Updated Experimental Ultimate Host Economy Statistics for U.S. Direct Investment Abroad

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Abstract This paper provides an update on BEA's research into ultimate host economy statistics for U.S. direct investment abroad (USDIA). A previous BEA working paper (Brew et al. 2023) explored producing statistics on equity position by ultimate host economy using six different methods for reallocating equity position by immediate host economy. The present paper introduces three sets of methodological updates to the previous research: (1) modifications to three of the original six reallocation methods, (2) the addition of three new methods to the collection of methods under consideration by BEA, and (3) the incorporation of U.S. affiliates into the ownership chains used to reallocate USDIA equity position. Of the nine methods under consideration, six are selected for comparison across a variety of dimensions using USDIA data collected for 2019 and 2020. Based on this comparison, three methods are identified as meriting further exploration, and country and sector-level results for 2019 and 2020 are presented for the selected methods.

Keywords Foreign direct investment, official statistics

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1. Introduction

The U.S. Bureau of Economic Analysis (BEA) is engaged in ongoing research that aims to develop ultimate host economy statistics for U.S. direct investment abroad (USDIA). These new statistics would supplement the official statistics that BEA already produces on bilateral U.S. direct investment abroad. In accordance with international guidelines, these existing statistics are compiled and presented by immediate partner economy, which, in the case of U.S. multinational enterprises (MNEs), is the economy where the first non-U.S. entity in the ownership chain is located. The presentation by immediate partner economy is well suited for many purposes, including for understanding the cross-border flow of funds in BEA's International Transactions Accounts. However, it can lead to difficulty in interpreting direct investment statistics, especially in identifying the economies that are the ultimate destinations, or hosts, of U.S. direct investment abroad.

The need for a separate set of statistics that identify the economies that ultimately host USDIA arises from the fact that many of the affiliates directly held by U.S. MNEs are holding companies or other special purpose entities set up not to engage directly in productive or operating activities but to channel investments to other countries where productive and operating activities occur.[1] These special purpose entities contribute to MNEs' pursuit of profit maximization by taking advantage of the favorable tax or regulatory regimes of the countries in which they are set up, and they have become an increasingly common feature of MNEs' global structures in recent decades.[2] As a result of these entities' prevalence, BEA's existing bilateral outward direct investment statistics do not reflect the full range of the countries and industries of the foreign affiliates ultimately owned or controlled by U.S. parent companies, even though they do represent the countries and industries of the affiliates with which U.S. parents have direct transactions and positions.[3] The purpose of ultimate host economy (UHE) statistics is to bridge this gap by providing information on the countries and industries of the foreign affiliates that are the ultimate targets of USDIA.

In its effort to develop UHE statistics, BEA has examined a series of techniques that reallocate the USDIA equity position by immediate host economy to produce USDIA equity position by UHE. The initial research on this topic was described in Brew et al. (2023). In addition to providing background information on BEA's direct investment statistics, the paper summarized investigations into six methods that reallocate direct investment equity position by immediate host economy to generate equity position by UHE. (The focus on equity position, which is shared by the present paper's analysis, is seen as a practical first step to BEA's eventual goal of reallocating the total position.) The analysis concluded that three of the six methods were worthy of further analysis, while the other three were judged to have shortcomings that made them unsuitable, at least without significant modifications, for further consideration. The three reallocation methods selected for further analysis, and for which the paper presented country and sector-level results using data collected for 2019 on BEA's direct investment surveys, were:

- First operating affiliate

[1] Special purpose entities are legal entities with little or no employment or physical presence.

[2] For example, the proportion of the outward U.S. direct investment position that is in holding companies increased from 9.4 percent in 1982 to 52.1 percent at its peak in 2017 and, as of the 2024 USDIA position, currently stands at 47.3 percent.

[3] For more detailed evidence on this point, see "Introduction" in Brew et al. (2023).

