

The Missing Profits of Nations: Online Appendix*

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Abstract

This Appendix supplements our working paper “The Missing Profits of Nations”

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The goal of this Appendix is to allow the reader to reproduce all the results of the paper starting from readily available public statistics. We describe each of the steps that leads from the published data to the results. The Appendix is supplemented by an Excel file containing all relevant formulas with the details of each computation and by a set of Stata files.¹

The Working Paper summarizes the main steps. The Appendix gives additional details, provides consistency and robustness checks, compares the choices made in this research with those made in other studies, lists all relevant references, and produces additional results excluded from the Working Paper for the sake of conciseness. The Appendix is structured as follows:

- Section A discusses the data and computation of the amount of corporate profits in each country, including the decomposition between the profits of foreign-controlled vs. local firms, and our estimates of profits artificially shifted to tax havens.
- Section B discusses balance of payments and trade data, and how we use these data to apportion the shifted profits to the countries where they have been made (or where the multinationals that shift profits are headquartered).
- Section C presents GDP, profits, capital shares, and profitability statistics for the world's main countries corrected for artificial profit shifting.
- Section D compares our estimates of multinationals' profit shifting to previous studies.
- Section E provides data and information on how tax authorities attempt to enforce taxes on multinational groups (mutual agreement procedures, etc.). In this section we also present a simple theoretical model to understand the patterns observed in international tax enforcement.
- Section F presents data on the evolution of corporate tax rates and multinational companies share of the global economy.
- Section G lists the various data outputs created by this research.

A Data on Corporate Profits Across the World

This Section presents our database of corporate profits across the world. This database decomposes corporate profits into profits made by foreign-controlled corporations vs. local firms, and

¹Available online at: <http://gabriel-zucman.eu/missingprofits>.

into actual profits vs. artificially shifted profits. We describe the construction of the database step by step starting from easily accessible public statistics. All our computations are for the year 2015, the latest year for which comprehensive data was available at the time this research was conducted. The database is available in Excel format, with tables numbered A.1 to A.11. We start by presenting the data sources we use, and then discuss the construction of each of these tables in turn.

A.1 Main Data Sources

A.1.1 National Accounts Data

The starting point to measure the corporate profits made in each country is the national accounts. National accounts data report information on value-added in each domestic sector of the economy: non-financial corporations, financial corporations, the government sector, the household sector, and non-profit institutions. In turn, value-added is decomposed into compensation of employees paid and operating surplus (i.e., profits); see Section A.2 below. By adding the operating surplus of non-financial and financial corporations, we obtain the recorded amount of profits made by domestic corporations. We use two sources of national accounts data.

OECD National Accounts Data. First, we rely on the detailed OECD national accounts by sector (OECD Table 14a).² The OECD database includes all OECD countries and a number of large developing non-OECD countries (Brazil, China, Colombia, Costa Rica, India, Russia, and South Africa). We include all these countries in our own database.

Tax Havens National Accounts Data. Second, we extend the OECD database to non-OECD tax havens by relying on the national accounts data disseminated by tax havens' official statistical institutes and/or central banks. Our list of non-OECD tax havens includes Cyprus, Malta, Marshall Islands, Singapore, Hong Kong, Puerto Rico, and all the small offshore financial centers listed in Table 1 of Lane and Milesi-Ferretti (2010): Andorra, Anguilla, Antigua and Barbuda, Aruba, The Bahamas, Bahrain, Barbados, Belize, Bermuda, the British Virgin Islands, the Cayman Islands, Gibraltar, Grenada, Guernsey, the Isle of Man, Jersey, Lebanon, Liechtenstein, Macao, Mauritius, Monaco, the Netherlands Antilles, Panama, Samoa, Seychelles, St. Kitts and Nevis, St. Lucia, St. Vincent & Grenadines, Turks and Caicos, Vanuatu.

Many of these tax havens publish their own national accounts, and use them whenever they exist. These national accounts are imperfect, in the sense that they typically don't attempt to es-

²https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE14A

timate the profits shifted inward into the offshore sector. Take the case of Bermuda, for instance. The national accounts of Bermuda provide estimates of value-added, compensation of employees paid, and operating surplus by sector of the economy.³ They isolate an offshore corporate sector (called the “international business” sector) from the rest of the domestic economy. The national accounts of Bermuda report compensation of employees paid in this international business sector (namely, \$1.438 billion—the Bermudian dollar is equal to 1 US dollar). But they put operating surplus at 0 for this sector. In effect they do not attempt to include into Bermuda’s GDP the amount of profits recorded by the foreign-controlled firms located in Bermuda, which would inflate enormously the GDP of Bermuda (hence would make even more apparent than already is the extent of inward profit shifting into the island). Therefore, to estimate the amount of profits booked (for tax reasons) in offshore tax havens, we start with the official data reported by these havens, and then make a number of step-by-step corrections described precisely in Appendix A and B below.

A.1.2 Foreign Affiliates Statistics

The second key data source we use is foreign affiliates statistics (FATS). While national accounts data provide information on the total amount of corporate profits made in each country, they do not show how much profits are made in foreign-controlled corporations vs. local firms. The FATS enable us to bridge this gap. Inward FATS of country A provide key economic indicators for firms operating in country A that are foreign-controlled, i.e., whose ultimate controlling institutional unit is located in a foreign country. (Outward FATS, symmetrically, provide key economic indicators for foreign affiliates of multinational companies whose ultimate controlling institutional unit is a resident of country A.) We use inward FATS to decompose the corporate profits made in each country into profits made by foreign-controlled firms vs. local firms (i.e., not foreign-controlled). A firm is foreign-controlled if a single investor or a group of associated investors acting in concert own more than 50% of ordinary shares or voting power. However, this condition is sufficient but not necessary: other criteria may also be relevant for defining foreign control, and thus other cases (multiple minority ownership, joint ventures, and qualitative assessment determining control) are sometimes used to assess control, cf. Eurostat (2012).

FATS disseminated by Eurostat and the OECD. In the European Union, the first regulations mandating the compilation of FATS were introduced in 2007. In July 2007, Eurostat—

³See for 2015 https://www.gov.bm/sites/default/files/GDP_2015.pdf.

the EU statistical institute—published a first edition of its recommendation manual for foreign affiliates statistic. A second edition was published in 2009 and a third edition in 2012.⁴

Since 2008, all EU countries generally report annual foreign affiliates statistics to Eurostat. Before 2008 a number of EU countries reported FATS statistics, but coverage was more limited (e.g., Ireland did not report data; countries reported fewer variables) and the statistics were less harmonized. Post-2008 FATS include estimates of value-added, compensation of employees paid, and gross operating surplus for foreign-controlled corporations, by sector of the economy and country of the controlling entity. However, they do not include further decompositions of gross operating surplus (into net interest paid, net dividends paid, corporate income tax paid, and depreciation). Moreover, the FATS data disseminated by Eurostat currently only cover non-financial corporations, and coverage among non-financial corporations is not always complete (see discussion in Section A.3 below).⁵

The OECD also disseminates FATS data, called “activities of multinational enterprises” (AMNE) statistics. For EU countries, the data are identical to those disseminated by Eurostat. The OECD also includes FATS for non-EU countries: Canada, Switzerland, Turkey, and the United States. Except for the United States, these statistics are typically more limited than for EU countries (i.e., fewer variables are included).

BEA Survey of Foreign Operations of U.S. Multinationals. The United States has been compiling particularly detailed data on the activities of U.S. multinational companies (and foreign multinationals operating in the United States) since the 1950s. These data are compiled by the Bureau of Economic using mandatory surveys.⁶ The first modern survey of the activities of U.S. multinationals was conducted in 1950. Since 1982, a survey is conducted annually; an exhaustive (census) benchmark survey is conducted every five years. The latest benchmark survey was conducted in 2014. These data are richer than the FATS currently compiled by other OECD countries. In particular and importantly, they contain detailed decomposition of the profits made by affiliates of U.S. multinationals abroad, including foreign income taxes paid.

⁴<http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-12-016>

⁵Data are available online at <http://ec.europa.eu/eurostat/web/structural-business-statistics/global-value-chains/foreign-affiliates>.

⁶The data are available at: https://www.bea.gov/international/direct_investment_multinational_companies_comprehensive_data.htm.

A.1.3 Foreign Direct Investment Statistics

In a number of countries, statistics on the activities of multinational companies (i.e., FATS) are still not available. In that case we rely instead on foreign direct investment statistics to estimate the amount of profits made by foreign-controlled corporations.

There are two main sources of direct investment statistics: the OECD and the IMF. The OECD sets the world standards for compiling FDI statistics through its Benchmark Definition of Foreign Direct Investment. We rely primarily on FDI statistics disseminated by the OECD.⁷ These statistics follow the 4th edition of the OECD benchmark definition of foreign direct investment (BMD4) that was published in 2008.⁸ The BMD4 improved upon previous definitions along two dimensions: first it encouraged countries to compile FDI statistics separately for resident special purpose entities (SPEs), i.e., “entities with no or few employees, little or no physical presence in the host economy and whose assets and liabilities represent investments in or from other countries and whose core business consists of group financing or holding activities.” Second, it encouraged countries to compile inward investment positions according to the ultimate investing country to identify the country of the investor that ultimately controls the investments in their country. While BMD4 was completed in 2008, it is only since September 2014 that the OECD has been collecting FDI statistics from member countries according to the updated benchmark definition. Data for previous years followed earlier versions of the benchmark definition.

We also rely on FDI statistics disseminated by the IMF when no data are available from the OECD. For OECD countries, there is generally a small discrepancy between direct investment statistics reported by the OECD and by the IMF. OECD and IMF research demonstrated that the main differences between their FDI statistics are largely due to the timing of revisions.⁹ In addition to the OECD and the IMF, the UNCTAD also disseminates FDI data that are in a number of cases different than the OECD due to adjustments; we do not use UNCTAD data in this research.

A.2 Computation of Domestic Profits

A.2.1 From GDP to Corporate Value-Added (Table A.1)

We start in Table A.1 by reporting the decomposition of GDP by sector: GDP (at factor cost, i.e. net of taxes on production) is equal to the value-added of corporations (financial plus non-

⁷Available online at <http://www.oecd.org/daf/inv/mne/statistics.htm>.

⁸<https://www.oecd.org/daf/inv/investmentstatisticsandanalysis/40193734.pdf>

⁹<https://www.oecd.org/daf/inv/FDI-statistics-explanatory-notes.pdf>

financial corporations), plus the value-added of the government, plus the value-added of the rest of the economy (non-corporate businesses, households, and non-profit institutions serving households).

The data for OECD countries and the main developing countries are taken from the OECD detailed national accounts by sector. In cols. 3–8, all taxes on production net of subsidies are removed for each sector; these taxes include all “taxes on production and imports” (code D2 in the System of National Accounts 2008). That is, they include both taxes on products (code D21) and “other taxes on production” (code D29), net of the respective subsidies (codes D31 and D39).¹⁰ For China and India we use data from their respective statistical agencies (Chinese national accounts data are from 2013, but inflated using GDP growth from 2013 to 2015). Data for South Africa and Brazil are for 2014 (with no adjustment). When no data is available, we impute the share of the corporate sector in total value-added at factor cost as the average value for similar countries (see Excel formulas in Table A.1).

For non-OECD tax havens we use UN National Account data to estimate GDP at factor cost (see do-file “UN National Accounts.do”). To decompose GDP by production sector, whenever data is available (which is the case for, e.g., Singapore, Puerto Rico) we use data from the havens’ official statistical agencies. If no data is available, we first try to impute current values using past values; otherwise we use average shares among non-OECD tax havens. The do-file “UN National Accounts.do” explains the imputation procedure in detail.

A number of results are worth noting. At the global level the share of the corporate sector in total value-added is slightly higher than 60% (61.4% in 2015), but this average masks interesting heterogeneity. First, The corporate share in tax havens is particularly high: the country with the highest corporate share of domestic value-added is Ireland (80%), closely followed by Luxembourg, the Netherlands, and Switzerland. Tax havens typically have corporate shares between 70% and 80%. Second, among non-haven OECD countries, there are variations in the corporate share of total value-added. Most importantly, the U.S. share is relatively low (57.6%) due to the importance of non-corporate businesses (partnerships) and of non-profit institutions (especially in the health care sector). When one looks at the share of non-corporate businesses and non-profits in total value-added, the United States is among the countries with the highest share. Third, the share of corporate value-added in total value-added is quite similar in developing countries vs. OECD countries. The difference is that in developing countries, a relatively

¹⁰Product taxes strictly speaking (D21) include sales taxes, value-added taxes, excise duties, import taxes and various other consumption taxes, while “other production taxes” (code D29) include a number of property taxes and non-social-contributions payroll taxes.

low fraction of value-added is made in the government sector and a relatively high fraction is made in non-corporate businesses (e.g., by self-employed individuals). By contrast, in OECD countries a relatively low fraction of value-added is made in the non-corporate business sector and a relatively high fraction is made in the government sector.

Some of the cross-country variation in the sectoral composition of value-added also reflect a lack of harmonization in national accounts data across countries. Importantly, as pointed by Pionnier and Guidetti (2015), countries differ in the way they record the self-employed and other non-corporate businesses. Germany and Italy record certain self-employed workers in the corporate sector (and their income under corporate profits). This artificially inflates the share of the corporate sector in total value added (and affects other statistics such as effective corporate income tax rates, see below). We did not attempt to address this problem in this research and refer to Pionnier and Guidetti (2015) for a detailed discussion and plausible corrections that would make Germany and Italy more comparable to other OECD countries.

