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International Distribution of the Corporate Tax Base: Implications of Different Apportionment Factors under Unitary Taxation

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Summary

Under the current system of separate accounting, tax-motivated international profit shifting results in misalignment of profits and real economic activity. While the Organisation for Economic Co-operation and Development (OECD) Base Erosion and Profit Shifting initiative aims to measure and curtail this, critics claim serious progress is only possible with greater emphasis on formulary apportionment methods (Picciotto 2013), or other methods outside the present international tax architecture (IMF 2014). In this paper we use the leading global database of company balance sheets to compare the distribution of profit and potential apportionment factors. Although data coverage is problematic for developing countries, we find that apportioning profit according to measures of actual economic activity would result in a major redistribution of the tax base at the expense of a particular group of jurisdictions, and in most cases towards the lower-income countries in the sample. International loss consolidation facilitated by a global switch to unitary taxation would reduce the overall tax base by around 12 per cent.

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Contents

Acknowledgements

Acronyms

BEPS	Base Erosion and Profit Shifting
CCCTB	Common Consolidated Corporate Tax Base
EU	European Union
FDI	Foreign Direct Investment
ICTD	International Centre for Tax and Development
IMF	International Monetary Fund
OECD	Organisation for Economic Co-operation and Development
US	United States

Introduction

The growing importance of multinational corporations and their opportunity to reduce their tax bill via international reallocation of the corporate tax base has been a topic of considerable interest both to academic researchers and to policymakers.[1] In light of the fiscal pressures arising from the recent financial crisis there has been further impetus to the debate by the OECD's Base Erosion and Profit Shifting (BEPS) initiative, launched in 2013 with the backing of the G8 and G20 groups of countries.

The UK's Chancellor of the Exchequer, George Osborne, reflected the strength of criticism of the current system when he hailed the BEPS Action Plan as 'a major step forward towards a global tax system that is fair and fit for purpose'.[2] The Action Plan (OECD 2013) declares that 'A realignment of taxation and relevant substance is needed' (p.13), and takes as its aim that it 'should provide countries with domestic and international instruments that will better align rights to tax with economic activity' (p.11).[3]

Under the current system of separate accounting, profits of multinational companies are taxed in the respective countries in which they are earned. For the purpose of corporate taxation, the subsidiaries of these companies are treated as individual firms when it comes to calculation of the taxable profits.[4] Given the persistent disparities in corporate tax rates, this creates an incentive for multinational companies to misallocate their taxable income with the aim of reducing their overall tax burden. There are a number of empirical studies using corporate balance sheet data which support the hypothesis that international profit shifting in response to tax differentials is statistically and economically significant within European Union (EU) and OECD countries.[5]

Similar evidence for developing countries is lacking, reflecting the scarcity of balance sheet data. Instead researchers in this area have tended to focus on analysis of trade data, where abnormal pricing suggests large illicit outflows from developing countries, but where attribution to multinational tax practices is problematic – see, for example, the range of views among contributors to the World Bank's major volume on illicit financial flows (Reuter 2012, including Eden 2012; Fuest and Riedel 2012; Leite 2012; Murphy 2012; and Nitsch 2012).

In order to restrict tax-motivated relocation of corporate profits, increasingly complex approaches have emerged to transfer pricing, thin capitalisation, questions of permanent residence and related issues. The application of these rules varies widely, even between OECD member states, and a critical view is that BEPS is primarily addressing the difficulties of the system of separate accounting, rather than addressing the fundamental problem – the system itself. The International Monetary Fund (IMF), arguably the leading international institution in terms of developing country tax advice, has stated bluntly that 'Current

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[1]   For a recent survey on the topic, see Fuest et al. (2013).

[2]   Osborne's comments were made in the UK government's press release at <https://www.gov.uk/government/news/g20-next-stage-in-securing-new-global-standard-for-tackling-avoidance-and-evasion-reached> (accessed 10 March 2014).

[3]   It is interesting that the OECD has set this target for the BEPS initiative, since alignment of profit and economic activity is not the aim of the current system. Under the separate accounting approach misalignments will reflect not only tax motivated 'profit shifting', but also differences in the actual profitability of different entities within a particular multinational group. There is also no articulated theoretical basis for alignment as a goal of international tax rules - a potentially important avenue for future research.

[4]   For a detailed description on the historical origins and the resulting shortcomings of the current international tax system see Picciotto (2013).

[5]   See Grubert and Mutti (1991) for early evidence for the US; Huizinga and Laeven (2008), Weichenrieder (2009) and Loretz and Mokkas (2011) for more recent evidence for European multinationals.

initiatives, which operate within the present international tax architecture, will not eliminate spillovers' (IMF 2014: 35).[6]

The alternative of unitary taxation has been proposed: treating each multinational group of companies as a unit, regardless of the geographical and juridical location of the individual subsidiaries; calculating profit and loss on a group-wide basis; and then allocating the taxing rights on this consolidated profit between the jurisdictions with which the group has a nexus, according to the extent of actual economic activity. Systems of unitary taxation with formula apportionment currently exist only at the national level, most notably in the United States (US), Canada and Switzerland, and - for local business tax - in Germany. There is also a longstanding proposal of the European Commission (2011) to extend unitary taxation and formulary apportionment to the whole of the European Union under the Common Consolidated Corporate Tax Base (CCCTB).

In practice, OECD transfer pricing guidelines allow a range of methods to allocate (or apportion) profit between entities within a group, so rather than seeing a choice between polar opposite systems it is possible to think of changes within the current framework that would make the extent of apportionment more coherent and transparent (Picciotto 2013). As such, research into the distributive implications of full global apportionment also shed light on the direction of travel that would follow from more gradual steps.

The underlying idea of the allocation formulae (which may typically include assets, sales and employment) is that they should reflect economic substance: that is, they should reflect the location of corporate economic activity across countries. As such, any assessment of tax base redistribution under a particular formula will to some extent reflect the misalignment between current profit declaration and the location of economic activity, as captured by the formula in question. The disparity between the allocation of the apportionment factors and the taxable profit is likely also to reflect differences in productivity or in the valuation of the apportionment factor in question, and therefore might have non-tax reasons. Therefore any strong conclusions about tax-induced misalignment should be drawn with utmost care.

Sales factors reflect the demand for goods and services, while labour and assets reflect the supply process. There is no 'true' formula that objectively captures the location of economic activity, but a number of formulae are in operation or have been proposed, and this paper considers a range of these. The specific apportionment formula chosen is likely to have substantial redistributive consequences – given that proposals for unitary taxation originate largely from the observation that profits are misaligned under the current system, redistribution of taxable income is the logical consequence.

The most active proponents of international formulary apportionment have been EU countries, suggesting they are expecting to benefit in the form of more tax base allocated to them. At the same time, critics of the current system have long highlighted that reliance on transfer pricing and the arm's length principle may produce a systematic distortion of the tax base away from developing countries.[7] While both OECD countries and developing countries could plausibly gain tax base at the expense of low tax jurisdictions with disproportionate profit declaration, the identity of the winners and losers will depend on the nature of the current distribution of declared profits and on the precise formula used. While there has been some analysis of revenue effects of different formulae for the US and the European Union, it has not yet been investigated at a worldwide level.

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[6] Rather than emphasise profit misalignment, the IMF uses the broader concept of spillovers in international corporate taxation (defined as the effect of one country's rules and practices on others). IMF (2014: 1) highlights that adverse spillovers are 'especially marked and important for developing countries'.

[7] See, for example, Cobham and McNair (2012).

This paper aims to investigate the revenue consequences of various apportionment factors, with the particular intention of extending knowledge of the distributional implications beyond the major industrialised countries. There are reasons to think that the current system of separate accounting and transfer pricing may raise particular difficulties for developing countries (OECD 2014). The pattern of investment may also differ, with lower-income countries receiving a greater share of vertical investment focused on resource extraction and use of low cost labour, compared to horizontal investment, primarily for market access reasons. Differences in factor prices in lower-income countries are also likely to have a direct impact on the revenue consequences of the choice of apportionment factor. At the same time it is crucial to point out that we fully abstract from behavioural changes of multinational companies in response to the move towards unitary taxation with formula apportionment. Insofar as we believe that part of the redistribution of the corporate tax base is due to profit shifting activities under the current system, it is very likely that companies will adjust their behaviour and that allocation of real assets will be affected by corporate taxation. This is a very important aspect of a change towards unitary taxation which is beyond the scope of this paper, but certainly needs to be the focus of future research.

Finally, data availability presents a particular challenge in assessing tax changes in lower-income countries. Hence this study aims to both explore what we can learn from available data, and highlight where data shortcomings are particularly pronounced. In this way the current study fits with Action 11 of the BEPS initiative, aiming to 'establish methodologies to collect and analyse data on BEPS and the actions to address it'. Data availability in respect of lower-income countries is likely to be a major problem for the OECD when ensuring that their baseline data and subsequent monitoring has global coverage.

We use the largest commercially-available database of company balance sheets, *Orbis*, provided by Bureau van Dijk. Using a dataset of up to 211,360 individual companies in 26,795 corporate groups, we simulate the static distributional consequences of a number of different apportionment factors. The most obvious finding is that coverage is severely limited among developing countries, and increasingly so for lower-income countries. Despite the large number of firms in the initial dataset, the level of reporting for lower-income countries is insufficient to predict revenue consequences reliably. The challenge for the OECD BEPS initiative is clear.

Nevertheless, our study highlights some interesting aspects of a move towards unitary taxation and formula apportionment. A first robust finding is that the implicit introduction of international loss consolidation would reduce the overall corporate tax base significantly – in our sample of firms for the years 2003-2011 by more than 10 per cent. Furthermore, the exact design of the apportionment mechanism will be crucial for the distribution of the corporate tax base between countries. While this result is neither surprising nor new, it highlights the likely political difficulties that would arise in seeking multilateral agreement on a specific formula.

The analysis in this paper is based on all the countries in the world participating in the move to unitary taxation with formula apportionment. In reality it is much more likely that tax havens and other countries benefitting from the current separate accounting system will opt to stay out of a unitary taxation system. We do not model this in the current paper, but previous results have shown that if only high tax countries move to a formula apportionment system, in relation to profits arising within their own economies, the revenue consequences will be much less pronounced.[8] Alternatively, a country or economic region (e.g. the EU or the East African Community) might unilaterally decide to apply unitary taxation in order to determine their apportioned share of the worldwide profits of multinational groups operating in their

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[8]   For example, Devereux and Loretz (2008) model only a sub-group of countries participating in the proposed CCCTB and find the distributional consequences are much smaller.

jurisdiction. The results here shed light on the potential scale of change in the tax base before the effect of any subsequent decisions about tax rates and the location of economic activity.

Despite the shortcomings of the data, a remarkably clear picture emerges. Of the countries with sufficient data, those with lower per capita income would benefit from apportionment according to either tangible assets or number of employees. In contrast, apportionment according to turnover or cost of employees will allocate a larger share to higher income countries. Similarly a two-part apportionment formula in the spirit of Avi-Yonah et al. (2009) would also benefit high-income high-tax countries (here the assumed rate of return on operating expenses crucially affects the results). Finally we investigate the impact on tax revenue, which seems to be slightly positive (in the range of two to four per cent) – although strong assumptions are necessary to make such an estimate.

The paper is structured as follows. Section 1 discusses the literature on unitary taxation and formulary apportionment. Section 2 outlines algebraically the approach taken to apportionment, including the role of international loss consolidation. Section 3 presents the data and outlines the empirical approach, with the results being set out in Section 4. A final section concludes.