- Last affiliate
- Passthrough with ownership chains

The three non-preferred methods were:

- PESAA (or U.S. parent's equity share in affiliates' assets)
- Apportionment
- Passthrough-apportionment hybrid

Building on the work in Brew et al. (2023) and on extensive feedback on its analysis, the present paper introduces three main sets of methodological updates to BEA's research on UHE statistics.[4] The first set of updates consists of changes to the methodology already described in Brew et al. (2023). These updates involve modifications to three of the original six reallocation methods (first operating affiliate, passthrough with ownership chains, and PESAA) to address conceptual and methodological shortcomings. This first set of updates also includes improvements to the construction of the MNE ownership chains that were used in the implementation of all the methods other than apportionment and passthrough-apportionment hybrid. Whereas ownership chains were initially constructed based on data from BEA's annual and benchmark surveys of USDIA, it has been possible to increase the number of entities included in the chains by drawing on data from BEA's quarterly survey of USDIA.

The second methodological update consists of the addition of three new reallocation methods to the stable of methods being considered by BEA. The three new methods are:

- Passthrough minimum
- Operating assets apportionment
- Composite index apportionment

The passthrough minimum method is a version of the passthrough with ownership chains method and is examined here primarily for the sake of completeness. It provides useful insight into the logic behind the passthrough with chains method and helps to delineate a key boundary on possible variations of the method, but the passthrough minimum method was not empirically implemented. The other two new reallocation methods, operating assets apportionment and composite index apportionment, represent an important advancement over the apportionment method examined in Brew et al. (2023). Like the original apportionment method, these new methods reallocate USDIA equity position among the foreign affiliates of U.S. MNEs in a way that is proportional to the relative level of productive, or operating, activities undertaken by foreign affiliates in each locale. However, unlike the original apportionment method, they take advantage of BEA's detailed company-level microdata (including U.S. MNE ownership chains) rather than relying solely on country-level aggregate measurements on the extent of U.S. MNEs' productive activities.

The third methodological update is the incorporation of U.S.-based affiliates into the ownership chains used to implement the reallocation methods. In Brew et al. (2023), the ownership chains only included

[4] BEA's initial UHE research was presented to the BEA Advisory Committee, Suitland, MD, October 13, 2023; at the Organisation for Economic Co-operation and Development Working Group on International Investment Statistics meeting, October 3–5, 2023, Paris, France; and at the second edition of the External Statistics conference organized by the Irving Fisher Committee with the European Central Bank, February 12-13, Madrid, Spain.

the foreign affiliates of U.S. MNEs, which meant that USDIA equity positions could only be reallocated to affiliates in foreign countries and never back into the United States. By drawing on data collected by BEA's Benchmark and Annual Surveys of Foreign Direct Investment in the United States, it has been possible to construct ownership chains for U.S. MNEs that include U.S. affiliates. The inclusion of U.S. affiliates in the ownership chains makes it possible to estimate the portion of the USDIA equity position that is ultimately hosted by U.S.-based affiliates as well as, to the extent that U.S. affiliates are also parents of foreign affiliates, the portion that passes through the United States before returning abroad.

Based on the updated UHE methodology, this paper presents a comparison of the relative advantages and disadvantages of the reallocation methods. This analysis focuses on the three preferred methods from the previous paper (first operating affiliate, last affiliate, and passthrough with ownership chains), the updated version of PESAA, and the two new apportionment methods (operating assets and composite index). The discussion is based primarily on the empirical results produced by implementing these six methods using data collected by BEA's direct investment survey program for the years 2019 and 2020. The six methods are compared across a variety of dimensions, including conceptual accuracy, ease of implementation, degree of dependence on detailed microdata, robustness to inconsistencies in the data used to implement them, whether they are liberal or conservative in the amount of the USDIA equity position they reallocate, and their consistency with international statistical guidelines. The analysis finds that three of the methods—first operating affiliate, passthrough with ownership chains, and composite index apportionment—are most worthy of further investigation.

