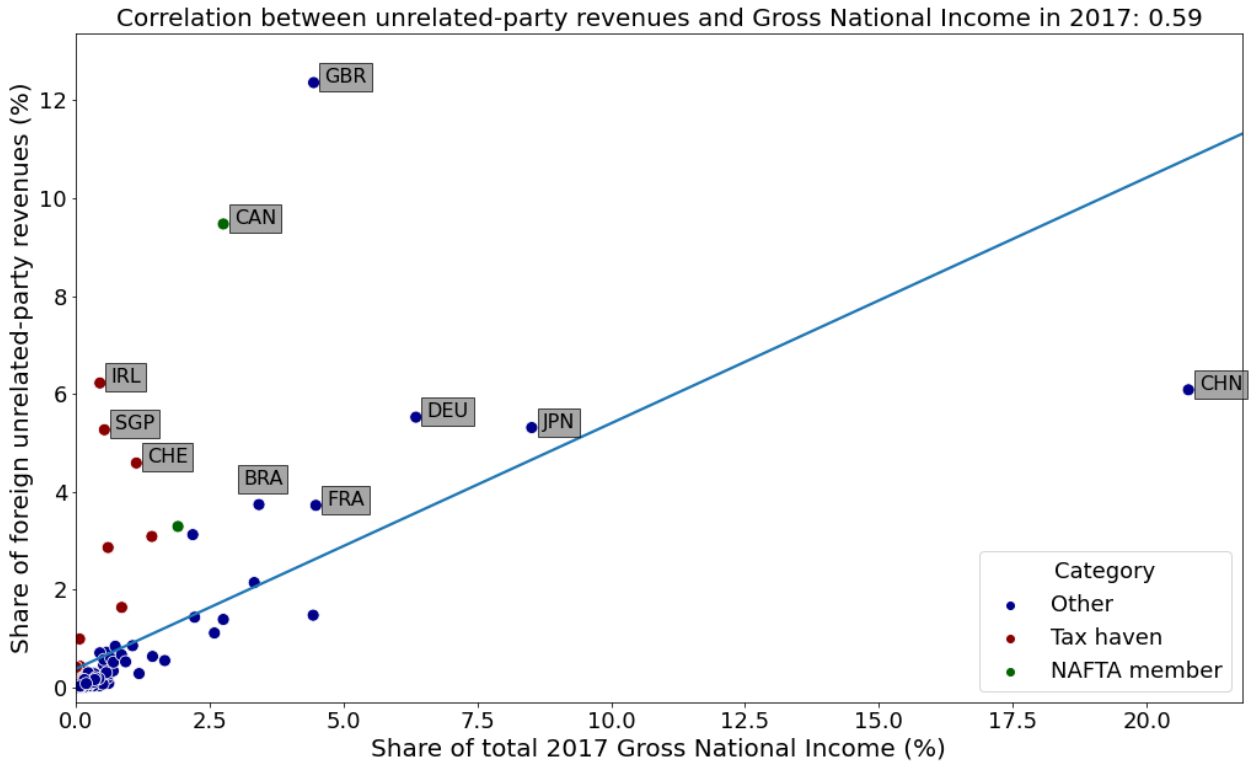
Note: This table indicates the 10 main affiliate countries from which the post-adjustment unrelated party revenues of US multinational companies in Lebanon are sourced. The "Share of Lebanon in exports" column indicates the weight of Lebanon in the affiliate country's exports based on our retained set of trade statistics. Note that the export percentages actually used in the computations (that exclude the US from the set of destinations) are higher by, say, a few percentage points except for the US itself. It is used to determine the unrelated party revenues eventually allocated to Lebanon following the methodology of our destination-based adjustment. Adjusted unrelated-party revenues are expressed in 2017 million USD in the "UPR (million USD)" column.

B.5.3 Robustness to the choice of macro-indicator

To assess the relevance of the adjustment of country-by-country revenue variables, one criterion consists in comparing the distribution of unrelated party revenues to that of a proxy for market size. In the benchmark evaluation of the adjustment, consistently with the draft nexus and revenue sourcing rules for Pillar One Amount A released by the OECD in February 2022, we use final consumption expenditures (UNCTAD (2016-2019)). Considering the IRS' 2017 country-by-country report statistics, the correlation between affiliate / destination countries' share of foreign unrelated party revenues and their share of consumption expenditures is initially of 0.66 and increases up to 0.79 with the adjustment.

Now considering Gross National Income (GNI), we initially have a low correlation (0.59) between affiliate countries' share of foreign unrelated party revenues and their share of the market size proxy. In Figure 20, we observe that essentially two types of affiliate countries are located very significantly above the line of best fit (i.e., their share of foreign unrelated party revenues is disproportionately large compared with their share of GNI): close commercial partners of the US (the UK in blue and Canada in green) on the one hand and tax havens on the other hand. This is very close to what we could observe with final consumption expenditures.

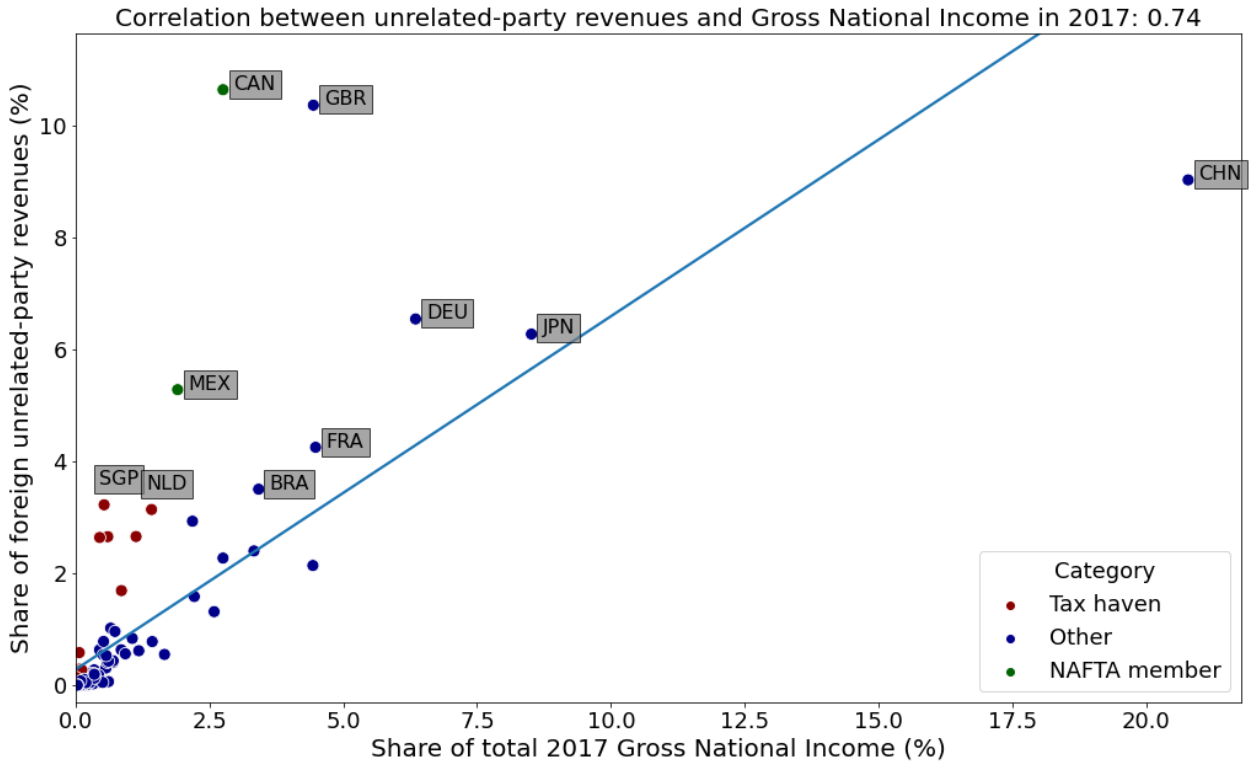
Figure 20: Relationship between all affiliate countries' share of foreign unrelated party revenues and their share of GNI



