WP/19/213

IMF Working Paper

An Assessment of Global Formula Apportionment

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INTERNATIONAL MONETARY FUND

 WP/19/213

IMF Working Paper

Fiscal Affairs Department

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Authorized for distribution by Michael Keen

October 2019

Abstract

Formula apportionment as a way to attribute taxable profits of multinationals across jurisdictions is receiving increased attention. This paper reviews existing literature and discusses experiences in selective federal states to evaluate the economic properties of formula apportionment relative to the current international tax regime that is based on separate accounting. It highlights major advantages, such as the elimination of profit shifting within multinational groups; and it discusses new distortions and the impact on tax competition. The analysis exploits different datasets to assess the direct revenue implications for individual countries under alternative formulas. The distributional effects across countries are found to be large, reflecting major discrepancies between where profits are currently attributed and where factors of production are located or sales take place. The largest losses appear in investment hubs (i.e. countries with a disproportionate ratio of foreign direct investment to GDP), while several large advanced countries are likely to gain. Developing countries gain most likely if employment receives a large weight in the formula; they also tend to benefit, on average, from a formula based on sales by destination.

JEL Classification Numbers: F23, H25

Keywords: International corporate taxation; Multinationals; Formula apportionment.

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I. INTRODUCTION[1]

Subnational corporate income taxes (CITs) commonly work by formula apportionment (FA). Under such systems, accounts of all company's affiliates are consolidated to generate a common tax base that is apportioned across jurisdictions on a formulaic basis. Jurisdictions then apply their own tax rate to the apportioned base. This contrasts with today's international tax rules, which are based on separate accounting (SA). Under SA, the accounts of an affiliate terminate at the border and profit attribution to each affiliate is determined by arm's-length pricing (ALP) of intracompany transactions, i.e. based on prices that would prevail if those affiliates were unrelated.

Subnational FA exists in several countries, such as Canada, Germany, Japan, and the United States. These systems vary in several dimensions (Table 1). In Canada, for example, the tax base of a corporation with a permanent establishment in more than one province is apportioned across those provinces based on an equal weighting of payroll and gross revenue, with special weights or formulas applying to certain sectors (such as insurance, banking, and transportation). The provinces retain autonomy to apply their own tax rate and tax credits to the apportioned tax base. In the U.S., states can choose different weights for assets, payroll, and sales; and these may vary by sector; Alaska, for instance, uses an origin-based sales factor for extractive industries.[2]

The conceptual and practical difficulties to apply the ALP in international taxation have sparked public interest in proposals to use FA at the regional or even global level. The subnational experiences indicate that, as economic and political integration proceeds, FA may present itself as better suited than ALP for dividing profits of related companies across jurisdictions. In this spirit, the European Commission has proposed a 'Common Consolidated Corporate Tax Base' (CCCTB) for the EU, implemented through a two-step approach. First, a uniform common tax base is established across member states. Second, EU-wide taxable profit is apportioned across member states by three equally-weighted factors: assets, sales by destination and labor (in turn equally weighting payroll and employees).[3] Worldwide formula apportionment has been proposed by, for example, the Independent Commission for the Reform of International Corporate Taxation (2018). Several scholars have also advocated such an approach, see e.g. the contributions in Picciotto (2016).[4]

Introduction of FA at the international level would mean a significant departure from current practice. To inform the public debate on such a fundamental reform, careful consideration and analysis of its implications are needed. A small but growing economic literature has assessed the

[1] We thank Vitor Gaspar, Cory Hillier, Michael Keen, Alexander Klemm, Peter Merrill, Tom Neubig, Victoria Perry and several IMF colleagues for excellent comments. We also benefited from useful discussions with Ray Mataloni from the Bureau of Economic Analysis. Outstanding research assistance was provided by Alice Park.

[2] See Weiner (2005) for an assessment of FA systems in Canada and the U.S.

[3] See European Commission (2016) for a description and impact assessment of the CCCTB.

[4] Avi-Yonah and Clausing (2008) propose unilateral adoption of FA by the U.S., i.e. the U.S. tax base would be a fraction of the worldwide income of each MNE operating in the U.S., based on the share of worldwide sales. The focus in this paper is on international adoption.

distributional and economic implications of FA; Section II of this paper discusses the key findings. Section III then presents the main contribution of this paper: an assessment of the direct effect on countries' tax revenue of replacing the current system by global FA. In doing so, we exploit three different data sources:

Table 1. FA in Selected Federal States

	Subnational tax	Tax base	Apportionment formula	Tax rates
Canada	Provincial CIT	Mostly follows the federal CIT base. Applies to corporations operating through permanent establishments.	Equal weights on payroll and gross revenue (attributed to the PE). Different formulas for selected industries.	Vary between 11 and 16 percent. For small businesses, rates vary between 0 and 8 percent.
Germany	Municipal trade tax	Similar to the federal CIT, with some modifications (e.g. a 25% add-back of interest expense).	Based on payroll of the business.	Vary between 7 and 19 percent; average is 14 percent.
Japan	Prefectures and municipalities levy corporate inhabitant tax and enterprise tax.	Derived from the national CIT base.	Based on the number of employees and number of offices in each location.	Vary by prefecture and municipality. The average for large firms is 7.4 percent in Tokyo.
United States	U.S. states levy CIT since the early 20th century.	Typically follows the federal CIT, sometimes with subsequent adjustments to determine the state tax base.	States choose their own formula. Seven States use an equally-weighted formula based on property, payroll and sales. Others have a higher sales weight, some use a sales-only weight.	Vary from 3 to 12 percent; the average is 6.6 percent.

- *ORBIS*, a firm-level database that is especially rich in the coverage of European multinational enterprises (MNEs). It has been used by e.g. Devereux and Loretz (2008) and Cobham and Loretz (2014) to assess both the impact of cross-border loss consolidation and the re-allocation of tax bases under FA. Our analysis differs from theirs in that we use an improved method to assess the impact of loss consolidation and reduce possible measurement error by restricting the sample to a subset of companies that is broadly representative of the global activities of the MNE group. To assess the effect of tax bases under FA, we use two weighting schemes including the size of fixed assets and employment, respectively.

- *Bureau of Economic Analysis* data on the operations of U.S. MNEs abroad.[5] This has been used by e.g. IMF (2014). Compared to that analysis, this paper uses more recent data for 2011-2016, which expands the number of countries from 29 to 52. It also uses a better

[5] Note that the data are based on the U.S. tax system before the tax cuts and jobs act of 2017. The analysis would probably yield different outcomes for the post-reform period.

indicator for economic profit, which excludes foreign earned income from the tax base (as this income is generally exempt from tax). This dataset allows us to explore five more weighting schemes than in the ORBIS dataset, including payroll, sales by destination (instead of origin), value added, a Cobb-Douglas formula and the CCCTB formula.

- *Internal Revenue Service* data on country-by-country reports of U.S. based MNEs. This dataset further expands the country coverage to 140 and includes more low-income countries than the BEA data. However, it only includes large MNEs (with global revenue exceeding $850 mln.) for the year 2016 and is more limited in terms of calculating different formulas (e.g. it lacks information about sales by destination).

The analysis in this paper yields a number of important insights. For instance, the ORBIS data indicate that the global tax base under FA could be reduced by up to 10 percent due to cross-border loss consolidation. The associated loss in global CIT revenue is much smaller though (and can even be positive), as the tax base shifts from low-tax to high-tax countries. As substantiated by the analysis with BEA and IRS data, effects on the revenue distribution can be large, with corporate tax revenue losses from MNEs of up to 80 percent incurred by countries with low tax rates and a high ratio of FDI-to-GDP (so-called 'investment hubs'). Developing countries are more likely to benefit from FA if the number of employees has a large weight in the formula—the BEA data, for example, suggest a doubling of CIT revenue in the median of the group of non-OECD countries. The BEA data suggests that developing countries might also benefit from apportionment by destination sales. The G7 countries typically gain from FA, although less so when the formula is based on the number of employees.

II. Economic Assessment of Formula Apportionment

A. What is Formula Apportionment?

The current international tax framework is based on separate accounting (SA), meaning that the accounts of an MNE group are separated between the entities operating in different countries. Taxing rights of a country over business profits are based on identifying the source of the profits and the residence of the corporate taxpayer. Source refers to where investment is made, and production takes place and is largely determined by the physical presence of labor and/or capital. Residence means the place where the company receiving the income is deemed to have its primary location. The international convention is that source countries have primary taxing rights over the active business income, subject to having a sufficient physical presence (nexus) that is defined by reference to a permanent establishment (PE). Residence countries retain the right to tax passive income flows. The attribution of income between countries depends on the valuation of intra-company transactions within an MNE. To avoid strategic pricing decisions that exploit differences in national tax laws, most countries rely on the arm's-length principle (ALP), which stipulates that internal prices between related parties should resemble prices that would prevail between independent parties.

The SA concept implemented through the ALP has come under significant stress in recent years (Andrus and Collier 2017). Its application has become increasingly complex and arbitrary due to the growing importance of hard-to-value intangible assets; and the way in which risk is divided across an MNE's operations has received ample criticism as it lacks a clear economic rationale

and is prone to arbitrage opportunities. Internationally agreed guidelines on how to calculate ALPs are inevitably to some extent arbitrary and subjective, leading to protracted disputes in highly complex cases. These conceptual and practical difficulties have sparked interest in proposals to apply formula apportionment (FA) at the international level.

Another reason for the growing interest in FA lies in the digitalization of the economy. Some of the largest global companies today conduct business in numerous countries, while having little or no physical presence there. Therefore, those countries have no taxing rights on the profits of those companies. This has sparked debate on whether taxing rights in an increasingly digitalized economy should be allocated differently, for instance, to where the consumers or users are based.[6] Since ALP is ill-suited to establish such attribution to destination countries, this has sparked further interest in FA as a way to allocate income of MNEs.

While the principle idea of FA is straightforward, it would be a significant deviation from current norms. FA will need to be implemented through domestic law, with their reallocation supported by tax treaties. Designing such a system in practice as a basis for the international tax framework requires numerous choices. A unitary group needs to be defined and its consolidated tax base calculated on a common set of agreed rules (e.g. building on the International Accounting Standards). The unitary base could also be separated between different types of income or different types of activities undertaken by the MNE. In the US, for instance, a distinction is made between business income (which is consolidated) and non-business income (which is directly assigned to a jurisdiction). The legal implementation of these policy design choices will be critical to avoiding double taxation (or under taxation) and managing the risk of other adverse spillovers occurring across jurisdictions. However, where FA is properly implemented, the increased reliance on formulaic approaches when determining and allocating profits should ensure greater ease of legal implementation and administration when compared to SA, which is imperative for low-income countries.

Some flexibility could be achieved by allowing countries to modify their apportioned share of the unitary base, for instance by offering additional R&D deductions. Flexibility is also created if countries can choose their own apportionment formula, as is practiced at state level in the U.S. However, this can lead to either more, or less than 100 percent of total profits being allocated somewhere. Divergent weights also evidently complicate implementation. Securing agreement on a common apportionment scheme would be extremely difficult though and an equalization scheme might be necessary to achieve that. The precise design of an agreed system of FA would therefore be hard to predict, yet it will be critical for its economic and distributional implications.

[6] Allocation to the country where users are based stems from the idea that users generate information that is of value to the business. Drawing a line between users and consumers as contributors to the business is inherently difficult, however, implying that sales by destination might be a reasonable factor to reflect allocation to user countries.