A series of country- and sector-level results for these three preferred methods are presented for 2019 and 2020.[5] These country and sector results are based on data that incorporate EZS noise infusion to protect survey-respondent confidentiality.[6] This paper represents the first time that noise infusion has been used for confidentiality protection in a BEA publication; its use allows for the presentation of more complete and detailed results than would otherwise be possible.[7]

The rest of the paper proceeds as follows. Section 2 provides a detailed explanation of the data sources used for the analysis. Section 3 explains the refinements to the methodology that was presented in Brew et al. (2023). Section 4 presents the three new reallocation methods not previously considered. Section 5 discusses the approach taken to incorporating U.S. affiliates into ownership chains. Section 6 presents empirical results produced by implementing the first operating affiliate, last affiliate, passthrough with ownership chains, PESAA, operating assets apportionment, and composite index apportionment methods, and these results are used to analyze these methods' advantages and disadvantages. Section 7 provides country and sector-level results for the three preferred methods identified in section six: first operating affiliate, passthrough with ownership chains, and composite index apportionment. Section 8 concludes.

[5] Brew et al. (2023) also presented UHE statistics by country and industry for 2019. Due to the methodological improvements described in this paper, the results for 2019 presented here supersede those in the previous paper.
[6] EZS noise infusion refers to a noise infusion method developed at the U.S. Census Bureau; see Evans, Zayatz, and Slanta (1998).
[7] For a discussion of BEA's standard approach to disclosure avoidance, which relies on cell suppression, and of the potential for widespread use of EZS noise infusion by BEA, see Bockrath and Yorgason (2023).

2. Data Sources

BEA's direct investment survey program collects quarterly, annual, and benchmark surveys for both USDIA (or "outward" investment) and foreign direct investment in the United States (FDIUS, or "inward" investment).[8] For the present study, the quarterly, annual, and benchmark USDIA surveys are the primary sources of data, as they provide information on the structure and activities of U.S. MNEs and on the USDIA equity position. However, data collected on the annual and benchmark FDIUS surveys also play an important role as they make possible the incorporation of U.S. affiliates into the analysis. It is important to point out that, for both USDIA and FDIUS surveys, a key distinction between the benchmark and annual surveys is that although both collect annual data, the benchmark survey is more comprehensive (see below for details) and is conducted every five years while the annual survey is conducted in years the benchmark is not conducted. Moreover, although the quarterly surveys collect, as the name indicates, data on a quarterly basis, the present study relies on an annualized version of the data collected by these surveys.

Table 1 summarizes the main data items used in the present analysis, which of BEA's surveys they are drawn from, and who is required to file each of the surveys. Note that the U.S. persons required to file the quarterly, annual, and benchmark surveys of USDIA, who are referred to here and in BEA publications as U.S. parents, are defined in the broad legal sense as including individuals, partnerships, corporations, or other forms of organization. Regarding the Quarterly Survey of USDIA, this survey is required, as the table indicates, from U.S. persons that have direct transactions or positions with a foreign business enterprise in which they have a direct or indirect ownership interest of 10 percent or more and that meet other reporting requirements related to the size of their foreign affiliate(s).[9] The main data items provided by the quarterly USDIA survey are USDIA equity positions by immediate partner economy and the primary industry (defined by largest sales) and country location of foreign affiliates of U.S. MNEs.[10] Furthermore, though the annual and benchmark USDIA surveys provide more comprehensive data on the ownership relationships among the entities in each U.S. MNE, the quarterly survey also provides valuable information on MNE ownership structure. In addition to identifying the foreign affiliates in which U.S. parents (USPs) have a direct equity position, the survey collects information for every foreign affiliate on whether it is directly or indirectly owned by its USP. As explained in section 3, one of the methodological refinements introduced in this iteration of BEA's research into ultimate host economy statistics is in constructing ownership chains, to use the ownership information collected by the quarterly survey to supplement the more comprehensive information provided by the annual and benchmark surveys when it is missing or incomplete.