A.2.2 Decomposition of Corporate Value-Added (Table A.2)

Table A.2 decompose the value-added of corporations by cost component. Corporate value-added (at factor cost, i.e., net of indirect taxes) is equal to compensation of employees paid, plus net operating surplus, plus depreciation.

Compensation of employees (code D1) paid by the corporate sector includes both wages and salaries and supplements to wages and salaries (e.g., mandatory employer social contributions, employment fringe benefits such as pension contributions, etc.). Net operating surplus is equal to gross operating surplus (code B2G) minus capital depreciation (code K1). Net interest is equal to the interest paid by corporations (D41 paid) minus the interest received by corporations (D41 received). Corporate profits are computed as net operating surplus minus net interest paid, and correspond conceptually to what the corporate income tax attempts to tax (as depreciation and interest payments are typically tax deductible).

We take the data from the OECD detailed national accounts by sector and countries' official national accounts for non-OECD countries. We impute compensation of employees, net interest paid, and depreciation when no data is available using the mean of these variables (as a fraction of corporate value-added) for comparable countries (typically, the mean for OECD countries for OECD countries with missing data; the mean for developing countries for developing countries with missing data; the mean for non-OECD tax havens for non-OECD tax havens with missing data; see Excel formulas in Table A.2). We attribute to Bahrain and Lebanon the average labor

share of non-OECD tax havens (see Excel formulas in Table A.2); data exist for these havens but they imply implausibly low labor shares. For net interest paid by non-OECD havens (col. 4), we only have data for Singapore; we therefore proceed as follows. For Malta, Hong Kong, Cayman Islands, and Cyprus we estimate net interest paid as net FDI interest paid to the rest of the world, using balance of payments data. For other non-OECD tax havens, net interest paid is imputed using the weighted average share of net interest paid to corporate value-added in these five non-OECD tax havens.

In cols. 7–9 we compute factor shares (the share of labor and the share of capital in total corporate value-added), both gross of capital depreciation and net of capital depreciation. We also report in col. 10–11 two of our key ratios of interest in this research: the ratio of net interest paid to net operating surplus (col. 10), and the ratio of taxable corporate profits (defined as operating surplus net of capital depreciation and of net interest payments) to compensation of employees.

A number of results are worth noting. First, we observe very high capital shares in tax havens compared to all other countries, and accordingly high profits to compensation ratios. However tax havens are not the only countries that have capital share and profits/compensation ratios; a number of developing countries also do (Mexico, India, Turkey, etc.), as well as a number of resource-rich countries (Chile, Norway, Russia, South Africa). Developed, high-tax countries tend to have the lowest capital shares (France, Canada, Finland, Belgium, United States, Austria, Spain, Austria, etc.). The patterns are similar when looking at the corporate capital share within non-financial corporations only, i.e., excluding financial corporations (Table A.2b).

The high capital share of corporate value-added in developing countries means that a large fraction of global profits come from developing countries today. When one ranks countries by the size of their corporate profits (in US\$ using market exchange rates), then the number one country in the world is not the United States (as when ranking countries by GDP), but China. India is 6th, Mexico 7th, Russia 8th, and Brazil 9th. By contrast, France (which is the 7th largest country by size of GDP) is only 13th by corporate profits.

Second, there is substantial variation in the ratio of net interest paid to operating surplus. Net interest paid by corporations in high-tax countries is typically positive while net interest paid by corporations in tax havens is typically negative. Part of this reflects the fact that tax havens host a large financial industry, which typically receives positive net interest. In Appendix Table A2.b, we provide a decomposition of the value-added of the non-financial corporate sector.

We see here that non-financial corporations in all countries have typically positive net interest payments, with again substantial variation across countries. Net interest paid by non-financial corporations are particularly high in Canada, France, and the United States—potentially reflecting a greater use of interest payments for tax avoidance purposes in these countries. They are also very high in Luxembourg, potentially reflecting income payments of hybrid securities (i.e., securities treated as bonds for tax purposes in Luxembourg and equity for tax/regulatory purposes in other countries; these securities are commonly used to avoid corporate taxes, see Johannesen, 2014).

A.2.3 Distribution of Corporate Profits (Table A.3)

Table A.3 decomposes corporate profits into net dividends paid, corporate income tax paid, and retained earnings. Corporate profits are the profits reported in col. 5 of Table A.2, i.e., operating surplus net of capital depreciation and of net interest payments—typically what the corporate tax attempts to tax. Dividends include the “distributed income of corporations” (code D42 in the SNA) plus “investment income disbursement” (code D44), which includes investment income attributable to insurance policy holders, payable on pension entitlements, and attributable to collective investment funds. Retained earnings (col. 5) are computed as a residual, hence include net rents (code D45, usually zero or negligible) and net business transfers (such as fees paid to the government, fines, donations, etc.; usually small) in addition to pure retained earnings.

In the national accounts, corporate income tax payments include the profits of central banks (which by convention are treated as if they were 100% taxed by governments). Because these profits have increased after the financial crisis of 2008-2009, they can bias computations of effective corporate tax rates based on national accounts data. Therefore in column 7, we report the actual corporate tax revenue received by governments of each country as reported by the OECD in its tax revenue statistics.¹¹ The difference (col. 8) can be interpreted as the profits of central banks (and other measurement and conceptual differences between the national accounts and the OECD revenue statistics).

A number of results are worth noting. First, as shown in col. 9, the global average corporate income tax rate (defined as corporate income taxes paid over corporate profits recorded in the national accounts, after net interest payments) is a bit below 20% (19.3%). Unsurprisingly, effective corporate tax rates are particularly low in the main tax havens, Ireland, Luxembourg,

¹¹<https://stats.oecd.org/Index.aspx?DataSetCode=REV>

and the Netherlands; they are also low in most Eastern European countries (Poland, Latvia, Hungary, Estonia, etc.) that have low statutory rates. Germany also shows up with a low corporate tax rate of 11%. One likely explanation is that German figures for corporate value-added and profits are distorted by the inclusion of the self-employed in the corporate sector (Pionnier and Guidetti, 2015).¹² Because the self-employed do not pay corporate taxes, the inclusion of the self-employed in the corporate sector (and of their income under corporate profits) biases effective tax rates downwards. Moreover, the corporate income tax payments recorded in the OECD revenue statistics (which we use to compute the effective corporate tax rate) for Germany are markedly lower than the corporate income tax payments recorded in the national accounts; using the latter, the German effective corporate income tax rate would rise to 14.4%. It is unclear why there is such a large gap between corporate tax revenue in the national accounts vs. the revenue statistics for Germany. Last, it is possible that there is sizable tax avoidance by German firms (and/or that many German corporations do not have to pay the corporate income tax), which could explain why the effective rate is substantially below the statutory rate of about 30%.

Effective corporate income tax rates are high in countries that have high statutory rates, mainly large developed countries: the United States, Japan, France, Scandinavian countries. Interestingly, effective corporate tax rates are also high in Australia and Canada, where the corporate tax is integrated with the personal income tax, which in principle reduces the incentives for corporate tax avoidance. A few developing countries have relatively high effective tax rates (Colombia, South Africa), but most have low or very low rates (India, India, Mexico, Russia).

Turning to patterns in retained earnings, column 10 shows that countries vary a lot in the fraction of after-tax corporate profits that are distributed vs. retained. For the world as a whole, slightly more than half of post-tax corporate profits are retained. There has been a sharp increase in corporate retained earnings in recent years (Chen, Karabarbounis and Neiman, 2017). Retained earnings are higher in developing countries (maybe due to more binding credit constraints) than in OECD countries (around 70% vs. around 40%). Within OECD countries, there are extreme variations. In the Netherlands almost 100% of profits are retained earnings, maybe reflecting profit shifting and tax avoidance (e.g., by U.S. multinational companies, which until 2018 had incentives to retain profits offshore). In Luxembourg by contrast, retained earnings are negative, which could be due to several things. By construction, for the mutual fund industry (which is particularly large in Luxembourg) all profits are distributed (under code

¹²As pointed by Pionnier and Guidetti (2015), the same problem occurs in Italy, which also shows up with a relatively modest effective corporate tax rate of 18%, way below the statutory rate of 31.4% in force in 2015.

D44 in the national accounts). Moreover, for non-financial corporations, figures for Luxembourg may be distorted by the use of hybrid securities, as discussed below.

A.3 Computation of Profits of Foreign-Controlled Firms

A.3.1 Corporate Value-Added: Local vs. Foreign-Controlled Firms (Table A.4)

Table A.4 decomposes corporate value-added into the value-added of foreign-controlled firms and the value-added of other firms (not foreign-controlled). Following internationally-agreed guidelines, foreign-controlled firms include all firms where foreign investors own more than 50% of shares with voting rights. However this condition is sufficient but not necessary: there are some other ways firms can be foreign controlled (see Eurostat, 2012).

The key data source is the inward FATS statistics disseminated by the OECD, the Bureau of Economic Analysis, and Eurostat (see section A.1 above). Specifically, for European Union countries, we use the FATS disseminated by Eurostat, for the United States we use the FATS disseminated by the Bureau of Economic Analysis (majority-owned affiliates of U.S. multinationals, see Section A.1 above), and for other OECD countries we use the OECD FATS when data exist.

A few remarks are in order about foreign affiliates statistics. First, the FATS disseminated by the OECD and Eurostat currently only cover non-financial corporations (except for the United States). This means in particular that they exclude financial holding companies, including special purpose entities (SPEs). Second, coverage among non-financial corporations is not always complete. In Table A.9, we reconcile foreign affiliates statistics with national accounts data. In most countries, the value-added of non-financial corporations recorded in the FATS (for both foreign-controlled and local firms) adds up to around 90%-95% of the value-added of non-financial corporations recorded in the national accounts. In some countries, however, the coverage ratio is lower, e.g., France (83%), Spain (79%), and a number of Eastern European countries. This could be due to the fact that some countries collect data from non-financial corporations based on a sample rather than an exhaustive census. Surveys face non-response problems, especially when answering the survey is not made compulsory by law.

Therefore, to estimate the total amount of employee compensation and profits made by foreign-owned corporations in Table A.4, we proceed as follows. We compute what fraction of employee compensation and profits are made by foreign-owned non-financial companies in the FATS, and we apply this ratio to the total employee compensation and profits of domestic firms

(financial and non-financial) as recorded in the national accounts.¹³

When compensation of employees is not reported in the inward FATS (or where no inward FATS are disseminated, which is the case for most developing countries and non-OECD tax havens), we impute it by assuming that non-U.S. affiliates have the same profitability as U.S. affiliates. Specially, we apply the profits / compensation ratio of U.S. affiliates (as reported in the outward FATS of the United States) to the total amount of profits in the foreign-controlled sector, as estimated in Table A.5 below using balance of payments statistics.¹⁴ When no data is available, we impute the share of compensation which is paid in the foreign-controlled sector by using the weighted average share for similar countries, see Excel formulas in Table A.4.

A number of results are worth noting. First as shown by col. 8, the value-added of foreign-controlled firms accounts for 12% of global corporate value-added: 15% in OECD countries and 9% in developing countries. Among OECD countries, tax havens (Luxembourg, Ireland, the Netherlands) and Eastern European countries (most prominently Hungary, Slovakia and the Czech Republic) appear to be largely foreign-owned, with more than 40% of all corporate value-added made in foreign-controlled corporations (and as much as 65% in Luxembourg). In tax havens, these high ratios are driven by the fact that an even fraction of total domestic corporate surplus is made in foreign-controlled corporations (col. 10): as much as 75%–80% of all profits made in Ireland and Luxembourg are made in foreign-controlled firms. In Eastern European countries, a high fraction of both compensation of employees (col. 9) and profits is made in such firms. At the opposite end of the spectrum, large economies—whether developed or developing—tend to have low ratios of foreign ownership: China, Turkey, Japan, India, the United States and Korea all have around 10% or less of their corporate value-added made in foreign-controlled firms.

In Table A.4 we also report estimates of the value-added of foreign-controlled firms in non-OECD tax havens. However, it is important to keep in mind that these figures severely underestimate the importance of foreign-controlled businesses, for two reasons. First small tax havens typically do not record the profits made by offshore firms accurately (or even not at all). Take the case of Bermuda, already mentioned. The national accounts of Bermuda provide estimates of value-added, compensation of employees paid, and operating surplus by sector of the economy.¹⁵ They isolate an offshore corporate sector (called the “international business” sector)

¹³For Luxembourg, we assume that 100% of the value-added in the financial sector (which is not reported in the FATS) is in foreign-controlled firms.

¹⁴For Brazil and Russia we use the U.S. affiliate profitability of 2014 instead of 2015, as most U.S. affiliates are in the oil sector and 2015 profitability ratios are affected by the collapse in oil prices in 2015.

¹⁵See for 2015 https://www.gov.bm/sites/default/files/GDP_2015.pdf.

from the rest of the domestic economy. The national accounts of Bermuda report compensation of employees paid in this international business sector (namely, \$1.438 billion—the Bermudian dollar is equal to 1 US dollar). But they put operating surplus at 0 for this sector. In effect they do not attempt to include into Bermuda’s GDP the amount of profits recorded by the foreign-controlled firms located in Bermuda, which would inflate enormously the GDP of Bermuda (hence would make even more apparent than already is the extent of inward profit shifting into the island). Second, the data reported in Table A.4 exclude special purpose entities (and the profits shifted into such entities). We correct for these two issues in Table A.6 below.