B. Revenue Effects

FA allocates the consolidated tax base of an MNE using proxies for substantial economic activities. It thus can align tax payments more closely with some observable fundamentals. Commonly used apportionment factors are:

> ***Production factors.*** Payroll, employment and assets are commonly used. Profit attribution can thus closely follow the principle of 'where value is created' in the sense of where production factors are based. Payroll would be relatively difficult to misrepresent as these involve third-party transactions; and much labor is relatively immobile (although issues may arise with the measurement of benefits, carried interest, deferred payments and stock compensation). For tangible assets, valuation can be non-trivial (e.g. with respect to depreciation, inventory valuation, leases) but there are commonly-used methods; they (and some skilled labor) are though relatively mobile, so that differences in tax rates across jurisdictions will distort their allocation (see below). Intangible assets are usually excluded because they are hard to value and relatively easy to relocate. And to the extent that intangible assets derive from employment (R&D workers) or tangible investments (such as laboratories), they are captured by those other factors.
>
> ***Third party sales.*** These can be measured either on an origin basis (where the seller resides) or on a destination basis (where the consumer resides). Using sales by destination as apportionment factor has the advantage that consumers are relatively immobile so that distortions are small. However, risks of tax planning arise through the channeling of sales through unrelated firms based in low-tax countries. Note that any form of destination-based profit taxation requires adjustment of the nexus definition in tax treaties.[7]

Specific issues may arise for specific sectors. The formula applied to the financial sector, for instance, is generally different. Indeed, fixed assets comprise only a small fraction of total assets of financial companies, as most of their assets are based on loans and deposits; and sales are of a different nature than for other companies, e.g. receipts usually come from margins on interest, money market instruments or credit cards. Canada therefore uses an allocation formula based on both payroll (one third) and loans and deposits (two third, to measure sales). In the US, the sales factor for financial companies is replaced by a gross receipts factor. In the European CCCTB proposal, ten percent of the value of financial assets is added to the asset factor. Similarly, the formula applied for extractive industries can also be adjusted, to reflect that natural resources generate a location-specific rents for the source country. In the U.S., for instance, Alaska uses an extraction factor based on production in the formula that is used to allocate income for petroleum and pipeline companies. In the CCCTB proposal, allocation of income for the petroleum sector uses origin-based sales (rather than destination-based sales).

The allocation of tax bases under FA can be markedly different from that under the current system. Several studies have analyzed the distributional implications of FA, especially for regional

[7] In the U.S., many states use throwback rules that attribute taxable income back to the source state if a company has no nexus in the State where the goods are sold.

implementation in Europe. They generally ignore behavioral responses, and focus mostly on allocations based on production factors, as information about sales by destination is often not available in datasets. Fuest, Hemmelgarn and Ramb (2007) use German micro data to assess the impact of FA with a three-factor formula of assets, employment and sales by origin. They find that tax base changes are large. Small European countries such as Ireland and the Netherlands would lose part of their tax base under FA, while large countries such as Germany, Italy, France and the UK would benefit. Devereux and Loretz (2008) use ORBIS data for firms across Europe and find that, irrespective of the apportionment factors used, Belgium, Denmark, Finland, Germany, Greece, Italy and Luxembourg would see a reduction in tax revenues, while Spain, Sweden, the UK and some countries in Central and Eastern Europe would experience an increase. IMF (2014) and Cobham and Loretz (2014) look at global FA, using data from respectively the BEA and ORBIS. Exploring different formulas, they report large changes in the tax base for individual countries, with gains reported mostly in large economies with relatively high tax rates and losses found in small countries with relatively low tax rates. Faccio and Fitzgerald (2018) use country-by-country reports of one company, Vodafone, to show the reallocation of profit if the CCCTB formula would be used. They find significant gains for Germany and the UK and losses for Luxembourg and Malta.

Some studies have analyzed the revenue effect of unilateral adoption of FA by the U.S., i.e. if the U.S. would tax U.S.-based MNEs on a fraction of their worldwide income. Shackelford and Slemrod (1998) use the financial reports of 46 U.S.-based MNEs during 1989-1993 and find that their tax liabilities would increase by 38 percent if an equal-weighted three-factor formula based on assets, payroll and sales would be used. Clausing and Lahav (2011) update the analysis using more recent financial statements of 50 large U.S. MNEs in 2005-2007. They find a more modest increase of U.S. tax liabilities of 14 percent. Both studies, however, ignore behavioral effects.

Moving from SA to FA can have two effects on aggregate global CIT revenue:[8] an effect through loss consolidation and an effect through reallocation of the tax base from low to high-tax countries. Regarding the first, CIT systems usually do not grant an immediate tax refund if a corporation suffers a loss. Instead, they generally offer limited loss carry forward, without indexing for interest. Under SA, this limitation to loss offset applies separately to each subsidiary or, if there is domestic group taxation, to the group of subsidiaries within the borders of a country. Under FA, however, profits and losses within a group are immediately offset into the consolidated account, also across borders. Therefore, cross-border loss consolidation under FA will reduce the overall tax base of the MNE.[9] Fuest, Hemmelgarn and Ramb (2007) assess the base effect of loss consolidation in the EU, using data for German MNEs and find a reduction in the EU-wide CIT base of more than 20 percent. Cobham and Loretz (2014) use a larger set of unconsolidated firm-level data from ORBIS to assess the effect of global FA; they report a loss of around 10 percent. Model simulations with a CGE model for Europe by Bettendorf et al (2010),

[8] A third effect would occur if the common tax base under FA is chosen to be different from the weighted average tax base of countries under the current system. Here, we assume that this is not the case.

[9] Mardan and Stimmelmayr (2018) show that the revenue loss from loss consolidation might be more than offset in the longer term as MNEs re-optimize their strategies and governments their policies.

however, arrive at a smaller reduction in the tax base from loss consolidation of close to 7.5 percent in the long term, i.e. when the stock of loss carry forwards from past years has stabilized.

The second direct effect on CIT revenue is due to the reallocation of the tax base between countries. It can (partly) offset the impact of a narrower tax base if the base is shifted from low to high-tax countries, since this will boost aggregate CIT revenue. For the EU, Devereux and Loretz (2008) find that this reallocation effect will more than offset the effect of loss consolidation and that EU-wide tax revenues will rise by 2 percent. For global FA, Cobham and Loretz (2014) also report a net increase in total tax revenue by between 2 and 4 percent.

C. Effects on Efficiency

Moving from SA to FA would have several implications for efficiency. This section discusses, respectively, effects on profit shifting, factor distortions and tax competition.[10] There are also important implications for tax administrations and for tax compliance costs. For instance, eliminating ALP would be a major saving in administrative and compliance costs. However, the administrative and compliance costs under FA are hard to predict without specifying more details on how it would be designed and implemented. For instance, calculation of a commonly agreed tax base would require effective information exchange between tax authorities.

Profit Shifting

MNEs can currently use tax planning techniques to shift taxable income between entities in the group to minimize their overall CIT liability. The precise channels of tax avoidance can vary, depending on the specific features of national tax systems and treaty networks. They include (i) abusive transfer pricing (stretching, violating or exploiting weaknesses in the ALP); (ii) debt shifting through intracompany loans (excessive borrowing in high-tax countries and lending from low-tax countries); (iii) risk transfer (conducting operations in high tax jurisdictions on a contractual basis to limit profits); and (iv) strategic location of management of intellectual property (IP). There is ample evidence for their presence (see Beer et al. 2019 for an overview). With respect to the overall magnitude of tax avoidance, Beer et al. (2019) report a consensus estimate derived from available empirical studies of the semi-elasticity of –1.5, i.e. a 10 percent difference in statutory tax rates between countries will induce profits to be shifted by, on average, 15 percent from the high to the low-tax country.

By taxing MNEs on a consolidated basis, FA eliminates scope for profit shifting as prevalent under SA—e.g. cutting a swathe through the problems of the ALP and eliminating other forms of profit shifting. This does not mean, however, that profit shifting will disappear altogether. Rather, FA would induce a different form of profit shifting by creating distortions in corporate structures since related and unrelated parties will be treated differently. For instance, combining two independent firms would generally change their combined tax liability under FA, while such a

[10] Another effect, not discussed here, is on risk taking. Under FA, cross-border loss offset implies that the CIT becomes a better insurance device, thereby encouraging risky investments (the Domar-Musgrave effect). Empirical evidence finds that limitations to loss offset indeed hurt investment and risk taking (Dressler and Overesch 2013).

group would be treated the same under SA if transfer prices would be at arm's length. This effect is emphasized by Gordon and Wilson (1986), who show that companies will have an incentive to spread excess returns to low-tax jurisdictions under FA by merging with companies in low tax states. Also, Hines (2010) emphasizes ownership distortions due to FA by reallocating taxable income between operations in jurisdictions with differing tax rates. Nielsen et al (2003) argue that such shifting might be especially large under conditions of imperfect competition. Using confidential firm-level tax-return data for the local business tax in Germany, Buetner et al (2011) empirically explore profit-shifting under FA in Germany as companies can choose whether their affiliates are included in the consolidated group or not. They find that MNEs exploit the definition of the consolidated group strategically by running individual affiliates as separate unconsolidated firms for tax purposes if intra-group tax-rate differences are large.

Despite the distortions in ownership structures, FA is generally thought to be less vulnerable to manipulation than SA. This was stressed by e.g. Musgrave (1973) and is confirmed by empirical evidence for Canada by Mintz and Smart (2004). In Canada, firms can be taxed under either a regime where they must use FA (if they operate in multiple provinces using a single corporation) or the SA regime (if they incorporate a separate affiliate in each province in which they operate). Mintz and Smart (2004) find that the elasticity of taxable income for firms that can shift income under SA is more than two times larger than it is for firms that use FA.

Factor Distortions

Under FA, the CIT becomes a tax levied on the factors of the formula (McLure, 1981). Hence, tax rate differences between countries may distort the allocation of those factors, especially if those are mobile across borders. Several studies try to quantify this distortion. Goolsbee and Maydew (2000), for instance, explore the sensitivity of employment to the payroll weight in the formula of U.S. states, using data over the period 1978-1994. They report significant effects. Gupta and Hofmann (2003) use aggregated data from 1983 to 1996 to explore the effect of the asset factor on investment in the manufacturing sector. They find that investment decreases in the tax burden on the asset factor. Clausing (2016) examines the effects of U.S. tax rates on employment, investment, and sales, depending on the formula weights. She finds that these factors have not been particularly sensitive to tax rates, suggesting that distortions might in fact be modest. Riedel (2010) analyzes the impact of the German local business tax that applies FA regulations with income apportionment according to the relative payroll share. She finds that, on average, a 1-percentage-point-increase in the tax rate differential between an affiliate and foreign group members lowers the affiliate's payroll to capital ratio by 1.9 percent.

Tax Competition

Under FA, tax competition does not disappear as countries can continue to compete with their tax rate to attract whatever factors are given high weight in the formula. This incentive may be even stronger than under SA, since the revenue gain from attracting such factors is not from a marginal increase in some local tax base, but from the greater share of the group's overall profit that is brought into tax (Nielsen et al 2010). This effect on tax competition, however, will depend on the choice of formula factors. Pethig and Wagener (2007) find that tax competition under FA produces lower tax rates if the formula share is more elastic. Tax competition is thus most intense

when apportionment is based on asset-shares, followed by payroll and sales. Eichner and Runkel (2008) show that FA with a sales factor may mitigate or even eliminate fiscal externalities associated with tax competition. Calibrating the model for the EU, they show that FA with a sales-only formula will raises average CIT rates by 2 percentage points and generate positive welfare effects. Becker and Fuest (2007) add tax enforcement as an additional policy instrument to address profit shifting under SA. They find that tax enforcement levels may be too high under SA due to negative fiscal externalities. In contrast, under FA, tax enforcement is likely to be too low due to positive externalities of tax enforcement. It implies that, under FA, there is no tendency towards inefficiently high effective tax rates.