As table 1 indicates, the benchmark and annual USDIA surveys provide four different types of data used in the present study. First, like the quarterly USDIA survey, the benchmark and annual USDIA surveys provide information on the primary industry and country location of foreign affiliates, and these data

[8] For more information, see *A Guide to BEA's Direct Investment Surveys*.
[9] The Quarterly Survey of U.S. Direct Investment Abroad is collected through the BE–577 form. A BE–577 form is required for every directly owned foreign affiliate whose assets, annual sales, or annual net income(loss) is greater than $60 million and for every indirectly owned foreign affiliate that meets the $60 million threshold and has an intercompany receivable or payable balance with the U.S. parent that exceeds $10 million.
[10] BEA's direct investment statistics use industry classifications adapted from the North American Industry Classification System (NAICS). In 2019 and 2020, BEA survey industry classifications were adapted from the 2017 NAICS.

items are used to supplement the industry and country information provided by the quarterly survey when it is missing or incomplete. Second, while these surveys collect a variety of financial and operating data for USPs and their foreign affiliates, this study relies primarily on a small subset of the data items collected for foreign affiliates: owners' equity, equity investment in child affiliates, assets, physical capital (property, plant, and equipment), and employment.[11] In addition, foreign affiliates' value added is used by one of the reallocation methods (composite index apportionment), though rather than being collected directly from survey respondents, value added is derived by BEA based primarily on other data items collected on the benchmark and annual USDIA surveys.[12] The two other data items consist of information on ownership relationships within U.S. MNEs. These data items make possible the construction of ownership chains for each U.S. MNE and provide the percentage ownership interest values (both between parent and child affiliates and between USPs and affiliates) used in many of the reallocation methods' calculations.

[11] Subsequent sections provide a detailed accounting of which of these data items are used by each reallocation method.

[12] A complete explanation of the procedures used to derive value added is available in *U.S. International Accounts: Concepts and Methods*, June 2024, pp. 235–237.

Table 1. Summary of Data Sources

BEA survey	Required reporters	Key data items
Quarterly Survey of U.S. Direct Investment Abroad	U.S. persons that have direct transactions or positions with a foreign business enterprise in which they have an ownership interest of 10 percent or more and that meets minimum size requirements (see footnote 3)	• USDIA equity positions • Country and primary industry of foreign affiliates • Identification of foreign affiliates as directly or indirectly held by U.S. parent
Benchmark Survey of U.S. Direct Investment Abroad	U.S. persons with at least a 10 percent voting ownership interest in one or more foreign affiliates	• Country and primary industry of foreign affiliates • Foreign affiliates' owners' equity, equity investment in child affiliates,[1] assets, physical capital, employment, and value added • Ownership relationships among foreign affiliates, including ownership percentages • U.S. parents' percentage ownership interest in directly held foreign affiliates
Annual Survey of U.S. Direct Investment Abroad	U.S. persons with at least a 10 percent voting ownership interest in one or more foreign affiliates whose assets, sales, or net income (loss) is greater than $60 million[2]	
Benchmark Survey of Foreign Direct Investment in the United States	U.S. business enterprises in which a foreign person owns a voting ownership interest of 10 percent or more	• U.S. affiliates' owners' equity, assets, physical capital, employment, and value added • Primary industry of U.S. affiliates • Identification of foreign parents and ultimate beneficial owners, including their percentage ownership interest in U.S. affiliates
Annual Survey of Foreign Direct Investment in the United States	U.S. business enterprises in which a foreign person owns a voting ownership interest of 10 percent or more and whose assets, sales, or net income (loss) is greater than $40 million	

1. An affiliate of a U.S. MNE that is directly owned (in whole or part) by another affiliate of the MNE is referred to here as the child affiliate of its direct owner. Likewise, an affiliate is referred to as the parent affiliate of any affiliates in which it has a direct ownership interest.
2. For foreign affiliates acquired or established in the year of the survey, the minimum reporting threshold is $25 million.

Although the annual and benchmark surveys of USDIA provide the same broad categories of data, there are significant differences between the surveys regarding how comprehensively they survey the universe of USPs and their foreign affiliates and the level of detail of the information they collect. As indicated in table 1, the benchmark survey is collected from all U.S. persons that have at least a 10 percent voting

ownership interest in one or more foreign affiliates, regardless of the affiliates' size, while the annual survey is only collected from U.S. persons with at least a 10 percent voting ownership interest in one or more foreign affiliates whose assets, sales, or net income (loss) is greater than $60 million. For both the annual and benchmark surveys, a separate survey form is submitted for each affiliate for which the reporting threshold is passed, where the detail and complexity of the form depends on the size of the affiliate and whether it is majority- or minority-owned by the U.S. parent. However, the benchmark survey forms collect more information overall and have lower affiliate-size thresholds for reporting many of the data items collected by both surveys. An example relevant to this paper's analysis is that the benchmark survey collects, for majority-owned foreign affiliates whose assets, sales, or net income (loss) is greater than $80 million, information on equity investments in child affiliates, while the annual survey only collects this information for majority-owned affiliates whose assets, sales, or net income (loss) is greater than $300 million.