Note: This figure presents the relationship between affiliate countries' share of US multinational companies' foreign unrelated party revenues and their share of the total GNI observed in the sample. The x-axis corresponds to GNI and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of GNI. Revenue shares come from the IRS' country-by-country report statistics; GNI data from from the World Bank's and the OECD's National Accounts Statistics.

After the adjustment of country-by-country revenue variables, the correlation between destination countries' share of foreign unrelated party revenues and their share of GNI is substantially higher (0.74). The dots associated with tax havens in Figure 21 are now grouped closer to the line of best fit, meaning that the weight of these destination countries in the distribution of US multinationals' extra-group sales is more in line with the size of their economies. On the other hand, Mexico has moved away from the regression line, coming closer to other large commercial partners of the US that still display disproportionate shares of foreign unrelated party revenues (the UK in blue and Canada in green).

Figure 21: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of GNI



Note: This figure presents the relationship between destination countries' share of US multinational companies' adjusted foreign unrelated party revenues and their share of the total GNI observed in the sample. The x-axis corresponds to GNI and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of GNI. Revenue shares come from adjusted country-by-country report statistics; GNI data from from the World Bank's and the OECD's National Accounts Statistics.

B.5.4 Exclusion of the US in the extended adjustment

When evaluating the extended adjustment, we find that the correlation between affiliate / destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures is increased: from 0.84 based on the OECD's non-adjusted country-by-country report statistics to 0.89 using the adjusted sales mapping. The importance of tax havens is reduced as the weight of the jurisdictions listed by Tørsløv, Wier, and Zucman (2018) moves from 21% of foreign unrelated party revenues to 16%. However, one may be concerned about the extent to which these results are driven by the sole adjustment of US multinational companies' revenues. We therefore review the key points of this assessment while excluding the US from our extended sample of 15 headquarter countries.

First, we consider the ranking of the 20 largest affiliate countries based on unaffiliated transactions, as per the non-adjusted country-by-country report statistics of the OECD. Table 23 relates their share of foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample.

Table 23: Relationship between the 20 largest affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures, for non-US multinationals only

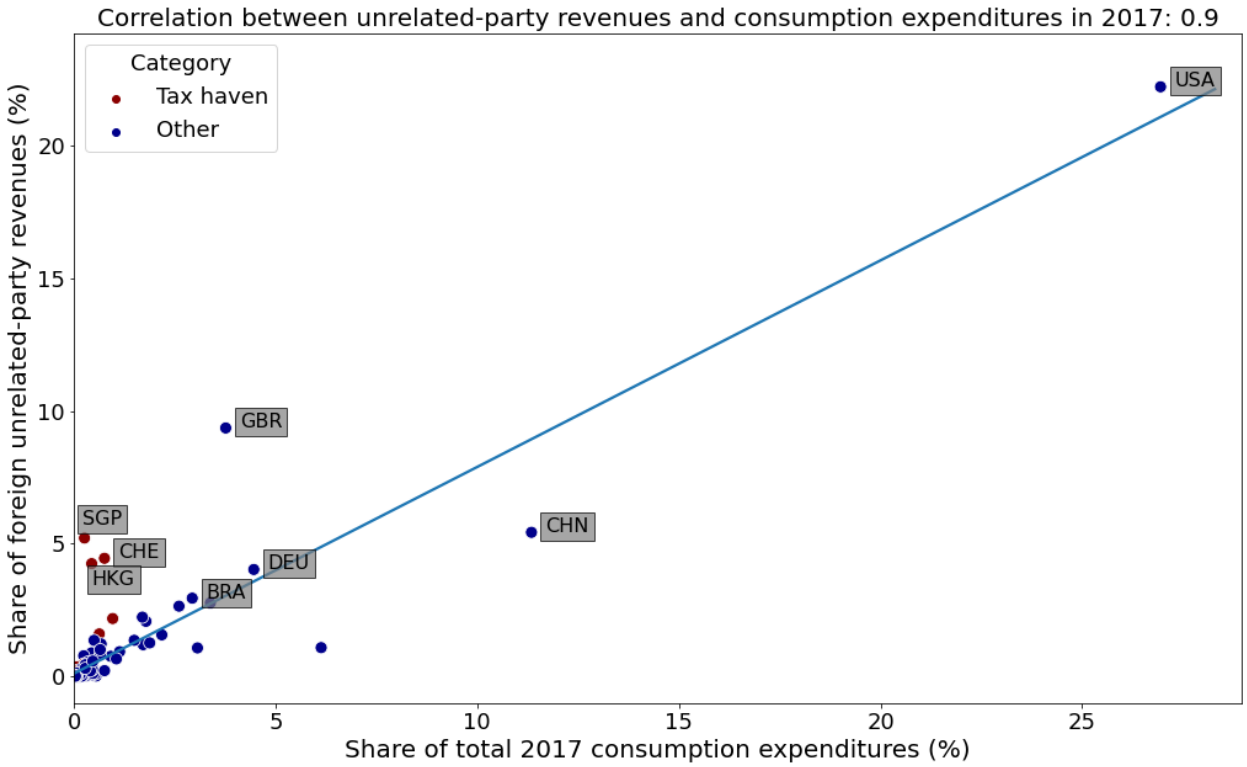
Affiliate country	Share of foreign UPR (%)	Share of cons. exp. (%)
United States	22.2	26.9
United Kingdom	9.4	3.8
China	5.4	11.3
Singapore	5.2	0.3
Switzerland	4.5	0.8
Hong Kong	4.3	0.4
Germany	4.0	4.5
Brazil	3.0	2.9
France	2.8	3.4
Italy	2.7	2.6
Spain	2.2	1.7
Netherlands	2.2	1.0
Australia	2.1	1.8
Belgium	1.6	0.6
Canada	1.6	2.2
Mexico	1.4	1.5
Thailand	1.4	0.5
Russia	1.3	1.9
Poland	1.2	0.7
Korea	1.2	1.7

Note: This table presents the 20 main affiliate countries for the multinational companies headquartered in 14 parent countries (excluding the US), based on unrelated party revenues. It displays each country's share of the total foreign unrelated party revenues (i.e., excluding domestic observations) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 9.4% of multinational companies' unrelated party revenues outside their headquarter countries and 3.8% of the total consumption expenditures of in-sample affiliate countries. Revenue shares are based on the IRS' country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Comparing this table with our benchmark descriptive statistics, we first observe that the ranking of the largest affiliate countries is rather robust to the exclusion of the US from the set of headquarter countries. Except for Ireland and Japan, that drop out from the ranking and are replaced by Thailand and Poland, the list of affiliate countries stays almost the same. The US, the UK, China, Singapore and Switzerland still make up the top 5 in that order, while the most notable change comes from Canada (from 7^{th} with 3.9% to 15^{th} with 1.6% of foreign unrelated party revenues). The latter observation may not be surprising as Canada is a close commercial partner of the US. Finally, the share of the foreign unrelated party revenues of the US increases substantially (from 15.7% to 22.2%), which is a mechanical outcome of the exclusion of US multinational companies' non-US sales.