1 Previous literature

Given the gap in research addressing the empirical implications of a shift to unitary taxation for lower-income countries, this paper is most closely related to two different research questions. One strand of literature is mostly concerned with profit shifting out of the US, and investigates how much more tax base would be allocated to the US if they were to extend unitary taxation and formula apportionment to the worldwide income of US-headquartered multinationals. Shackelford and Slemrod (1998) use segmental reporting data, and show that 46 of the largest US firms would face a 38 per cent increase in their tax burden. Clausing and Lahav (2011) update the analysis of Shackelford and Slemrod, but find only a modest increase of the tax base in the US. While this approach is appealing because it uses consolidated group profits as a starting point, it is highly data-demanding and therefore was only conducted for a small number of companies. Furthermore, segmental reporting does not usually allow identification of the distribution of the apportionment factors in all countries, and hence the two studies are limited to the revenue impacts on the headquarters economy.

A range of studies have considered the application of formulary apportionment within national borders. Mintz and Smart (2004) find that apportionment between Canadian provinces results in substantially less income shifting. Where Canada has a common formula (based on sales and wages), US states can apply their own factors. Clausing (2014: 25) assesses the experience in the US, and finds 'some cautious optimism for advocates of international formulary apportionment. Formulary apportionment has the potential to reduce income-shifting incentives without generating accompanying large tax responses in economic activity such as employment and investment'.

A different approach is used in papers addressing the revenue impact of various potential apportionment factors in the context of European tax harmonisation. Here the approach is bottom-up, as the information of the subsidiaries is aggregated to obtain the geographical distribution of the profits and the apportionment factors. Fuest et al. (2007) use data about German inbound and outbound foreign direct investment (FDI), while Devereux and Loretz (2008) use international data to investigate the same questions. Aside from the higher quality of the German administrative data used by Fuest et al. (2007) and the broader coverage in the international data used by Devereux and Loretz (2008), the main difference in approach

is that the latter explicitly model the impact of international loss consolidation. Devereux and Loretz (2008) also investigate the impact of a *voluntary* system of formula apportionment, since this is discussed in the European Union.

The core of the current paper is an extension of Devereux and Loretz (2008) to all countries for which equivalent balance sheet data is available. In addition to the apportionment factors proposed by Agúndez-García (2006), we also consider the two-part apportionment discussed in Avi-Yonah et al. (2009). This method allocates ordinary profits according to the geographical distribution of operating expenses, and excess profits are then allocated according to additional factors (e.g. assets). Very recently IMF (2014) uses Bureau of Economic Analysis investment data on US outbound FDI to investigate the impact of different apportionment factors on tax revenue in selected advanced and emerging countries. This provides a sample with broad international coverage in terms of host economies, but narrow by home economy (i.e. US only). In addition, data is from survey responses rather than audited accounts. Nonetheless there are important commonalities in the findings, which we discuss briefly in Section 4.

2 Mechanisms of formula apportionment and loss consolidation

The main question we are concerned with in this paper is which countries could benefit from a move to unitary taxation through a larger corporate tax base being apportioned to them (once international loss consolidation is allowed for). Note that apportionment of a larger tax base need not necessarily imply higher ultimate revenue, since the change in system would change both states' incentives for setting rates, and corporate incentives for the location of economic activity. Nonetheless, relative changes in tax base are significant to the extent that they reflect the relative power of states in terms of any subsequent revenue-investment trade-off.

To answer this question this section first sets out to describe the basic mechanism of formula apportionment, and how we can compare the tax base under separate accounting to the hypothetically-apportioned tax base under unitary taxation with different formulae. Then we highlight the role of international loss consolidation under unitary taxation.

2.1 Basic mechanism of formula apportionment

Let π_{ij} denote the declared, taxable profit of corporate group j in country i. The total declared taxable profit of the group across all N_j countries in which it operates, is then given by

$$\Pi_j = \sum_{i=1}^{N_j} \pi_{ij} \ .$$

Under the current system of separate accounting the corporate group is liable to corporate taxation on its profit in each country π_{ij} at the corporate tax rate τ_i.[9] For the moment, let us assume that the group is profitable in all countries where it operates. Hence under separate accounting the total tax revenue of each country is i given by:

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[9]   Note that for reasons of simplicity we do not distinguish between one or many subsidiaries of the same corporate group in a given country. In countries where (loss) consolidation between members of a group is not possible, this distinction might be important.

$$T_i^{SA} = \sum_{j=1}^{J_i} \tau_i \pi_{ij} \tag{1}$$

where J_i denotes the number of groups country i.

In contrast, under a unitary taxation approach the taxable profit of the corporate group is aggregated first, and then taxing rights are allocated to the individual countries according to a formula. Abstracting from the possibility that countries chose their own formula this yields total tax revenue for each country of:

$$T_i^{UT} = \sum_{j=1}^{J_i} \tau_i \theta_{ijX} \Pi_j \tag{2}$$

where θ_{ijX} is the share of the total profit allocated to country i if factor X is used to apportion the profits among the N_j countries in which group j operates, and is defined according to:

$$0 \le \theta_{ijX} \equiv \frac{X_{ij}}{\sum_{i=1}^{N_j} X_{ij}} \le 1 \tag{3}$$

Note that the share of the apportionment factor is bounded between zero and unity under normal circumstances (i.e. the apportionment factor is non-negative in all countries).
In the case of the two-part apportionment process proposed by Avi-Yonah et al. (2009) the apportionment factor will be

$$0 \le \theta_{ijX} \equiv \frac{pE_{ij}}{\Pi_j} + \left(1 - \frac{p\sum_{i=1}^{N_j} E_{ij}}{\Pi_j}\right) \frac{X_{ij}}{\sum_{i=1}^{N_j} X_{ij}} \le 1 \tag{4}$$

where E_{ij} denotes the operating expenses of group j in country i, and p the assumed standard return to the expenses.

In consequence country i will receive higher tax revenue from group j under unitary taxation if the following condition is fulfilled:

$$T_{ij}^{UT} > T_{ij}^{SA} \Leftrightarrow \frac{X_{ij}}{\sum_{i=1}^{N_j} X_{ij}} > \frac{\pi_{ij}}{\sum_{i=1}^{N_j} \pi_{ij}} \Leftrightarrow \theta_{ijX} > \frac{\pi_{ij}}{\Pi_j} \tag{5}$$

The condition in (5) simply states that a country will receive more tax revenue from a multinational group if the share of the apportionment factor in the country is bigger than the share of profits reported in the country under separate accounting.

To generalise, this will hold for the overall corporate tax revenue of the country by using the average over all multinational groups with a taxable nexus in the country.[10] That is, if the average share of the apportionment factor ($\overline{\theta_{ijX}}$) across all groups is larger than the average share of profit, tax revenue will be higher under unitary taxation. Denoting the average *worldwide* profit of multinationals with a nexus in the country as $\overline{\Pi_j}$, and the average profit *in this country* of these multinationals $\overline{\pi_{ij}}$, we have:

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[10]   Note that the last steps in equations (6) and (9) only work if the number of groups with a taxable nexus does not change through the switch from separate accounting to unitary taxation. For example, in the case of apportionment by sales by destination this could imply the use of throwback rules.

$$T_i^{UT} > T_i^{SA} \Leftrightarrow \sum_{j=1}^{J_i} T_{ij}^{UT} > \sum_{j=1}^{J_i} T_{ij}^{SA} \Leftrightarrow \frac{\sum_{j=1}^{J_i} X_{ij}}{\sum_{j=1}^{J_i} \sum_{j=1}^{N_j} X_{ij}} > \frac{\sum_{j=1}^{J_i} \pi_{ij}}{\sum_{j=1}^{J_i} \Pi_j} \Leftrightarrow \overline{\theta_{ijX}} > \frac{\overline{\pi_{ij}}}{\overline{\Pi_j}} \tag{6}$$

In other words, a country will receive more tax revenue from multinational groups if the average share of the apportionment factor for all groups in the country is bigger than the average share of profits reported in the country under separate accounting.

Finally, note that for any given formula which is considered to reflect actual economic activity (e.g. an equally-weighted combination of sales, employment and fixed assets), the ratio of tax revenue – or equally, of tax bases, since the τ_i will drop out – under unitary and separate accounting will provide a measure of the misalignment between profit and activity.

2.2 The role of (international) loss consolidation

An additional aspect to be considered is the consolidation of losses within the corporate group. In most countries corporations do not get immediate relief for losses, but rather can use the losses against profits in other subsidiaries in the same country, or carry them forward to be offset against future profits. However, with very few exceptions losses cannot be offset against profits made in subsidiaries in other countries.[11]

This situation changes when group-wide profit is calculated under unitary taxation. The resulting elimination of differences in the treatment of domestic and foreign losses is a major argument used by the EU in support of a move to CCCTB. These considerations have an important effect on tax revenue both under the current system and proposals for unitary taxation. Under the current system the taxable income and tax liabilities of an individual firm j in country i need to be adjusted to reflect the loss carry forward and the asymmetric treatment of profit and losses. Let t denote the taxable year and $\lambda_{ij,t-1}$ the losses brought forward into the period, one can rewrite the taxable income and the loss carry forward of current period as

$$\pi_{ij,t}^{SA} = \max(0, (\pi_{ij,t} + \lambda_{ij,t-1}^{SA})) \text{ and } \lambda_{ij,t}^{SA} = \min(0, (\pi_{ij,t} + \lambda_{ij,t-1}^{SA})), \tag{7}$$

which can then be aggregated to the total taxable profit under separate accounting

$$\Pi_{j,t}^{SA} = \sum_{i=1}^{N_{j,t}} \pi_{ij,t}^{SA}.$$

Under a unitary taxation approach, losses in individual countries will be immediately offset against the profits elsewhere, and losses will only be carried forward at the corporate group level. Hence the profit and the loss carry forward will be

$$\Pi_{j,t}^{UT} = \max(0, (\Pi_{j,t}^{UT} + \Lambda_{j,t-1}^{UT})) \text{ and } \Lambda_{ij,t}^{UT} = \min(0, (\Pi_{j,t-1}^{UT} + \Lambda_{j,t-1}^{UT})). \tag{8}$$

Hence with the current asymmetric loss treatment, the total corporate tax base will be different depending on the tax system. Changing from a system of separate accounting to unitary taxation may have a short-run transition effect because of stocks of losses in the

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[11] One notable exception is Austria, which has a very generous loss consolidation system for Austrian-headquartered companies.

respective countries.[12] However, even abstracting from this short-run transition effect, the switch from separate accounting to unitary taxation has two counteracting effects on the overall tax base. First, there is the direct effect that more losses are usable immediately, which has a depressing effect on the overall tax base. At the same time, the fact that losses are more likely to be used immediately implies that the stock of losses to be carried forward will be smaller. This has a positive impact on the overall tax base. Which of the two effects dominates depends on the level and the variance of the expected profits.

Taking into account that the overall tax base will be different under the two tax systems, the condition under which any individual country will be better off can now be written as.

$$T_{i,t}^{UT} > T_{i,t}^{SA} \Leftrightarrow \sum_{j=1}^{J_{i,t}} T_{ij,t}^{UT} > \sum_{j=1}^{J_{i,t}} T_{ij,t}^{SA} \Leftrightarrow \frac{\sum_{j=1}^{J_{i,t}} X_{ij,t}}{\sum_{j=1}^{J_{i,t}} \sum_{i=1}^{N_{j,t}} X_{ij,t}} > \frac{\sum_{j=1}^{J_{i,t}} \pi_{ij,t}^{SA}}{\sum_{j=1}^{J_{i,t}} \Pi_{j,t}^{UT}} \Leftrightarrow \overline{\theta_{ijX,t}} > \frac{\overline{\pi_{ij,t}^{SA}}}{\overline{\Pi_{j,t}^{UT}}} \tag{9}$$

A country will receive relatively more tax base under unitary taxation if the average share of the apportionment factor is bigger than the average ratio between the profit under separate accounting to the total taxable profit under unitary taxation.

A final complication arises when the two-part apportionment proposed by Avi-Yonah et al. (2009) is used. If the overall profit of the corporate group is positive but smaller than the assumed return on expenses, the residual profit to be apportioned in the second stage is negative which can result in an overall negative tax base allocated to some countries. In this case we set the apportionment factor in this country to zero. Technically this implies that the inequality in equation (4) does not necessarily hold, since it is possible that the assumed return on expenses is larger than the overall profits.