The year 2019 is used as the first year analyzed in this study because the most recent USDIA benchmark survey was conducted in 2019. It is important to point out that although the 2020 Annual Survey of USDIA did not collect as comprehensive data as the 2019 USDIA Benchmark Survey, the analysis for 2020 is still based on the full universe of USPs and foreign affiliates as established by the 2019 survey, in addition to foreign affiliates, and their USPs, that were newly acquired or established in 2020 and passed the reporting threshold. To create the full universe of data for non-benchmark years, BEA has developed a set of systematic imputation procedures.[13] For data items collected only on the most detailed annual survey forms, BEA generally bases imputations on relationships among data items reported for above-threshold affiliates. For other items, imputations are based on values reported for the affiliate in a previous year (likely the benchmark year) extrapolated by the year-to-year movement in the data reported by a selection of affiliates in similar industries and countries.

The data on U.S. affiliates used in this study are drawn from the 2019 and 2020 Annual Surveys of Foreign Direct Investment in the United States.[14, 15] As indicated in table 1, the annual survey of FDIUS must be submitted by all U.S. business enterprises whose assets, sales, or net income (loss) is greater than $40 million and in which a foreign person (in the broad legal sense) owns, directly or indirectly, a voting ownership interest of 10 percent or more. (The benchmark FDIUS survey is required from all U.S.

[13] These procedures are also used in benchmark years in the case of U.S. parents and/or foreign affiliates for which required forms are not submitted or for which the submitted forms are incomplete.

[14] In principle, the benchmark survey of FDIUS would also provide the data needed, but the benchmark survey was last conducted in 2017 and 2022.

[15] Sometimes a U.S. business enterprise meets the requirements to file as both a U.S. affiliate on the annual or benchmark FDIUS survey and as a U.S. parent on the annual or benchmark USDIA survey. When it is majority foreign-owned and has assets, sales, or net income (loss) greater than $300 million, it files an abbreviated U.S. parent form on the USDIA survey (and is still required to file separate forms for each of its foreign affiliates) and is also required to submit financial and operating data on the most detailed of the annual or benchmark FDIUS survey forms. However, when the U.S. business enterprise is minority foreign-owned or its assets, sales, and net income (loss) are all less than or equal to $300 million, then it is required to report its financial and operating data on a complete USDIA survey form and on a less detailed FDIUS survey form. The present study had to choose from which of the two forms to draw its data for the U.S. business enterprise. When both sources were available, the study used the financial and operating data reported on the more detailed survey form.

business enterprises, regardless of their size, in which a foreign person has a voting ownership interest of 10 percent or more.) A foreign person that owns a 10 percent or more voting interest in a U.S. affiliate is referred to here and in BEA publications as a foreign parent. The term foreign parent always refers to the first person outside the U.S. in a foreign chain of ownership.

For both the annual and benchmark FDIUS surveys, each U.S. affiliate submits one survey form, where the complexity and level of detail collected by the form is greater for larger affiliates. As with the USDIA annual and benchmark surveys, the FDIUS benchmark survey collects more information overall compared to the annual FDIUS survey, and it also has lower affiliate-size reporting thresholds for some data items. As a result, the creation of a full universe of data for U.S. affiliates in non-benchmark years relies on the same types of estimation procedures as used to create the full universe of data for U.S. parents and their foreign affiliates in years when the benchmark USDIA survey is not conducted.