Some studies have also explored tax competition through the choice of the formula factors, assuming jurisdictions are granted full fiscal autonomy with respect to formula design. In the U.S. for example, states have increasingly moved toward a greater weight of the sales factor. Anand and Sansing (2000) find that importing states generally have incentives to increase the sales factor, whereas exporting states will tend to increase input factors. Edminston (2002) uses a CGE model to show the long-term economic gains if all U.S. states would be moving to a sales formula. Omer and Shelley (2004) find significant strategic responses to the choice of formula factors in other states, i.e. the probability of changing one's formula weights is larger if neighboring states did that. This is consistent with tax competition for capital and jobs and may explain the convergence in the U.S. towards larger sales weights. Runkel and Schjeldrup (2007) theoretically explore the optimal choice of the apportionment formula in a strategic setting. They find that it will contain both mobile (capital) and immobile (labor) factors, with the positive formula weight on capital arising because it also taxes location-specific economic rents.

III. A Quantitative Revenue Assessment of Global Formula Apportionment

This section explores the effects of FA on the tax base and tax revenue, both of individual countries and globally. The analysis is static in that it ignores behavioral responses. Subsection A describes the equations underlying the calculations. Subsection B then describes the three datasets that are used for the analysis and discusses descriptive statistics. Subsection C discusses the impact of FA on the global tax base through cross-border loss consolidation. Subsequently, subsection D explores the change in tax revenue of countries under alternative formulas. Finally, subsection E discusses dynamic effects of FA.

A. Modeling Base and Revenue Effects from FA

Separate Accounting

Consider subsidiary $i = 1, \dots, s_c$ that is part of MNE group $j = 1, \dots, n$ and based in country $c = 1, \dots, m$. Its observed profit in year $t = 1, \dots, T$ is denoted by π_{ijct}. Under separate accounting (denoted by superscript S), the taxable income of this subsidiary is given by

$$\beta_{ijct}^{S} = Max\left[\pi_{ijct} + \lambda_{ijct-1}^{S}; 0\right] \geq 0 \qquad (1)$$

i.e. it is equal to the reported profit before tax minus the stock of losses carried from previous years ($\lambda^S_{ijct-1} < 0$), at least as long as this balance is positive; otherwise, taxable income is zero. The stock of carried losses is

$$\lambda^S_{ijct} = Min[\pi_{ijct} + \lambda^S_{ijct-1}; 0] \leq 0$$

which is zero if all losses have been absorbed; otherwise it is denoted as a negative number that reflects the accumulated losses from the past. The aggregate tax base in country c in year t is the sum over all subsidiaries per group and all MNE groups

$$\beta^S_{ct} = \sum_{i=1}^{s_c} \sum_{j=1}^{n} \beta^S_{ijct}$$

and the global tax base is

$$\beta^S_t = \sum_{c=1}^{m} \beta^S_{ct}$$

Similarly, tax revenue (ρ) per country and globally is the tax base multiplied by the tax rate

$$\rho^S_{ct} = \tau_{ct} \beta^S_{ct}$$
$$\rho^S_t = \sum_{c=1}^{m} \rho^S_{ct}$$

Consolidation

Under unitary taxation, profits and losses are consolidated at the group level. Hence, the consolidated statement of the MNE group j in year t would be the overall profit of all subsidiaries based in all countries:

$$\pi_{jt} = \sum_{c=1}^{m} \sum_{i=1}^{s_c} \pi_{ijct}$$

Hence, losses in one subsidiary can be immediately offset against profits in other subsidiaries. This is unlike SA, where losses in a subsidiary can only be carried forward, but not consolidated with profits. The consolidated tax base of group j in year t under unitary taxation (β^F_{jt}) is

$$\beta^F_{jt} = Max[\pi_{jt} + \lambda^F_{jt-1}; 0] \geq 0$$

where superscript F denotes the regime under FA. The stock of loss-carry forward at the consolidated group level is

$$\lambda^F_{jt} = Min[\pi_{jt} + \lambda^F_{jt-1}; 0] \leq 0$$

Formula Apportionment

Alternative factors can be used to apportion the consolidated income of an MNE group. Denoting the factor that is being used by α_{ijct} (which can represent assets, payroll, employment, sales or a combination of those), the apportionment share is defined as:

$$\omega_{ijct} = \frac{\alpha_{ijct}}{\sum_i \sum_c \alpha_{ijct}}$$

so that $\sum_i \sum_c \omega_{ijct} = 1$. The tax base of the individual subsidiary i of MNE group j is given by

$$\beta^F_{ijct} = \omega_{ijct} \beta^F_{jt}$$

The aggregate tax base in country c in year t is

$$\beta^F_{ct} = \sum_{i=1}^{s_c} \sum_{j=1}^{n} \beta^F_{ijct}$$

and the global tax base

$$\beta^F_t = \sum_{c=1}^{m} \beta^F_{ct}$$

The tax paid by an individual subsidiary is determined by

$$\rho^F_{ijct} = \tau_{ct} \beta^F_{ijct}$$

where the tax rate, τ_{ct}, is assumed to be the same as under SA. Aggregation at the country and global level would imply

$$\rho^F_{ct} = \sum_{i=1}^{s_c} \sum_{j=1}^{n} \rho^F_{ijct}$$

$$\rho^F_t = \sum_{c=1}^{m} \rho^F_{ct}$$

In the calculations below, we compare a countries' tax base under SA (β^S_{ct}) with that under FA (β^F_{ct}) and do the same for revenue ($\rho^F_{ct} - \rho^S_{ct}$). The global change in the tax base ($\beta^F_t - \beta^S_t$) and tax revenue ($\rho^F_t - \rho^S_t$) are also explored.

The expressions presented above apply to firm-level data (such as ORBIS), which provide information of the unconsolidated accounts of MNEs. For country-level data (such as BEA or IRS), we observe only aggregate information for MNEs operating abroad. In the terminology above, we thus observe π_{ct} and α_{ct}, so that profits and losses are consolidated across all MNEs per country. We use π_{ct} as a proxy for the CIT base of a country (instead of β_{ct}), i.e. the balance of profits and losses. The consolidated global tax base is then calculated as $\pi_t = \sum_{c=1}^{m} \pi_{ct}$ and the allocation under FA is computed as $\pi_{ct}^F = \alpha_{ct}\pi_t$. For sensitivity analysis, we also consider an alternative indicator for profit, derived from taxes paid divided by the statutory tax rate.

B. Data

We exploit three datasets to analyze the revenue impact of FA: (i) firm-level data from ORBIS, which captures the global activities of a large group of MNEs, especially from Europe; (ii) aggregate data from the Bureau of Economic Analysis (BEA), which provides country-level information on the key financial activities of all majority-owned affiliates of US MNEs worldwide; and (iii) aggregate data from the Internal Revenue Service (IRS) based on country-by-country reports by U.S. MNEs with revenue greater than USD 850 million (approximately 10 thousand MNE sub-groups). While none of these datasets provide a comprehensive coverage of the worldwide population of MNEs, they complement each other by allowing for analysis of different aspects of FA. For instance, the firm-level data in ORBIS can be used for an assessment of loss consolidation; the BEA data is the only dataset that provides information about sales by destination; and the IRS dataset is based on tax returns and has the widest coverage of countries.

ORBIS

We start with a large sample of all MNE subsidiaries in the ORBIS database, provided by Bureau van Dijk (BVD). All subsidiaries are majority owned by their ultimate parent company, either directly or indirectly. An MNE group is defined as a corporate group which owns at least one subsidiary in a different country than where the parent company resides. We match the unconsolidated financial report in each subsidiary-year with the corresponding consolidated accounts of their parent company, using the BVD id of the parent company, whenever available. Consolidated financial statements depict information on key variables reflecting the overall economic activity of the entire MNE group. We then restrict the sample to include only subsidiaries for which the sum of employment within each MNE group represents at least 70 percent of total employment reported in the consolidated account. While this restricts the size of the sample for analysis, it overcomes the well-known caveat that the coverage of ORBIS is limited for some MNEs and ensures that the unconsolidated accounts of individual subsidiaries are representative of the worldwide operation of the MNE group.[11]

The final sample comprises of 58,345 unique companies in 7,772 MNE groups during 2011-2016. Table 2 shows the distribution of firms in broad country groups, where columns depict the location of the respective subsidiary, while the rows show the location of the ultimate parent

[11] This selection process differs from Cobham and Loretz (2014) who include all MNE subsidiaries in their sample. On average, companies selected in our sample are considerable larger in terms of turnover, fixed assets, and number of employees than in their analysis.

company. The final sample mainly consists of subsidiaries of European MNEs. Nevertheless, the dataset provides some information on their activities in the rest of the world, including in many emerging economies, and on the worldwide activities of 9,881 subsidiaries from more than 2,000 non-European MNEs.

Table 2. Number of Firms in MNE Groups in ORBIS, by Location and Owner Country Groups

	Europe	North America	Asia	Latin America and the Caribbean	Middle East/Western Asia	North Africa	Oceania	Sub-Saharan Africa
Europe	45,787	918	1,514	255	6	5	416	7
Asia	87	22	5,060	24	0	0	8	0
Latin America and the Caribbean	239	11	19	383	0	0	2	0
Middle East/Western Asia	2	0	0	1	40	0	0	0
Oceania	98	19	59	7	0	0	334	6
Sub-Saharan Africa	8	0	2	0	0	0	1	35
North Africa	0	0	0	0	0	8	0	0
Total	46,221	970	6,654	670	46	13	761	48

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

Bureau of Economic Analysis

The BEA publishes annual data on the aggregate finances and operations of U.S. based MNEs, with separate statistics for U.S. parent companies and their majority-owned foreign affiliates in 199 countries. The data used for the analysis covers the entire operation of the affiliates and has not been pro-rated by the ownership share of the U.S. parent. For affiliates in 52 countries, there is detailed information on the foreign income tax paid by all affiliates, the profit they report, and the level of fixed assets in each country. Although data availability narrows the number of countries included in our analysis, the countries with reported data make up around 92 percent of total worldwide profits of majority-owned affiliates. Regarding information on sales, the BEA provides information on sales by origin as well as partial data on sales by destination. Specifically, for each country where an affiliate is located, it reports goods and services supplied to unaffiliated persons in either the U.S., the host country, or other foreign countries.[12] For about 10 percent of sales to unaffiliated persons, the destination country is not specified in the BEA data. However, in the benchmark survey years, data is provided on the destination region (i.e. Canada, Europe, Latin America and Other Western Hemisphere, Africa, Middle East and Asia Pacific) for these sales.[13] To allocate sales to countries within each region specified by the BEA, data on bilateral exports is used.

[12] Table II.E 2 Goods and Services Supplied by Affiliates, Country by Destination

[13] Table II.D 7 Sales by Affiliates to Unaffiliated Foreigners in Foreign Countries Other Than the Host Country, Country by Country of Destination. The most recent benchmark year is 2014; benchmark surveys are completed every 5 years.

Internal Revenue Service

To enhance transparency and assist tax administrators in a high-level assessment of transfer pricing and other BEPS risks, the OECD has adopted Country by Country (CbC) reporting by MNEs as a minimum global standard. In 2017, over 60 tax jurisdictions, including the U.S., have required large MNEs to report on their income, taxes paid and other indicators of economic activity such as employment and assets on a country by country basis. The IRS publishes aggregate data based on these reports covering 142 tax jurisdictions.

Descriptive Statistics

Table 3 reports basic statistics of each of the three datasets for the profit measure, the apportionment factors and (effective) tax rates. Panel A shows firm-level data from ORBIS. We use the variable "Earnings Before Taxes" to represent profits. [14] Its mean value is almost USD 10.5 mln, but with a range between a loss of USD 12.6 bln and a profit of USD 31.3 bln. Overall, 27 percent of the subsidiary-year observations shows a loss. When calculating taxable profit for each subsidiary under SA (i.e. without loss consolidation but with loss carry forward), the mean is markedly higher at USD 14.5 mln, i.e. 38 percent larger than the mean of profit/loss of all companies.[15] ORBIS provides information about fixed assets and employment in each subsidiary, which are the two formula factors used in our analysis. Information about salaries is also available in ORBIS but is missing for subsidiaries in many countries. We therefore do not explore formulas that include the payroll factor. Also, information about sales by destination is not available from ORBIS.