The main limit of current foreign affiliates statistics is that they do not decompose gross operating surplus into net dividends, net interest, corporate tax paid, retained earnings, and depreciation. For some havens, most spectacularly Luxembourg, a lot of profit shifting is done through interest payments. Operating surplus is not affected by intra-group interest payments, so operating surplus alone is not informative of the full scale of profit shifting. To bridge this gap, we need to decompose the operating surplus of foreign-controlled corporations, a task we now turn to.

A.3.2 Operating Surplus of Foreign-Controlled Companies (Table A.5)

Table A.5 decomposes the gross operating surplus of foreign-controlled companies (excluding SPEs) into net interest paid, net dividends paid, retained earnings, corporate income tax paid, and depreciation. Because foreign affiliates statistics do not currently provide such details, these components must be estimated from other sources. To do so, we use balance of payments statistics on direct investment (DI) income. Conversely, in Table A.5 we also construct estimates of the gross operating surplus of foreign-controlled companies for the countries that have no foreign affiliates statistics (mostly non-OECD tax havens) by using balance of payments statistics on direct investment income.

Consistency between FATS and DI statistics Direct investment data capture the cross-border interest, dividends, and retained earnings flows of firms who are more than 10% owned by foreign investors. These flows are apportioned proportionally to what fraction of equity is foreign-owned. This is not the same definition as the definition of “foreign-controlled” used in FATS statistics (which typically cover firms that are more than 50% owned by foreign investors, with no apportionment by equity ownership). Hence our decomposition of the operating surplus of foreign-controlled corporations has some margin of error. But this margin of error is usually relatively small, because in practice there is sizable overlap between foreign-controlled firms and

DI firms. Therefore as a baseline we use the DI balance of payments data with no adjustment, and we conduct a number of sensitivity tests and checks to make sure that our imputations deliver sensible results; we also always make sure that all adding up accounting constraints are respected.

The only systematic correction we make to the DI data is to remove the flows of special purpose entities, since these SPEs (and financial corporations more broadly) are not included in foreign affiliates statistics. Following the implementation of the OECD 4th benchmark definition of direct investment, compiling countries have been encouraged to publish direct investment statistics separately for SPEs and non-SPEs (i.e., operating units). When no information in the DI flows of SPEs exists, we assume these flows are zero.

We now describe how we decompose the operating surplus of foreign-controlled firms component by component.

Net interest paid. We estimate the amount of net interest paid by foreign-controlled companies (col. 2) as the amount of net interest paid on inward direct investment recorded in the balance of payments (excluding SPEs). This is equal to the difference between (i) interest paid to foreign parents and fellow enterprises with a foreign ultimate controlling parent (interest paid, col. 3), and (ii) interest received from foreign parents and fellow enterprises with a foreign ultimate controlling parent (interest received, col. 4). All of these interest flows are reported in balance of payments statistics that follow the 6th edition of the IMF balance of payments manual, and are reported in Tables B.3, B.4, and B.5 in Appendix B below. We borrow the numbers from these Tables, further described below.

Note that by construction, our measure of the net interest paid by foreign-controlled companies only takes into account intra-group interest flows. That is, it disregards any interest payments made to/received from firms outside of the multinational group (such as interest payments on money borrowed from unaffiliated banks). These non intra-group interest flows are likely to be small, as most of the financing of the affiliates of foreign multinationals is typically intra-group. Disregarding these flows has no material impact on our estimates.

Net dividends paid. We estimate the amount of net dividends paid by foreign-controlled companies (col. 5) as the amount of net dividends paid on inward direct investment recorded in the balance of payments (excluding SPEs). This is equal to the difference between (i) dividends paid to foreign parents and fellow enterprises with a foreign ultimate controlling parent (dividends paid, col. 6), and (ii) dividends received from foreign parents (typically 0) and from

fellow enterprises with a foreign ultimate controlling parent (dividends received, col. 7). All of these dividends are in principle reported in balance of payments statistics that follow the 6th edition of the IMF balance of payments manual (see Tables B.3, B.4, and B.5 in Appendix B below).

Retained earnings. The retained earnings of foreign-controlled corporations are equal to the amount of reinvested earnings on inward foreign direct investment recorded in the balance of payments, excluding SPEs (as reported in Table B.4 and B.5 below).

Corporate income tax. One limitation of current foreign affiliates statistics is that they do not report the amount of corporate income taxes paid by foreign-controlled corporations. To our knowledge, only one country reports such information in its own outward FATS: the United States, in the BEA survey of the foreign operations of U.S. multinationals (see section A.1 above for a presentation of this dataset). Therefore, in col. 9 we estimate the amount of taxes paid by foreign-controlled corporations by applying the effective tax rate faced by all domestic firms (from Table A.3, col. 9) and for tax havens and a few other countries we use instead the effective rate faced by U.S. affiliates (reported in col. 16); see Excel formulas in Table A.5. We compute the effective tax rate faced by U.S. affiliates in foreign countries using the BEA survey of the the foreign operations of U.S. multinationals. For both domestic firms and U.S. affiliates, the effective rate is similarly computed as the ratio of income taxes paid to pre-tax corporate profits (i.e., net of depreciation operating surplus minus net interest paid).¹⁶

Depreciation. We compute depreciation in foreign-controlled corporations as a residual, i.e., as gross operating surplus, minus net interest paid, net dividend paid, corporate income taxes paid, and retained earnings. We checked that the implied depreciation is reasonable, i.e., that the ratio of depreciation to gross operating surplus for foreign-controlled corporations is similar to the ratio recorded for all corporations and for U.S. affiliates (see cols. 11–13). This is the case in all countries (suggesting that our imputation of net interest, dividends, retained earnings, and taxes for foreign-controlled corporations delivers reliable results), except in the case Luxembourg. The discrepancy for Luxembourg probably owes to differences in scope

¹⁶In the United States, the BEA provides a decomposition of the operating surplus of the foreign affiliates of U.S. multinationals which we report in Table A.10 (for 2015) and Table A.10b (for 2014). It also reports a decomposition of the net income of foreign affiliates of U.S. multinationals which we report in Table A.11 (for 2015) and Table A.11b (for 2014). Pre-tax corporate profits is equal to what BEA calls “profit-type return” (Table A.10) and can equivalently be computed as net income plus foreign income taxes paid minus income from equity investments minus capital gains (Table A.11).

between FATS and DI statistics. Therefore for Luxembourg, we simply set depreciation rates in the foreign-controlled sector equal to the depreciation rate observed for the entire corporate sector; we assume that the effective corporate tax rate is the same as in the entire corporate sector, we assume that net dividends and retained earnings are accurately estimated using DI statistics, and we compute net interest paid as a residual; see formulas in Table A.5.

In Table A.5, we also estimate the gross operating surplus of foreign-controlled corporations for the countries where no (or insufficiently detailed) FATS exist, namely Australia, Canada, Chile, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Switzerland, Turkey, non-OECD developing countries, and non-OECD tax havens. For these countries, we estimate net interest paid, net dividend paid, and retained earnings from balance of payments statistics just as described above. We estimate corporate income taxes by applying the average corporate tax rate observed for the overall domestic corporate sector (or for affiliates of U.S. multinationals).¹⁷ We compute depreciation by applying the rate of depreciation observed for the overall domestic corporate sector (or for affiliates of U.S. multinationals); see Excel formulas in Table A.5.¹⁸

A.3.3 Corrected Corporate Profits (Table A.6)

In Table A.6, we correct the estimates of corporate profits presented so far to account for the profits that go unrecorded in the national accounts and/or international investment data that we relied on until now. There are two types of profits that go unrecorded. First, non-OECD tax havens typically do not measure the profits made in the offshore sector (cf. the case of Bermuda already discussed, where the operating surplus in the “international business” sector is set to zero in the official national accounts). Second, even in countries that record profits made in the foreign-controlled sector, these profits are sometimes under-counted. This is the case for the E.U. tax havens, which pay less direct investment income than what partner countries say they receive from them. E.U. havens, in particular, substantially under-estimate the amount of profits made by affiliates of U.S. multinationals.

In Table A.6, we correct for these two problems. The general principle guiding our correction is the following: our goal is to ensure that at the global level, the total profits made by affiliates as reported by the countries where affiliates are located add up to the total profits made by affiliates as reported by the countries where the parents are located. That is, our target is to

¹⁷For non-OECD tax havens, we apply the statutory rates (usually in the range of 0% to 5%).

¹⁸Using available balance of payments data, Malta shows up as having much more profits in foreign-owned corporations than in the total economy (probably due to inconsistencies between balance of payments statistics and national accounts statistics); therefore for Malta we set the gross operating surplus of foreign-controlled corporations to 0.

ensure that the global balance on direct investment income sums up to zero, which seems a reasonable requirement.

As we show in detail in Appendix B below, in the available data this is not the case: at the global level, according to the IMF balance of payments statistics, there is each year more direct investment received than paid (see shown in Table B.9). That is, the world runs a direct investment income surplus. This surplus is large and growing: in 2015 it reached about \$200 billion. This problem has two reasons. First a number of countries, most importantly Caribbean tax havens (e.g., the British Virgin Islands), do not publish balance of payments statistics; or when they do (e.g., Bermuda, the Cayman Islands, the Bahamas), they only report incomplete data (with no or very incomplete direct investment income data). Because these territories are used by multinational companies to shift profits, they are likely to have a negative direct investment balance (i.e., profits are being booked in these territories that accrue to foreign parents), which contributes to explaining why the world as a whole seems to run a direct investment income surplus. Second, there is measurement error in DI income statistics and inconsistencies in the definitions used across countries. For instance some countries may miss some affiliates of foreign multinationals (e.g., shell companies); the coverage of real estate is imperfect (in principle, according to BPM6 guidelines, cross-border real estate holdings should be recorded as direct investment, but not all countries collect the data necessary to estimate the related flows and positions accurately); not all countries apply the OECD 4th benchmark definition of direct investment consistently (e.g., some countries may apply a different ownership threshold than the 10% mandated by the OECD). Therefore we proceed in two steps.

Step 1. First, we correct the data of the main E.U. tax havens: Belgium, Ireland, Luxembourg, and the Netherlands. We base our correction on a systematic investigation of the discrepancies in bilateral direct investment income data when both the investor and the host countries report bilateral DI income statistics (Table B.11 below). This investigation reveals that the European Union tax havens under-estimate the DI income they pay by \$107 billion in 2015. Almost all of this gap owes to a large gap (\$95 billion) between what these havens report paying to the United States and what the United States declares receiving from these havens—in fact, with other partners, there is almost no discrepancy. We add these unrecorded profits to the amount of profits recorded by Belgium, Ireland, Luxembourg, and the Netherlands in their foreign-controlled corporations (Table A.6, col. 1 and 7).¹⁹ This adds more than \$100 billion in profits

¹⁹Direct investment income is net of corporate taxes; because we are interested in estimating pre-tax corporate profits, we upgrade the missing DI income flows using a low corporate tax rate, see Excel formulas in Table A.6.

to the E.U. tax havens.

In principle, the discrepancy between the DI income received by the United States from the E.U. tax havens and the DI income paid by these havens to the United States may not imply that E.U. havens under-estimate the profits made by U.S. affiliates on their territory. It could be that the United States over-estimates the profits made by its affiliates in these countries. It could also be that the E.U. havens assign the profits of some subsidiaries ultimately controlled by U.S. parents to countries such as Bermuda or Jersey that are used as intermediaries for foreign direct investments, while the U.S. may “look through” such intermediaries and assign the profits to Ireland. In a closely related context (that of DI stock positions), the Central Statistics Office—Ireland’s national statistical institute—argues that this can explain the bulk of the discrepancy between the DI inward liabilities reported by Ireland vis-a-vis the United States and the DI outward assets reported by the United States in Ireland (CSO, 2016).

Although differences in the way subsidiaries are attributed to specific countries are also likely to explain part of the bilateral discrepancies in DI income between EU havens and the United States, our computations suggest that this cannot explain the bulk of the gap, for the following reasons.

First, it is important to note that both the United States and EU havens report data on an immediate counterpart basis, as this is the global standard for DI statistics. That is, if a U.S. multinational owns a company in Ireland via a holding in Bermuda, the U.S. must record transactions and positions with Bermuda—not Ireland; and Ireland must record transactions and positions with Bermuda—not the United States. In principle (and disregarding other issues such as reverse investments), if all countries did report consistently on an immediate counterpart country basis, there should be no bilateral inconsistency. It is apparent that the U.S. reports DI data on an immediate counterpart basis. More than half of the foreign direct investment of the United States show up as investments in holding companies today; in 2015 the largest sources of DI income receipts recorded by the United States are the Netherlands, Bermuda, and Caribbean tax haven, which together account for 30% of all US direct investment income received by the US (see Zucman, 2014, Figure 2; and Wright and Zucman, 2018, for an update to 2016). Ireland also accounts for a large part of the total—13%, with a sharp growth since 2011–2012 (6%–7%). But the point is that the United States does not “look through” intermediate holding companies in Bermuda or Caribbean havens—these show prominently in its DI data. Moreover, the United States has a sophisticated system to monitor its multinationals: the BEA survey of the foreign operations of U.S. multinationals (from which DI statistics are derived).

Reporting is mandatory; the BEA has decades of experience with this survey, which has been used by many researchers; there is extensive cross-checking and error-spotting. It thus seems unlikely that it would systematically over-estimate profits made in E.U. havens, especially since U.S. data are generally consistent with the counterpart data of non-havens.