As table 1 indicates, the benchmark and annual FDIUS surveys provide three main categories of data that are used by this paper's analysis. First, while these surveys collect a variety of data items related to the financial and operating activities of U.S. affiliates, the present analysis relies primarily on data on U.S. affiliates' owners' equity, assets, physical capital, and employment. Value added for U.S. affiliates is derived by BEA based primarily on other survey items. These surveys also collect data on affiliates' primary industry and on the identity of the affiliates' foreign parent(s) and ultimate beneficial owner(s), including name, primary industry, and country location of each. The information on the identity of the foreign parent and ultimate beneficial owner is needed, as explained below, to link U.S. affiliates to the U.S. MNE ownership chains constructed from the USDIA survey data, while the ownership percentages are involved in the calculations used by many of the reallocation methods.

3. Methodological refinements

This section explains a series of refinements to the equity position reallocation methodology presented in Brew et al. (2023). These changes have two components: (1) improvements to the methodology for constructing the ownership chains used by most of the reallocation methods and (2) modifications to certain reallocation methods described in the previous paper. Whereas the original methodology for constructing ownership chains was based solely on the data provided in the benchmark and annual surveys of USDIA, the updated methodology draws on ownership information provided by the quarterly USDIA survey to increase the number of directly held foreign affiliates included in the ownership chains (and thereby increase the number of directly held foreign affiliates whose equity positions can be reallocated). Also presented are refinements to the first operating affiliate, passthrough with ownership chains, and PESAA reallocation methods. These changes aim to overcome a variety of methodological and conceptual weaknesses in these methods that have been identified since the release of the previous paper.

Ownership chains

The USDIA benchmark survey collects, for each foreign affiliate whose assets, sales, or net income (loss) is greater than $25 million, information on which (if any) of its USP's other affiliates have a direct

ownership interest in it. The USDIA annual survey collects the same information for foreign affiliates whose assets, sales, or net income (loss) is above $60 million. In Brew et al. (2023), these data points, combined with information collected by the annual and benchmark surveys on which affiliates were directly held by the USP, provided the basis for the construction of U.S. MNE ownership chains.

The weakness of this approach is that sometimes the data collected on the annual and benchmark survey forms are incomplete. As a result, foreign affiliates identified by the quarterly survey as having USDIA equity positions may be excluded from the ownership chains, or treated as only indirectly held by the USP, and thus not have their equity positions reallocated. For example, the form submitted for a foreign affiliate on the annual or benchmark survey might be missing the information that it is directly owned by its USP even though its quarterly survey form indicates the USP has a direct equity position in it. The modification adopted here is to include affiliates as directly held by the USP in their respective ownership chains if the quarterly survey indicates the USP has a direct equity position in them. By taking advantage of the quarterly survey data regarding direct ownership, this change allows more of the USDIA equity position to be reallocated to affiliates that are indirectly owned by the USP.

Another way the quarterly data can be used to increase the number of foreign affiliates in the ownership chains is by helping to identify affiliates that are directly held by the USP and have no child affiliates. In cases where incomplete data from the benchmark or annual survey otherwise prevents the construction of complete ownership chains, it is sometimes possible to categorize all of a USP's affiliates as directly held without child affiliates based on a combination of quarterly and benchmark or annual survey data. If all three of the following conditions are met for a USP, then all of its affiliates are included in the ownership chains as directly held with no child affiliates: (1) all of the affiliates reported on the quarterly survey are reported as directly held; (2) no affiliates are reported on the annual or benchmark survey that are not also reported on the quarterly survey; and (3) the USP does not have any indirectly held affiliates according to the annual and benchmark survey data. It should be emphasized that, since equity positions in foreign affiliates without child affiliates cannot be reallocated, this update to the ownership chains does not increase the amount of the USP equity position that can be reallocated. Its significance is that it allows the analysis to categorize less of the unreallocated equity position as not reallocated due to data limitations and instead categorize it as not reallocated due to there being no child affiliates.