Panel B of Table 3 describes aggregate statistics by country-year based on the BEA data. In this dataset, two alternative proxies of the tax base are used. The first is reported 'economic profit', which reflects operating income, excluding capital gains and losses and income from equity investments (which are usually exempt, to avoid double taxation). It represents the balance of all reported profits and losses by U.S. based MNEs operating in the country and is smaller than true CIT base because in practice there are restrictions to loss offset within and across company groups. In computing the revenue implications of tax base changes under FA, we use the effective tax rate, defined as taxes paid over the reported profit before tax. The second proxy for the tax base (labeled 'Taxable income' in Table 3) is estimated by taking data on CIT paid in each country of operation, divided by the prevailing statutory tax rate for that country. This proxy captures the impact of losses but could suffer from measurement error if the standard CIT rate

[14] While this is the most comprehensive measure of profit that is liable to tax in the financial statement, earnings before taxes does include income from equity investment and hence income from own affiliates, if any. Double counting of profits for those with affiliates would imply that total tax base when measured with earnings before tax is somewhat overestimated. To check the robustness of our analysis, we use "Operating Revenue and Losses" as an alternate profit indicator and report the results in Appendix 2.

[15] Our calculations assume that group relief exists at neither the domestic nor the international level. As some countries do allow for domestic relief/loss consolidation, the tax base presented here likely presents an upper bound of true tax base under SA (and the difference with FA is likely to be smaller). For example, 18 of the 27 EU Member States provide a form of domestic group relief/consolidation. Only few countries allow for cross-border loss offsets.

does not apply to every unit of profit. In calculating the revenue implications of FA with this indicator, the statutory CIT rate is used.

Table 3. Descriptive Statistics for Key Variables

	Observations	Mean	Standard Deviation	Min	Max
Panel A: the ORBIS dataset, 2011-2016 (firm-level data)					
Profit/loss before taxes	241,986	10.49	190	-12,590	31,260
Tax base, SA	241,889	14.45	201	0	31,260
Turnover	245,480	163.5	1,503	0	192,800
Fixed Assets	245,480	151.3	1,799	0	129,100
No. of employees	245,480	349	3,409	0	372,562
Effective Tax Rate (mean, country-level)	336	0.21	0.25	0.00	1.75
Panel B: the BEA dataset, 2011 – 2016 (aggregate data per country/year)					
Profit before taxes	337	34,604	145,812	-5,246	1,124,857
Taxable income (tax paid/tax rate)	293	33,041	124,338	-5,246	848,900
Payroll	985	19,012	160,194	0	2,196,665
Employment ('000 persons)	1,047	296	2,175	0	28,046
Value Added	887	42,642	316,470	-8,476	3,949,236
Fixed Assets	335	249,150	1,253,607	915	10,277,053
Tax	286	9,538	41,532	4	331,712
Effective Tax Rate	284	0.29	0.18	0.00	0.96
Panel C: the IRS dataset, year 2016 (aggregate data per jurisdiction)					
Profit before taxes	137	10,357	74,879	-6,204	867,852
Profit, non-loss-making companies only	87	20,214	106,826	16	990,019
Employment ('000 persons)	137	201	1,406	0	16,377
Fixed Assets	137	45,217	362,056	4	4,223,575
Tax	137	1,914	15,846	0	185,540
Effective Tax Rate	137	0.20	0.12	0	0.68

Notes: All values except number of employees and tax rates are in million USD.

Please refer to the Appendix for full list of tax jurisdictions.

* Observations with negative tax or an effective tax rate greater than 1 have been dropped

In terms of information about possible formula factors, the BEA data is the richest among the three datasets, containing fixed assets, payroll, employment and sales by destination.[16] This allows us to also explore two multiple-factor formulas. The first, 'Cobb Douglas' (CD) formula, combines asset and payroll shares – to roughly reflect the shares of capital income and labor income in aggregate value added. The proportion of the tax base allocated to country j under the CD formula is defined as:

$$\omega_{CD,j,t} = \frac{1}{3}\alpha_{assets,j,t} + \frac{2}{3}\alpha_{payroll,j,t}$$

The second multiple-factor formula is that used in the CCCTB proposal for the EU. Under this proposal, the share of the tax base allocated to country j is defined as:

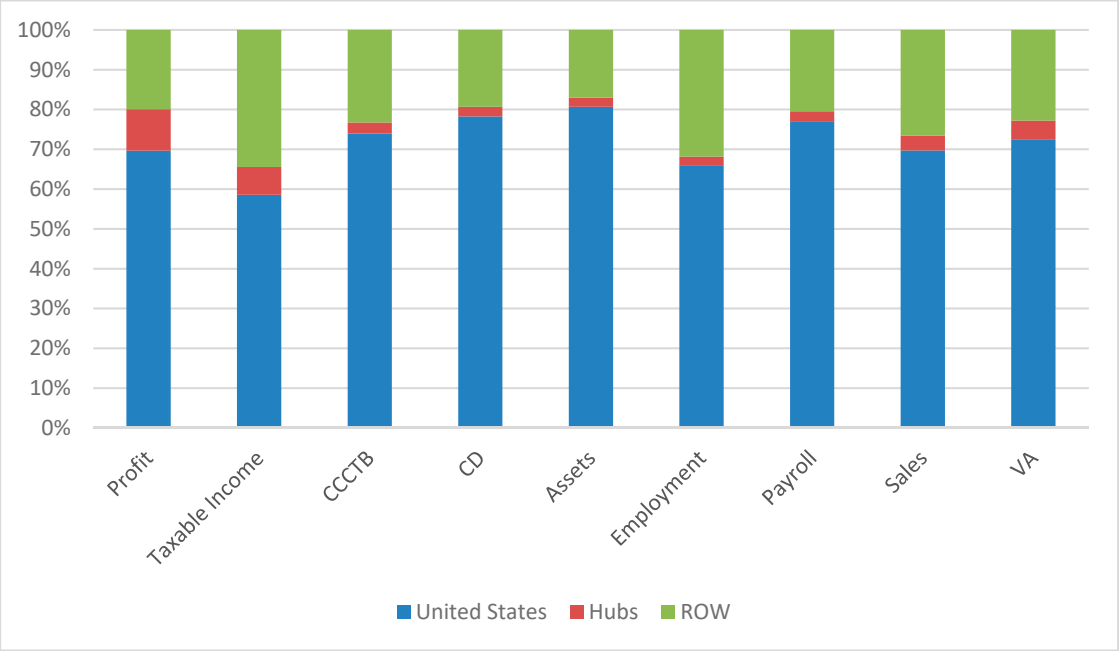
$$\omega_{CCCTB,j,t} = \frac{1}{3}\alpha_{assets,j,t} + \frac{1}{3}\alpha_{sales,j,t} + \frac{1}{3}\cdot\left(\frac{1}{2}\alpha_{payroll,j,t} + \frac{1}{2}\alpha_{employment,j,t}\right)$$

Figure 1 uses the BEA data to indicate the shares of profit, taxable income and the weights under each of the seven formulas, for three different groups of countries: the U.S., a group of 10 so-called "investment hubs" (defined as countries featuring in the world's top 10 in terms of their inbound FDI/GDP ratio) and the rest of the world. The share of profits allocated to the U.S. is 70 percent, while that of investment hubs is 10 percent and ROW is 20 percent. For the seven apportionment formulas, clearly, the share of the investment hubs is much smaller than it is for the profit variable, typically only between 2 and 3 percent of the global aggregate. The share of the U.S. in the formulas weights ranges from 66 percent (for employment) to 80 percent (for assets). For ROW, shares range from 17 percent (assets) to 32 percent (employment). Since the weights of the formulas for the U.S. are generally larger than the global share of U.S. profits (except for the employment factor), we expect that moving to FA will lead to a gain in the apportioned tax base for the U.S. For the investment hubs, we expect the opposite, i.e. their tax base will shrink. Such reallocation will have important global revenue implications, as the effective tax rates differ significantly between groups: for the US it is 27.7 percent; for ROW it is 30.8 percent, on average; and for Investment hubs, it is only 14.7 percent, on average. Reallocating one dollar of the tax base from investment hubs to ROW would thus more than double tax revenue from that dollar.

[16] Allocation factors will depend on country-specific macro-economic conditions, including cyclical conditions, and thus affect automatic stabilization of the CIT. However, the consolidated profit might be relatively more robust and less dependent on asymmetric shocks.

Figure 1. Allocation of the Tax Base Under Various Formulas

(Percent)



Source: BEA data and IMF staff calculations

Panel C of Table 3 describes statistics from the IRS country-by-country reports for the 2016 tax year. The variable "Profit" reflects the profit according to the prevailing rules of the country and can be based either on the company's financial statements or their tax records. The tax variable includes income taxes and withholding taxes paid on payments received by the subsidiary. The IRS publishes aggregate data for profitable and loss-making companies separately. In 2016, profitable U.S. MNEs reported total profits of USD 1,759 billion across all jurisdictions, with over half of these profits reported in the U.S. (USD 990 billion). Loss-making U.S. MNEs reported USD 338 billion in losses, of which USD 122 billion was reported in the U.S.[17] The IRS data contain information on fixed assets and employment in foreign affiliates, allowing us to explore these two formula factors under FA. The narrower scope of the IRS data is reflected in the reported indicators; 42.3 million workers are employed by U.S. MNEs covered by the BEA data, compared to 27.6 million covered by the IRS data.

C. Effects on Global Tax Revenue

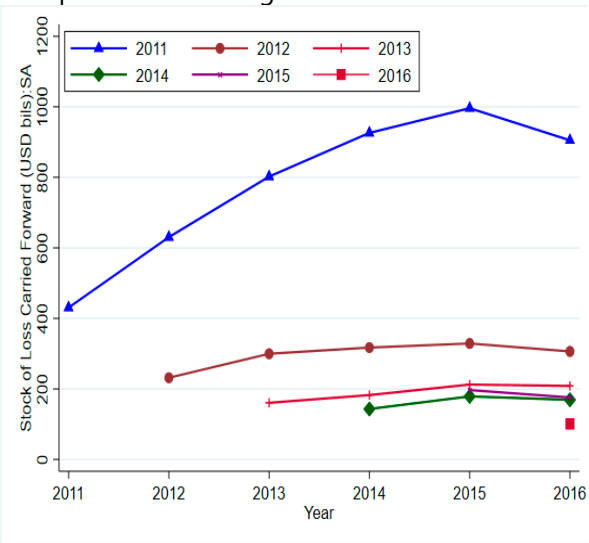
ORBIS data are used to assess the impact of cross-border loss consolidation on the global corporate tax base, $\beta_t^F - \beta_t^S$. We start with the loss carry forward in 2011, based on the reported losses in 2010—this is done both under SA and consolidation with FA. In subsequent years, the stock of losses carried forward grows with new losses and shrinks with the losses that are offset

[17] Due to the aggregate nature of the data, estimating the revenue effects of cross-border loss consolidation within company groups is not possible (as the data also offset losses between company groups).