Second, E.U. havens do not record excessive DI income paid to countries other than the United States. DI income paid to OECD countries other than the United States match the DI income that these countries declare receiving. And crucially, income paid to tax havens—such as Bermuda or Jersey, that are used as intermediaries for foreign direct investments—is relatively small. Take the case of Ireland. According to Eurostat data, in 2015, the United States says it made 47 billion euros in net DI income on its outward direct investment in Ireland. Ireland says it paid only 0.7 billion euros in net DI income on its inward direct investment from the United States. (The gap, 46 billion euros, was multiplied by two between 2013 and 2015.) Ireland reports that it paid 28 billion euros to offshore financial centers, an aggregate which includes 40 countries.²⁰ Even if all this income corresponded to income paid to holdings in Bermuda and similar havens ultimately controlled by the United States, and even if the United States systematically mis-classified these holdings as being in Ireland, it could only explain about half of the discrepancy between Ireland and the United States (60% in 2015, 46% in 2014, 52% in 2016). There is simply not enough DI income recorded by Ireland as being paid to foreign countries.

Third, as shows in Section A.4 below, in foreign affiliates statistics (FATS) we find discrepancies between the bilateral data reported by E.U. tax havens and those of partner countries (especially the United States) similar to the discrepancies we find in DI statistics. Unlike DI statistics, FATS are compiled according to the ultimate controlling unit concept. This suggests that tax havens do under-estimate the activities of foreign multinationals (especially U.S. multinationals) on their territory.

Therefore, in our benchmark scenario, we assume that the U.S. data are correct and upgrade the data of E.U. havens so as to close the discrepancy with the United States. This correction allows us to reduce the global direct investment income gap by about half. That is, about half of the puzzling discrepancy between DI income received and DI income paid globally can be explained by the fact that Belgium, Ireland, Luxembourg, and the Netherlands under-estimate

²⁰Of which European financial centers, such as Liechtenstein, Guernsey, Jersey, the Isle of Man, Andorra, and Gibraltar; Central American OFC such as Panama and Caribbean islands like Bermuda, the Bahamas, the Cayman Islands and Turks and Caicos Islands; and Asian OFC such as Bahrain, Hong Kong, Singapore and Philippines.

the profits made by affiliates of U.S. multinationals on their territory. After this correction, we are left with about \$100 of missing net DI income paid to allocate, which we allocate to non-OECD tax havens. Note that if we attributed less unrecorded profits to the E.U. havens (e.g., if we did not correct the DI income statistics of Ireland to make them consistent with the US data), then we would have to allocate more profits to the non-E.U. tax havens (e.g., Bermuda), leaving our global estimate of the amount of profits shifted offshore unchanged.²¹

Step 2. We allocate the remaining unrecorded profits to the non-OECD tax havens, which publish no or very incomplete DI statistics.²² Specifically, we correct the DI income data of the non-OECD tax havens as follows. First, we correct their reported DI income received and paid figures, such that they at least add up to the sum of the bilateral DI income data reported by E.U. and OECD partners (Table B.10, cols. 5 and 14). Second, we use direct investment position data (from the IMF Coordinated Direct Investment Survey) to impute direct investment income (paid and received) in the non-OECD tax havens where derived DI income is implausibly low, essentially the British Virgin Islands and Curacao, formerly the Netherlands Antilles (see Table B.10, col. 8). Last, we scale up the estimated DI income paid by the other non-OECD tax havens so as to close the remaining global DI income gap; see Excel formulas in col. 9 of Table B.10. By construction, this ensures that global DI income paid equals global DI income received.²³

²¹Taking seriously the DI income data of EU havens instead of correcting them to match the US data would only affect the geography of where profits are shifted. Namely, we would find more profit shifting to the Caribbean and Asian havens, and less shifting to the EU havens. In our view, however, the 0.7 billion euros in net DI income paid to the United States reported by Ireland does not correctly reflect the geography of where profits are shifted.

²²In addition to non-OECD tax haven, a few other countries do not report DI statistics to the IMF, the two notable ones being China and Taiwan. China publishes its balance of payments (on the website of the State Administration of Foreign Exchange, <http://www.safe.gov.cn>, but does not decompose investment income flows into direct investment, portfolio investment, and other. In 2015, the investment income balance is negative (-\$69bn). It is unclear, however, whether this owes more to DI or portfolio investment (as a number of large Chinese companies are listed with foreign portfolio investors). Therefore we simply assume that half of all the gross investment income flows (credits and debits) recorded in the Chinese BoP are for direct investment and half are for portfolio investment, hence that half of the negative investment income balance owes to DI and half to PI. We observe this 50/50 split in other large developing economies such as Brazil, India, and South Africa. Regarding Taiwan, the official data published by the Taiwanese Central bank at <https://www.cbc.gov.tw> report a negligible DI income balance, +\$0.2 billion, so we simply omit Taiwan in Table B.10, without this affecting any of our computations.

²³Note that we also upgrade DI income received by OECD countries when there is evidence—from our investigation of anomalies at the bilateral level—that these are under-estimated; see col. 14 of Table B.10. Therefore to completely close the global DI income gap, we need to add more than \$100 billion in net DI income paid by non-OECD countries.

We add the unrecorded profits made in tax havens to their reported profits in col. 3 of Table A.6. By construction, all the unrecorded profits allocated to the E.U. havens are made in foreign-controlled corporations (col. 4); so the correction does not affect local profits (col. 10). For the non-E.U. havens, we start with our corrected estimate of the total amount of profits made in these territories (col. 1), and we allocate this total across foreign-controlled vs. local firms as follows. We assume that the profits/wage ratio in the local sector is the same as the global average profitability of local firms estimated in Table A.7 (namely, 48%) and we compute the profits made in foreign-controlled firms as a residual.

A.3.4 Computation of Shifted Profits (Table A.7)

Table A.7 presents our computation of the amount of profits artificially shifted to tax havens. As described in the Working Paper, to estimate the amount of shifted profits, we assume that absent profit shifting, profitability in the foreign-controlled sector of tax havens (π_f) would be the same as in their local sector (π_l). Any profitability above that level reflects profit shifting.

We compute profitability in the foreign-controlled sector by dividing the profits made by foreign-controlled corporations (as constructed in Table A.6 above) by the wages paid by foreign-controlled corporations (as constructed in Table A.4). We compute profits in the local sector as total domestic corporate profits minus profits made in foreign-controlled firms, and minus profits of offshore mutual funds (i.e., mutual funds with mostly foreign investors and foreign investments). We exclude the profits made by these mutual funds (which among OECD countries are only significant in Luxembourg, Ireland, and to a much lesser extent the Netherlands) because they would otherwise distort the local profitability of tax havens: by convention mutual funds have an apparently high profitability as defined in our paper (i.e., after net interest payments), but for purely accounting reasons.²⁴ We estimate the amount of “profits” made in the offshore mutual fund sector of Luxembourg, Ireland, and the Netherlands and remove it in col. 3. To do so, we start with national accounts data on the amount of investment income attributable to investment fund holders (from the OECD sectoral national accounts; code D44 in the System of National Accounts). By construction this gives the total amount of income paid by mutual funds in these countries; we assume all of it is paid to foreign investors. If mutual funds only owned equities, then their accounting “profits” (in the sense we use in this research) would be zero; by contrast if they only invested in bonds, then all of the investment income they receive (and pay) would show up as “profits.” Based on statistics published by the European Fund and

²⁴Mutual funds invest in equities and bonds, hence receive dividends and interest, but in the national accounts they only pay dividends to their shareholders (not interest); hence they are receivers of net interest.

Asset Management Association, we estimate what fraction of the income they receive is interest vs. dividends, and compute their “profits” accordingly.²⁵

In cols. 11–14, we report the profitability of foreign-controlled vs. local firms. Remarkably, tax havens have systematically higher profitability in the foreign-controlled sector than in the local sector, while the opposite is true for almost all non-haven countries.²⁶ As reported in col. 15, the excess foreign profits in tax havens exceed \$600 billion, while the shortage of foreign profits in non-haven countries (i.e., the profits that we would observe if profitability in the foreign-controlled sector of these countries was the same as in their local sector) is around \$450 billion.

It is important to note that setting π_f equal to π_l in non-haven countries would understate the amount of profits that are shifted out of non-haven countries, because π_l in these countries is downwards biased due to outward profit shifting by local firms. That is, the local sector in each country includes parent firms of multinational enterprises; for instance, Apple, Alphabet, and Facebook are local firms in the United States (they are not foreign-controlled). To the extent that these local firms shift some of the profits they make in the United States out of the U.S., π_l will be under-estimated in the United States. That is why one cannot simply estimate how much profits are shifted out of non-haven country by setting π_f equal to π_l : one needs to look at the cross-border transactions that shift profits (such a cross-border interest payments, service imports, etc.), which capture all shifting (whether by foreign-controlled firms or by local firms), a task we do in Section B below.

If anything, our estimate of the amount of profits shifting into tax havens may be underestimated, for the following reason. The profitability of the local sector in tax havens may be inflated by profit shifting, as parent firms in tax havens may receive profits from subsidiaries in high-tax countries. This could explain part of the relatively high local-sector profitability reported for Ireland, for instance. Due to data limitations, however, we cannot address this potential concern in a systematic manner.

In col. 16 we report an alternative estimate of the excess foreign income in tax havens. First, we use CDIS data on inward and outward FDI stocks. When tax havens don’t report FDI stocks we use mirror data and scale this up by the factor of own reports to mirror reports in non-

²⁵Specifically, we know that Ireland hosts a lot of money market funds (which typically receive interest); while Luxembourg and the Netherlands have more diversified funds; see formulas in Table A.7 col 3.

²⁶The only notable exception is Canada, where foreign-controlled firms appear more profitable than local firms. This could be explained by the sectoral composition of foreign investments in Canada, which are largely in the natural resources sector (e.g., oil), which tends to be highly profitable. It could also be due to measurement errors.

OECD tax havens (approx. a factor 2). For tax havens where the mirror data reports are larger than the self reported stocks we correct these reports using mirror data. We then calculate the average discrepancy between inward investments in tax havens and outward investments from tax havens in high-tax countries, which is 3 percentage points. The average return on FDI investments according to the UNCTAD WIR 2016 is 6%, and we hence estimate the inward FDI return in tax havens as $6\% + 1.5\% = 7.5\%$ and the FDI outward return as $6\% - 1.5\% = 4.5\%$ such that the average discrepancy is 3%-points and the mean return is 6%. For further details see the stata do-file "FDI numbers" and TWZ2018 sheet A2. This estimate yields a consistent, however, slightly lower estimate of the excess profits in non-OECD tax havens \$280 compared to \$310 Bn. (excluding Puerto Rico which is part of the US and hence has no meaningful CDIS data). The largest deviations are Bermuda and Cayman Islands both receiving significantly more artificial profits using the alternative approach (col. 16) compared to our preferred estimate (col. 15.). Contrary Panama, Singapore and Hong Kong receive less in the alternative estimate.

A.4 Supplementary Data on Corporate Profits

A.4.1 Discrepancies in foreign affiliates statistics (Table A.8)

Table A.8 compares the inward foreign affiliates statistics of the E.U. tax havens (Belgium, Ireland, Cyprus, Luxembourg, the Netherlands) with the outward foreign affiliates statistics reported by partner countries, namely the E.U. countries and the United States.

A number of results are worth noting. First, and consistent with our analysis of discrepancies in bilateral DI statistics, E.U. tax havens tend to under-estimate the activities of affiliates of U.S. multinationals. For instance, Ireland reports that Irish affiliates of U.S. multinationals had turnover of \$246 billion in 2015 (col. 5), while the United States reports a turnover of \$368 billion (col. 6). In contrast to direct investment statistics, FATS are compiled according to the ultimate controlling institution concept.²⁷ That is, affiliates of foreign multinationals are classified according to the location of the ultimate parent (not the immediate counterpart as in DI statistics), so differences in the treatment of intermediate holding companies are unlikely to explain the gap (since these intermediaries are "looked through" for the purpose of the FATS). There is a similarly large gap for U.S. affiliates in Belgium, Luxembourg, and the Netherlands.

Second, consistent with our analysis of discrepancies in bilateral DI statistics, in the FATS the E.U. havens also appear to be somewhat under-estimating the activities of E.U. multinationals,

²⁷Defined as follows: the "ultimate controlling institutional unit of a foreign affiliate shall mean the institutional unit, proceeding up a foreign affiliate's chain of control, which is not controlled by another institutional unit."; see Eurostat (2012, p. 18).

but the discrepancies are smaller than for the United States. The one important exception is the Netherlands: E.U. countries seem to generally under-estimate the operations of their affiliates in the Netherlands, with large discrepancies for both turnover and number of employees. These differences may be due to differences in the way that ultimate controlling parents are identified (e.g., France may consider that Airbus—headquartered in the Netherlands but whose main offices are in France—is ultimately a Dutch company, while the Netherlands may consider it a French company with investments in the Netherlands). More work is needed to reconcile the FATS of E.U. countries. Unfortunately, the outward FATS of EU countries are at this stage still very limited: they only provide information on turnover and the number of employees, not on operating surplus. This limits the comparison we can make. Only the United States reports data on the operating surplus of its foreign affiliates.