First operating affiliate

The basic logic of the first operating affiliate method is that, for each affiliate in which the USP has a direct equity position, the first operating (i.e., non-holding company) affiliate beneath it in the ownership chain is identified and the equity position is reassigned to that affiliate.[16] (For an example of applying this method, see appendix B. This appendix demonstrates how to apply the first operating affiliate method, as well as the other methods analyzed in the paper, to a hypothetical MNE.) The modification to this method adopted here consists of a revision to the scheme for determining when the reallocation of a USP's direct equity position is not possible due to the incompleteness of BEA's survey

[16] Operating affiliates are defined as affiliates whose primary industry, defined by sales, is not classified as a holding company. If an affiliate directly held by the U.S. parent is an operating company, then the equity position in it is not reallocated. Further details on this method are provided in Brew et al. (2023).

data. In general, when any of the reallocation methods cannot reallocate a direct equity position due to incomplete ownership chain information, the equity position is categorized as not reallocated due to data limitations. This approach has been modified slightly for the first operating affiliate method to exclude cases where the directly held affiliate is an operating company because in those cases information on the ownership chain is not necessary to determine that the equity position should not be reallocated away from the directly held affiliate.[17] This modification largely accounts for the fact that the proportion of the total USDIA equity position not reallocated due to data limitations is significantly lower for the first operating affiliate than the other reallocation methods (see table 5).

Passthrough with ownership chains

To briefly review the method, passthrough with ownership chains reallocates each direct equity position in a step-by-step manner along the ownership chain. For each affiliate in the chain, the method calculates the portion of the USP's equity position that is passed to it from its parent and then, of the equity received from the parent, the portion that is retained, or hosted, and the portion that is passed further along to the affiliate's own child affiliate (or affiliates). For each affiliate, the amount of equity that it passes through to its child affiliates is calculated as a function of its inward equity (i.e., the equity passed from its immediate parent)[18] and its reported equity investment in its child affiliates (or its outward equity). The USP's reallocated equity position in each affiliate is then calculated as the affiliate's inward equity less its passthrough equity. For affiliate *k*, passthrough equity is calculated as,

$$if\ IE_k \geq 0\ and\ OE_k \geq 0, then\ PTE_k = \min(IE_k, OE_k \times USPPctOwn_k); \quad (1)$$

$$else\ if\ IE_k \leq 0\ and\ OE_k \leq 0, then\ PTE_k = \max(IE_k, OE_k \times USPPctOwn_k); \quad (2)$$

$$else\ PTE_k = 0; \quad (3)$$

where *PTE* = passthrough equity, *IE* = inward equity, *OE* = outward equity, and *USPPctOwn* = the USP's percent ownership share in the affiliate.

When an affiliate has two or more child affiliates, its passthrough equity is divided among its child affiliates (becoming their inward equity) in a manner that is proportional to its direct ownership interest in each child affiliate and the total owners' equity of each child affiliate. If there are *n* child affiliates, then the inward equity for the *p*th child affiliate is calculated as,

$$IE_p = PTE_k \times \frac{PctOwnership_p \times owners'\ equity_p}{\sum_{l=1}^{n} PctOwnership_l \times owners'\ equity_l}. \quad (4)$$

The modification to the passthrough with ownership chains method adopted here consists of placing an additional constraint on the amount of equity that each affiliate can pass through to its child affiliates.

[17] It should be emphasized that this change was only adopted for the first operating affiliate method so that cases of incomplete ownership chain information where the directly held affiliate is an operating company are still treated as a data limitation by all the other reallocation methods.

[18] The inward equity of a directly held affiliate is the USP's equity position in the affiliate.

Equations 1 to 3 ensure that an affiliate cannot pass a quantity of equity to its child affiliates that is larger than its reported equity in other affiliates (or, more precisely, than the USP's interest in its reported equity in other affiliates). The new constraint complements this original constraint by requiring that passthrough equity also not exceed the reported owners' equity of the child affiliates.[19] This additional constraint is necessary due to inconsistencies in the reporting of parent and child affiliate data. In particular, as discussed in more detail in section 6, the equity investment in other affiliates reported for parent affiliates sometimes exceeds the owners' equity reported for their child affiliates. It should be noted that a potential drawback of this change is that it tends to decrease the portion of the USP's equity position that is reallocated to affiliates at each step down the ownership chain.