3 Data and empirical approach

To address the questions raised here one would ideally have access to country-by-country reporting of profits and losses, as well as of the relevant apportionment factors. At present this is not available for all companies worldwide. However, international civil society campaigning has resulted in its being required for extractive sector companies listed in the EU and USA, and the OECD has been mandated by the G8 and G20 groups of countries to create a standard for private country-by-country reporting to tax authorities.[13]

3.1 Data

In the current absence of the ideal dataset, we use the largest available dataset of firm-level accounts, *Orbis*, provided by Bureau van Dijk. *Orbis* contains the balance sheet, profit and loss accounts, and most crucially the ownership structure, of all registered companies worldwide. For a subset of headquarter countries, both the consolidated and the unconsolidated accounts are available. For the main approach of this paper we follow Devereux and Loretz (2008), and aggregate the individual unconsolidated accounts to obtain the necessary country-by-country information. This results in an incomplete picture, since information is often unavailable for some of the subsidiaries within a group. In addition,

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[12]   It is not clear whether one would want to include stocks of losses into the calculation of current taxable profits. There is also the proposed solution that stocks of losses may be carried forward against the tax liability resulting from the apportioned share of profits.

[13]   Part of the basis for the international civil society campaign has been, precisely, its potential to demonstrate the misalignment of profits and activity, and, for some, to make the case for unitary taxation. See e.g. Murphy (2008) on the country-by-country proposal and the argument for the wider public to be able to scrutinise multinational groups' tax payments.

where there are non-random reasons for information to be missing (e.g. accounts in low-tax jurisdictions are less likely to be included in the dataset), this will result in systematic biases to the results. Notwithstanding these issues, however, our view is that at the current moment *Orbis* provides the best opportunity to consider patterns among multinational groups of global origin – albeit from a limited field.

In principle the *Orbis* online database contains all firms worldwide, and currently amounts to approximately 100 million entries.[14] However, for the vast majority of these companies there is only very basic information, such as name and address. At the same time, any switch from separate accounting to unitary taxation will not directly affect small independent and purely domestic companies. Therefore the starting point of the analysis is to identify which companies will be affected by a switch to unitary taxation. Since this study focuses on the revenue effects of different apportionment factors, and is not concerned with other important aspects of a change towards unitary taxation, the companies which will be affected need to be multinational groups. We define multinational groups as corporate groups which own at least one subsidiary in a different country. We define ownership as owning either directly or indirectly more than 50 per cent, which implies that we can allocate any subsidiary unambiguously to its owner. Further we exclude public authorities or individuals owning corporate groups. In cases where a multinational group is globally owned by individuals or public authorities, we use the highest-level corporate owner as the global owner.[15]

This results in a sample of 322,525 individual corporate entities in 29,984 groups. Table 1 shows the basic sample allocated into broad country groups. The columns depict the location of the respective subsidiary, while the rows show the location of the owner. It becomes evident that *Orbis* data is dominated by European companies, and that there is very little information about developing countries. Nevertheless, this is still the most comprehensive dataset with which to investigate the question at hand.

All databases from Bureau van Dijk including *Orbis* provide information about the last ten years. Given that accounts are reported with some delay and the information for the year 2012 is still incomplete, this implies that we can use a time window of nine years, namely from 2003 to 2011. However, for some companies not all the necessary information is available for all years. To maximise the coverage we calculate the resulting tax base allocation for each factor separately, which results in different sample sizes for the different variables.

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[14] The 100 million companies also include a large number of public authorities, e.g. universities or hospitals, which are not relevant for the purpose of our analysis. For comparison, OpenCorporates.com has data on 62 million companies (as at 7 January 2014).

[15] It is noteworthy that Bureau Van Dijk only reports the ownership information on a cross-sectional basis. This implies that newer ownership information replaces previous information, and all the information about the group structure is based on the information available at the time of the download (Autumn 2013).

Table 1 Number of firms in MNE groups, by location and owner country groups

	European Union	Other Europe	North America	Asia	Australasia	Latin America	Caribbean	Central American	North Africa Middle East	Sub-Saharan Africa	Total
European Union	177,275	10,246	9,025	2,651	387	1,326	23	10	632	138	**201,713**
Other Europe	8,785	11,742	908	342	71	100	4	2	57	8	**22,019**
North America	27,736	1,165	23,095	1,997	366	767	23	13	113	12	**55,287**
Asia	7,220	502	4,218	19,585	204	198	40	3	67	11	**32,048**
Australasia	1,529	52	406	145	384	32	3	0	4	2	**2,557**
Latin America	324	13	137	11	3	512	1	4	2	5	**1012**
Caribbean	3,055	424	396	393	24	49	89	5	2	2	**4,439**
Central American	83	11	23	1	0	2	2	8	0	0	**130**
North Africa/Middle East	1,633	126	257	36	5	14	0	0	522	1	**2,594**
Sub-Saharan Africa	571	19	40	19	15	17	1	0	3	41	**726**
Total	**228,211**	**24,300**	**38,505**	**25,180**	**1,459**	**3,017**	**186**	**45**	**1,402**	**220**	**322,525**

Notes: The columns describe the region in which the subsidiary is located, while the rows describe the region of the group headquarters.

Table 2 reports the basic statistics for the profit measure and the apportionment factors used. Overall we have the necessary information for about 200,000 distinct companies in more than 26,000 groups. Only for payroll does the number of companies covered fall significantly, to 147,054 companies.[16]

Table 2 Descriptive statistics profit and loss and apportionment factors

	Observations	Mean	Standard deviation	Minimum	Maximum	Distinct companies	Distinct groups
Profit/loss before taxes	1,363,640	9.84	716.00	-76800.00	763,000.00	211,448	26,801
Turnover	1,241,751	118.00	1240.00	0.00	352,000.00	198,288	26,341
Tangible assets	1,272,769	26.10	575.00	0.00	453,000.00	199,844	26,397
Total assets	1,359,831	513.00	11200.00	0.00	2,480,000.00	211,360	26,795
Payroll	911,999	11.80	87.80	0.00	17,100.00	147,054	23,824
No. of employees	1,021,917	244.15	2321.996	0.00	961,000.00	182,481	25,393
Taxation	1,241,044	1.69	63.8	-5310	42,700.00	201,583	26,460

Notes: All values except number of employees and the number of companies and groups are in million USD. All observations with negative values for the apportionment factors are dropped.

The use of this dataset has at least two relevant dimensions, along which a selection bias can occur. The first occurs when specific types of companies (e.g. companies in low-tax countries, or very large or very profitable ones) are either not included in the database at all, or have missing or false ownership information. The second occurs when specific companies do not report the variables necessary for our analysis. While it is difficult to judge whether the overall coverage is good and whether ownership information is reliable, we can at least investigate the relative coverage across countries to see whether there is a strong selection in terms of coverage. While for most factors the number of companies dropping out from the initial sample is evenly distributed across countries, there appears to be a relevant bias for the employment and payroll factor. For the latter this becomes very evident with a few countries dropping out completely because of insufficient payroll numbers being reported.

Particular issues arise with using *Orbis* to look across countries at different income levels (rather than, for example, comparing within the EU only). One is that the requirements of financial accounting may be more variable. Another is that many developing countries use tax holidays or special rates to a greater extent than industrialised countries, and so it is not always clear to what extent lower tax revenue may be due to a small tax base or to a low (preferential) rate being applied. Since there is no plausible way to infer from financial accounts the applied tax rate, we first circumvent this problem by only analysing how the corporate tax base would be affected. In a second step we use the reported tax payments as the starting point for the tax base, at the potential cost of significant measurement errors.

3.2 Empirical approach

To simulate the tax base effect of a move to unitary taxation with formula apportionment we need information about the tax base under separate accounting ($\Pi_{j,t}^{SA}$), the tax base under unitary taxation ($\Pi_{j,t}^{UT}$) and the apportionment factors (θ_{ijX}). The simplest way to measure the tax base is to use profit and loss before tax (*PLBT*) as reported in the accounts. In order to account for the possibility of domestic loss consolidation and loss carry forwards, we aggregate *PLBT* at the country-firm level and carry the losses forward to be set off against future profits as in equation (7). Similarly we aggregate *PLBT* at the firm level and carry

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[16] In order to minimise further attrition of the database we linearly interpolate missing values before we calculate the hypothetical loss carry forward. We also set the initial stock of losses brought into the first period as zero.

remaining losses forward as in equation (8). The main alternative tax base measure is derived from reported tax payments in the accounts. In line with the approach in Devereux and Loretz (2008), we define the tax base as the positive tax payments divided through the statutory corporate tax rate. In the case of a non-positive tax payment, we use the lower value of earnings before interest and taxation (*EBIT*) and the ratio between the tax payment and the statutory tax rate.

For the apportionment factors we use total assets (*ASSETS*) and tangible assets *(TANG)* as a measure for capital invested, turnover (*TURN*) as a proxy for sales by origin, the number of employees (*EMP*) and the cost of employees (*PAY*) as employment factors.[17] For the two-part approach by Avi-Yonah et al (2009), we define operating expenses as the difference between *TURN* and *EBIT*. After assuming a one (five) per cent ordinary return, we apportion the excess profits according to *ASSETS.*

The lack of coverage for lower-income countries, the absence of any information about sales by destination, and comparison with the results of Shackelford and Slemrod (1998) and Clausing and Lahav (2009), are the main motives for also using consolidated data. The International Financial Reporting Standards require large companies to provide segmental reporting along business lines and geographical markets. Unfortunately the geographic reporting is not standardised, so it is not feasible to use the full geographic breakdown. Nevertheless, for 3,667 corporations in 32 different countries we are able to identify the proportion of profits, sales and assets in the domestic segment. Then we compare the profits reported in the home country to the profits which would be allocated to the home country if sales or assets had been used as an apportionment factor.

4 Empirical results

4.1 Tax base effects

This section presents some of the basic results. For reasons of space we only present the country-by-country results for the largest sample with formula apportionment according to total assets. For all other apportionment factors the detailed results can be found in the Appendix Tables, having the same structure. To give an indication of the representativeness of the results, the first column presents the average number of firms the results are based on. The next column presents the simple sum of profit and loss before taxes in the country, reported in million USD. This is the sum over all firms located in this country and over the years 2003 through to 2011. The third column presents the percentage change if we adjust the sum of the profit and loss measure for domestic group relief and loss carry forward. Specifically, we aggregate profits and losses within the same country, and we carry remaining losses forward and set them off against profits in the next periods. The last two columns present the core results of this paper, namely the impact on the corporate tax base through a move to unitary taxation and apportionment. To separate partly the effects of loss consolidation and apportionment, we compare the allocated tax base under unitary taxation first to the simple sum of profit and losses in [2], and then to the tax base measure which is already adjusted for loss carry forward and group relief within the same country in [3].

Table 3 reports the baseline results for total assets as apportionment factor. The rather large and positive changes in column [3] show that losses played a significant role in the period investigated. Compared to simply aggregating profit and losses before taxation in column [2],

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[17]   All the proposals and existing systems have sales by destination rather than sales by origin as an apportionment factor. Since we are not able to obtain sales by destination and also cannot distinguish between inter-company and customer sales, we have to rely on turnover as a proxy for the sales factor.

the modelling of group relief and loss carry forward increases the measure of the corporate tax base significantly. The simple sum of profit and losses in column [2] would imply an immediate recognition of tax losses, which is clearly not realistic. Therefore we think that column [3] is a more realistic benchmark. Nevertheless the comparison between the two measures gives an indication of the extent to which the treatment of losses matters. China and Greece are clearly outliers because some of the largest losses in our dataset are reported in a Chinese subsidiary and a Greek bank, but overall the loss consolidation or carry forward makes up a significant share.[18] Even for countries where the coverage is broad and therefore a few large loss-making companies should matter less, the modelling of loss carry forward increases the tax base measure by 20 per cent (France) to 30 per cent (United Kingdom).