The gross operating surplus of U.S. affiliates in the E.U. havens is higher when reported by the United States than by the E.U. havens. This is again consistent with our analysis of the discrepancies in DI income statistics and the general notion that E.U. havens under-estimate the operations of U.S. affiliates on their territory. The one exception is Ireland in 2015: in that year, Ireland reports that the gross operating surplus of U.S. affiliates was \$89 billion, while the U.S. reports \$76 billion. One important part of the explanation owes to differences in the treatment of depreciation. The United States does not capitalize R&D in its outward FATS, hence does not include depreciation on intangibles as part of value-added and gross operating surplus. By contrast, following changes introduced in the 2008 System of National Accounts, Ireland capitalized R&D for its national accounts and inward FATS statistics. Out of the \$76 billion in gross operating surplus reported by the United States, only \$6 billion corresponds to depreciation. There is no data on how large a fraction of the \$89 billion in gross operating surplus reported by Ireland corresponds to depreciation, but it is likely to be a very large fraction (at least 35%—the ratio of depreciation to gross operating surplus for the entire Irish corporate sector, see Table A.5). We hypothesize that the inconsistent treatment of depreciation explains why Ireland reports higher gross-operating surplus than the U.S., despite recording less turnover, employees, employee compensation, and DI income. Consistent with this, note that the gross operating surplus of U.S. affiliates recorded by Ireland almost doubled in 2015 when it is believed that U.S. multinationals incorporated subsidiaries with sizable intangibles in Ireland, boosting recorded GDP and depreciation.²⁸ Before 2015, the gross operating surplus of U.S. affiliates was 50% larger in the U.S. data than in the Irish data.

²⁸<http://www.oecd.org/sdd/na/Irish-GDP-up-in-2015-OECD.pdf>

Table A.9 was described above. Tables A.10 and A.11 are reproductions of tabulations prepared by the BEA from its survey of the operations of U.S. multinationals abroad.

B Balance of Payments Data

This corresponds to Tables B.1 to Tables B.12

B.1 Data Sources

Balance of payments statistics are disseminated by several organizations. In writing this paper, we used the following data:

B.1.1 IMF Balance of Payments

We use the standard presentation from the IMF for details on individual countries balance of payments (accessed 1st of October 2017 via bulk download). For the years 2009-2015 the IMF additionally estimate global balance of payments items on trade, primary income and total current account, which we exploit (prior to 2009 we use Zucman (2013) global estimates of these).

B.1.2 IMF Coordinated Direct Investment Survey

We use the the IMF CDIS database(accessed 1st of October 2017 via bulk download). CDIS summarize both countries own reported FDI investments with a country breakdown and mirrored reports of the partner countries.

B.1.3 Bilateral Eurostat Balance of Payments

Eurostat tables "bop its6 det" and "bop fdi6 inc" is the key data source for EU tax havens (Belgium, Cyprus, Ireland, Luxembourg, Malta and Netherlands). The data is comprehensive and relatively high quality, but not perfect. The key strength is that the exporter accounts are the only ones to reflect direct business to consumer sales. As we shall see in table B12 as much as 50% of service exports from Luxembourg are not recorded in importer accounts - our interpretation of this gap is the substantial chunk of direct service exports to consumers from tax havens (an indication of how the modern economy allow companies to avoid physical presence in high-tax countries).

B.2 Data on Cross-Border Flows

B.2.1 Current Account (Table B1/B1b)

Table B1-B1b breaks down the current account by country. The data source is from the IMF BOP database. For the case of Singapore, data on income is from the "Monetary Authority of Singapore"²⁹ For Puerto Rico the data is from the "Puerto Rico Fiscal Agency and Financial Advisory Authority"³⁰

B.2.2 Cross-Border Investment Income Flows (Table B2)

Table B2 shows the cross border investment positions and income of countries on a directional principle. For the Japanese data, we use data on the asset/liability basis instead of the directional principle. For OECD countries OECD DI statistics on income and stocks are used as is but replaced with (non-corrected) IMF BOP/CDIS data if OECD DI statistics are missing.

For non-OECD countries IMF, statistics are used. We correct DI income as described in table B10. When positions are not reported the mirror data from other countries is used to estimate the correct figure (source IMF CDIS). The positions of "Rest of world" are calculated using IMF CDI values only (mirror values are used when own reports are not available). The income flows of "Rest of world" is calculated in table B10

B.2.3 Direct Investment Income Received and Paid (Tables B3-B4)

Table B3-B4 shows the composition of the DI income in detail. When no decomposition of dividend received is available, we assume that all dividends received are from foreign affiliates. For OECD countries we use the OECD statistics with the asset/liability principle. For non-OECD countries we use the IMF BOP and CDIS data and the directional system is therefore used.

B.2.4 Direct investment income and positions of Special Purposes Entities (SPEs) (Table B5)

Table B5 summarises the share of Special Purpose Entity (SPE) income out of total DI income for OECD countries using OECD statistics on DI income.

²⁹http://www.mas.gov.sg/~media/resource/publications/macro_review/2017/April/202017/MRapr17_AP.pdf Table 9 p. 103.

³⁰<http://www.aafaf.pr.gov/spanish/assets/apendiceestadistico2016.pdf>

B.2.5 Returns on direct investment (Table B6)

Table B6 calculate the gap between inward and outward investment income yields in each country. The data used is described in table B2. With some variation, we see in col. 7 a tendency of tax havens having lower returns on their outward investments compared to their inward investments.

B.3 Discrepancies in Global Direct Investment Income

B.3.1 Global discrepancies (Table B7-B9)

Tables B.7, B.8. and B.9 present the world current account credits, debits, and discrepancies. We use the global accounts reported by the IMF on trade, primary income and secondary income. In all other cases we simply add up all accessible accounts in the IMF country reports. Col. 1 shows the number of countries used in the estimation of global FDI equity income, which is our main variable of interest.

From Table B.9. we see that the world is running a current account surplus of \$280 Bn. in 2015 (col. 2). This surplus is driven by a substantial trade surplus of (\$364 Bn. in goods and \$148 Bn. in services, col. 3-4) and a FDI income surplus (missing profits, col. 7) of \$187 Bn. (of which 203 FDI equity income surplus, col. 8). Contrary, as documented by Zucman (2013), there is a global portfolio income deficit of \$300 Bn. (col. 10).

For an analysis of global discrepancies similar to ours but at the stock level we refer to Angulo and Hierro (2017), “Asymmetries in the Coordinated Direct Investment Survey: What Lies Behind?”. They analyse discrepancies in DI positions using CDIS. We refer to their paper for an analysis . The results are generally consistent at the flow and stock level. That is, at the global level total outward equity positions are each year larger than total inward equity positions.

One advantage of flow data compared to stock data is that there no valuation issues (i.e., one does not have to put a price on the value of unlisted businesses). By contrast one of the reasons for the statistical discrepancies in position data is the different valuation methods used across countries. Angulo and Hierro (2017) write that “The investments abroad are higher valued than the investment in the reporting economy where the information is easier to measure and tends to be more accurate. Therefore, in principle, investment in equity abroad (outward equity) tends to be overestimated.” However our results in flow anomalies suggest that valuation methods probably do not explain the bulk of the DI equity position anomaly. It is more likely that tax

havens miss some of the profits and assets in affiliates of foreign multinationals such as SPEs.

For debt the global discrepancy has the opposite sign as for equity, that is, the total amounts reported under outward debt position are smaller than the total amounts reported under inward debt positions. This is consistent with the hypothesis that tax havens fail to include some affiliates used for profit shifting, since such affiliates typically have negative inward net debt positions (they lend to their foreign parents more than they borrow, in order to shift interest income to low tax places).

CDIS has \$2 trillion inward/outward DI equity discrepancy in 2015. With 6% return this is consistent with \$300 billion DI equity income discrepancy. Discrepancy reaches \$5 trillion in IIP assets/liability data.

However in positions data, Netherlands reports more inward DI liabilities than creditors report (main exception being U.S.). But Angulo and Hierro (2017) do not provide a breakdown a bilateral asymmetries by equity vs. debt so hard to interpret.

B.3.2 Table B10

Table B10 corrects FDI income to ensure that the global DI income balance is equal to 0. In cols. 1, 2, 11, and 12, we reported the self-reported inward and outward FDI income of each country. In col. 3 and 13 we report the mirrored data of OECD partners, i.e., income as reported by OECD partners. For non-OECD tax havens there is either no data on FDI income or very low values. We hence add up partner accounts to estimate the FDI income in these cases in col. 5 and 14.

Second, We use the Eurostat table “bop fdi6 inc” to calculate bilateral discrepancies in DI income whenever data is available (see table B.11). We find that the United States reports 122 billion USD higher DI income in the EU compared to what EU countries report paying out to the US, essentially because of missing income in Belgium, Ireland, Luxembourg and the Netherlands. As the US accounts are likely to be more accurate (see detailed discussion in Section A above, discussion of Table A.6) we add this unreported income (\$95 billion) to these four EU countries in column 5. Third, For OECD countries, we correct outward FDI income to match the partner accounts whenever inward FDI income is larger than outward at a bilateral basis. Fourth, For the British Virgin Islands, Curacao, St. Kitts and Nevis and the Turks and Caicos the net FDI income is either zero or negative after conducting our first imputations. As an alternative estimate for these countries we use CDIS stock data and apply the average rate of return on inward and outward FDI in tax havens in col. 8. Finally, after having done

these imputations, a global FDI income gap of 82 billion still exists. This is expectable as the imputations based on partner accounts does not include all partners. We hence scale up the partner account estimates in non-EU tax havens proportionally to close the 82 billion dollar gap in col. 9; see Excel formulas and detailed discussion in Section A above (discussion of Table A.6).

B.3.3 Bilateral DI income discrepancies (Table B11)

In Table B11 we calculate bilateral discrepancies using Eurostat table "bop fdi6 inc". That is we compare investor and investee reports and compute the discrepancies. The Luxembourg DI income reports are imputed using the procedure explained in table C1. When possible we exclude SPE income to avoid statistical noise. We find that the United States reports 122 billion USD higher FDI income in the EU compared to what EU countries report paying out to the US. We find that 95 billion of the 122 billion of lost US income in the EU is lost in Belgium, Ireland, Luxembourg and the Netherlands. All other discrepancies are small compared to these.

B.3.4 Bilateral service trade discrepancies (Table B12)

Table B12a and b exploits eurostat table "bop its6 det" to calculate bilateral service trade discrepancies when both accounts exists. In col. 1. we see that the EU is importing 93 billion euros less from the EU than what the EU is exporting to the EU . This discrepancy corresponds to 11% of the EU to EU service exports - implying that 9% of EU to EU service exports are lost in transition. Digging deeper into this discrepancy reveals some interesting patterns. First, when removing EU tax havens (Belgium, Cyprus, Ireland; Luxembourg; Netherlands and Malta) the discrepancy drops to 3%. The service export/import discrepancy is hence negligible between EU non-havens. Second, an enormous amount of service exports goes missing when tax havens transact with non-havens. This becomes very clear when zooming into "the case of Luxembourg" where we see that more than 50% of Luxembourg's service exports to non-haven EU countries is not recognized by the importers. Similar high shares are seen for the remainder of tax havens and overall 31% of EU haven exports are never found in the importer data. The do-file "discrepancies" details the calculation and the underlying data can be found under the raw data tab "Disc.1".

C Macro Statistics Corrected for Profit Shifting

This corresponds to Tables C.1 to Tables C.6.

C.1 High risk payments to tax havens

In table C1-C2 we describe the data used in our benchmark allocation of the artificially shifted income to tax havens. That is, the allocation key used to allocate the \$650 Bn. from table A7.

C.1.1 High-risk payments to tax havens (Table C1)

Table C1 shows the high risk payment flows to tax havens across countries. We define high risk transactions as FDI interest paid and service payments categorized as: royalties, insurance, ICT, financial and "other" (hereunder management services). We know from various leaks and discussions with tax authorities that these payments are key in profit shifting strategies.

High risk payments to EU tax havens The key source of information is Eurostat table "bop its6 det" and "bop fdi6 inc", which details service trade and FDI interest flows at the bilateral level for all European countries. We use this data to compute the high risk service exports and fdi interest payment received by EU tax havens from all countries globally. Export data has the advantage of recording direct business to consumer exports, which are not being recorded in importer data (see table B12). For countries where information on EU tax haven exports is missing or classified, we impute the information using an advanced procedure that ensures internal consistency such that all bookkeeping principles are adhered to (see the stata do-file "internal EU-credit" and "non EU -credit").

High risk payments to Switzerland, Singapore, Puerto Rico and Hong Kong For non-EU tax havens we only have (limited) bilateral exporter information on Switzerland supplied by Eurostat. Additionally, using IMF data, we can compute total high risk exports of Switzerland, Singapore and Hong Kong. For Puerto Rico, we use the total export reported by their statistical agency and multiply these by the average share of high risk exports in EU tax havens (73%). When comparing the Swiss high risk exports to the EU and the US with the reported imports by the EU and the US there is a gap of 25%. That is, the EU and the US claims to be importing 25% more from Switzerland than what Switzerland reports they export to the EU and US. This raises the concern of whether all exports are properly registered in Switzerland. We hence proceed as follows: For the EU and the US we use importer data and make no correction of these (with the concern of business to consumer sales being unrecorded).³¹

³¹For EU countries where information on non-EU tax haven imports is missing or classified, we impute the information using an advanced procedure that ensures internal consistency such that all bookkeeping principles are adhered to (see the stata do-file "non EU -debit")

For the rest of the world we allocate the remainder of non-EU tax havens high risk exports according to FDI inward shares (as a proxy for MNE activity). We scale up the total exports of Switzerland, Singapore and Hong Kong by 25% to account for the under-reporting of exports observed in Switzerland - this simply ensures that we are not under-allocating tax losses to non-EU non-US countries.