In addition to the consistency of the ranking, after excluding the US from the set of headquarter countries, we still observe substantial heterogeneity in the relationship between affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures. In particular, the disproportionate weight of Singapore, Switzerland and Hong Kong that rank from 4^{th} to 6^{th} and cumulatively account for around 1.5% of final consumption expenditures remains striking. We therefore illustrate this relationship for all affiliate countries in Figure 22.

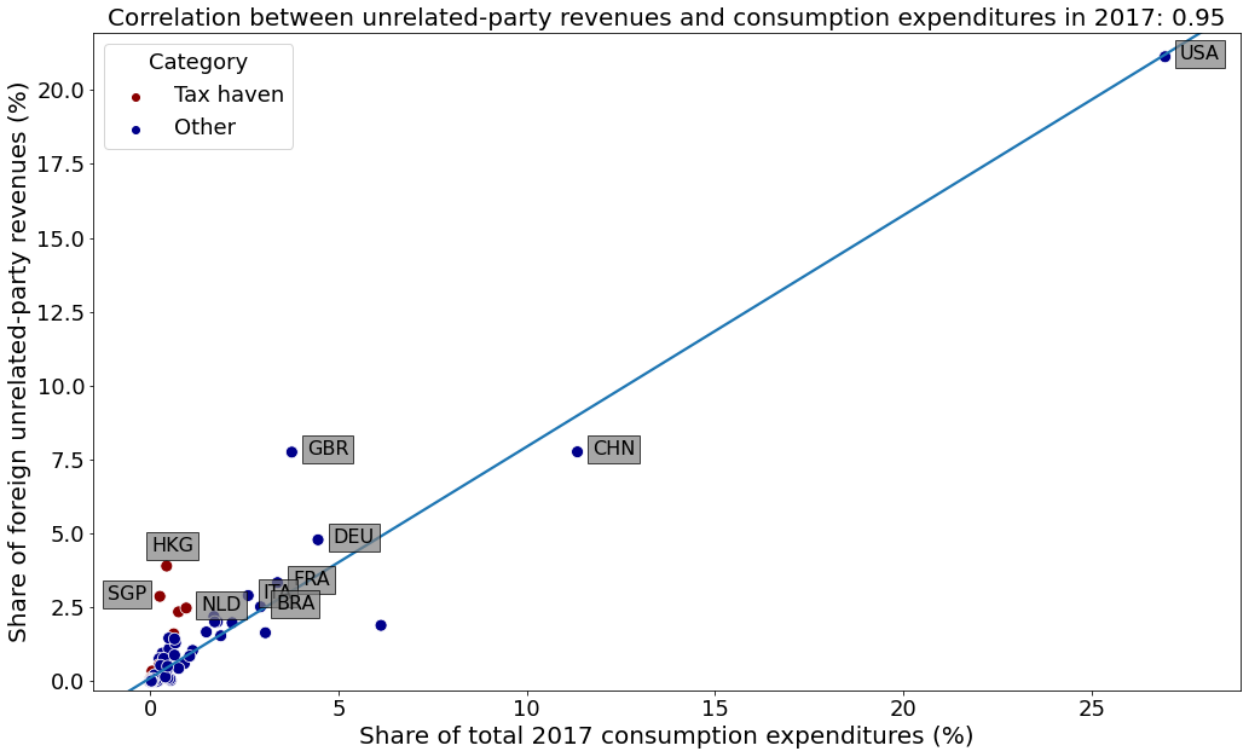
Figure 22: Relationship between all affiliate countries' shares of foreign unrelated party revenues and final consumption expenditures, for non-US multinationals only



Note: This figure presents the relationship between affiliate countries' share of multinational companies' foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. Multinational companies headquartered in the US are excluded from the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

While we found a correlation of 0.84 in the benchmark descriptive study, we now observe a correlation of 0.90 between affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures. While this change may hint at a lower intensity in the use of sales platforms by non-US multinational companies, it is also driven (at least partly) by the mechanical increase in the US share of foreign unrelated party revenues, making the comparison of these correlations difficult. That being said, two points can be mentioned regarding the relationship between the concentration of extra-group sales and market size. First, we still observe the disproportionate weight of some tax havens, which stand well above the line of best fit on the left-hand part of the graph. Second, after our destination-based adjustment, the weight of these jurisdictions in the distribution of extra-group sales is reduced and the correlation between destination countries countries' share of foreign unrelated party revenues and their share of final consumption expenditures increases (0.90 to 0.95). Figure 23 reproduces the above based on the adjusted mapping of sales.

Figure 23: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, for non-US multinationals only



Note: This figure presents the relationship between destination countries' share of multinational companies' foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. Multinational companies headquartered in the US are excluded from the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Eventually, as a last indicator, when excluding the US from the set of headquarter countries, the adjustment still reduces the weight of tax havens in the distribution of multinationals' extra-group sales. The share of the jurisdictions listed by Tørsløv, Wier, and Zucman (2018) indeed moves from 19% of foreign unrelated party revenues in the OECD's country-by-country report statistics to 15% in the adjusted mapping. Overall, we conclude that the results presented in our benchmark descriptive study and in the assessment of the proposed adjustment for the extended sample of headquarter countries are not driven solely by the US.

B.6 Main Results for Other Income Years

In the following section, we reproduce the main tables and figures that allow to assess the benchmark destination-based adjustment of country-by-country revenue variables for different income years. Section B.6.1 presents the results for the 2016 income year, considering the adjustment for US multinational companies and the extension to other headquarter countries. In Sections B.6.2 and B.6.3, we apply our methodology respectively to the IRS' 2018 and 2019 country-by-country report statistics.