Concerning the change from separate accounting to unitary taxation with apportionment according to total assets, the results in column [5] surprisingly show that primarily Belgium will gain corporate tax base on a large scale, while most other countries lose compared to the scenario in column [3]. This again highlights that in the period observed losses are playing an important role. While the positive results in column [3] indicate that there are a lot of losses which can not be offset within the own country and therefore are only carried forward, the primarily negative result in column [5] tells a story that group-wide consolidation under unitary taxation would allow firms to use at least a part of the losses currently trapped in individual countries. Thus the effect of international loss consolidation will on average shrink significantly - by 13.4 per cent - the overall tax base available to distribute. Multinational groups would experience a corresponding reduction in the disincentive to make risky investments in new countries that results from current arrangements.

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[18]   Iceland is an even larger outlier, with the overall sum of the tax base measure being negative.

Table 3 Baseline results for total assets as apportionment factor

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Argentina	15	679.31	36.6%	164.1%	93.3%
Australia	233	248,254.49	7.5%	7.5%	0.0%
Austria	2,376	136,956.72	22.1%	-1.4%	-19.2%
Belgium	6,178	305,520.39	33.3%	78.5%	33.9%
Bosnia Herzegovina	217	964.58	73.2%	78.7%	3.2%
Brazil	228	84,875.08	6.1%	-28.6%	-32.7%
Bulgaria	559	12,552.12	23.8%	-0.5%	-19.6%
Chile	20	38,317.72	0.5%	-72.3%	-72.4%
China	754	22,501.51	305.4%	254.9%	-12.5%
Colombia	299	30,024.14	5.5%	-14.2%	-18.7%
Croatia	870	13,146.01	32.7%	-12.8%	-34.3%
Cyprus	10	3,175.48	2.1%	-35.0%	-36.3%
Czech Republic	3,842	96,163.61	10.9%	-30.6%	-37.5%
Denmark	2,411	137,370.11	27.6%	13.9%	-10.8%
Estonia	1,074	11,977.64	14.0%	-29.9%	-38.5%
Finland	3,059	106,247.17	21.3%	-4.2%	-21.0%
France	23,109	1,390,729.50	20.6%	6.8%	-11.4%
Germany	11,153	772,192.12	30.6%	17.8%	-9.8%
Greece	899	1,044.08	4,302.7%	3,319.5%	-22.3%
Hungary	769	89,504.92	10.1%	-59.5%	-63.2%
Iceland	114	-7,195.50	-163.5%	-145.0%	-29.1%
India	336	22,738.74	32.3%	-23.4%	-42.1%
Indonesia	12	0.00	0.0%	*1,283.33*	*1,283.33*
Ireland	2,080	81,212.61	134.3%	123.8%	-4.5%
Italy	11,682	387,360.13	50.2%	42.4%	-5.2%
Japan	4,642	522,716.17	4.9%	-2.8%	-7.3%
Kazakhstan	69	3,050.68	44.0%	-72.3%	-80.7%
Latvia	398	1,569.92	210.6%	111.5%	-31.9%
Lithuania	382	8,087.82	28.8%	10.4%	-14.2%
Luxembourg	929	123,380.03	93.2%	99.5%	3.2%
Macedonia	13	368.28	16.1%	-41.1%	-49.2%
Malta	135	18,844.27	19.1%	-24.8%	-36.9%
Mexico	193	35,743.75	21.7%	-49.1%	-58.2%
Montenegro	12	231.01	79.3%	32.2%	-26.2%
Netherlands	4,157	673,708.62	25.7%	13.9%	-9.4%
New Zealand	99	3,544.38	8.9%	-23.0%	-29.3%
Norway	6,061	435,510.78	11.6%	-11.1%	-20.3%
Peru	49	18,011.34	0.6%	-38.2%	-38.5%
Philippines	165	10,799.52	7.0%	-19.8%	-25.0%
Poland	4,490	157,218.02	15.0%	-23.5%	-33.5%
Portugal	2,356	108,700.20	18.1%	-4.5%	-19.2%
Romania	2,476	27,036.24	54.2%	15.6%	-25.0%
Russia	2,964	349,608.91	6.8%	-14.8%	-20.2%
Serbia	897	2,685.57	249.7%	166.9%	-23.7%
Singapore	400	168,812.62	3.3%	-22.2%	-24.6%
Slovak Republic	891	26,241.98	24.0%	0.5%	-18.9%
Slovenia	214	5,228.90	46.1%	57.0%	7.5%
South Korea	1,058	455,117.80	8.6%	-2.2%	-9.9%
Spain	11,038	562,483.36	31.9%	5.6%	-19.9%
Sweden	4,846	381,676.92	28.6%	2.8%	-20.1%
Switzerland	129	61,223.95	10.9%	4.2%	-6.0%
Taiwan	155	110,691.72	15.6%	12.1%	-3.0%
Turkey	87	37,827.49	3.7%	-29.2%	-31.7%
Ukraine	874	30,103.59	22.0%	-20.0%	-34.4%
United Kingdom	29,166	3,778,569.50	51.2%	28.3%	-15.2%
United States	668	220,764.94	7.4%	-6.8%	-13.2%
Total	**152,313**	**12,325,871.00**	**32.5%**	**14.7%**	**-13.4%**

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD. In the case of Indonesia, the total amount allocated to the country is reported in the Table.

Put differently, countries with a decrease of less than 13.4 per cent will be relative winners. For the results in Table 3, the list of relative winners includes mostly the high tax countries like Italy, Japan and the United States, indicating that these countries are suffering from profit shifting under the current system of separate accounting. Like the surprise winner Belgium, there are some further results that are worth mentioning. Luxembourg and Ireland are relative winners compared to their European peers, as is Singapore compared to the major economies of Brazil and Mexico. This is most likely due to the fact that 'total assets' includes intangible assets, and most importantly financial assets. Since these two types of assets are used to a non-negligible extent to move profits to more favourable tax jurisdictions, this also explains that the redistribution of the corporate tax base is less pronounced than for the other apportionment factors.

On a different note, if the apportionment factor results in redistribution into countries with significantly higher tax rates, this could also result in higher overall tax revenue. However, due to restrictions on the availability of reliable tax rate information, we have not yet investigated the tax revenue consequences. In the next subsection we will use a different tax base measure to investigate revenue impacts inclusive of the impact of reallocation to higher tax countries.

One immediate concern is the role played by losses during the recent financial crisis. The results in Table 3 refer to a period of nine years. To investigate whether single crisis years are driving the results, Figure 1 shows a box plot over the country-years. Each box plot shows the interquartile range of the ratio of the tax base allocated under unitary taxation and the tax base allocated under separate accounting, corresponding to the results in column [5]. The line inside the box marks the median result and the whiskers are at 1.5 times the interquartile range. Yearly values outside this range are displayed as dots. For some countries some yearly results are very high and the graph would be difficult to present. Since these graphs are for illustrative purposes only, we have set values above 100 per cent to 100 per cent. In the case of apportionment by total assets this is only relevant for some observations in Argentina and Montenegro. The red line represents the overall average, so all results above the red line present a country being a relative winner under unitary taxation.

Figure 1 confirms the claim that for most countries the overall result is not driven by extreme results during the crisis years. As mentioned above, the two most notable countries where single years with extreme losses dominate the results are China and Iceland. This is visible through the fact that there are both positive and negative outliers present.

Figure 1 Tax base allocation over time: apportionment by total assets

Next we discuss the results for the different apportionment factors. In order to use as much of the information as possible, we first simulate the tax revenue effect for each of the apportionment factors separately. The detailed results of these simulations can be found in Appendix Tables A1-A6.

In the case of **tangible assets** as apportionment factor, the coverage is only slightly reduced and the overall reduction in the tax base of 13.4 per cent remains unchanged. However, the distributional effects are markedly different from the scenario in Table 3. Belgium is no longer the only relevant gaining country, but rather is in line with most established European economies losing tax base to Eastern European countries like Bulgaria, Bosnia Herzegovina, Czech Republic, Estonia, Latvia, Lithuania and Poland. In fact the only notable exception in Eastern Europe is Hungary, which loses significantly. A result worth mentioning is that Switzerland is among the winners, albeit with a very small number of companies backing up this result. The case of the large reported losses in China is now even more evident, since the simple sum of the profit and losses is negative. These large losses are offset to a large extent against taxable profits in the US, resulting in a substantial loss of tax base to the United States.

Using **turnover** as apportionment factor the sample size is slightly further reduced but the overall picture regarding the losses and the overall reduction of the tax base is broadly the same, with an overall reduction of 10.6 per cent due to international loss consolidation. Interestingly the picture from the result with total assets is restored, with high tax countries like the United States, Japan and Italy gaining tax base. At the same time the result that some of the established European countries lose to Eastern European countries is less pronounced. Countries that are commonly associated with a favourable tax system, like Luxembourg, Ireland, the Netherlands, Belgium and Switzerland, are now all seen to lose tax base. The Swiss case should again be treated with caution due to the small number of observations.

The results for the **number of employees** as apportionment factor are based on a roughly 10 per cent smaller sample with approximately 117,000 individual firms. Nevertheless, the international loss consolidation still implies an overall reduction to the tax base of about 12 per cent, in line with previous results. Appendix Table A3 shows that basing the apportionment on the number of employees has vast redistributive consequences. By and large all the emerging economies gain a significant proportion of tax base, while some of the large established economies, such as Germany, France and the United States, lose significantly. Again, those jurisdictions with favourable tax treatment, like the Netherlands, Singapore, Ireland, Belgium, and Switzerland, are among the countries losing the largest share of their tax base.

The results for apportionment according to the **cost of employees** suffer from the problem that payroll data is not available for some countries like the United States, Mexico, China, Singapore, Russia and Australia, and hence the sample is reduced to about 100,000 firms on average. The reduction is even more pronounced in the sum of profit and losses, which now make up only half of the sum of the baseline case in Table 3 (where total assets is used as the apportionment factor). For this reason, direct comparisons to the previous results need to be treated cautiously. The next subsection shows the results of re-running the analysis with a subsample for which all the apportionment factors are reported, to allow a direct comparison. Nevertheless, the main change here, compared to previous results, is that less of the Eastern European countries turn out to be winning (unsurprisingly, since these countries typically have lower wages). This is in particular true for countries like Romania or Bulgaria. Among the few countries winning with cost of employees as apportionment factor is Italy.

For the **two-part apportionment** mechanism proposed by Avi-Yonah et al (2009), a fixed rate of return is first applied to the operating expenses in each country. In the second step the residual profit is allocated among countries using an apportionment factor. Note that the results here are a strong simplification from the original proposal, which is designed to be applied on a case-by-case basis. Due to data limitations it is not possible to identify the separate business lines as would be required for such an application, and therefore these results should only be seen as a first approximation to the proposal of Avi-Yonah et al. (2009). Significant further work would be necessary to provide a direct application. For our simulation we first use a **1 per cent return on expenses,** and then allocate the residual profit according to the country shares of total assets. The overall change in the tax base is in line with the other apportionment factors (a reduction of 11.4 per cent). The United States, Japan and Italy are among the winners. More surprising is that most of the Eastern European countries lose significantly. This is slightly reversed once a **5 per cent return on expenses** is assumed. In this case the overall reduction of the tax base is somewhat smaller, with only 10.5 per cent reduction.

Next, to compare directly the different apportionment factors we restrict our sample to those firms where we have the necessary information for all apportionment factors. This reduces the number of firms to a sample of 85,986 firms on average. The overall impact of loss-making companies is comparable to the individual results above, with a reduction of 11.7 per cent of the overall tax base.

The most striking feature in Table 4 is that the differences between the various apportionment factors are very pronounced. Even for countries with relatively good coverage like Germany, Italy, France and the United Kingdom, the results differ significantly depending on the factor used to apportion the tax base. Further it is striking that total assets affects the relative distribution of the tax base the least, most likely due to the above-mentioned fact that total assets include financial and intangible assets which are partly used to relocate profits under the current system.