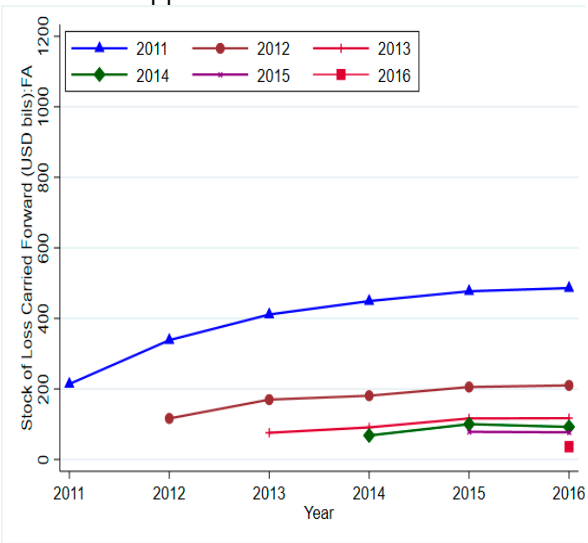
against profits in that year.[18] Figure 2 shows how the stock of loss carry forward develops between 2011-2016 under SA (left) and FA (right). It reveals two important messages. First, the stock of loss carried forward grows in the initial years, since the additional new losses exceed the offset of prior losses. This growth levels off after a few years as the offsets become larger. Between 2015 to 2016, the stock even declines under SA and is virtually stable under FA. These dynamics imply that it can be misleading to assess the impact of loss consolidation based on the initial years, since the stock of loss carry forwards has not yet converged to its new equilibrium. Therefore, effects are best assessed based on data for 2015 and 2016 when convergence has been achieved. Second, Figure 1 makes clear that the stock of loss-carry forward is much larger under SA than under FA: under SA, it grows from an aggregate USD 400 bln to 1100 bln, while under FA it rises from a total of USD 200 bln to 500 bln. This is as expected, since cross-border loss offset within groups under FA significantly reduces the losses that are carried forward.

Figure 2. Stock of Loss Carryforward, by Year of Initial Losses

A. Separate Accounting



B. Formula Apportionment



Source: IMF staff estimates.

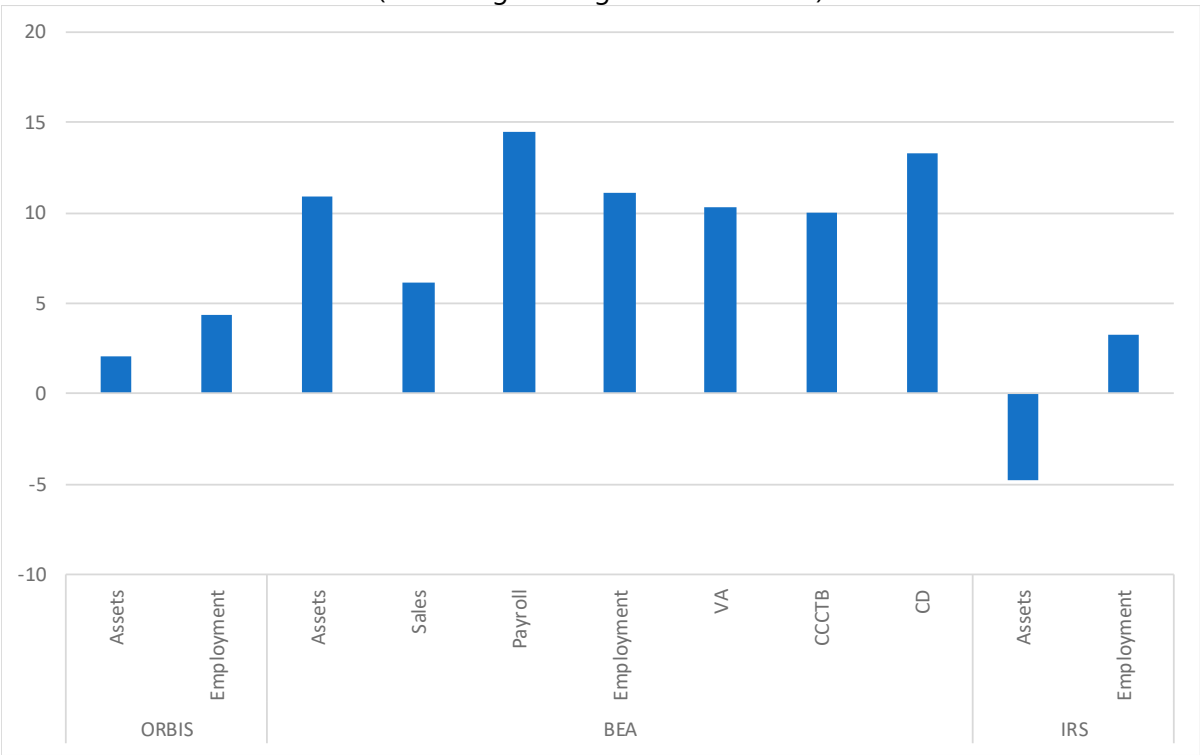
The difference in loss treatment under these two regimes affects the tax bases of countries. For all companies that incurred some losses in 2011, the global CIT base under cross-border consolidation is estimated to be 10 percent smaller than under SA with loss carry forward in 2016. Note that this number represents an upper bound on the tax base change, because some countries currently already allow for domestic relief/loss consolidation—which is not captured in this analysis.

To determine the net global revenue effect of FA, we not only need to consider the effect of loss consolidation, but also the impact of the reallocation of the tax base. If the base is relocated from low-tax countries to high-tax countries, for example, this would increase total tax revenue. Such

[18] The analysis ignores limitations in the period of loss carry forward, which are relevant in several countries. However, since the period explored here is only 5 years and almost all countries have periods exceeding this, the assumption of unlimited carry forward does not have implications for the results.

offsetting impact is assessed with each of the three datasets and shown in Figure 3. First, using ORBIS data, we find that the relocation effect boosts global CIT revenue by 2.2 percent if assets are used in the formula and by 4.6 percent if employment is used. With the IRS data, the revenue gain is 3 percent if employment is used as a factor. For the asset factor, however, there is a negative revenue effect from relocation. This is driven by the reallocation of the tax base into the U.S. (which gains an additional 7 per cent of the global tax base), combined with a relatively low effective tax rate of 18 percent in the IRS data. This is in sharp contrast to the BEA data, which reports an effective tax rate in the US of 27.7 percent. In the BEA data, the relocation of the tax base therefore yields much larger positive effects on global revenue, ranging between 6 and 15 percent, depending on the formula used.

Figure 3. Revenue Effects of FA from Reallocating the Tax Base
(Percentage Change in CIT Revenue)



D. Effects on the Distribution of Tax Revenue

Figure 4 summarizes the effects of FA on the distribution of CIT revenue paid by MNEs for different country groups:[19] (a) US versus rest of the world (ROW); (b) OECD versus non-OECD; (c) below and above the median tax rate. For each group, Figure 4 shows the median impact in percent of current tax paid by the MNEs in the sample. The bars show the effect based on either

[19] Country-specific effects are provided in Appendix 1. Revenue effects are presented in percentage change relative to current revenue. If the tax rate is the same under SA and FA, then the percentage increase/decrease in revenue is the same as the percentage increase/decrease in the tax base.

of the three data sets employed (ORBIS, BEA and IRS) and the formula used. Figure 5 highlights specifically the revenue effects for investment hubs.[20]

United States Versus Rest of World (Panel A)

Results for the U.S. are only provided for the BEA and IRS data, not for ORBIS where U.S. firms are poorly represented. The specific effects for the U.S. are important for understanding the results in other countries, given the very large share of the U.S. tax base (over 50 percent) in the samples (see Figure 1). For instance, if the U.S. would gain significantly under a certain formula, it might well be that all other countries in ROW will lose and that the median loss would be relatively large. Panel A in Figure 4 shows that U.S. tax revenue from MNEs would expand under most formulas, except when the employment factor is used (in which case U.S. tax revenue falls by 14 percent in the IRS data). In the BEA data, the revenue increase for the U.S. ranges from 1 percent for the employment factor to 20 percent for the asset factor. The effect for the median country in ROW largely mirrors the effects for the U.S. For example, tax revenue falls under the asset, payroll and CD formulas, while it expands under the employment formula. These effects range from a decrease under the asset factor of around 20 percent in both the BEA and IRS data, to an increase under the employment factor of between 35 and 65 percent. Under the sales by destination formula, we find that tax revenue in the median country in ROW increases.

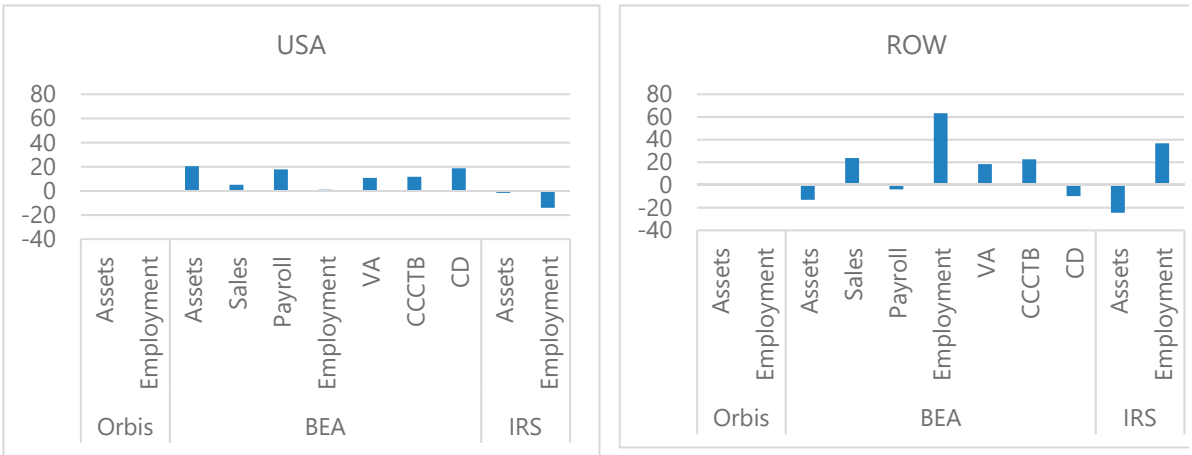
Advanced Versus Developing Economies (Panel B)

For ORBIS data, we see that the median OECD country suffers a loss in revenue from FA, either when the asset factor or the employment factor is used. This partly reflects the impact of loss consolidation, which narrows the global tax base by 10 percent. The median non-OECD country shows a revenue increase if the employment factor is used, but not for the asset factor. This picture is somewhat different when we use data for U.S. MNEs (either BEA or IRS). In these cases, OECD countries typically enjoy an expansion of revenue under most formulas, except the pure asset factor. The latter mirrors the impact for the U.S. which enjoys a gain from using the asset factor. The gain for OECD countries is largest under a value-added apportionment, for which the median OECD country experiences a 27 percent revenue increase from U.S.-based MNEs. For the median non-OECD country, revenue tends to decline under apportionment by assets or payroll. Yet, it expands significantly (by nearly 85 percent) under apportionment by the number of employees. Interestingly, also apportionment by destination sales expands tax revenue in the median non-OECD country—presumably as consumption is high relative to production (reflecting e.g. a trade deficit for MNEs or because people in these countries consume out of development aid or remittances).

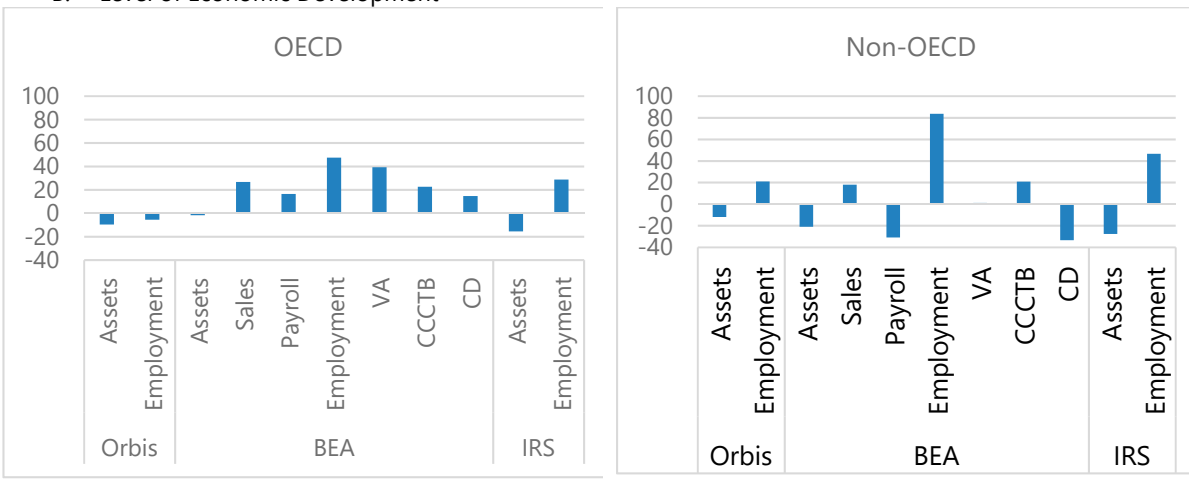
[20] The revenue results are broadly similar if taxable income is used as the proxy for the tax base instead of profits, see Appendix A, Table A.2.