B.6.1 Results for 2016

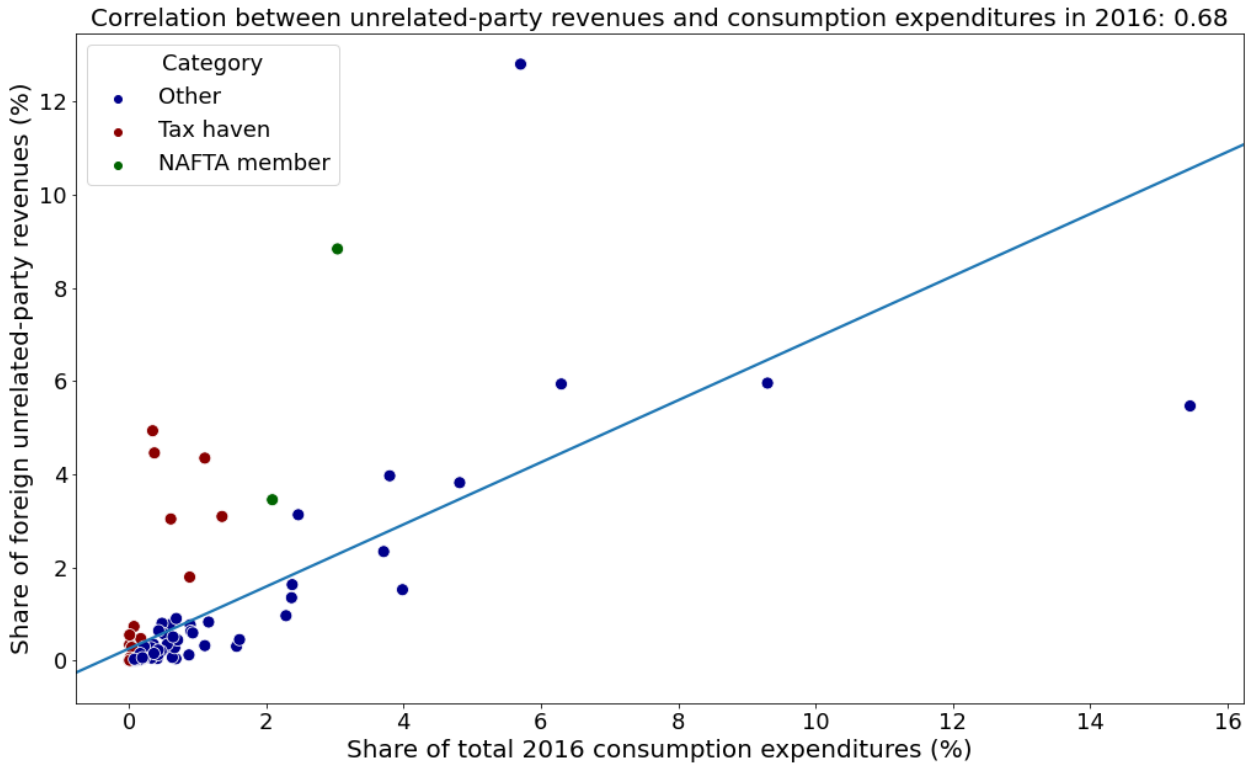
Focusing on US multinational companies

Table 24: Top twenty largest affiliate countries [2016]

Affiliate country	UPR (USD billion)	Share of foreign UPR (%)
United Kingdom	386.3	12.8
Canada	266.6	8.8
Japan	179.7	5.9
Germany	179.1	5.9
China	164.9	5.5
Ireland	148.8	4.9
Singapore	134.5	4.4
Switzerland	131.1	4.3
Brazil	119.7	4.0
France	115.2	3.8
Mexico	104.2	3.4
Australia	94.4	3.1
Netherlands	93.3	3.1
Hong Kong	91.7	3.0
Italy	70.6	2.3
Belgium	54.1	1.8
Spain	49.2	1.6
India	45.9	1.5
Korea	40.7	1.3
Russia	29.1	1.0

Note: This table presents the 20 most important affiliate countries for US multinational companies. This ranking is based on the unrelated party revenues booked by US multinational enterprises in each of these jurisdictions. Revenues are presented in absolute amounts (expressed in 2017 billion USD) and as a share of US multinational companies' total foreign unrelated party revenues (expressed in percentage). All figures are based on the IRS' 2016 country-by-country report statistics. "UPR" stands for unrelated party revenues.

Figure 24: Relationship between all affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2016]



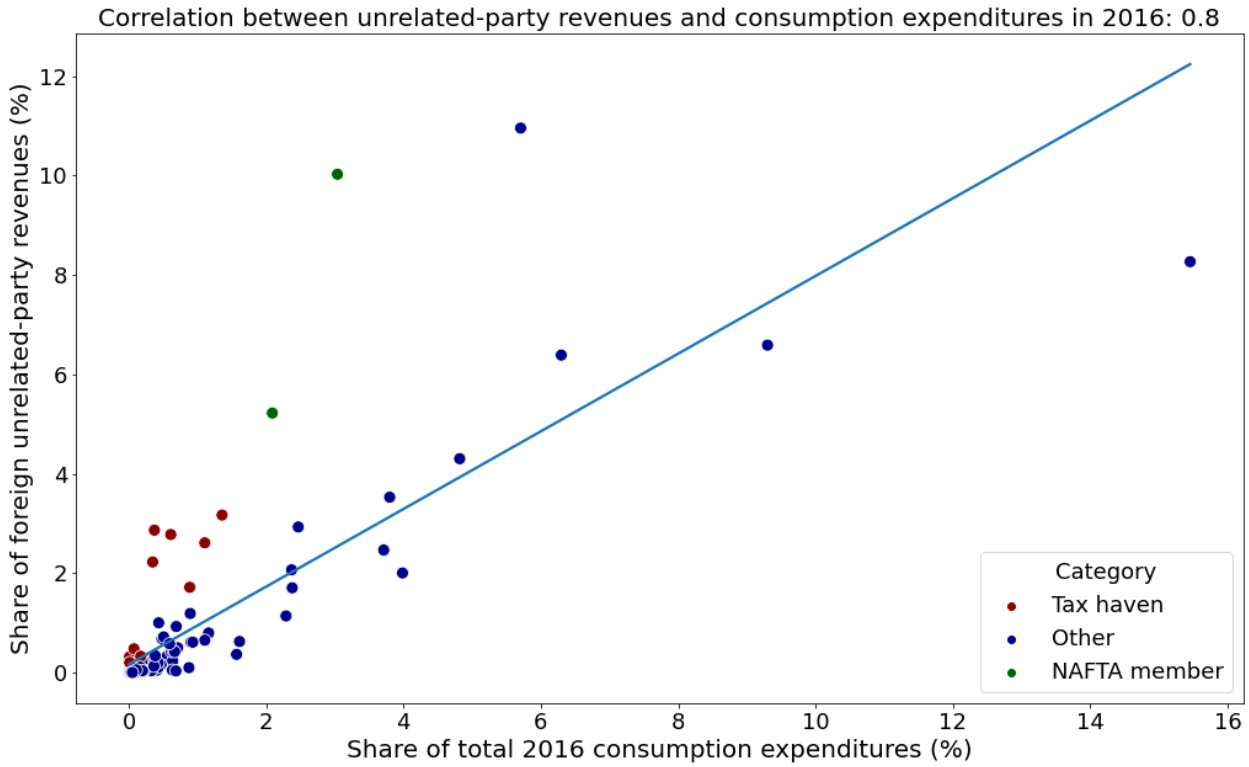
Note: This figure presents the relationship between affiliate countries' share of US multinational companies' foreign unrelated party revenues and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Table 25: Relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, based on adjusted revenue variables [2016]

Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
United Kingdom	423.9	11.0	5.7
Canada	388.0	10.0	3.0
China	320.0	8.3	15.5
Japan	255.0	6.6	9.3
Germany	247.2	6.4	6.3
Mexico	202.1	5.2	2.1
France	166.5	4.3	4.8
Brazil	136.6	3.5	3.8
Netherlands	122.7	3.2	1.4
Australia	113.4	2.9	2.5
Singapore	110.9	2.9	0.4
Hong Kong	107.5	2.8	0.6
Switzerland	101.0	2.6	1.1
Italy	95.4	2.5	3.7
Ireland	86.1	2.2	0.3
Korea	80.0	2.1	2.4
India	77.6	2.0	4.0
Belgium	66.4	1.7	0.9
Spain	66.0	1.7	2.4
Taiwan	46.0	1.2	0.9

Note: This table presents the 20 main destination countries for US multinational companies, based on adjusted unrelated party revenues. It displays each country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding the US-US observation) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 11.0% of US multinational companies' adjusted foreign unrelated party revenues and 5.3% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Figure 25: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2016]



Note: This figure presents the relationship between destination countries' share of US multinational companies' adjusted foreign unrelated party revenues and their share of final consumption expenditures. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

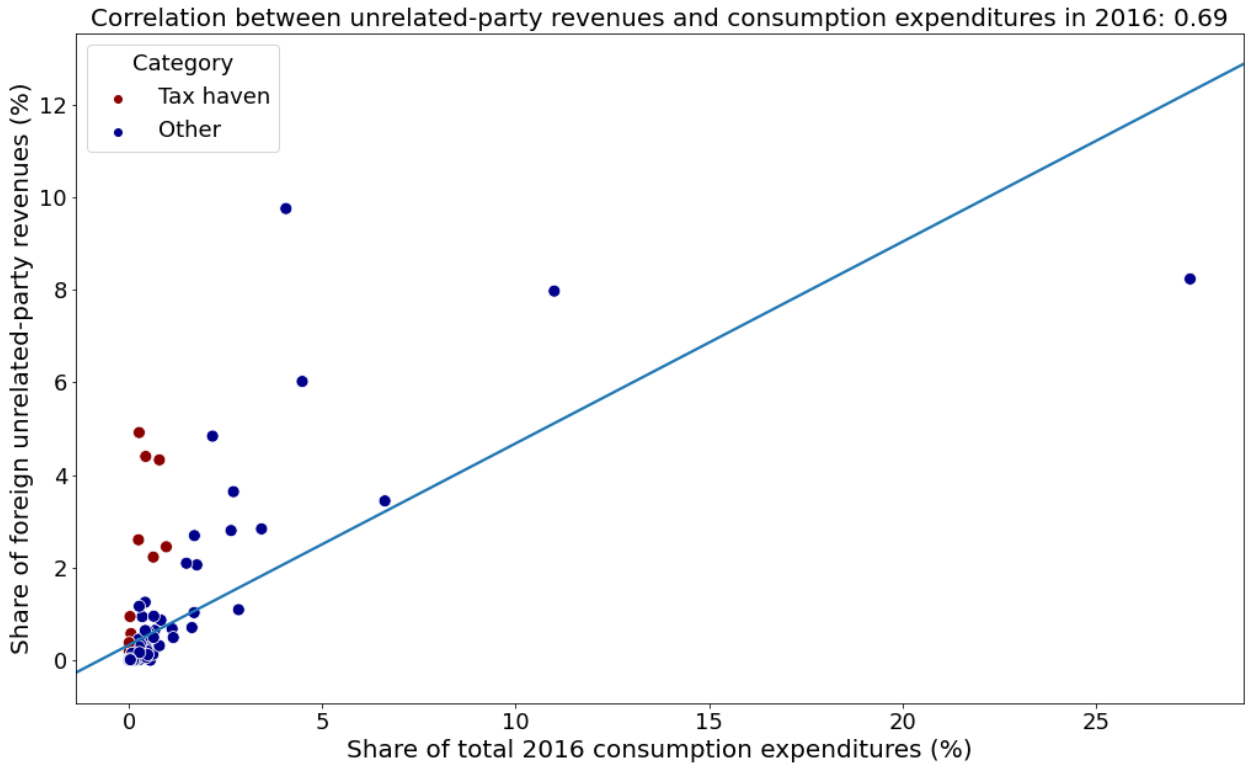
Extension to other headquarter countries

Table 26: Relationship between the 20 largest affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures, including non-US multinationals [2016]

Affiliate country	Share of foreign UPR (%)	Share of consumption expenditures (%)
United Kingdom	9.7	4.1
United States	8.2	27.4
China	8.0	11.0
Germany	6.0	4.5
Singapore	4.9	0.3
Canada	4.8	2.2
Hong Kong	4.4	0.4
Switzerland	4.3	0.8
Brazil	3.6	2.7
Japan	3.4	6.6
France	2.8	3.4
Italy	2.8	2.6
Spain	2.7	1.7
Ireland	2.6	0.2
Netherlands	2.4	1.0
Belgium	2.2	0.6
Mexico	2.1	1.5
Australia	2.1	1.8
Colombia	1.3	0.4
Peru	1.2	0.3

Note: This table presents the 20 main affiliate countries for the multinational companies headquartered in retained headquarter countries, based on unrelated party revenues. It displays each country's share of the total foreign unrelated party revenues (i.e., excluding domestic observations) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 9.7% of multinational companies' unrelated party revenues outside their headquarter countries and 4.1% of the total consumption expenditures of in-sample affiliate countries. Revenue shares are based on the IRS' country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Figure 26: Relationship between all affiliate countries' shares of foreign unrelated party revenues and final consumption expenditures, including non-US multinationals [2016]



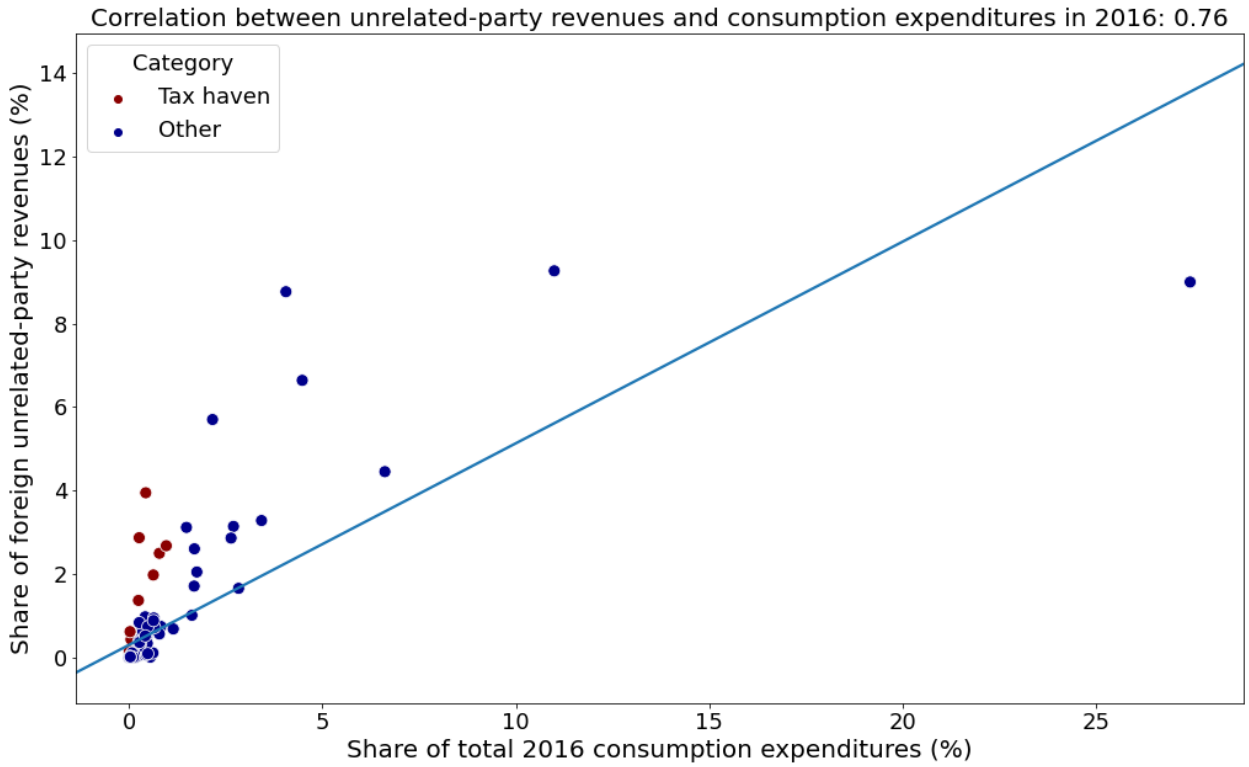
Note: This figure presents the relationship between affiliate countries' share of multinational companies' foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Table 27: Post-adjustment relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, including non-US multinationals [2016]

Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
China	752.8	9.3	11.0
United States	731.0	9.0	27.4
United Kingdom	712.1	8.8	4.1
Germany	539.6	6.6	4.5
Canada	463.3	5.7	2.2
Japan	361.8	4.5	6.6
Hong Kong	320.6	3.9	0.4
France	266.6	3.3	3.4
Brazil	255.2	3.1	2.7
Mexico	253.2	3.1	1.5
Singapore	233.1	2.9	0.3
Italy	232.4	2.9	2.6
Netherlands	217.6	2.7	1.0
Spain	211.5	2.6	1.7
Switzerland	202.8	2.5	0.8
Australia	166.4	2.0	1.8
Belgium	160.6	2.0	0.6
Korea	138.9	1.7	1.7
India	134.6	1.7	2.8
Ireland	111.1	1.4	0.2

Note: This table presents the 20 main destination countries for multinational companies headquartered in the retained headquarter countries, based on adjusted unrelated party revenues. It displays each destination country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding the domestic observations) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 8.8% of multinational companies' adjusted foreign unrelated party revenues and 4.1% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on the adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Figure 27: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, including non-US multinationals [2016]



Note: This figure presents the relationship between destination countries' share of multinational companies' adjusted foreign unrelated party revenues (i.e., excluding domestic observations) and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into two groups: tax havens as listed by Tørsløv, Wier, and Zucman (2018) and non-haven jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

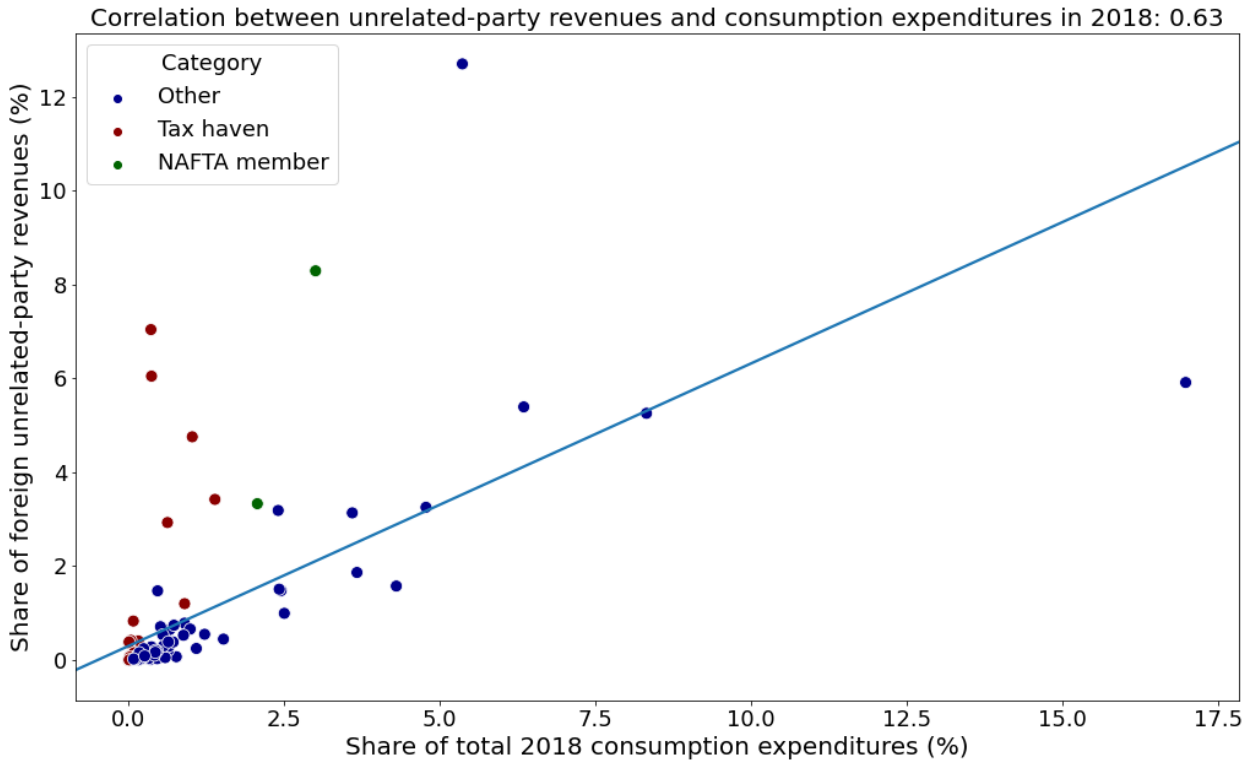
B.6.2 Results for 2018

Table 28: Top twenty largest affiliate countries [2018]

Affiliate country	UPR (USD billion)	Share of foreign UPR (%)
United Kingdom	556.6	12.7
Canada	363.4	8.3
Ireland	308.6	7.0
Singapore	265.1	6.0
China	259.2	5.9
Germany	236.4	5.4
Japan	230.4	5.2
Switzerland	208.5	4.7
Netherlands	150.0	3.4
Mexico	146.0	3.3
France	142.7	3.2
Australia	139.7	3.2
Brazil	137.5	3.1
Hong Kong	128.4	2.9
Italy	81.8	1.9
India	69.1	1.6
Spain	66.2	1.5
Korea	64.9	1.5
UAE	64.7	1.5
Belgium	52.7	1.2

Note: This table presents the 20 most important affiliate countries for US multinational companies. This ranking is based on the unrelated party revenues booked by US multinational enterprises in each of these jurisdictions. Revenues are presented in absolute amounts (expressed in 2017 billion USD) and as a share of US multinational companies' total foreign unrelated party revenues (expressed in percentage). All figures are based on the IRS' 2018 country-by-country report statistics. "UPR" stands for unrelated party revenues.