Table 4 Baseline results for different apportionment factors

Country	No. firms	Sum profit and loss before taxes	% change under unitary taxation, apportioned by						
			Total assets	Tangible assets	Turnover	No. employees	Payroll	Avi-Yonah 1% return	Avi-Yonah 5% return
Austria	1,040	71,153.69	-21.3%	-31.4%	-21.7%	-34.4%	-19.7%	-20.7%	-17.6%
Belgium	4,296	293,037.10	29.7%	-48.6%	-24.8%	-46.5%	-30.1%	24.7%	6.0%
Bosnia Herzegovina	185	442.32	-7.2%	165.9%	17.1%	195.8%	24.0%	-5.7%	1.6%
Bulgaria	491	7,866.76	-19.3%	23.3%	-15.2%	67.4%	-31.7%	-18.8%	-16.1%
Croatia	784	6,741.58	-20.3%	4.8%	-13.1%	10.9%	-17.1%	-20.2%	-19.1%
Czech Republic	3,145	67,705.02	-25.5%	28.4%	-6.5%	31.4%	-26.4%	-24.1%	-18.6%
Denmark	1,365	65,639.08	-19.2%	-27.9%	-23.0%	-24.4%	-18.4%	-19.6%	-21.0%
Estonia	698	6,248.35	-22.1%	7.1%	-13.6%	73.2%	-23.6%	-21.8%	-19.5%
Finland	2,337	63,196.36	-25.6%	-24.5%	-14.9%	-15.6%	-15.4%	-25.1%	-22.7%
France	16,707	752,573.14	-17.5%	-17.3%	-11.8%	-24.8%	-6.8%	-16.8%	-13.8%
Germany	4,480	562,141.18	-24.1%	-30.5%	-14.5%	-23.5%	-12.4%	-23.1%	-18.7%
Hungary	403	16,094.57	-15.7%	26.5%	-6.2%	62.4%	-22.2%	-15.6%	-13.9%
Ireland	702	37,917.33	-12.2%	-17.9%	-18.4%	-44.6%	-48.2%	-13.4%	-16.8%
Italy	8,716	257,083.65	-4.1%	11.2%	11.4%	8.3%	6.3%	-2.9%	2.0%
Japan	1,535	142,926.62	-2.9%	1.9%	-2.0%	-1.2%	-10.8%	-3.9%	-3.7%
Latvia	27	-369.76	51.3%	91.5%	10.1%	116.5%	-4.4%	47.2%	35.4%
Luxembourg	154	47,508.76	-8.4%	-76.5%	-43.4%	-81.2%	-77.2%	-11.8%	-15.5%
Netherlands	775	91,369.11	-26.5%	-44.5%	-32.4%	-62.7%	-61.2%	-26.1%	-23.5%
Norway	3,147	154,679.47	-22.0%	-10.9%	-21.8%	-26.6%	-20.3%	-22.1%	-22.5%
Poland	2,504	67,735.79	-30.7%	33.3%	-5.3%	67.4%	-31.6%	-28.7%	-20.4%
Portugal	1,636	73,624.67	-13.3%	-5.6%	-11.0%	-5.0%	-11.9%	-13.4%	-13.7%
Romania	2,096	23,749.13	-30.5%	49.6%	-7.1%	160.0%	-13.3%	-29.8%	-26.1%
Serbia	839	1,217.25	-17.8%	75.6%	-12.7%	91.0%	5.7%	-18.4%	-19.2%
Slovak Republic	800	23,213.89	-10.3%	32.8%	1.2%	39.4%	-8.9%	-9.9%	-7.6%
Slovenia	192	2,808.68	-16.2%	0.9%	-12.5%	-1.0%	-12.7%	-16.1%	-15.6%
South Korea	793	90,274.47	-18.3%	-1.4%	-13.2%	-6.5%	-25.7%	-18.5%	-18.6%
Spain	9,692	447,315.23	-12.1%	-7.6%	-15.5%	-12.1%	-13.3%	-12.4%	-13.3%
Sweden	2,514	108,766.46	-10.9%	-19.3%	-24.6%	-29.4%	-21.4%	-11.9%	-15.7%
Switzerland	20	1,423.89	6.3%	15.6%	-18.7%	-3.3%	-1.2%	-2.3%	-20.8%
Taiwan	144	106,711.90	-1.5%	-1.6%	-2.0%	-2.1%	-2.9%	-1.6%	-1.9%
Ukraine	807	29,419.52	-39.8%	-1.3%	-19.2%	89.2%	-27.2%	-38.9%	-34.6%
United Kingdom	12,961	966,003.66	-6.2%	-0.5%	-7.0%	0.1%	0.8%	-6.0%	-5.1%
Total	**85,986**	**4,595,884.80**	**-11.7%**	**-11.8%**	**-11.7%**	**-11.8%**	**-11.8%**	**-11.7%**	**-11.1%**

Notes: No. firms refers to the average (over the period 2003 to 2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD.

The choice of apportionment factors matters most to the lowest-income countries in the sample, those of Eastern Europe. Using tangible assets allocates more of the tax base to lower-income countries, and most countries of the region are major winners if number of employees is used. This result is largely reversed if the cost of employees is used as allocation factor.

Figure 2 illustrates the results from Table 4 following the same logic as Figure 1. Regardless of the apportionment factors chosen, countries like Luxembourg, Ireland and the Netherlands will see a significant share of their tax base allocated away from them – reflecting the disproportionally large share of the tax base these jurisdictions have been able to attract under the current system of separate accounting.[19]
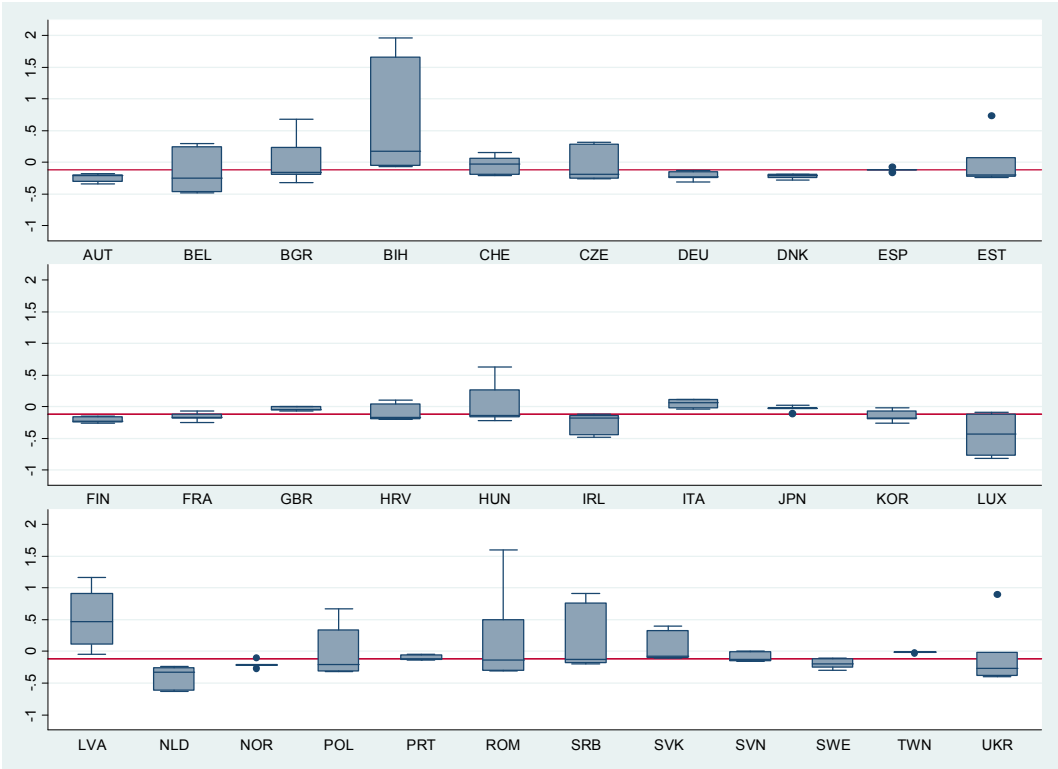
Figure 2 Tax base apportionment: variation across factors

Figure 3 shows the variation across countries for the different apportionment factors. Overall it is clear that the redistributive effects of apportionment are far greater for the relatively immobile factors – in particular, number of employees (including when compared to payroll), and tangible assets (including when compared to total assets).
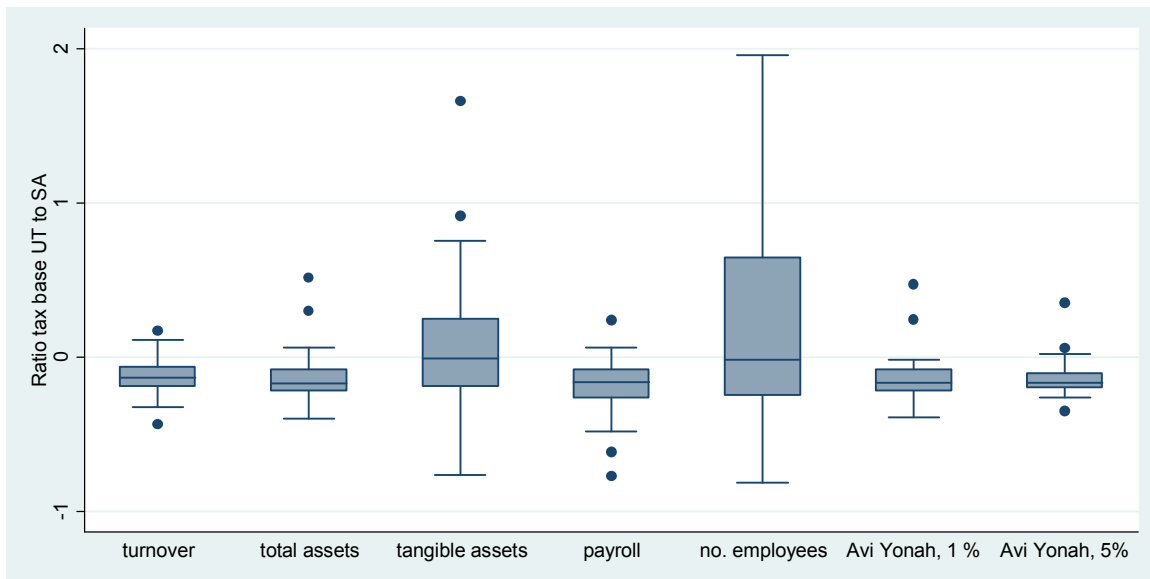
Figure 3 Tax base apportionment: variation across countries

4.2 Tax revenue effects

The analysis so far has concentrated on the distributional effects of unitary taxation on the corporate tax *base*. The question in the background that is really of interest is the difference in the extent to which countries would be able to raise tax revenue under the alternative system of unitary taxation. To get closer to the answer to this question we repeat the simulation exercise from above with a different tax base measure, based on the tax liabilities reported in the accounts. Then we compare the tax liabilities resulting from the allocated tax base to the sum of the tax liabilities reported under the current system. This approach is in line with the methodology of Devereux and Loretz (2008). Comparing the results to the previous results, one needs to bear in mind some caveats. First the tax base measure is now hinging on the assumption that the top statutory tax rate has been applied to all the taxable profits. Secondly we are now comparing our simulation results to the simple sum of reported tax liabilities - including negative tax liabilities - which implies that we treat negative tax liabilities as paid-out tax rebates. Third, in contrast to the results above, we are not trying to separate out the effects from international loss consolidation and loss carry forwards.[20]

Table 5 reports the results for our simulation of tax revenue distribution using the subsample of firms for which all the necessary data about tax liabilities and apportionment factors is available. Overall we find a slightly positive effect on tax revenue for all apportionment factors with the exception of number of employees. This is due to the fact that apportioning according to number of employees allocates a larger share of the tax base to lower-income and lower-tax countries in Eastern Europe.