Figure 4. Summary of Revenue Effects by Country Groups
(Percentage Change in CIT Revenue)

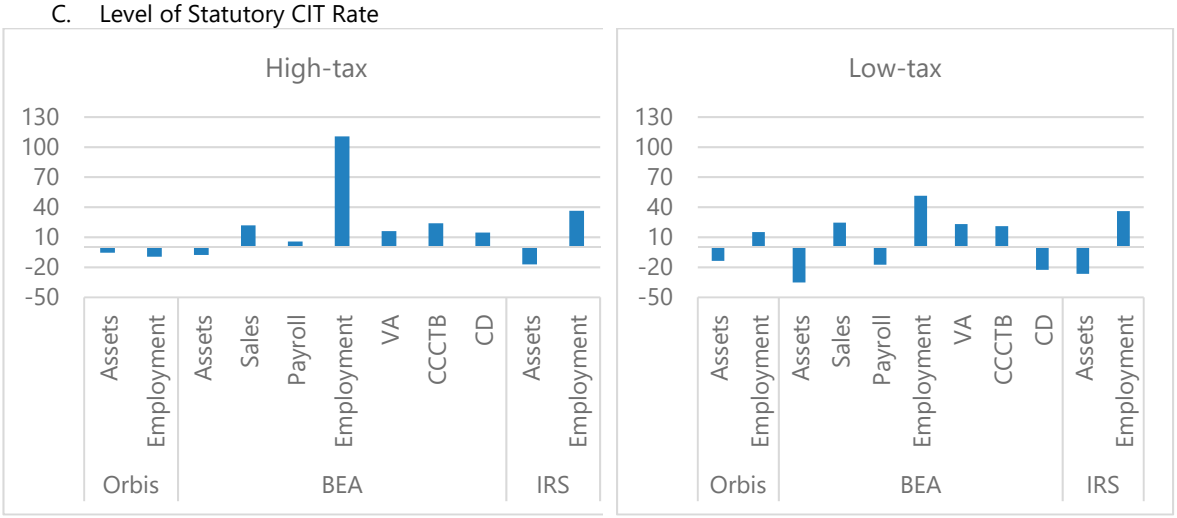
A. United States vs. ROW



B. Level of Economic Development



C. Level of Statutory CIT Rate



High Versus Low-Tax Countries (Panel C)

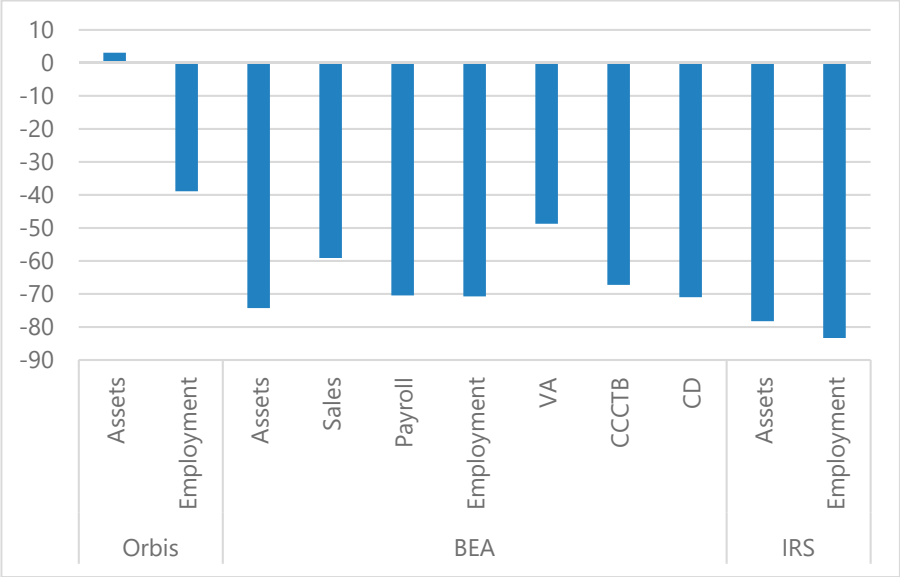
Figure 4 shows that countries with relatively high tax rates (i.e. higher than 22.8 percent, which is the average in the sample) tend to benefit from FA, except if the asset formula is used. In the latter case, both the median of the low-tax and high-tax countries loses revenue (which can be explained by the gain in the U.S.). Most low-tax countries lose revenue from FA when production factors are in the formula (e.g. asset, payroll, and Cobb-Douglas). They gain, however, when employment is used—which again is the mirror image of the effect for the U.S.

Investment Hubs (Figure 5)

Figure 5 shows the revenue effects of FA for the investment hubs, i.e. the countries characterized by a high ratio of FDI to GDP (Damgaard and Elkjaer 2017). In 2017 the top ten economies with the highest ratio of inward FDI to GDP are Cyprus, Hong Kong SAR, Hungary, Ireland, Luxembourg, Malta, Mauritius, Netherlands, Singapore and Switzerland.[21] When using ORBIS, however, the data is limited to only five countries: Hungary, Ireland, Luxembourg, Malta and the Netherlands. Generally, we see that investment hubs lose significant tax revenue from the introduction of FA, regardless of the apportionment factor used. The erosion of the tax base even exceeds 70 per cent of the MNE's current tax payments under some formulas. These results illustrate the large difference between the currently reported profits by U.S. MNEs in these countries and the reported factor share used in the FA calculation to apportion their global profits. There is one notable exception though, which is when ORBIS data are used and apportionment is by assets: in that case, the median investment hub in Europe sees its tax revenue increase. This result reflects the small group of investment hubs when using ORBIS data and the positive effect in four of the five countries where MNEs actually report large asset shares (the exception being Ireland). This could be due to the sample composition of the ORBIS datasets as the majority of firms are European-owned with a large share of assets in Europe. Indeed, the result does not carry over to the BEA or IRS data for U.S. MNEs.

[21] Based on 2017 CDIS and excluding resource-rich countries.

Figure 5. Summary of Revenue Effects for Investment Hubs
(Percentage Change in CIT Revenue)



E. Dynamic Effects

An important omission from the analysis above is that it reflects the static impact of reforms, without accounting for changes in the behavior of MNEs or for changes in corporate tax policies by individual countries. Such dynamic effects could significantly change the impacts.

Under FA, CIT rates will induce incentives for MNEs investment, employment and production if assets, labor or value-added factors are included in the formula. For instance, if assets are part of the formula, MNEs will have an incentive to locate more assets in low-tax countries and less in high-tax countries because such a relocation will expand the share of the consolidated profit that is taxed at the low rate. This can induce a significant tax savings for the MNE. A dynamic relocation of assets in response to FA would thus benefit countries with low CIT rates and harm countries with high CIT rates. This effect is opposite from the static effects reported above and will mitigate the revenue effects. Moreover, the relocation of capital may boost labor productivity in low-tax countries and reduce it in high-tax countries, which will be reflected in GDP and welfare. These effects are illustrated in a study by Bettendorf et al. (2010), who explore the impact of the CCCTB by using a CGE model for the European Union. From the static analysis in their study, it appears that low-tax countries like Ireland lose part of their tax base from the CCCTB. However, accounting for the dynamic effects on investment, it is found that Ireland will actually experience a net welfare gain from the CCCTB.

Also, Altshuler and Grubert (2009) explore the dynamic effects of FA but emphasize a different distortion. While companies will no longer have an incentive to manipulate transfer prices under FA, firms will instead have an incentive to manipulate their organizational structure, e.g. by outsourcing capital-intensive activities in high-tax countries while merging with capital-intensive activities in low-tax countries. Using a simulation model that incorporates these behaviors, the authors compare CIT revenue in the US under the current system with that under a unilateral

adoption of FA, with an equal-weight formula of assets, payroll and sales. Without behavioral responses, the static estimates suggest large revenue gains for the US. However, the simulations with behavioral responses show that this revenue gain virtually disappears.

While behavioral responses might thus significantly alter the results on the revenue effects of FA, they critically depend on the choice of the apportionment formula. If sales by destination is used, for instance, it is expected to produce much smaller behavioral effects since consumers are generally less responsive to differences in CIT rates than production factors. Therefore, sales by destination might provide a more robust FA system where dynamic effects are less important. A possible risk of using the sales factor is, however, that low-tax countries become sales hubs: MNEs might sell their products to third parties in these hubs to minimize their global tax liability; and these third parties can subsequently sell to the final consumers in high-tax locations.

Governments can respond to the changed incentives for tax competition. For instance, if assets receive a significant weight in the formula and MNEs respond to this by relocating assets, governments will have a strong incentive to reduce their CIT rates in order to attract investment. Indeed, simulations by Bettendorf et al. (2010) with their general equilibrium model suggest that the welfare gain of a CIT rate cut by an individual country is larger under FA than it is under the current system. Such incentives might be muted, however, if FA is based on sales by destination. Experience from the U.S. is that tax competition has led States to modify their formula by moving away from production factors towards a larger share of sales by destination.

Hence, dynamic effects can significantly change the assessment of both the revenue impact as well as the wider economic impact of FA. These effects, however, depend on the precise magnitude of the behavioral responses on which there is generally considerable uncertainty. Dynamic effects are likely to be more important if production factors receive a large weight in the formula and less so if sales by destination receives a large weight.

IV. CONCLUSION

This paper explores the economic and distributional impact of global formula apportionment. Existing literature emphasizes the substantial benefits from the elimination of profit shifting within MNE groups and the possible major simplification gains—both of which are particularly important for developing countries. However, experience from federal states suggests that new distortions will arise in the allocation of formula factors and that opportunities for tax planning will not go away (but will be of a different form). Moreover, tax competition will not disappear under formula apportionment and might intensify if the factors in the formula are mobile across borders.

The paper also assesses the direct revenue implications of formula apportionment for individual countries under alternative formulas. The results are no more than illustrative: they differ significantly between the datasets, and coverage of low-income countries in two of the datasets is sparse. The distributional effects are found to be large. The largest revenue decreases are apparent in investment hubs, where losses of up to 80 percent of MNE tax payments are reported. Many large economies experience an increase in CIT revenue. Developing countries

gain mostly if employment receives a large weight in the formula, yet also tend to benefit on average from a formula based on sales by destination.

The policy relevance of the analysis in this paper extends well beyond FA. For instance, the analysis makes transparent how profit would be allocated if it were to closely resemble the allocation of production factors or sales (either by origin or destination). This informs debates on the desirable allocation of taxing rights and profit attribution. Moreover, the analysis sheds light on the revenue implications of more incremental reforms that would only partly use formulary elements. For example, proposals for so-called residual profit allocation use FA for a fraction of the total profit (Avi-Yohah et al. 2009; Devereux et al. 2019; IMF 2019).