Figure 28: Relationship between all affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2018]



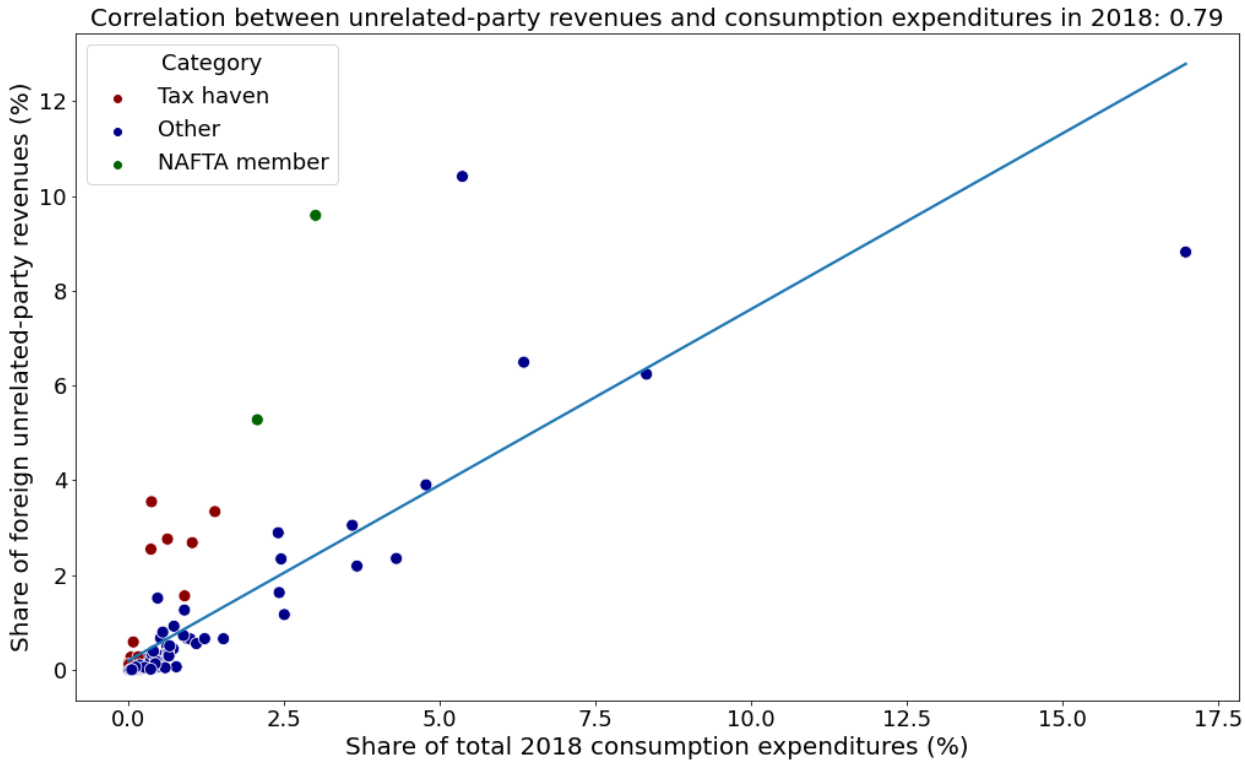
Note: This figure presents the relationship between affiliate countries' share of US multinational companies' foreign unrelated party revenues and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Table 29: Relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, based on adjusted revenue variables [2018]

Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
United Kingdom	592.4	10.4	5.4
Canada	545.7	9.6	3.0
China	501.7	8.8	17.0
Germany	369.4	6.5	6.4
Japan	355.0	6.2	8.3
Mexico	300.3	5.3	2.1
France	222.1	3.9	4.8
Singapore	201.9	3.5	0.4
Netherlands	190.0	3.3	1.4
Brazil	173.6	3.1	3.6
Australia	164.6	2.9	2.4
Hong Kong	157.1	2.8	0.6
Switzerland	152.7	2.7	1.0
Ireland	144.9	2.5	0.4
India	133.7	2.4	4.3
Korea	133.2	2.3	2.5
Italy	124.6	2.2	3.7
Spain	92.8	1.6	2.4
Belgium	88.9	1.6	0.9
UAE	86.1	1.5	0.5

Note: This table presents the 20 main destination countries for the US multinational companies, based on adjusted unrelated party revenues. It displays each country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding the US-US observation) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 10.4% of US multinational companies' adjusted foreign unrelated party revenues and 5.4% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Figure 29: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2018]



Note: This figure presents the relationship between destination countries' share of US multinational companies' adjusted foreign unrelated party revenues and their share of final consumption expenditures. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given destination country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the adjusted country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

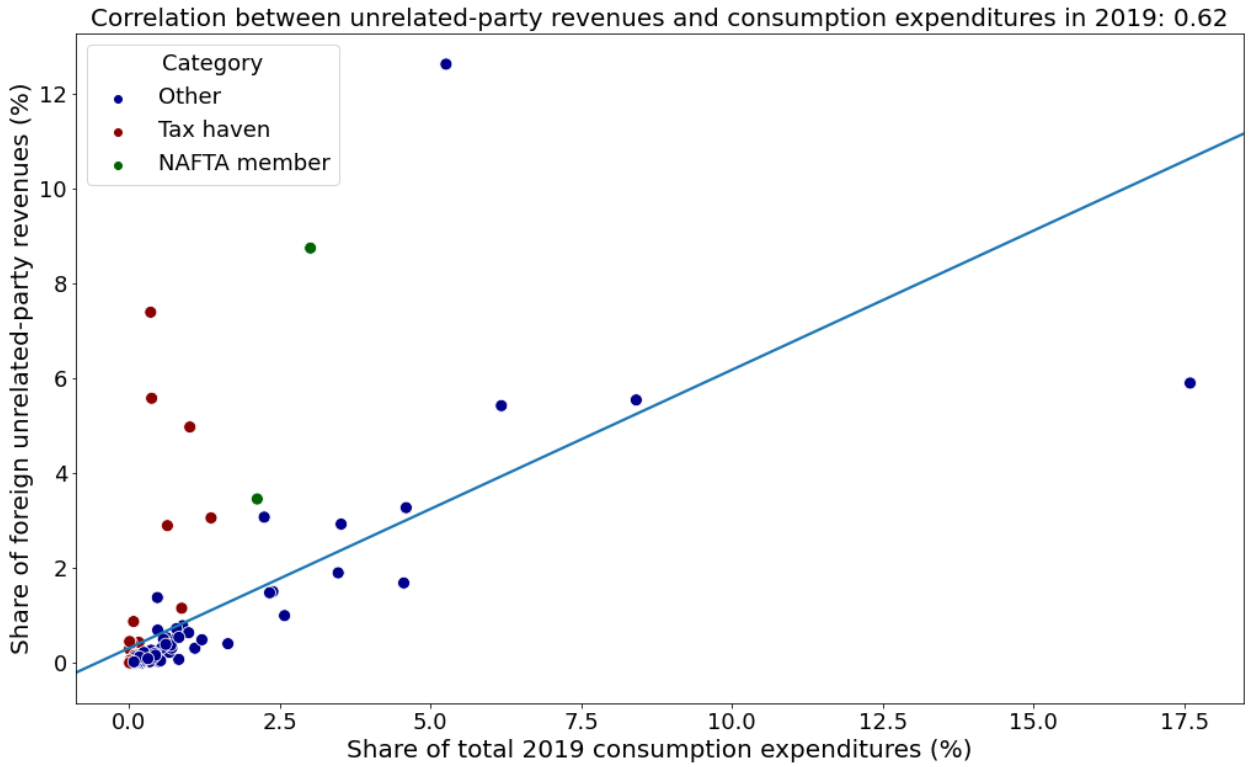
B.6.3 Results for 2019

Table 30: Top twenty largest affiliate countries [2019]