Overall the results for tax liabilities largely confirm the findings from above. Countries with a favourable tax system like Ireland and the Netherlands lose tax revenue regardless of the apportionment factor/s chosen, while high-income and higher-tax countries like the United Kingdom and Spain win under all scenarios. For Bosnia Herzegovina and Serbia we get rather extreme positive results. This is most likely reflecting the fact that deriving a tax base measure based on tax liabilities divided by the statutory tax rate is subject to substantial measurement error in young nation states with generous tax holidays.

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[20]   Doing so would put even more emphasis on our tax burden measure which hinges on the crucial assumption that all tax base is subject to the statutory tax rate. We have done this analysis and results show approximately a 7 per cent decrease in the benchmark tax base, changing the result to a larger positive effect overall.

The other conclusion that can reliably be drawn is that the different apportionment factors result in very different distribution of tax liabilities. In line with our baseline results, apportionment by number of employees strongly favours lower-income countries, while apportionment by cost of employees allocates the tax base to the richer economies.

Our results are also broadly in line with the recent analysis of IMF (2014), which uses data on US-headquartered multinational groups to show a strong positive effect for emerging economies and developing countries (e.g. China, India and South Africa) when using employment as the apportionment factor. The IMF study also finds a group of consistent losers (regardless of apportionment factor), namely the conduit jurisdictions of Bermuda, Ireland, Luxembourg, Netherlands, Singapore and Switzerland. Once these are taken out of the analysis, advanced economies taken together see tax base increases of a quarter to a half, depending on the apportionment factor.

Table 5 Results for tax reported, balanced subsample for different apportionment factors

Country	No. firms	Sum reported tax liabilities	% change under unitary taxation, apportioned by						
			Total assets	Tangible assets	Turnover	No. employees	Payroll	Avi-Yonah 1% return	Avi-Yonah 5% return
Austria	936	17,435.76	-16.7%	-24.4%	-13.2%	-33.6%	-10.5%	-16.1%	-12.6%
Belgium	3,714	35,907.10	145.9%	2.1%	51.6%	0.7%	28.7%	132.3%	90.8%
Bosnia Herzegovina	185	39.41	74.5%	287.5%	94.9%	329.0%	92.0%	75.8%	92.7%
Bulgaria	491	1,093.64	-5.1%	25.7%	-7.6%	65.9%	-28.4%	-6.0%	-7.2%
Croatia	784	1,607.59	-7.4%	19.0%	-0.9%	23.1%	-8.7%	-7.7%	-6.2%
Czech Republic	3,145	13,468.11	-23.5%	23.6%	-7.2%	24.9%	-29.7%	-21.6%	-12.8%
Denmark	1,365	21,051.29	-16.2%	-28.2%	-12.1%	-20.1%	-14.1%	-16.6%	-17.5%
Estonia	533	516.35	-1.5%	14.5%	-6.9%	85.6%	-19.5%	-0.7%	7.3%
Finland	2,122	11,499.48	-13.8%	-13.3%	-6.5%	-7.8%	-7.3%	-13.0%	-7.7%
France	16,706	160,761.14	4.4%	4.5%	12.5%	-2.5%	20.8%	5.9%	12.4%
Germany	4,249	141,524.73	-14.8%	-20.9%	1.5%	-14.6%	-1.1%	-13.1%	-4.4%
Hungary	340	2,045.87	-9.7%	61.4%	15.2%	89.7%	-7.7%	-9.7%	0.2%
Ireland	730	5,277.63	-20.3%	-33.2%	-25.1%	-55.2%	-57.9%	-20.8%	-21.1%
Italy	8,716	138,309.47	-12.2%	-7.3%	-4.6%	-0.1%	-2.1%	-11.1%	-6.1%
Japan	1,535	49,283.03	1.8%	5.6%	0.4%	4.8%	-7.0%	0.3%	2.2%
Latvia	27	40.70	28.0%	46.3%	-10.5%	42.5%	-22.2%	25.0%	16.1%
Luxembourg	142	4,398.86	101.9%	-62.8%	-6.9%	-68.0%	-63.6%	87.0%	63.0%
Netherlands	751	26,917.74	-23.5%	-24.4%	-20.8%	-60.7%	-59.7%	-23.2%	-18.3%
Norway	3,147	55,837.13	-27.1%	-18.1%	-34.4%	-46.8%	-39.4%	-27.2%	-27.6%
Poland	2,311	12,919.87	-33.5%	12.3%	-14.1%	75.3%	-33.7%	-31.0%	-20.3%
Portugal	1,594	13,442.49	-17.2%	-8.1%	-13.5%	-6.2%	-13.5%	-17.4%	-17.1%
Romania	2,096	6,718.75	-29.2%	27.3%	-26.3%	110.4%	-14.8%	-28.7%	-25.5%
Serbia	839	227.88	144.5%	365.5%	113.2%	406.3%	166.4%	140.0%	132.0%
Slovak Republic	800	4,799.56	-14.4%	21.4%	-8.1%	26.9%	-16.8%	-14.0%	-11.1%
Slovenia	158	650.42	-6.9%	15.9%	-3.5%	10.3%	-3.7%	-6.6%	-4.4%
South Korea	701	22,996.31	-14.8%	-2.6%	-12.8%	-6.6%	-21.9%	-14.9%	-13.9%
Spain	9,083	99,009.29	18.6%	23.3%	14.6%	17.9%	16.9%	18.1%	17.3%
Sweden	2,514	19,533.51	6.3%	-2.7%	-6.2%	-11.0%	-2.6%	4.2%	-1.3%
Switzerland	18	213.86	5.6%	29.6%	-34.8%	19.8%	16.6%	-6.8%	-35.7%
Taiwan	144	12,900.70	6.7%	6.6%	6.1%	6.0%	5.0%	6.5%	5.7%
Ukraine	807	10,098.12	-40.5%	-22.8%	-31.8%	21.3%	-35.2%	-39.9%	-36.4%
United Kingdom	11,662	216,528.84	11.6%	17.2%	7.5%	17.1%	19.9%	11.9%	13.7%
Total	**82,345**	**1,107,054.60**	**2.0%**	**0.5%**	**1.8%**	**-0.2%**	**2.3%**	**2.0%**	**4.1%**

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum reported tax liabilities refers to the simple sum of the tax liabilities in the accounts and is reported in million USD.

27

4.3 Results using segmental reporting

Table 6 reports the results for our analysis of segmental reporting in the consolidated reports. In the spirit of Shakelford and Slemrod (1998), we only look at the profit share of the home country. Specifically we calculate how much of the profits would be allocated to the home country if the share of the profit in the home country is in line with the share of assets or sales in the home country.

Table 6 Results for profit allocation using segmental reporting

Country	No. firms	Observations	Sum of profits	% of profit allocated through	
				Sales factor	Assets factor
Australia	535	1,682	90,382.26	90.3%	89.4%
Austria	23	82	6,495.57	111.4%	99.9%
Belgium	16	60	5,100.46	110.8%	94.4%
Canada	224	847	83,509.59	84.5%	89.1%
China	14	30	5,578.79	98.9%	98.9%
Finland	17	74	2,891.00	91.5%	84.1%
France	123	389	140,939.60	105.6%	108.6%
Germany	91	285	86,096.82	64.6%	81.1%
Greece	34	108	11,485.55	97.5%	99.0%
Hongkong	55	202	51,369.61	73.7%	79.7%
India	54	134	9,386.00	97.8%	96.5%
Indonesia	42	141	16,962.06	100.0%	99.8%
Ireland	19	63	2,501.98	97.9%	58.5%
Israel	91	354	13,216.50	63.9%	88.7%
Japan	1,038	6,787	1,030,347.00	93.6%	97.6%
Kenya	11	53	1,255.62	88.2%	90.0%
Kuwait	41	124	7,212.39	58.9%	54.5%
Malaysia	209	697	20,335.22	83.2%	74.9%
Netherlands	22	104	16,155.52	87.3%	68.5%
New Zealand	46	236	8,940.33	78.2%	75.7%
Norway	21	64	4,283.28	84.0%	87.3%
Oman	10	27	281.22	101.1%	113.2%
Philipines	13	49	3,025.44	90.5%	83.3%
Singapore	89	411	18,379.39	71.9%	69.0%
South Africa	76	256	51,065.13	86.6%	74.7%
Sri Lanka	10	62	654.80	126.5%	101.2%
Sweden	46	143	5,018.42	79.2%	61.6%
Switzerland	16	46	159,352.90	9.1%	91.4%
Taiwan	217	1,106	14,703.73	80.2%	84.9%
Thailand	80	324	20,698.70	91.9%	79.8%
Turkey	13	38	2,224.60	94.1%	101.5%
United Kingdom	371	1,340	159,053.70	105.7%	100.8%
Total	3,667	16,318	2,048,903.18	85.8%	94.5%

Notes: Sum of profits refers to sum of profits in the home country and is in million USD.

Our result implies that the share of profits at home are on average 15 per cent higher than the share of sales at home, and about 5 per cent higher than assets. This is in stark contrast to the results of Shackelford and Slemrod (1998), who find a disproportionately large share of the tax base of US multinationals abroad.

This difference is most likely due to the fact that we use the profit measure from the segmental reports, while Shackelford and Slemrod (1998) infer the taxable income from the footnotes of the tax provisions. It is also possible, however, that particular differences in the US approach (e.g. to worldwide corporate income taxation, and the tax implications of profit repatriation) result in US-headquartered multinationals displaying some important differences in tax behaviour from others. Apart from the unrealistic outlier Switzerland in the case of the sales factor, the usual suspects of Ireland and Singapore are seen to lose a large share of their profits. However, the overall results are mainly driven by Japan, which makes up one-third of the companies and two-thirds of the profits. This highlights once again that the analysis faces quite severe data limitations, while also confirming the importance of using available data to understand more about the differences in tax behaviour of multinational

groups headquartered in different economies (rather than relying, for example, on data for US-headquartered multinationals only).

5 Conclusion

The analysis here shows large variations between the location of real economic activity and the extent of profit declaration, or, equivalently, the difference between potential formulary apportionment mechanisms under a putative unitary taxation system in comparison to the current system of separate accounting.

The choice of apportionment factors is, unsurprisingly, of considerable importance. The different apportionment factors will result in very different redistributive outcomes. While total assets will change the relative allocation the least (with a surprise winner, Belgium), apportioning according to the number of employees will create the biggest redistribution.

Between the apportionment factors based on employment, apportionment according to payroll will harm the lowest-income countries in the sample (in Eastern Europe), while apportionment according to the number of employees will increase the size of their tax base.

By and large a shift to unitary taxation will – regardless of the apportionment factor – shift corporate tax base away from countries with 'favourable' tax regimes, for example, Luxembourg, the Netherlands and Ireland, which will see a smaller tax base under all scenarios.

In general the move towards unitary taxation results in a drop in corporate tax base of about 12 per cent due to international loss consolidation. It remains to be seen to what extent this reflects the global financial crisis falling into the period of analysis. Further work is also needed to investigate the extent to which this reflects a genuine reduction in the tax base, rather than being a feature of the sample period length or other components of the analysis.

The clearest result of this study, however, is that there is insufficient data to perform a full analysis of the revenue implications of a shift to unitary taxation – or, equivalently, of the scale of misalignment between corporate profits and the distribution of actual business activity. This is most glaringly true with respect to developing countries, which despite the global nature of the *Orbis* dataset are effectively excluded once the sample is required to include the standard set of possible apportionment factors.[21] Further analysis with the current data may yield additional insights into patterns of profit distribution by income level, but such a sample cannot be relied upon to reveal a great deal about the pattern across developing countries of different regions, income levels and economic structure.

Nevertheless, the results at hand suggest that apportionment by number of employees in particular would have a very strong distributive effect – and these are likely, by and large, to have opposing tax base effects for the industrialised and lower-income countries. The possibility of redistribution of the tax base away from jurisdictions in which profit declaration is disproportionate to real economic activity, however, raises the possibility that unitary taxation could deliver benefits for most countries – while posing a significant threat to those that benefit most from the current system.