High risk payments to remaining tax havens The remaining tax havens are somewhat of a black box. Using WITS data we see a general tendency that exports are much lower than what importers report. E.g. Bermuda reports service exports of 1.3 billion USD while partner countries report imports of 55 billion USD. To impute the high risk payments of these countries we simply add up the excessive foreign profits in Table A7 (totalling 180 billion USD). The allocation procedure thereafter follows the above method. That is, for the EU and the US we use importer data and make no correction of these (with the concern of business to consumer sales being unrecorded).³² for the rest of the world we allocate the remainder of non-EU tax havens high risk exports according to FDI inward shares (as a proxy for MNE activity).

High risk payments from tax haven to tax havens From table C1 col.1 it is immediately clear that tax haven to tax haven high risk transactions are enormous. Belgium and Ireland have almost as high risk payments to tax havens as France. Netherlands have twice as large, Luxembourg three times as large (almost equating Luxembourg with the US). We know that these transactions are inflated by pass through transactions. Take e.g. the Double-Dutch-Irish-Sandwich famously exploited by Google: in this tax scheme the a royalty payment is transferred back and fourth from Ireland to the Netherlands and Bermuda. These meaning of these transactions (and whether they are rightfully recorded) is very unclear and in the following we hence zoom in on non-haven to haven transactions. We for the same reason do not attempt to impute the transactions between non-EU tax havens and EU tax havens when this data is not readily available.

C.1.2 Excessive high risk payments to tax havens (Table C2)

In table C2 we compute the "excessive" high risk payments flowing to each tax haven. That is, we allow each tax havens to export high risk services and receive FDI interest comparable to the economy size and all payments over and above this level are deemed excessive. For

³²For EU countries where information on non-EU tax haven imports is missing or classified, we impute the information using an advanced procedure that ensures internal consistency such that all bookkeeping principles are adhered to (see the stata do-file "non EU -debit")

EU tax havens we distinguish between within EU transaction and external transactions - such that larger transactions are allowed between EU countries without being deemed excessive. As discussed in table C1, we see enormous flows between tax havens that are not easily interpreted - instead we focus our attention on the non-haven to haven payments.

Importantly, the amount of excessive high risk payments to tax havens almost exactly matches the excessive profits booked in tax havens (col.1 plus col. 12). This indicates two things 1) Excessive interest and service payments seem to be a good measure of profit shifting 2) Transfer mispricing of goods is small. This second point is supported by recent estimates of transfer mispricing of goods, as discussed in table D2 below. All things considered we find the excessive high risk payments from non-havens to havens as in itself an estimate of the amount shifted to tax havens (roughly \$650 Bn.) and will use each non-haven country's high risk payments as the relevant allocation key of the excessive profits in tax havens in table C4.

C.2 Ownership of profits in tax havens

As an alternative allocation of the profits in tax havens to high-tax countries we use the ownership data from table C3.

C.2.1 Total FDI stocks by ultimate owner (Table C3)

In table C3 we report the ultimate ownership of FDI stocks in tax havens based on Damgaard and Elkjaer (2017). In this paper the authors exploit recent data published by major OECD countries on ultimate ownership and holdings of special purpose enterprises (SPEs). The authors first show how SPEs and pass-through FDI investments distorts FDI positions for the countries with data and then extrapolate their findings to the global economy. Their main finding is that tax havens role in FDI is markedly reduced when removing pass-through investments and SPEs.

We use their estimates as a proxy for the ultimate ownership of the excessive profits being made in tax havens. As Damgaard and Elkjaer (2017) stress, the data is in no way perfect: "[it may be the case that] even economies that separate out SPEs in their data cannot fully identify SPEs" (pp. 20). That is, even though estimated FDI ownership drop significantly in Damgaard and Elkjaer (2017) compared to CDIS, we still see tax havens such as the British Virgin Islands owning unbelievably high FDI stocks of \$150 Bn in other tax havens (col. 1). To account for this, we make the simple assumption that tax havens net ownership of the excessive profits in tax havens (from table A7) is zero and in table C4 we allocate the excessive tax haven profits using the ownership shares of non-havens. Strikingly, we see in col. 1 that the US is estimated

to own \$1 trillion out of the \$2 trillion FDI stock in tax havens being held by non-havens.

C.3 Reallocating the tax haven profits

C.3.1 Allocating losses (Table C4)

In table C4 we allocate the excessive income of tax havens based on 1) Excessive service and interest payments to tax havens - our benchmark allocation scenario 2) Ultimate ownership of FDI stocks in tax havens. We interpret 1) as the individual countries loss of profits and 2) as the countries where the owners of profits in tax havens reside.

Table C4b shows the difference in allocation keys in method 1) and 2). By our estimates, The US owns 50% of all tax haven profits -but only lose 23 percent of the shifted profits to tax havens under governing tax laws. Contrary the EU and developing countries owns less of the tax havens profits, but are losing more due to profit shifting.

Table C4c translates the loss of tax base into tax revenue by using the statutory corporate tax rates of each country (downloaded from the KPMG corporate tax tables). The assumption here being that the statutory rates is the marginal tax rate that shifted profits would have been taxed by in the origin country (Following Devereux and Maffini, 2007). Under this assumption non-haven countries lose 10 percent of their global tax revenue due to profit shifting.

Table C4d use an alternative assumption to calculate the tax consequences of profit shifting. In this table we divide the shifted profits of each country by the corporate profits of each country - the implicit assumption being that shifted profits would be taxed at the effective rates in table A3. The tax loss falls to 6 percent in this case. Concerns on using these effective rates are discussed in table A3.

C.3.2 Corrected macro stats (Table C5)

Table C5 show the corrected macroeconomic statistics after reallocating profits back from the winners to the losers in our benchmark scenario. In col. 10 we see that at a whole, the capital income share of OECD countries increase by 1 percentage point after taking profit shifting into account - The US capital share also increase by 1 point. The UK sees the largest estimated increase in capital income share (2.7 percent). Contrary, tax havens capital income share fall by more than 10 percentage points in most cases and in some cases more than 30 percentage points. A few havens, which have previously failed to record foreign income, such as the Cayman Islands, we estimate to have much larger capital shares.

D Comparisons With Previous Estimates

D.1 Studies Based on Financial Accounting Data

A wealth of articles exploit micro-data from Bureau Van Dijk, namely Orbis and Amadeus (See Heckemeyer and Overesch 2013 for an overview), that collects public accounts on firms and subsidiaries throughout the world. The most cited papers are Huizinga and Laeven (2008), Dharmapala and Riedel (2013) and the OECD BEPS estimate by Johansson et al. (2017). The methodology in these papers is conceptually similar as they all relate profitability (or changes in profitability) to a profit shifting incentive (or changes in profit shifting incentive) and from this extrapolate the total amount of profits shifted.

One major concern when using Orbis data is that of coverage. In figure FD2, we compare the consolidated accounts of all firms in Orbis with the sum of unconsolidated accounts of each of the same firms in Orbis. Overall only 17% of the consolidated profits can be found in the unconsolidated accounts. We do the same exercise for the most well-known firms from the Paradise Papers leak (Apple, Alphabet, Facebook and Nike) in figure FD1a-FD1d and find coverage is near zero. This has the implication that we don't know the composition of earnings across countries in the bulk of firms.

Another concern related to micro-studies is how to measure the profit shifting incentive of each subsidiary. There is no clear way of doing so and a variety of methods are hence applied: the unweighted tax differential to all subsidiaries, the differential to the parent firm, the weighted tax differential or the differential to the minimum tax rate.

D.2 Studies based on macro-data

UNCTAD (2015) Most closely related work to our own as they use macro-statistics on FDI income to estimate profit shifting. The method applied is first to estimate the impact of tax haven exposure (measured as the share of FDI inward stock that is owned by tax havens) on profitability (measured as overall return on the FDI inward stock). They find a significant negative relationship -implying that higher tax haven exposure implies lower FDI inward return. From this they extrapolate the amount of profits shifted.

Crivelli et al., 2016 Estimate is based on the elasticity of corporate tax revenue with respect to changes in the average tax rate of tax havens. Since the average tax rate of tax havens does not differ across non-haven countries, the profit shifting effect is indistinguishable from a general time effect; and for each haven country it is readily seen to be a linear combination of its own

tax rate and the average rate across all havens, the latter equivalent to that same time effect. To address this, they take the same approach as Devereux et al. (2008) and restrict the form of time effects by assuming a common linear time trend. The authors use an autoregressive estimation model to allow for accumulating time effects- which implies that short-run estimates are scaled up by a factor 4 to allow for dynamic long-run effects. The long run estimated tax loss by Crivelli et al. is very substantial - \$600 Bn. - implying that profits shifted to tax havens would be at least in the ball-park of \$1800 Bn., which is more than the total profits of foreign owned corporations. Cobham and Jansky (2018) replicate Crivelli et al. (2016) and give a country by country split.

Clausing, 2016 Clausing (2016) use US data on multinationals to estimate the semi-elasticity of taxable income with respect to the corporate tax rate. She interprets this elasticity as the result of profit shifting and infers the amount of income shifted by us firms to 17 low-tax countries to be in the ball-park \$77 Bn. - \$111 Billion. She extrapolates these findings to the rest of the world by using Forbes 2000 as a proxy for global MNE profits and by assuming the same share of profits being booked in low-tax countries as done by US owned firms.

D.3 Transaction studies of transfer mispricing

Hebous and Johannesen (2017) Impressive study that finds clear evidence of transfer mispricing of services within German multinationals, especially for intellectual property (patents and trademarks), headquarter services (administration, management and advertising) and sea transport (shipping). In these service categories, trade with affiliates in tax havens is heavily skewed towards imports and the internal service providers in tax havens earn significant excess profits, consistent with the macro flows we discuss in our paper. However, in contrast to our work, Hebous and Johannesen (2017) conclude that “government revenue associated with mispricing of affiliate service trade is relatively modest.”. Two reasons can explain the relatively modest revenue loss estimated. First, Hebous and Johannesen (2017) look at service imported from directly-owned subsidiaries or direct parents in tax havens. According to this definition only 30% of service imports come from affiliates in tax havens and this is what they base their estimate on. Issues: 1) direct linkage is not needed to profit shift (on the contrary). Profit shifting can occur directly through business to consumer sales (no internal service payment needed) as we see with Spotify, Uber, Google etc. 2) We know imports of services from tax havens are systematically underestimated.

Transfer mispricing of goods A handful of studies deliver very convincing evidence of transfer mispricing of goods by comparing internal/external unit prices at the product-level and testing for systematic deviations. Notably, Cristeau and Nguyen (2014), Liu et al. (2017), Davies et al. (2016) and Bernard et al. (2006) all find that related exports to low-tax countries are systematically under priced (hence leading to income being shifted to lower taxed affiliates). Common to all of these studies, is that the magnitude of profits being shifted is extremely small (less than 2 percent of CIT revenue lost). This is in support with what we find table C2.

D.4 Benchmarking our results to previous literature

D.4.1 Comparison with other literature (Table D1)

Table D1a compares our global estimate of taxes lost to other estimates. We find that our estimate is very aligned with that of OECD’s BEPS estimate (Johansson et al., 2017) and UNCTAD (2015). Our estimate is, however, substantially smaller than Clausing (2016) and enormously smaller than the long run estimate of Crivelli et al. (2016).

Clausing (2016) gives a country breakdown of her estimate and Cobham and Jansky (2017) replicates Crivelli et al. (2016) to do a country breakdown. We compare their estimates at the country level to ours in table D1b.

D.4.2 Studies of transfer mispricing of goods (Table D2)

Table D2 summarizes the estimated tax loss of transfer mispricing of goods - in all studies the estimated loss is below 2 percent.

E Tax Enforcement

In this section we first introduce the workings and concepts of international tax enforcement. We then go on to present data on the distribution of international tax enforcement efforts. In particular, we find that tax authorities in high-tax countries spend more efforts on quarrelling with other high-tax countries than they spend on going after tax havens. Finally, we present a simple model to explain the observed patterns in tax enforcement. All our observations on international tax enforcement are the results of numerous conversations with tax officials from across the world.

E.1 Background on tax enforcement of transfer prices in practice

The arms-length price is bound with uncertainty . As clearly stated in the OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations (OECD 2010): transfer pricing is not an exact science (OECD 2010, pp. 2). This is in itself evident from the variety of possible methods applied to determine the arms-length price (Cost-plus pricing, Comparable unrelated transactions, Comparable related transactions, profit splits, etc.). In fact the arms-length pricing is often simply meaningless when it comes to service payments such as royalties or the purchasing of intellectual property. In any case, there is for certain a considerable amount of uncertainty involved in setting arms-length prices, which implies that firms will at times be at odds with tax authorities even when they have the best of intentions. In this section we present data on how of the tax authority efforts in practice.