Affiliate country	UPR (USD billion)	Share of foreign UPR (%)
United Kingdom	549.5	12.6
Canada	380.8	8.7
Ireland	321.9	7.4
China	256.9	5.9
Singapore	243.0	5.6
Japan	241.3	5.5
Germany	236.2	5.4
Switzerland	216.6	5.0
Mexico	150.5	3.4
France	142.6	3.3
Australia	133.9	3.1
Netherlands	133.2	3.0
Brazil	127.5	2.9
Hong Kong	126.1	2.9
Italy	82.8	1.9
India	73.5	1.7
Korea	65.6	1.5
Spain	64.5	1.5
UAE	60.1	1.4
Belgium	50.3	1.2

Note: This table presents the 20 most important affiliate countries for US multinational companies. This ranking is based on the unrelated party revenues booked by US multinational enterprises in each of these jurisdictions. Revenues are presented in absolute amounts (expressed in 2017 billion USD) and as a share of US multinational companies' total foreign unrelated party revenues (expressed in percentage). All figures are based on the IRS' 2019 country-by-country report statistics. "UPR" stands for unrelated party revenues.

Figure 30: Relationship between all affiliate countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2019]



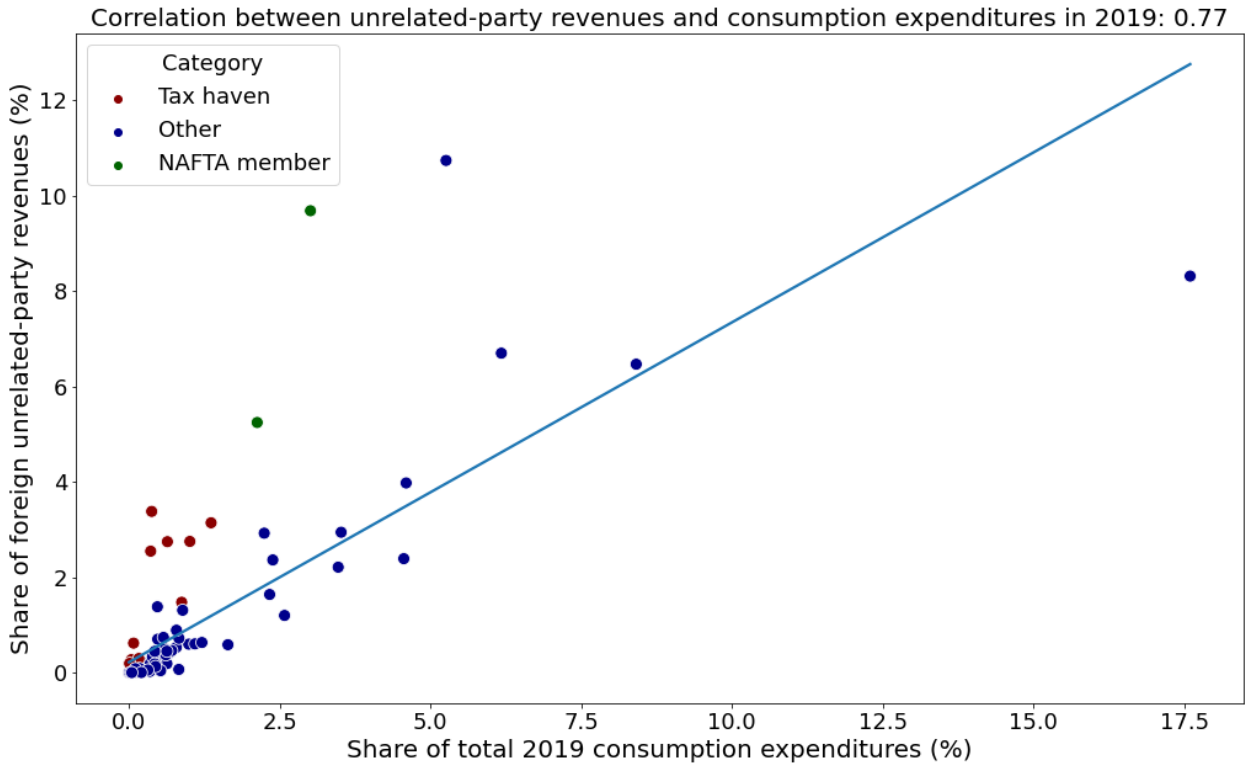
Note: This figure presents the relationship between affiliate countries' share of US multinational companies' foreign unrelated party revenues and their share of the final consumption expenditures observed in the sample. The x-axis corresponds to consumption expenditures and the y-axis to revenues. Dots, that all stand for a given affiliate country, are distinguished into three groups: NAFTA members (Canada and Mexico), tax havens as listed by Tørsløv, Wier, and Zucman (2018) and other jurisdictions. The indicative trend line is obtained via the ordinary least-squares estimation of a model regressing the share of unrelated party revenues over the share of consumption expenditures. Revenue shares come from the IRS' country-by-country report statistics; final consumption expenditures from the UNCTAD data portal.

Table 31: Relationship between the 20 largest destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures, based on adjusted revenue variables [2019]

Destination country	UPR (USD billion)	Share of UPR (%)	Share of consumption expenditures (%)
United Kingdom	600.0	10.7	5.3
Canada	541.1	9.7	3.0
China	464.5	8.3	17.6
Germany	374.3	6.7	6.2
Japan	361.3	6.5	8.4
Mexico	293.1	5.2	2.1
France	222.2	4.0	4.6
Singapore	188.9	3.4	0.4
Netherlands	175.6	3.1	1.4
Brazil	164.5	2.9	3.5
Australia	163.4	2.9	2.2
Switzerland	153.7	2.8	1.0
Hong Kong	153.4	2.7	0.6
Ireland	142.3	2.5	0.4
India	133.5	2.4	4.6
Korea	132.0	2.4	2.4
Italy	123.5	2.2	3.5
Spain	91.6	1.6	2.3
Belgium	82.5	1.5	0.9
UAE	77.2	1.4	0.5

Note: This table presents the 20 main destination countries for US multinational companies, based on adjusted unrelated party revenues. It displays each country's amount of unrelated party revenues, its share of the total foreign unrelated party revenues (i.e., excluding the US-US observation) and its share of the final consumption expenditures observed in the sample. For instance, the United Kingdom is found to account for 10.7% of US multinational companies' adjusted foreign unrelated party revenues and 5.3% of the total final consumption expenditures of in-sample destination countries. Revenue shares are based on adjusted country-by-country report statistics; final consumption expenditures are sourced from the UNCTAD data portal. "UPR" stands for unrelated party revenues.

Figure 31: Post-adjustment relationship between all destination countries' share of foreign unrelated party revenues and their share of final consumption expenditures [2019]



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