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[21]   As such, these findings indicate a serious obstacle for the OECD's commitment to evaluate BEPS progress in reducing the misalignment of profits.

Appendix

Table A1 Baseline results for tangible assets as apportionment factor

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Argentina	15	679.31	36.6%	996.3%	702.3%
Australia	221	118,671.47	15.0%	104.8%	78.0%
Austria	2200	114,972.43	22.8%	-10.4%	-27.0%
Belgium	5896	317,305.82	8.7%	6.0%	-2.5%
Bosnia Herzegovina	207	583.15	95.9%	298.7%	103.5%
Brazil	227	82,330.73	6.3%	41.3%	33.0%
Bulgaria	538	8,053.23	35.6%	176.1%	103.6%
Chile	20	38,317.72	0.5%	98.2%	97.2%
China	135	-10,915.30	-574.7%	-615.7%	8.6%
Colombia	291	29,608.19	5.5%	33.6%	26.6%
Croatia	850	6,785.12	60.5%	171.8%	69.3%
Czech Republic	3805	69,590.77	14.7%	148.7%	116.8%
Denmark	2157	101,241.94	35.1%	-7.4%	-31.5%
Estonia	1048	10,316.57	14.9%	136.3%	105.6%
Finland	2911	80,753.03	27.2%	3.9%	-18.4%
France	22862	1,103,884.70	23.3%	11.3%	-9.7%
Germany	10348	696,244.91	28.3%	6.9%	-16.7%
Greece	889	22,877.44	31.0%	27.5%	-2.7%
Hungary	723	78,962.95	9.7%	-29.3%	-35.5%
Iceland	105	-5,325.67	-151.5%	-447.1%	574.5%
India	19	3,744.46	4.7%	-2.8%	-7.1%
Ireland	1691	52,961.56	145.5%	139.0%	-2.6%
Italy	11519	270,947.28	54.7%	1.14	0.39
Japan	4624	385,199.07	4.7%	13.4%	8.3%
Kazakhstan	69	3,050.68	44.0%	-10.6%	-37.9%
Latvia	391	1,693.06	85.3%	173.5%	47.6%
Lithuania	368	7,740.78	15.9%	10.2%	-4.9%
Luxembourg	814	76,226.26	147.8%	-43.1%	-77.0%
Malta	130	17,073.28	20.3%	-59.9%	-66.6%
Mexico	165	5,637.23	131.3%	229.9%	42.7%
Netherlands	3,721	555,174.27	27.8%	-38.1%	-51.6%
New Zealand	99	3,537.64	8.9%	631.0%	571.2%
Norway	6,056	396,552.21	12.8%	8.6%	-3.7%
Peru	49	17,952.67	0.6%	7.8%	7.2%
Philippines	152	9,316.50	7.6%	74.9%	62.6%
Poland	4,342	108,176.58	21.2%	154.7%	110.2%
Portugal	2,334	96,366.79	16.6%	14.8%	-1.5%
Romania	2,455	22,765.96	60.5%	278.4%	135.7%
Russia	2,925	271,472.46	8.3%	17.8%	8.7%
Serbia	880	1,182.40	530.9%	1426.8%	142.0%
Singapore	400	167,128.14	3.3%	-1.2%	-4.3%
Slovak Republic	878	24,606.81	24.5%	102.2%	62.4%
Slovenia	199	2,815.45	50.4%	74.3%	15.9%
South Korea	997	440,381.87	6.7%	9.6%	2.7%
Spain	10,969	474,881.73	35.2%	40.7%	4.0%
Sweden	4,719	290,534.19	33.3%	0.8%	-24.4%
Switzerland	29	1,890.89	3.1%	40.3%	36.1%
Taiwan	155	110,691.72	15.6%	13.7%	-1.6%
Turkey	66	18,162.09	4.1%	-31.9%	-34.5%
Ukraine	863	29,470.53	19.7%	70.5%	42.5%
United Kingdom	22,869	3,086,419.30	57.0%	7.6%	-31.5%
United States	633	78,762.12	11.2%	-61.2%	-65.1%
Total	**141,029**	**9,897,454.40**	**34.9%**	**16.8%**	**-13.4%**

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD.

Table A2 Baseline results for turnover as apportionment factor

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Argentina	15	679.31	36.6%	212.4%	128.6%
Australia	236	244,682.32	7.6%	3.3%	-4.0%
Austria	2,074	139,916.53	23.4%	13.0%	-8.5%
Belgium	5,103	302,184.11	33.5%	25.1%	-6.3%
Bosnia Herzegovina	217	964.58	73.2%	114.7%	24.0%
Brazil	246	84,875.08	6.1%	-9.1%	-14.3%
Bulgaria	551	12,562.62	23.7%	48.7%	20.2%
Chile	20	38,317.72	0.5%	21.3%	20.7%
China	750	22,505.55	305.3%	331.6%	6.5%
Colombia	293	30,030.67	5.5%	5.2%	-0.2%
Croatia	870	13,146.01	32.7%	14.2%	-14.0%
Czech Republic	3,838	95,971.15	10.9%	13.1%	2.0%
Denmark	1,048	107,910.18	20.0%	12.6%	-6.2%
Estonia	1,044	11,827.00	13.1%	8.3%	-4.3%
Finland	2,989	106,727.82	20.1%	11.7%	-7.0%
France	23,112	1388,937.60	20.6%	1.5%	-15.9%
Germany	7,760	755,292.29	29.5%	28.8%	-0.5%
Greece	896	1,052.47	4,267.6%	4,609.7%	7.8%
Hungary	754	89,177.65	9.8%	14.7%	4.4%
Iceland	79	-4,629.17	-192.7%	-163.3%	-31.7%
India	337	23,168.04	31.7%	20.8%	-8.3%
Indonesia	12	0.00	0.0%	*629.22*	*629.22*
Ireland	1,513	111,601.91	36.1%	10.2%	-19.0%
Italy	11,678	387,362.78	50.2%	83.4%	22.1%
Japan	4642	522,716.17	4.9%	7.4%	2.4%
Kazakhstan	69	3,050.68	44.0%	-72.8%	-81.1%
Latvia	469	1,570.68	210.5%	308.9%	31.7%
Lithuania	396	8,092.88	28.7%	30.5%	1.4%
Luxembourg	800	123,284.28	93.2%	-17.6%	-57.3%
Macedonia	14	373.79	15.9%	-0.7%	-14.3%
Malta	135	18,844.27	19.1%	-60.4%	-66.8%
Mexico	211	35,747.76	21.7%	-24.6%	-38.0%
Montenegro	12	231.01	79.3%	77.7%	-0.9%
Netherlands	2,096	479,940.33	15.0%	-36.7%	-45.0%
New Zealand	99	3,544.63	8.9%	91.1%	75.5%
Norway	5,854	433,816.23	11.1%	-12.2%	-21.0%
Peru	23	17,178.90	0.3%	-28.3%	-28.5%
Philippines	164	10,797.01	7.0%	16.1%	8.5%
Poland	4,435	157,230.41	14.8%	27.9%	11.4%
Portugal	2,242	103,834.66	17.6%	8.3%	-8.0%
Romania	2,429	27,055.46	54.0%	95.8%	27.1%
Russia	2,964	349,608.91	6.8%	-4.7%	-10.7%
Serbia	896	2,685.57	249.7%	267.7%	5.2%
Singapore	398	168,851.78	3.3%	33.6%	29.4%
Slovak Republic	890	26,243.08	24.0%	51.0%	21.8%
Slovenia	209	5,220.62	45.6%	44.2%	-0.9%
South Korea	1,041	455,201.92	8.5%	-5.0%	-12.5%
Spain	10,889	563,882.29	31.3%	20.7%	-8.0%
Sweden	4,753	379,287.60	27.2%	-11.3%	-30.3%
Switzerland	132	61,215.76	10.9%	2.4%	-7.6%
Taiwan	155	110,691.72	15.6%	9.0%	-5.6%
Turkey	86	37,827.20	3.7%	-11.0%	-14.2%
Ukraine	858	30,098.81	22.0%	21.5%	-0.4%
United Kingdom	19003	2331675.30	17.1%	0.7%	-14.0%
United States	667	220929.70	7.4%	4.0%	-3.2%
Total	**132,468**	**10,654,994.00**	**21.1%**	**8.3%**	**-10.6%**

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD. In the case of Indonesia, the total amount allocated to the country is reported in the Table.

Table A3 Baseline results for number of employees as apportionment factor

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Australia	180	79,781.14	17.6%	30.5%	11.0%
Austria	1,649	100,914.31	24.3%	-11.3%	-28.6%
Belgium	5,221	299,774.80	20.7%	-24.5%	-37.5%
Bosnia Herzegovina	213	951.35	73.6%	447.6%	215.4%
Brazil	106	24,244.44	7.7%	83.7%	70.6%
Bulgaria	565	11,362.86	25.9%	168.4%	113.2%
China	753	22,021.44	310.2%	688.0%	92.1%
Colombia	39	4,900.26	2.2%	69.6%	65.9%
Croatia	801	12,986.39	31.6%	77.9%	35.2%
Czech Republic	3,232	89,309.41	10.4%	49.6%	35.5%
Denmark	1,876	125,678.66	23.9%	0.8%	-18.7%
Estonia	950	8,945.49	13.5%	93.4%	70.4%
Finland	2,554	102,024.70	19.5%	7.2%	-10.3%
France	22,015	1,222,765.40	22.2%	-15.7%	-31.0%
Germany	6,134	636,147.43	28.9%	9.8%	-14.8%
Greece	761	-645.07	-6,755.2%	-6,372.0%	-5.8%
Hungary	425	26,194.30	24.8%	101.3%	61.3%
Iceland	15	-1,722.93	-235.7%	-130.0%	-77.9%
India	13	4,171.51	10.8%	80.6%	63.0%
Indonesia	12	0.00	0.0%	*2,722,10*	*2,722,10*
Ireland	843	46,255.70	55.0%	-26.0%	-52.3%
Italy	8,870	370,223.24	43.5%	62.8%	13.4%
Japan	4,591	461,728.98	4.4%	0.7%	-3.5%
Kazakhstan	34	1,564.28	12.1%	292.4%	250.0%
Latvia	475	2,186.78	121.5%	529.0%	184.0%
Lithuania	399	8,032.72	28.7%	107.1%	60.9%
Luxembourg	244	87,114.93	4.6%	-65.5%	-67.0%
Macedonia	12	268.46	10.5%	377.2%	331.8%
Malta	33	6,569.62	3.3%	-11.2%	-14.1%
Mexico	105	23,409.30	2.4%	-1.1%	-3.5%
Montenegro	11	207.56	87.1%	248.6%	86.3%
Netherlands	3,144	466,052.55	15.9%	-65.1%	-69.9%
Norway	3,622	258,740.74	9.2%	-37.5%	-42.8%
Peru	13	2,089.58	3.4%	33.3%	28.9%
Philippines	19	2,795.86	3.8%	33.2%	28.4%
Poland	3,464	108,617.96	11.6%	136.0%	111.6%
Portugal	1,689	81,559.07	16.0%	7.4%	-7.4%
Romania	2,408	26,525.57	53.9%	372.9%	207.3%
Russia	2,730	263,472.06	8.2%	24.1%	14.6%
Serbia	893	2,568.20	260.0%	746.1%	135.0%
Singapore	58	15,244.92	6.6%	-45.9%	-49.3%
Slovak Republic	819	24,831.20	24.7%	112.6%	70.5%
Slovenia	206	4,940.46	47.8%	42.1%	-3.9%
South Korea	998	432,469.86	8.9%	1.8%	-6.5%
Spain	9,755	471,178.72	32.0%	21.4%	-8.0%
Sweden	6,668	346,056.55	31.6%	-20.5%	-39.6%
Switzerland	85	30,531.40	15.9%	15.9%	0.0%
Taiwan	145	106,733.12	15.9%	8.8%	-6.1%
Turkey	29	19,134.29	3.4%	-12.7%	-15.6%
Ukraine	854	29,868.91	20.8%	170.8%	124.2%
United Kingdom	16,200	1,273,338.40	29.6%	27.1%	-1.9%
United States	329	135,182.67	4.8%	-19.2%	-22.9%
Total	**117,259**	**7,879,299.60**	**23.5%**	**9.2%**	**-11.6%**

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD.