Transfer price corrections. In order to conduct a tax adjustment the tax authority must first argue that the arms length principle has not been followed by the multinational. Formally the tax authority must thus be able to point towards a specific (or series of) transaction(s) that was mispriced according to what a third party would have paid for the same transaction. To do this the tax authority will ask the corporation for its transfer price documentation, which sketches the transactions that have occurred between affiliates and give support of the value of these transaction. Based on this documentation the tax authority may then choose to conduct a transfer price correction. The tax authority will also try to gain supplementary data from corresponding tax authorities and public sources, such as news media and public accounts (e.g. Orbis). Based on these data, the tax authority alone makes the decision to conduct a transfer price correction, however, the firm can of course appeal this correction to the national courts. The transfer price correction can hence be seen as the initial target for a final tax adjustment.

An important point to note here is the information asymmetry between firms and tax authority. On one side we have firms with a thorough understanding of their own business and the industry preparing a document in defense of the chosen profit distribution - on the other side we have tax officials trying to content this. A second important point is the dependence on the corresponding countrys tax authority. If the corresponding country supplies supplementary information about the firm this eases the process of conducting a transfer price correction. Contrary, if the corresponding tax authority is not cooperating, this hardens the process.

Asking other countries for money (the Mutual Agreement Procedure) A heartfelt worry in the League of Nations was the issue of double taxation. If one tax authority increases the income of a subsidiary operating in their jurisdiction without another tax authority lowering the tax base of the same company profits may be double counted and double taxed. Thus treaties were put in place to ensure that any increase in the tax base of a multinational in one country should be offset by a corresponding reduction in another. In other words, for every winner of tax base there must be a loser as well. In the EU a particular strict system is in place, where firms can exploit the Arbitrage Convention to ensure that disputes over tax base among two EU countries are settled within two years. If the tax authorities do not come to terms an (expensive) external panel is brought in to settle the case.

The procedure is as follows: After a tax authority have decided on a transfer price correction nationally, the firm may ask the tax authority to enter into a Mutual Agreement Procedure with the countries accused of having overbooked taxable income. The tax authority that increased its own tax base will then approach the country that it perceives as the one having to reduce its tax base. Bluntly put, the tax authority conducting the transfer price correction will ask a foreign government to pay for this. It is worth stressing this point as we shall see that the bulk of transfer price corrections does not increase the tax payments of multinationals, but simply transfers tax payments between high-tax countries.

These mutual agreement procedures are extremely resource intensive relying on several employees in the tax authorities over several years. The conclusion of the negotiation (which outside of the EU may be non-agreement) is binding and often result in a compromise (a lower transfer price correction than initially chosen). The firm is again here a major player as it delivers the documentation that form the basis for the discussion.

E.1.1 The Danish tax enforcement effort in 2008, 2014, 2015 (Table E1)

Table E1 shows the distribution of the Danish tax authorities efforts to correct transfer prices. The Danish tax authority has shared details on the universe of transfer price correction with us when it was available, which is for the years 2008 and 2014-15. In col. 1, we see that over this period conducted transfer price corrections worth 2 billion a year (\sim \$2.5 Bn.) or roughly 5 percent of the estimated corporate tax base in Denmark. This relatively large amount is the result of only 70 cases pr. year - meaning that the average case size is quite large (30 million, col. 2). To the Danish state auditors, the transfer pricing unit has explained that small cases

are not prioritized due to the high costs of conducting a transfer price correction.³³ Surprisingly, only 14 percent of the dollar value collected from transfer price corrections involves tax havens (col. 4). That is the vast majority of the dollar value of transfer price corrections comes from other high tax countries.

E.1.2 Composition of EU (AC) cases by counterpart in 2011 (Table E2)

Table E2 shows the distribution of ongoing mutual agreement procedures (under the Arbitrage Convention) in the EU in 2011 (the latest year with bilateral information).³⁴ These are cases where a transfer price agreement has been conducted and the firms have now asked the tax authority to initiate mutual agreement procedures (to lower the tax base in the corresponding country) and in which the AC clause has been invoked (giving tax authorities a 2 year deadline before an external panel is brought in). Strikingly, we see in col. 4. that only 10.7 percent of mutual agreement procedures initiated by high-tax EU countries involve an EU tax haven. One caveat to keep in mind here is that a company may not bother to request a mutual agreement procedure if they are paying close to zero taxes in the EU tax haven to begin with.

E.1.3 Main targets of tax authorities around the world (Table E3)

Table E3 shows the main targets of tax authorities transfer price corrections globally. The data source is the EY 2014 global transfer pricing tax authority survey.³⁵ In this survey EY asked 50 tax authorities from a wide selection of countries to note their top 3 targets of transfer price corrections. In column 1 we summarize the report: The US, Germany and Japan are the top nations targeted when countries do transfer price correction. This again supports the notion that transfer price corrections in majority are aimed at high tax countries. Turning to the mutual agreement procedures we see in col. 2 this picture only becomes clearer - One caveat to keep in mind here is that a company may not bother to request a mutual agreement procedure if they are paying close to zero taxes in the EU tax haven to begin with.

E.1.4 Countries' top counterpart countries for TP and MAP cases, 2013 (Table E3b)

Table E3b shows country-by-country breakdown of main mutual agreement procedure and transfer price correction targets. Notably, no major economy has a tax haven as their number 1

³³<http://www.rigsrevisionen.dk/publikationer/2014/212013/110617/>

³⁴https://ec.europa.eu/taxation_customs/sites/taxation/files/resources/documents/taxation/company_tax/transfer_pricing/forum/jtpf/2012/map_ac_statistic_2011.pdf

³⁵<http://www.ey.com/Publication/vwLUAssets/EY-global-transfer-pricing-tax-authority-survey/FILE/ey-2014-global-transfer-pricing-tax-authority-survey.pdf>

transfer price

E.1.5 Transfer price corrections in the OECD (Table E4)

Table E4 shows the rise of Mutual Agreement Procedures in OECD countries in the new millennium. The increase in cases coincides with international efforts (especially in the EU) on easing the procedure. The inventory of cases is building up fast, suggesting that tax authorities are not able to keep up.

E.2 Model of international tax enforcement

In this section we present a simple model to help understand the observed patterns in international tax enforcement seen in the above section.

E.2.1 Summary

We present a theoretical illustration of how mutual agreement procedures that facilitate transfer price corrections between high-tax countries may lead to more profits being shifted to tax havens. In this model a tax authority in a high-tax country seeks to optimize the revenue collected from transfer price corrections. Additionally the tax authority faces some constraint on the total amount of corrections that it can do in a given year. We assume there are two types firms:

The first firm we refer to as the non-tax planning firm. This firm only transacts between high-tax countries with identical tax rates and as a result faces no tax incentive to shift profits between subsidiaries. However, when setting its transfer prices the non-tax planning firm does make non-systematic mistakes leading to transfer prices on individual transactions deviating from the arms-length price. Left unchecked the non-tax planning firm would make no systematic deviation from the arms-length prices. This implies that, left unchecked, the non-tax planning firms aggregate income in each country would not deviate from the situation where all transactions were priced according to the arms-length principle. Nonetheless, the tax authority of each high-tax country has an incentive to correct the individual mistakes made by the non-tax planning firm which (in isolation) benefit the country doing the correction (at the expense of the partner country). When the tax authority correct the non-tax planning firm this may fail with some likelihood if the firm challenges the correction in court or during the mutual agreement procedures. A successful transfer price correction of a transaction between

the two high tax countries will not affect the global tax payments of the firm. Our hypothesis is that the tax authority is unlikely to meet much resistance from the non-tax planning firm.

The second firm we refer to as the tax planning firm. This firm seeks to shift as much income possible from high-tax countries to low-tax countries. The firm does this by mispricing an internal service transaction between the high-tax country and a low-tax country. The optimal behaviour of the tax planning firm is to always choose a transfer price that maximizes the amount shifted to tax havens but does not get corrected. That is, the tax-planning firm will shift profits to the tax haven up to the point where the marginal yield of correcting the non-tax planning firm and the tax planning firm is the same. As the mutual agreement procedure facilitates correcting the non-tax planning firm, this increases the yield of correcting the the non-tax planning firm. When the yield of correcting the non-tax planning firm increases this in turn allows the tax-planning firm to shift more income to the low-tax country without being corrected. As a result, mutual agreement procedures can increase intentional profit shifting from high-tax countries to low-tax countries, by shifting the attention of the tax authority from intentional profit shifting to unintentional mistakes

We extend the model to allow high-tax authorities to invest in obtaining revenue from other high-tax countries through transfer price corrections. We find that high-tax countries will enter into an arms race and invest in obtaining tax base from each other despite this having no effect on global tax revenue - hence leading to a socially sub-optimal situation.

E.2.2 Basic setup

We begin with the simplest possible setup: A tax authority in a high-tax country deciding whether to correct transactions with another high-tax country or to correct a transaction with a low-tax country.

The model consists of three agents:

1. A non-tax planning firm consisting of 2 entities; one in country H1 and the other in high-tax country H2.
2. A tax authority operating in high-tax country H1

3. A tax planning firm consisting of 2 entities; one in country H1 and the other in low-tax country L

The choice variables of the agents are:

1. The tax planning firm decides how to set the transfer price p^L on its internal transaction between the high-tax country H1 and the low-tax country
2. Country H1 decides which transfer prices to correct

The exogenous variables of the model are:

1. p^a : denotes the arm's length price
2. N : denotes the continuum of services imported by the non-tax planning firm in country H1 from its affiliate in country H
3. t_{H1}, t_{H2}, t_L : denotes the corporate tax rate in country H1, H2 and L, respectively. We assume that $t_{H1} = t_{H2} \gg t_L$
4. $\epsilon_i = p_i^H - p^a$: denotes the *accidental* transfer price deviation on transactions flowing between the two high tax countries. We assume these mistakes are *unknown* and *unintentionally* made by the non-tax planning firm, but known by the tax authority. Further, we assume these mistakes follow a uniform distribution with standard deviation b and mean zero.
5. \bar{N} : denotes the resource constraint in facing the tax authority in country H1.

Variables that are exogenous in the basic model, but later endogenized:

1. γ_H : denotes the ease of doing transfer price corrections between the two high-tax countries H1 and H2
2. γ_L : denotes the ease of country H1 doing a transfer price correction against the low-tax country L

E.2.3 The non-tax planning firm

The non-tax planning firm has an affiliate in country H1 which is importing a continuum of $N = 1$ services from its affiliate in country H2 at the price p_i^H . The index i denotes the specific service and $\int_0^N i \, di = N$. An increase in any of the transfer prices applied will increase the

taxable income of the firm in country H2 and lower the taxable income in country H1 by the same amount - leaving the global income of the firm unchanged. For simplicity, we further assume that $t_{H1} = t_{H2}$, such that the global tax collection is also not impacted by the transfer price. That is, an increase in p_i^H by 1 will lower tax receipts in country H1 by t_{H1} but increase the tax receipts in country H2 by $t_{H2} = t_{H1}$ and hence leave global tax receipts unchanged.

Lemma 1: *As $t_{H2} = t_{H1}$, a transfer price correction of transactions flowing between the two high tax countries does not impact global tax receipts*

According to governing tax rules, the firm should set the transfer price according to the arm's-length p^a , which is for simplicity assumed to be constant across services. However, due to the lack of tax consequences of the transfer price, the firm is inattentive to following the arm's-length principle.³⁶ This leads to the firm *accidentally* mispricing it's transactions by $\epsilon_i = p_i^H - p^a$. We assume that these mistakes are uniformly distributed around the correct transfer price such that $\epsilon_i \sim U(-b, b)$ and $\int_0^N \epsilon_i di = 0$. If all transactions between the two high-tax countries were priced correctly the total value of internal imports would be $\int_0^N p^a di = p^a$. If the non-tax planning firm was never corrected the total value of internal imports would be $\int_0^N p^a - \epsilon_i di = p^a$. This implies that while individual transactions between the two high-tax countries may be mispriced there is no aggregate deviation from the arm's-length principle.

Lemma 2: *If the non-tax planning firm is left unchecked there will be no aggregate deviation from the arm's-length principle as arm's-length price deviations on individual transactions between the two high-tax countries are non-systematic*

E.2.4 The tax authority in country H1

To begin with we focus our attention on the behaviour of the tax authority in country H1 and assume that it simply seeks to maximize the tax revenue collected from transfer price corrections. We additionally assume that the tax authority has a limited amount of resources, which implies that following through with one transfer price correction lowers the amount of resources available to pursue another case. We model this constraint in a very simplistic way and simply assume that the tax authority can do a maximum of \bar{N} corrections pr. year, where

³⁶This assumption can be justified by assuming a fixed cost of knowing the actual arm's-length price p^a or an increased focus on non-tax considerations such as the ones described by Nielsen and Raimondos-Moller (2008)

$0 < \bar{N} < 1$. This strict constraint can be relaxed without changing the qualitative results, the important assumption is just that the tax authority faces *some* need to prioritize which cases to pursue.

Corrections may ultimately fail or be reduced in the mutual agreement procedures and/or in court. We allow the expected decrease in the initial correction to depend on the partner country. We let $(1 - \gamma_H)$ denote the expected decrease in a correction of the non-tax planning firm and $(1 - \gamma_L)$ denote the expected decrease in a correction the tax planning firm.

Our hypothesis is that the tax-planning firm will resist any corrections that move taxable income from the low-tax country to the high-tax country (as this will increase global tax payments), implying that $\gamma_L < \gamma_H$. This assumption is, however, not necessary to show the following propositions.