There are also limitations. For instance, there is lack of a global dataset for MNEs that could comprehensively analyze FA reforms, including for low-income countries. This issue might be resolved in the future if a database would be developed from the country-by-country reports of large MNEs. Also, the analysis shows the change in the tax base from multinational enterprises reflected in the data, but it is unclear what proportion of the total corporate tax payments these companies are responsible for. In addition, the analysis presented here is static in nature and ignores behavioral responses by firms and governments. It also ignores general equilibrium effects, such as exchange rate effects if the tax base is shifted from source to destination. These economic effects are ultimately critical for understanding the wider welfare implications of FA and thus its desirability.

Appendix 1. Revenue Effects of FA by Economy

This appendix shows the revenue effects of FA for individual economies. It first presents results using our standard profit variable. Then, it explores the robustness of the results with the BEA data by using an alternative measure for taxable profits, based on CIT revenue.

Appendix Table 1.1 presents the change in CIT revenue collected from MNEs if there is global adoption of formula apportionment (in percentage change). The results are presented based on various apportionment factors and using three different datasets. For example, the 'Employment' column shows the change in total CIT revenue from MNEs, if the share of employees in each economy is used to allocate the consolidated profit of the MNE. Appendix Table 1.2 uses taxable income as the proxy for the tax base, rather than economic profit.

Appendix Table 1.1. Revenue Effects of FA by Economy

(Percentage Change in CIT Revenue from MNEs)

Dataset:	BEA							IRS		ORBIS	
Economy/Apportionment Factor	Assets	Sales	Payroll	Employment	VA	CCCTB	CD	Assets	Employment	Assets	Employment
Africa, other countries								244.1	105.1		
Albania								-38.0	205.5		
Algeria								-85.2	-91.5		
Americas, other countries								-97.5	-99.1		
Argentina	2.8	-11.6	-27.5	21.6	19.4	-3.9	-17.4	-28.4	68.6		
Armenia								-39.5	1309.9		
Aruba								-47.9	-24.8		
Asia & Oceania, other countries								-23.6	103.3		
Australia	84.1	43.1	80.6	40.8	66.5	62.6	81.8	148.7	28.2	-4.1	-1.1
Austria	50.0	232.9	193.7	139.2	107.7	149.8	145.8	-17.2	36.1	-28.0	-75.5
Azerbaijan								38.2	-80.1		
Bahamas, The								-100.0	-100.0		
Bahrain								-100.0	-100.0		
Bangladesh								-17.1	-60.8		
Barbados	-75.0	-79.5	-96.9	-94.0	-48.9		-89.9	3499.2	-40.1		
Belarus								-35.2	271.3		
Belgium	-34.6	0.9	2.4	-25.3	13.3	-15.0	-9.9	22.5	-31.2	17.4	-4.9
Bermuda	-79.5	-91.7	-94.4	-96.6	-75.6	-88.9	-89.5	-92.6	-99.9		
Bolivia								47.9	224.5		
Bosnia and Herzegovina								-83.0	44.1	-20.2	69.3
Botswana								-38.1	328.1		

Dataset:	BEA							IRS		ORBIS	
Economy/Apportionment Factor	**Assets**	**Sales**	**Payroll**	**Employment**	**VA**	**CCCTB**	**CD**	**Assets**	**Employment**	**Assets**	**Employment**
Brazil	152.8	241.0	224.1	504.6	188.2	252.7	200.3	47.2	210.0	-38.9	-15.9
Brunei Darussalam								69.9	13.3		
Bulgaria								53.5	238.2	79.8	158.6
Cambodia								52.5	175.2		
Cameroon								-62.0	70.1		
Canada	32.7	22.2	5.7	27.9	16.0	23.9	14.7	32.2	31.8		
Cayman Islands								-95.8	-99.6		
Chile	160.5	87.3	24.3	223.6	54.0	123.9	69.7	-11.5	29.3		
China	-43.5	22.5	-39.0	173.6	-22.2	15.4	-40.5	-28.2	151.1	-4.7	-3.6
Colombia	49.6	74.6	37.7	176.4	72.9	77.1	41.7	8.0	142.7	-26.2	242.3
Congo, Republic of								549.6	-62.0		
Costa Rica	-20.6	-7.6	0.4	272.3	1.1	36.1	-6.6	-27.8	307.8		
Cote d'Ivoire								-13.4	4.7		
Croatia								-43.7	114.6	3.5	31.2
Curacao								-82.5	-59.4		
Cyprus								-92.8	-88.2		
Czech Republic	13.8	57.9	15.2	197.9	45.5	59.4	14.7	-13.8	295.9	-42.8	-5.6
Denmark	2.4	24.8	62.2	10.6	37.8	21.2	42.3	-25.5	1.1	-2.0	-20.4
Dominican Republic	-26.2	15.5	-54.9	182.8	0.3	17.7	-45.3	-36.4	187.8		
Ecuador	-35.3	68.0	-16.3	129.5	1.6	29.8	-22.6				
Egypt	232.5	68.1	-50.5	69.5	42.5	103.4	43.8	-9.5	32.0		
El Salvador								-21.1	438.0		
Equatorial Guinea								-0.9	-88.7		
Estonia								-39.6	277.5	-44.0	38.7
Europe, other countries								-97.1	-90.8		
Fiji								322.7	638.6		
Finland	6.9	149.7	115.2	90.1	48.7	86.4	79.1	-12.3	-6.0	-22.1	-18.0
France	26.1	177.3	219.7	189.9	148.6	136.1	155.2	7.0	91.7	-11.4	-18.9
Gabon								34.9	-3.2		
Georgia								32.5	1177.5		
Germany	17.6	119.7	150.7	111.0	117.8	89.4	106.3	-5.8	78.1	-26.0	-9.4
Ghana								318.8	36.3		
Greece	96.6	581.6	381.4	446.2	588.2	364.0	286.4	-77.4	-2.8	-20.0	-19.9
Guam								-6.5	69.1		
Guatemala								-28.3	295.6		
Guernsey								-100.0	-100.0		
Honduras	19.2	58.6	102.6	1298.8	65.3	239.1	74.8	5.5	1475.5		

Dataset:	BEA							IRS		ORBIS	
Economy/Apportionment Factor	**Assets**	**Sales**	**Payroll**	**Employment**	**VA**	**CCCTB**	**CD**	**Assets**	**Employment**	**Assets**	**Employment**
Hong Kong SAR	-76.4	20.7	-27.0	-32.6	-29.5	-28.5	-43.5	-81.0	-63.6		
Hungary	-25.3	4.7	-18.7	108.4	-11.3	8.1	-20.9	-85.5	-44.5	12.4	16.8
Iceland								1827.0	133.1	1.7	7.0
India	-39.7	3.5	60.8	573.8	23.1	93.7	27.3	-62.1	332.5	-5.4	-2.1
Indonesia	-7.7	-63.3	-76.1	-31.3	-28.7	-41.6	-53.3	22.8	-4.4		
Iraq								141.7	14.7		
Ireland	-76.9	-91.5	-91.1	-92.3	-57.0	-86.7	-86.4	-59.5	-87.6	-12.1	-5.5
Israel	-5.2	-51.1	47.6	49.1	40.8	-2.7	30.0	-38.2	-23.2		
Italy	21.1	177.8	127.4	110.7	140.3	106.0	91.9	0.8	68.8	-4.6	5.9
Jamaica								-57.1	904.1		
Japan	-65.3	-5.2	-19.0	-38.6	-26.0	-33.1	-34.4	-71.2	-40.6	-1.2	-5.8
Jersey								-100.0	-100.0		
Jordan								164.8	40.2		
Kazakhstan								419.6	-52.7	-8.5	10.6
Kenya								-37.1	66.5		
Korea	-41.4	25.7	-14.2	0.0	-11.3	-7.6	-23.2	-25.8	9.4	-22.9	2.3
Kuwait								-27.8	10.7		
Latvia								-95.7	-36.6	-21.9	38.6
Lebanon								-94.4	-36.3		
Lithuania								-71.3	198.6	-9.6	129.9
Luxembourg	-74.3	-71.9	-82.5	-86.3	-71.9	-76.9	-79.8	-75.5	-98.3	0.0	-49.0
Macau SAR								3100.7	2275.8		
Macedonia, FYR								147.6	1609.6	-57.0	0.6
Malaysia	-13.1	-40.2	-66.6	15.9	-34.1	-26.2	-48.8	15.4	120.4		
Malta								-84.3	-44.0	11.1	-38.9
Mauritius								-98.8	-80.3		
Mexico	-31.9	-12.5	-32.1	183.6	-17.5	10.5	-32.0	-6.3	289.7	-5.1	6.0
Monaco								122.4	33.2		
Montenegro, Rep. of										-15.4	118.0
Morocco								-48.9	364.6		
Myanmar								317.1	253.4		
Namibia								-53.0	243.4		
Netherlands	-62.2	-29.7	-39.6	-48.3	-45.7	-45.3	-47.2	-73.9	-87.1	3.1	-61.4
New Zealand	-17.9	36.0	-8.2	34.6	18.8	10.4	-11.4	-32.2	37.2		
Nicaragua								7.9	438.1		
Nigeria								254.7	-73.7		
Norway	-11.1	-51.3	-67.8	-79.9	-32.5	-22.0	-48.9	94.1	-23.0	-8.6	10.7

Dataset:	BEA							IRS		ORBIS	
Economy/Apportionment Factor	**Assets**	**Sales**	**Payroll**	**Employment**	**VA**	**CCCTB**	**CD**	**Assets**	**Employment**	**Assets**	**Employment**
Oman								-61.8	-78.3		
Pakistan								-49.1	59.0		
Panama	95.0	109.0	24.3	249.2	3.8	102.0	47.8	-31.2	-48.0		
Papua New Guinea								2418.3	-6.9		
Paraguay								59.1	4.2		
Peru	-7.5	-61.8	-73.7	-44.3	-41.4	-37.8	-51.6	52.7	-6.1		
Philippines	39.6	21.6	21.2	688.1	38.6	138.6	27.3	-27.7	489.2	-27.2	-100.0
Poland	10.8	65.2	9.1	190.8	60.7	58.6	9.7	13.1	326.8	-6.1	7.2
Portugal	-14.9	142.2	46.7	129.6	110.2	71.8	26.2	14.0	367.7	-24.8	-14.3
Puerto Rico								-91.0	-91.8		
Qatar								-33.2	-84.6		
Romania								41.3	543.9	-19.7	167.1
Russia	-4.2	169.2	1.2	142.2	44.2	129.0	-0.6	3.4	167.0	-8.5	9.8
Saudi Arabia			131.3	83.7	75.1			-6.3	23.8		
Senegal								-8.7	221.7		
Serbia								36.3	825.8	-23.9	101.9
Singapore	-72.1	-59.1	-70.5	-70.8	-48.8	-67.3	-71.0	-70.3	-79.7		
Slovakia								8.0	388.2	-16.9	28.0
Slovenia								48.3	270.1	-1.5	13.3
South Africa	-21.3	214.1	78.3	257.5	77.7	120.2	45.1	6.0	271.1		
Spain	33.4	147.6	120.5	139.2	71.0	103.6	91.5	-32.7	30.2	-1.6	-27.6
Sri Lanka								-81.5	42.7		
St. Kitts and Nevis								340.3	231.6		
St. Lucia								819.4	240.9		
Stateless entities and other country								-35.6	-81.8		
Sweden	-55.4	23.7	40.3	17.6	17.9	-0.9	8.4	-62.7	-24.3	-15.1	-33.2
Switzerland	-89.6	-72.9	-76.2	-87.6	-53.4	-81.5	-80.7	-64.9	-86.5		
Taiwan Province of China	-39.1		-46.7	8.9	-32.9		-44.2	-31.9	46.6		
Tanzania								673.7	636.3		
Thailand	17.7	24.3	-50.9	91.4	28.4	20.8	-28.0	-15.5	50.7		
Trinidad and Tobago								18.1	-8.0		
Tunisia								-54.2	805.1		
Turkey	-61.3	142.6	-10.0	45.8	117.0	30.4	-27.1	-29.7	122.4		
Uganda								57.9	33.5		
Ukraine								-52.6	347.2	-0.3	109.4
United Arab Emirates	-57.1		-60.7	-70.2	-37.6		-59.5	-31.7	-47.5		