Table A4 Baseline results for payroll as apportionment factor

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Austria	1,550	105,202.21	23.6%	-0.2%	-19.2%
Belgium	5,330	304,742.55	8.3%	-22.6%	-28.6%
Bosnia Herzegovina	186	442.28	99.1%	163.1%	32.1%
Bulgaria	493	7,876.77	34.7%	-7.5%	-31.3%
Croatia	794	6,736.11	60.1%	30.9%	-18.2%
Czech Republic	3,296	68,575.50	13.8%	-15.1%	-25.4%
Denmark	1,698	86,164.62	24.7%	-2.2%	-21.5%
Estonia	744	7,518.64	9.1%	-12.6%	-19.9%
Finland	2,672	64,141.99	23.9%	6.0%	-14.4%
France	17,015	763,198.33	20.3%	16.4%	-3.3%
Germany	6,678	631,807.26	24.1%	10.1%	-11.3%
Hungary	696	77,996.68	9.2%	-10.7%	-18.2%
Iceland	37	321.36	320.9%	173.0%	-35.2%
India	287	20,935.65	33.1%	-20.0%	-39.9%
Ireland	798	33,629.19	49.0%	-20.2%	-46.4%
Italy	9,972	268,381.46	48.6%	60.5%	8.1%
Japan	1,547	143,429.24	6.1%	-4.4%	-9.9%
Latvia	33	-366.32	-163.9%	-162.3%	-2.4%
Luxembourg	466	72,042.12	88.5%	-62.0%	-79.8%
Malta	12	1,563.73	3.7%	-0.87	-0.88
Netherlands	1,092	103,691.86	24.1%	-47.2%	-57.5%
New Zealand	83	2,883.43	8.5%	23.9%	14.3%
Norway	3,986	209,153.57	15.0%	-4.2%	-16.6%
Poland	3,378	75,266.17	18.6%	-17.7%	-30.6%
Portugal	2,065	83,758.37	15.9%	1.8%	-12.2%
Romania	2,125	23,731.93	52.4%	34.6%	-11.6%
Serbia	839	1,217.36	511.8%	562.5%	8.3%
Slovak Republic	850	23,723.78	25.3%	13.6%	-9.3%
Slovenia	194	2,810.07	49.1%	35.9%	-8.8%
South Korea	847	91,476.30	8.3%	-18.6%	-24.8%
Spain	10,017	448,961.80	31.5%	18.1%	-10.2%
Sweden	3,714	109,706.61	26.5%	2.9%	-18.6%
Switzerland	25	1,760.38	3.3%	2.9%	-0.4%
Taiwan	149	109,360.05	15.6%	11.2%	-3.8%
Ukraine	809	29,418.27	19.6%	-10.5%	-25.2%
United Kingdom	15,318	1,176,679.20	24.0%	19.5%	-3.7%
Total	99,795	5,157,938.50	24.0%	8.9%	-12.2%

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD.

Table A5 Baseline results for two-part apportionment factor according to Avi-Yonah et al (2009) - 1 per cent return in the first stage

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Argentina	15	679.31	36.6%	142.0%	77.1%
Australia	217	115,438.90	16.0%	1.3%	-12.7%
Austria	1,714	120,656.35	24.0%	-8.9%	-26.6%
Belgium	5,046	322,423.56	8.7%	30.3%	19.8%
Bosnia Herzegovina	207	583.15	95.9%	88.4%	-3.8%
Brazil	227	82,330.71	6.3%	-30.5%	-34.6%
Bulgaria	532	8,115.74	35.3%	28.5%	-5.0%
Chile	20	38,317.72	0.5%	-76.7%	-76.8%
China	746	22,266.76	308.6%	250.1%	-14.3%
Colombia	293	30,030.67	5.5%	-16.4%	-20.7%
Croatia	850	6,785.12	60.5%	15.0%	-28.4%
Czech Republic	3,806	69,699.03	14.7%	-17.9%	-28.4%
Denmark	1,027	72,210.97	27.3%	19.7%	-5.9%
Estonia	1,035	10,118.51	14.6%	-26.5%	-35.9%
Finland	2,979	81,690.75	25.9%	-9.3%	-27.9%
France	22,860	1,102,099.90	23.3%	3.2%	-16.3%
Germany	6,438	679,911.50	27.5%	3.6%	-18.7%
Greece	886	22,885.83	31.0%	-16.2%	-36.0%
Hungary	733	79,875.45	9.3%	-63.1%	-66.3%
Iceland	74	-2,723.36	-192.9%	-195.4%	2.7%
India	335	22,444.06	31.7%	-19.8%	-39.1%
Indonesia	12	0.00	0.0%	*898.24*	*898.24*
Ireland	1,448	85,179.63	42.2%	0.38	-0.03
Italy	11,515	270,947.16	54.7%	49.3%	-3.5%
Japan	4,624	385,199.06	4.7%	-0.3%	-4.7%
Kazakhstan	69	3,050.68	44.0%	-76.1%	-83.4%
Latvia	328	1,138.42	120.0%	89.6%	-13.8%
Lithuania	368	7,748.07	15.8%	1.3%	-12.5%
Luxembourg	716	78,445.94	144.4%	122.0%	-9.1%
Malta	130	17,073.28	20.3%	-33.7%	-44.8%
Mexico	190	35,121.27	22.1%	-47.6%	-57.1%
Netherlands	2,061	419,228.47	14.2%	21.2%	6.1%
New Zealand	99	3,544.63	8.9%	-34.0%	-39.4%
Norway	5,839	394,857.69	12.2%	-14.3%	-23.6%
Peru	23	17,105.41	0.3%	-36.5%	-36.7%
Philippines	164	9,949.23	7.6%	-30.4%	-35.3%
Poland	4,387	109,731.63	20.6%	-22.4%	-35.7%
Portugal	2,220	91,685.90	15.9%	-9.0%	-21.5%
Romania	2,408	22,782.67	60.4%	17.7%	-26.6%
Russia	2,925	271,472.47	8.3%	-15.3%	-21.8%
Serbia	880	1,182.40	530.9%	394.6%	-21.6%
Slovak Republic	878	24,606.82	24.5%	4.0%	-16.5%
Slovenia	195	2,807.39	49.3%	26.8%	-15.1%
South Korea	976	440,840.41	6.5%	-5.2%	-11.0%
Spain	10,824	476,193.31	34.5%	3.8%	-22.8%
Sweden	4,599	290,445.63	31.3%	-0.6%	-24.3%
Switzerland	35	1,899.52	3.1%	842.5%	814.5%
Taiwan	155	110,691.72	15.6%	10.5%	-4.3%
Turkey	66	18,162.09	4.1%	-33.6%	-36.1%
Ukraine	848	29,469.10	19.7%	-22.6%	-35.3%
United Kingdom	18,647	2,029,639.40	16.6%	18.0%	1.1%
United States	442	79,045.30	11.1%	13.6%	2.2%
Total	128,110	8,615,085.30	21.6%	7.7%	-11.4%

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD. In the case of Indonesia, the total amount allocated to the country is reported in the Table.

Table A6 Baseline results for two-part apportionment factor according to Avi-Yonah et al (2009) - 5 per cent return in the first stage

	No. firms	Sum profit and loss before taxes	% change through group relief and losses carried forward	% change under unitary taxation	
				Relative to [2]	Relative to tax base measure underlying [3]
	[1]	[2]	[3]	[4]	[5]
Argentina	15	679.31	36.6%	134.0%	71.2%
Australia	217	115,438.90	16.0%	7.4%	-7.4%
Austria	1,714	120,656.35	24.0%	-0.8%	-20.0%
Belgium	5,046	322,423.55	8.7%	24.6%	14.6%
Bosnia Herzegovina	207	583.15	95.9%	113.2%	8.9%
Brazil	227	82,330.71	6.3%	-26.1%	-30.4%
Bulgaria	532	8,115.74	35.3%	51.9%	12.3%
Chile	20	38,317.72	0.5%	-76.2%	-76.3%
China	746	22,266.77	308.6%	277.7%	-7.6%
Colombia	293	30,030.67	5.5%	-10.8%	-15.4%
Croatia	850	6,785.12	60.5%	25.2%	-22.0%
Czech Republic	3,806	69,699.03	14.7%	-1.3%	-13.9%
Denmark	1,027	72,210.97	27.3%	17.0%	-8.1%
Estonia	1,035	10,118.51	14.6%	-18.0%	-28.5%
Finland	2,979	81,690.75	25.9%	-1.3%	-21.6%
France	22,860	1,102,099.90	23.3%	5.7%	-14.2%
Germany	6,438	679,911.52	27.5%	11.3%	-12.7%
Greece	886	22,885.83	31.0%	0.5%	-23.3%
Hungary	733	79,875.46	9.3%	-43.6%	-48.4%
Iceland	74	-2,723.36	-192.9%	-193.2%	0.4%
India	335	22,444.07	31.7%	-8.6%	-30.6%
Indonesia	12	0.00	0.0%	*430.18*	*430.18*
Ireland	1,448	85,179.62	42.2%	0.31	-0.08
Italy	11,515	270,947.15	54.7%	68.7%	9.1%
Japan	4,624	385,199.07	4.7%	7.0%	2.2%
Kazakhstan	69	3,050.68	44.0%	-80.0%	-86.1%
Latvia	328	1,138.42	120.0%	152.7%	14.9%
Lithuania	368	7,748.07	15.8%	5.7%	-8.7%
Luxembourg	716	78,445.94	144.4%	91.8%	-21.5%
Malta	130	17,073.28	20.3%	-44.3%	-53.7%
Mexico	190	35,121.27	22.1%	-34.0%	-45.9%
Netherlands	2,061	419,228.46	14.2%	5.8%	-7.4%
New Zealand	99	3,544.63	8.9%	-11.6%	-18.8%
Norway	5,839	394,857.68	12.2%	-13.9%	-23.3%
Peru	23	17,105.41	0.3%	-35.3%	-35.5%
Philippines	164	9,949.23	7.6%	-8.8%	-15.3%
Poland	4,387	109,731.63	20.6%	-5.3%	-21.4%
Portugal	2,220	91,685.90	15.9%	-5.5%	-18.4%
Romania	2,408	22,782.67	60.4%	35.8%	-15.3%
Russia	2,925	271,472.46	8.3%	-14.3%	-20.8%
Serbia	880	1,182.40	530.9%	439.5%	-14.5%
Slovak Republic	878	24,606.82	24.5%	19.2%	-4.3%
Slovenia	195	2,807.39	49.3%	30.4%	-12.7%
South Korea	976	440,840.41	6.5%	-7.1%	-12.7%
Spain	10,824	476,193.33	34.5%	12.7%	-16.2%
Sweden	4,599	290,445.61	31.3%	-3.1%	-26.2%
Switzerland	35	1,899.52	3.1%	699.0%	675.2%
Taiwan	155	110,691.72	15.6%	10.4%	-4.5%
Turkey	66	18,162.09	4.1%	-24.7%	-27.6%
Ukraine	848	29,469.10	19.7%	-14.0%	-28.2%
United Kingdom	18,647	2,029,639.30	16.6%	13.6%	-2.6%
United States	442	79,045.29	11.1%	12.8%	1.6%
Total	128,110	8,615,085.20	21.6%	8.9%	-10.5%

Notes: No. firms refers to the average (over the period 2003-2011) number of firms these results are based on. All countries with less than 10 firms on average in all apportionment factors are excluded. Sum profit and loss refers to the simple sum of profit and loss before taxes and is reported in million USD. In the case of Indonesia, the total amount allocated to the country is reported in the Table.

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