E.2.5 Correcting mistakes only

We begin by disregarding the tax-planning firm and describe a situation where the tax authority only corrects the mistakes of the non-tax planning firm. The expected yield to the tax authority of correcting service transaction i of the non-tax planning firm is $t_{H1}\gamma_H\epsilon_i$. For an arbitrary number $z \sim [-b, b]$ we denote the number of service transactions for which $\epsilon_i > z$ as $F(z)$ and following the properties of the uniform distribution we note that:

$$F(z) = \frac{b - z}{2b} \quad (1)$$

The tax authority will correct the \bar{N} largest mistakes (ϵ_i) of the non-tax planning firm conditional on $\epsilon_i > 0$ in all \bar{N} cases. We let ϵ^N denote the the \bar{N} 'th largest mistake and note that:

$$F(\epsilon^N) = \frac{b - \epsilon^N}{2b} = \bar{N} \Rightarrow \epsilon^N = b - 2b\bar{N} \quad (2)$$

Which implies that the yield of correcting the \bar{N} 'th largest mistake of the non-tax planning firm will generate a yield of $Y^N = t_{H1}\gamma_H(b - 2b\bar{N})$. If $Y^N < 0$ the tax authority will not correct all \bar{N} corrections (as doing so would reduce the taxable income of country H1) but only correct the number of transactions for which $Y^N > 0$. From eq. 2 it follows that:

$$t_{H1}\gamma_H(b - 2b\bar{N}) > 0 \Rightarrow \bar{N} > \frac{1}{2} \quad (3)$$

The tax authority will hence correct \bar{N} transactions unless $\bar{N} > \frac{1}{2}$ in which case the tax authority will only correct $\frac{1}{2}$ transactions. In optimum the expected marginal yield (Y^*) of correcting the non-tax planning firm alone is:

$$Y^* = \begin{cases} t_{H1}\gamma_H(b - 2b\bar{N}) & \text{if } \bar{N} < \frac{1}{2} \\ 0 & \text{if } \bar{N} \geq \frac{1}{2} \end{cases} \quad (4)$$

E.2.6 The tax planning firm

The tax planning firm imports one service from its affiliate in low-tax country L (where $t_{H1} \gg t_l$) at transfer price p^L . The goal of the tax planning firm is to maximize p^L such that it transfers as much income as possible from the high tax country to the low tax country. The expected yield to the tax authority of correcting the tax planning firm is $t_{H1}\gamma_L(p^L - p^a)$. The tax planning firm knows the expected marginal yield of correcting the non-tax planning firm (Y^*) and will hence ensure that the tax authority does not correct p^L by making it marginally more attractive to correct the marginal transaction of the non-tax planning firm. The optimal transfer price p_*^L thus satisfies:

$$Y^* = t_{H1}\gamma_L(p_*^L - p^a) \Rightarrow \quad (5)$$

$$p_*^L - p^a = \begin{cases} \frac{\gamma_H}{\gamma_L}(b - 2b\bar{N}) & \text{if } \bar{N} < \frac{1}{2} \\ 0 & \text{if } \bar{N} \geq \frac{1}{2} \end{cases} \quad (6)$$

If the tax authority has sufficient capacity $\bar{N} > \frac{1}{2}$ the tax authority can pursue all cases that increase the taxable income of country H1 and there is hence no need for the tax authority in country H1 to prioritize between cases (they just pursue them all). In such a case the non-tax planning firm will not be able to shift any profits to the low-tax country. In practice, we know that the tax authority have to do some prioritization and cannot pursue all cases - so we focus on the situation where the tax authority is sufficiently constrained in capacity such that $\bar{N} < \frac{1}{2}$.³⁷ In this case we find:

Proposition 1: *If the tax authority is sufficiently constrained ($\bar{N} < \frac{1}{2}$), the amount of intentionally shifted profits to the low-tax country ($p_*^L - p^a$) will depend positively on b (the size of the mistakes made by the non-tax planning firm), negatively on γ_L (the ability to correct the tax-planning firm) and positively on γ_H (the ability to correct the mistakes of the non-tax*

³⁷In reality tax authorities only have capacity to audit a tiny fraction of transactions. Our discussions with tax authorities across the world suggests that less than 1% of multinational firms are audited

planning firm)

This result is very intuitive: the larger the mistakes of the non-tax planning firm is (scaled by b) and the larger the success rate of correcting these mistakes are, the higher the transfer price deviation $p_*^L - p^a$ will be.

E.2.7 Improving mutual agreement procedures

At its heart mutual agreement procedures are meant to ease the correction of transfer prices applied between high-tax countries (see OECD action point 14) and as we have empirically documented these procedures have been ambitiously promoted during the last 30 years. If we interpret an improvement of the mutual agreement procedures as an increase in γ_H it follows directly from proposition 1 that improving mutual agreement procedures will increase the amount of profits shifted to tax havens - insofar the tax authority is sufficiently capacity constrained ($\bar{N} < \frac{1}{2}$).

E.2.8 Extension of the model: High-tax authority arms race

We now introduce the second tax authority of high-tax country H2 with an analogue objective of country H1. We allow the tax authorities to have differing capacity and let $\bar{N}_{H1}, \bar{N}_{H2}$ denote the constraint in country H1 and H2, respectively. We continue to assume that the tax authorities are constrained to the point where $\bar{N}_{H1}, \bar{N}_{H2} < \frac{1}{2}$. For simplicity we assume that the only multinational operating in country H2 is the non-tax planning firm. Where the tax authority in country H1 wanted to correct the mistakes of the non-tax planning firm whenever the transfer price was too high ($\epsilon_i = p_i^H - p^a > 0$) the tax authority in country H2 faces the opposite incentive (as the host of the exporting affiliate): Their tax base increases with p_i^H and hence they will aim to correct transfer prices that are too low ($p_i^H - p^a < 0$). We allow the ability of the tax authority to differ (proxied by γ_H). We let γ_H^{H1} denote the success rate of the tax authority in country H1 and γ_H^{H2} denote the success rate of the tax authority in country H.

Remembering that the number of services for which $\epsilon_i > z$ is given by eq. 1 it follows that the total value of the \bar{N}_{H1} largest corrections of the non-tax planning firm in country H1 is:

$$t_{H1}\gamma_H^{H1} \int_0^{\bar{N}_{H1}} b - 2bx \, dx = t_{H1}\gamma_H^{H1} [bx - bx^2]_0^{\bar{N}_{H1}} = t_{H1}\gamma_H^{H1}(b\bar{N}_{H2} - 2b\bar{N}_{H1}^2) \quad (7)$$

Completely analogue we find that the value of the \bar{N}_{H2} largest corrections of the non-tax planning firm in country H2 is:

$$-t_{H2}\gamma_H^{H2} \int_0^{\bar{N}_{H2}} -(b-2bx) dx = t_{H2}\gamma_H^{H2} [bx - bx^2]_0^{\bar{N}_{H2}} = t_{H2}\gamma_H^{H2}(b\bar{N}_{H2} - 2b\bar{N}_{H2}^2) \quad (8)$$

It is important to note that the total impact of *all* transfer price corrections on the tax base of each country is the sum of your own corrections *less* the corrections of the partner country. Additionally, as we have assumed that $t_{H1} = t_{H2}$ the net impact on global tax revenue of *any* transfer price correction between the two high-tax countries is always zero (see lemma 2).

As an additional extension of the model, we now allow the success rate of each tax authority to be the result of an investment by the tax authority in human capital, technology et cetera. Such that:

$$\frac{\delta\gamma_H^{H1}}{\delta C^{H1}} > 0, \quad \frac{\delta^2\gamma_H^{H1}}{\delta^2 C^{H1}} < 0 \quad (9)$$

$$\frac{\delta\gamma_H^{H2}}{\delta C^{H2}} > 0, \quad \frac{\delta^2\gamma_H^{H2}}{\delta^2 C^{H2}} < 0 \quad (10)$$

Where C_{H1} is the investment made by country H1 and C_{H2} is the investment made by country H2. From a social point of view - any investment in conducting transfer price corrections between the two high-tax countries is sub-optimal as the impact on global tax revenue is zero. However, each individual high-tax country have an incentive to invest in obtaining the tax base of the other country and in a Nash-equilibrium both countries will therefore invest in γ_H up to the point where the marginal return (to your own country) equals the cost.

$$\frac{\delta\gamma_H^{H1}}{\delta C_*^{H1}} = t_{H1} [b\bar{N}_{H1} - 2b\bar{N}_{H1}^2] \quad (11)$$

$$\frac{\delta\gamma_H^{H2}}{\delta C_*^{H1}} = t_{H2} [b\bar{N}_{H2} - 2b\bar{N}_{H2}^2] \quad (12)$$

Several interesting conclusions are visible from eq. 11 and 12. First, both high-tax countries will invest in obtaining revenue from each other by correcting mistakes in a nash-equilibrium - leading to a sub-optimal outcome from a global perspective. Second, all other things equal, the tax authority with highest capacity \bar{N}_{H2} will invest more in obtaining tax base from the other high-tax country and as a result obtain a higher share of total tax revenue. This second point has important implications when considering the dynamics of transfer price corrections between high/low income countries.

Proposition 2: *In a nash-equilibrium both high-tax countries will invest in obtaining tax base from each other despite this having no effect on global tax revenue - hence leading to a socially sub-optimal situation. All other things equal, the tax authority with the highest capacity will end up obtaining the most tax revenue*

F The rise of the MNE and the fall of the corporate tax

In this section we document the striking fall of the corporate tax and the rapid increase MNE activity in the last decades.

F.1 Data on corporate tax rates and revenue

We use data from KPMG corporate tax tables and OECD tax tables to document the decline of the nominal corporate tax rate. The following tables summarize our findings.

F.1.1 Top statutory corporate income tax rates since 2003 by country (Table F1a)

Table F1a shows the falling top statutory tax rates across the world since 2003. The data is from KPMG and can be found readily on their web page³⁸. For The United States, tax rate is reported not as the top statutory tax rate, but as the average statutory tax rate across states from OECD tax tables.

F.1.2 OECD top statutory tax rates since 1981 (Table F1b)

Table F1b shows the top statutory tax rates of the OECD since 1981 as reported by the "Tax Foundation". Also here a falling trend is seen. The data can be found on github³⁹.

We use this time series to impute the world average corporate tax rate for the years where the world average is missing in the KPMG tax tables (1981-2003). This is done by multiplying the OECD average by the calculated ratio between the OECD average and the world average in the years where both are present.

F.1.3 Corporate tax revenue as a share of GNI (Table F2)

Table F2 shows the corporate tax revenue as a share of GNI for the four largest economies in the EU (Germany, United Kingdom, France and Italy), as well as the weighted average of these.

³⁸<https://home.kpmg.com/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html>

³⁹https://github.com/TaxFoundation/data/blob/master/OECD-corporate-income-tax-rates/OECD_corporate_income_tax_rates_1981-2015.csv

In column 6, we scale the share of GNI up to take depreciation into account. A depreciation of 15% is assumed. The data is all found in the OECD Tax Database

F.2 The rise of the multinational firm

Another remarkable trend in the last decades is the explosion of multinational activity (globalisation). We document this in table F3.

F.2.1 Multinational profits as share of global profits decannially (Table F3)

Table B6 shows the dramatically increasing share of foreign owned income out of total corporate income from the 1930's until today. For the years where we have global data in table C6 we use this to calculate the share of foreign owned income in corporate profits from 1980's until today (col. 1). Remarkably, we see how the share has gone from 4 % in the 80's to 15 % in the 2010's. We extrapolate the series back to 1930's using the trend of US owned firms (col. 2) and estimate that merely 1% of corporate profits were owned by foreign residents in the 1930's (col. 3) - implying an astounding 15-fold increase in multinational profits share of corporate profits from the 30's until today.

G List of files

There are three main Excel files:

- TWZ2018.xlsx: main tables and figures (included in main paper).
- TWZ2018AppendixTables.xlsx: appendix tables (printed at the end of this document).
- TWZ2018AppendixFigures.xlsx: appendix figures (printed at the end of this document).

We also make available all the raw data that we used in this research, in the TWZ2018RawData.zip file. This file includes a number of raw files downloaded from various data sources (OECD, IMF, central banks, etc.). These files are collected in four raw data Excel files:

- TWZ2018RawDataA.xlsx: raw national accounts and foreign affiliates statistics
- TWZ2018RawDataB.xlsx: raw balance of payments and other international investment statistics
- TWZ2018RawDataC: raw tax haven data (national accounts, balance of payments, other)

- TWZ2018RawDataD: miscellaneous raw data.

The various Excel files are constructed as follows. The raw files A, B, C, D have no external links. TWZ2018AppendixTables.xlsx has links to the 4 raw files and no other link. TWZ2018AppendixFigures has links to TWZ2018AppendixTables and no other link. Similarly, TWZ2018 has links to TWZ2018AppendixTables and no other link.

In addition, we also make available the Stata programs and bulk downloads we used in this research, in the TWZ2018Programs.zip file. This folder is organized as following:

- master.do: the master do-file that replicates all our stata output and describes the operations of each underlying do-file. Also describes how to update the results.
- Eurostat: contains all do-files used to manage eurostat data and the bulk downloads from eurostat. The folder is further divided into FDI income statistics and service trade.
- IMF data: contains all do-files used to manage IMF data and the bulk downloads from IMF. The folder is further divided into balance of payment flows and investment stock data.
- UN data: contains all do-files used to manage UN data on national accounts and the bulk downloads from UN data.
- Excel output: We attach all the raw excel output tables produced within each section in the folder "output tables" with a sub-folder for each do-file. A readme.pdf file in each output folder will further explain the content of the excel output.

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