Dataset:	BEA							IRS		ORBIS	
Economy/Apportionment Factor	**Assets**	**Sales**	**Payroll**	**Employment**	**VA**	**CCCTB**	**CD**	**Assets**	**Employment**	**Assets**	**Employment**
United Kingdom	1.8	27.6	65.4	56.9	52.7	30.2	44.2	-12.8	-2.6	-15.8	-11.3
United Kingdom Islands, Caribbean	-76.3	-92.7	-95.7	-95.4	-74.3	-88.2	-89.2				
United States	20.4	5.0	17.8	0.9	10.8	11.6	18.7	-1.7	-14.0		
Uruguay								-85.7	-71.8		
Venezuela	-54.8	5.4	-30.9	6.4	-26.7	-20.5	-38.8	-75.3	-47.5		
Vietnam								-31.4	251.1		
Virgin Islands								413.5	261.0		
Zambia								-40.3	212.3		
Zimbabwe								39.1	454.0		
Median	-12.1	23.1	0.4	56.9	17.9	21.2	-8.3	-23.6	36.3	-9.6	0.6
Average	-4.1	46.6	17.0	114.0	30.5	40.7	8.6	94.6	156.7	-11.0	17.4
Aggregate	11.0	6.2	14.5	11.1	10.3	10.1	13.3	-4.8	3.2	-7.8	-5.4

Appendix Table 1.2. Revenue Effects of FA by Country; Using Taxable Income as the Proxy Tax Base

(Percentage Change in CIT Revenue)

Dataset:	BEA						
Economy/Apportionment Factor	Assets	Sales	Payroll	Employment	VA	CCCTB	CD
Argentina	-44.2	-51.7	-60.8	-33.2	-34.4	-47.6	-55.3
Australia	31.1	2.3	27.8	-0.8	20.7	15.7	28.9
Austria	-1.1	118.7	95.7	61.2	39.1	65.3	63.4
Barbados	3.3	-65.7	-88.5	-76.0	137.8		-57.6
Belgium	-16.2	28.1	31.0	-4.6	44.1	8.4	15.3
Bermuda	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brazil	43.3	101.1	86.6	241.6	69.9	102.8	72.2
Canada	46.0	34.7	16.4	40.6	28.1	36.4	26.3
Chile	-27.6	-51.0	-66.4	-11.7	-58.6	-39.2	-53.5
China	-45.5	17.6	-41.4	163.8	-25.1	11.1	-42.8
Colombia	-49.3	-39.9	-53.0	-6.7	-39.7	-39.7	-51.8
Costa Rica	40.5	62.6	81.9	574.8	85.1	143.8	68.1
Czech Republic	-17.9	15.1	-16.1	116.6	6.0	15.8	-16.7
Denmark	-54.1	-44.9	-29.5	-51.2	-41.2	-46.5	-37.7
Dominican Republic	-49.6	-22.6	-68.7	95.4	-30.8	-19.6	-62.3
Ecuador	-26.2	93.1	2.5	170.0	15.4	51.0	-7.1
Egypt	-19.2	-59.1	-88.0	-58.8	-65.4	-50.6	-65.0
Finland	31.5	220.2	161.8	133.5	115.1	133.1	118.4
France	-30.4	52.3	76.4	58.8	37.1	29.9	40.8
Germany	-21.6	45.1	65.7	38.4	44.1	25.2	36.6
Greece	-46.6	88.4	31.9	53.2	88.6	28.1	5.8
Honduras	199.9	1530.7	441.6	3733.4	382.6	3387.0	361.1
Hong Kong SAR	-81.1	-4.9	-43.7	-47.4	-44.6	-43.9	-56.2
Hungary	-39.0	-18.1	-34.5	63.8	-21.1	-14.2	-36.0
India	-53.9	-20.7	23.0	415.3	-5.4	48.2	-2.6
Indonesia	-55.4	-82.2	-88.5	-66.7	-65.0	-71.7	-77.5
Ireland	-60.4	-85.0	-84.4	-86.5	-24.6	-76.9	-76.4
Israel	-8.4	-53.2	41.2	43.0	38.5	-6.5	24.6
Italy	-31.8	57.9	27.9	19.6	35.5	16.6	8.0
Japan	-67.8	-10.8	-23.1	-41.9	-30.5	-37.0	-38.0
Korea	-48.8	10.6	-24.5	-11.7	-21.9	-18.8	-32.6
Luxembourg	-59.7	-51.4	-71.7	-78.2	-46.8	-62.0	-67.7
Malaysia	11.3	-24.4	-56.9	49.2	-19.6	-5.7	-34.2
Mexico	-47.3	-32.3	-47.8	119.0	-37.1	-14.6	-47.6

Dataset:	BEA						
Economy/Apportionment Factor	**Assets**	**Sales**	**Payroll**	**Employment**	**VA**	**CCCTB**	**CD**
Netherlands	-68.4	-41.3	-50.0	-56.8	-52.4	-54.4	-56.1
New Zealand	17.3	94.6	31.6	93.2	69.8	58.1	26.8
Norway	-63.3	-78.9	-86.6	-91.6	-72.4	-66.1	-78.8
Panama	5.2	56.2	-31.8	95.8	-45.7	51.0	-19.5
Peru	-37.6	-74.2	-82.4	-62.4	-60.6	-57.7	-67.4
Philippines	3.0	-9.9	-9.9	488.7	2.7	77.5	-5.6
Poland	4.4	55.6	2.9	174.7	50.8	49.6	3.4
Portugal	27.5	264.3	118.8	245.1	213.0	157.9	88.4
Russia	-56.4	-5.9	-53.7	9.8	-33.1	-19.9	-54.6
Saudi Arabia			-9.1	-27.8	-31.2		
Singapore	-49.8	-25.7	-46.8	-47.2	-7.5	-40.8	-47.8
South Africa	-38.8	143.7	37.6	166.8	39.1	69.0	12.2
Spain	2.7	91.8	70.8	84.2	32.9	57.3	48.1
Sweden	-66.0	-4.1	8.5	-10.5	-7.5	-23.7	-16.3
Switzerland	-82.3	-53.4	-58.8	-78.6	-17.7	-68.1	-66.6
Taiwan Province of China	-51.0		-57.0	-12.1	-46.0		-55.0
Thailand	-39.3	-38.9	-75.2	-4.7	-35.7	-39.4	-63.2
Turkey	-73.0	73.8	-37.3	1.5	51.2	-6.6	-49.2
United Arab Emirates	-69.9		-72.5	-79.1	-56.2		-71.6
United Kingdom	-32.9	-15.8	9.2	3.3	1.1	-14.1	-4.8
United Kingdom Islands, Caribbean	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	40.5	22.4	37.4	17.8	29.1	30.1	38.4
Venezuela	-61.5	-9.1	-40.3	-8.8	-36.3	-31.7	-47.3
Median	-35.3	-4.5	-23.1	3.3	-7.5	-5.7	-26.0
Mean	-23.0	40.8	-3.0	114.3	9.9	68.9	-9.6
Aggregate	14.1	6.9	15.5	8.4	11.9	11.1	15.0

Note: Aggregate for BEA is calculated between 2014 - 2016 due to a break in the data

Appendix 2. Revenue Effects of FA using EBIT to Measure Taxable Profit

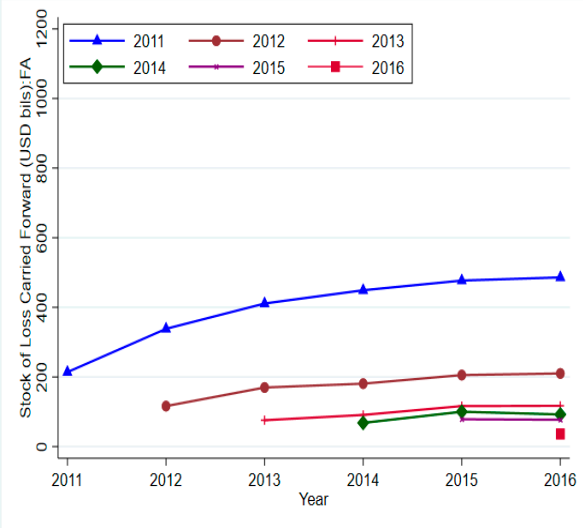
This appendix presents results on the revenue effects of FA, including from loss consolidation and from reallocation of tax base, using an alternative measure of pre-tax profit – earnings before interest and tax (EBIT). Comparing to pre-tax profit, the main advantage of using EBIT is that it excludes any income from equity investment in affiliates, should the company included in our analysis has any subsidiaries. For these companies, pre-tax profits measured by EBT would also include these passive incomes, thus introducing measurement noise in the taxable profit of the respective country. As EBIT is reported before reconciliation of any financial income, it does not double count income or loss from subsidiaries. On the other hand, interest income/payment are still part of EBIT, so EBIT may inflate the pre-tax profit with additional interest income or payment. For these considerations we do not use EBIT as the main measure of pre-tax profit with the ORBIS data, but instead assess the revenue effects of FA using EBIT as an alternative measure of taxable profit.

Effects on Global Tax Revenue

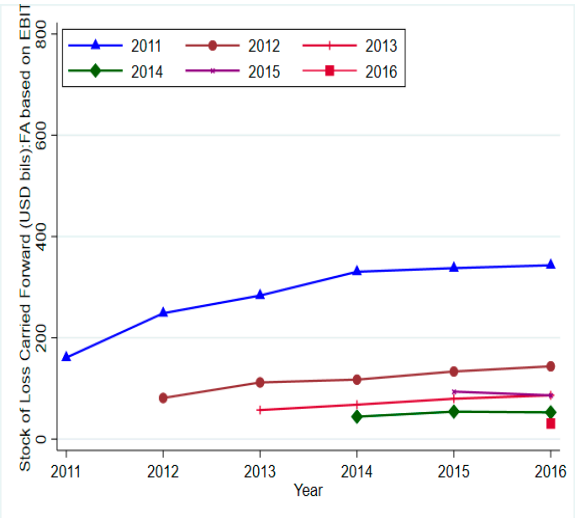
Impact of Loss Consolidation. To assess the impact of cross-border loss consolidation on the global tax base, we use the same approach as used in Section C. Namely, we start with the loss carry forward in 2011, based on the reported losses in 2010. In subsequent years, the stock of losses carried forward grows with new losses and shrinks with the losses that are offset against profits in that year. While the pattern of the stock of loss carryforward remains very similar (Appendix Figure 2.1), more losses are offset in the current year under EBIT, leading to a somewhat smaller global CIT base after loss consolidation. Specifically, for all companies that incurred some losses in 2011, the global CIT base under cross-border consolidation is estimated to be 14 percent smaller than under SA with loss carry forward in 2016. The extent of reduction is slightly larger than that based on EBT (10 percent).

Appendix Figure 2.1. Stock of Loss Carryforward, by Year of Initial Losses

A. Formula Apportionment, EBT



B. Formula Apportionment, EBIT



Source: IMF staff estimates.

Incorporating the effect of reallocation. To determine the net global revenue effect of FA, we follow Section C and allocate the new global CIT tax base among countries, based on their respective share of fixed assets and employment. The relocation effect is quite similar under EBIT, boosting global CIT revenue by 3 percent if assets are used in the formula and by 5 percent if employment is used. In net, using EBIT as an alternative measure of taxable profit, global CIT tax revenue would decrease by 11 percent under the fixed asset formula, and by 9 percent under the employment formula. The size of reduction is slightly larger than the prior assessment, mainly due to a smaller global CIT base after loss consolidation using EBIT.

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