Formally, the new constraint is implemented as follows for affiliate *k* with *l = 1, …, n* child-affiliates and where inward equity (IE_k) and outward equity (OE_k) are both greater than or equal to zero.

a) PTE_k is calculated using only the *j* = 1, …, *m* child-affiliates with positive owners' equity (where the *m* child-affiliates with positive owners' equity are a subset of the *n* total child-affiliates*)*. $PctOwnership_j$ represents affiliate *k*'s ownership interest in child-affiliate *j*.

$$PTE_k = \min\left(IE_k, OE_k \times USPPctOwn_k, \sum_{j=1}^{m} USPPctOwn_k \times PctOwnership_j \times owners'\ equity_j \right). \quad (5)$$

b) PTE_k is then split among the *l* = 1, …, *n* child-affiliates to determine their inward equity. The inward equity for the *p*th child-affiliate is calculated as:

$$IE_p = PTE_k \times \max\left[0, \frac{PctOwnership_p \times owners'\ equity_p}{\sum_{l=1}^{n} PctOwnership_l \times owners'\ equity_l}\right]. \quad (6)$$

PESAA

The PESAA method is named for the fact that it relies on the calculation of the U.S. parent's equity share of its affiliates' assets. Its essential logic is similar to that of the passthrough with ownership chains method in that it is based on calculating, in a step-by-step fashion along the ownership chain, the portion of the direct equity position that is reallocated to each indirectly held affiliate. As originally conceived the PESAA method worked as follows. For affiliate *k* with $j = 1, \ldots, n$ directly owned child affiliates where *k*'s ownership interest in each is represented as $PctOwnership_j$, the passed through equity (*PTE*) from *k* to each *j* child affiliate was calculated as:

$$PTE_{kj} = PctOwnership_j \times PESAA_k \times owners'equity_j \quad (7)$$

where *PESAA* was the total equity passed through to affiliate *k* by its parent or parents (i.e., its inward equity) divided by its assets. As with the passthrough with ownership chains method, the USP's

[19] One caveat is that, to ensure that the total USDIA equity position after reallocation is the same as before reallocation, this additional constraint is not applied to the inward equity received by directly held affiliates from USPs.

reallocated equity position in each affiliate was then calculated as the affiliate's inward equity less its passthrough equity.[20]

Brew et al. (2023) identified the PESAA method as one of the three least-preferred reallocation methods of the six examined. The most problematic aspect of the method was its tendency to create additional dollars of positive and negative equity position in affiliates along the ownership chain, especially in cases where a child affiliate had a larger owners' equity value than its parent. These additional positive and negative dollars always netted to zero so that the overall net value of the equity position being reallocated remained unchanged. However, these additional dollars of equity position still distorted the country and industry level results since the additional positive and negative dollars were not always reallocated to affiliates in the same country and/or industry.

This paper presents a modification to the PESAA method that prevents the creation of these additional dollars of positive and negative equity position. The modification consists of modeling the method more closely on the passthrough with chains method while keeping the U.S. parent's equity share of affiliates' assets as a central component of the calculations. By no longer including owners' equity in the calculation of passthrough equity, the method's results are much less sensitive to inconsistencies in the owners' equity values reported for parent and child affiliates with the result that additional positive and negative equity positions are not created. The new equations for calculating *PTE* now resemble those used by the passthrough with ownership chains method with the exception that *PESAA* is substituted for the U.S. parent's percent ownership interest. For affiliate *k*,

$$if\ IE_k \geq 0\ and\ OE_k \geq 0, then\ PTE_k = \min(IE_k, OE_k \times PESAA_k); \quad (8)$$

$$else\ if\ IE_k \leq 0\ and\ OE_k \leq 0, then\ PTE_k = \max(IE_k, OE_k \times PESAA_k); \quad (9)$$

$$else\ PTE_k = 0. \quad (10)$$

For an affiliate with multiple child affiliates, passthrough equity is now calculated in the aggregate rather than separately for each parent-child pair. As a result, it is necessary to adopt a method for splitting passthrough equity, when necessary, among multiple child affiliates. In general, when there are *n* child affiliates, the inward equity of the *p*th child affiliate is calculated using equation 4, which is the equation used by the passthrough with ownership chains method to split passthrough equity among multiple child affiliates.[21]

[20] Also following the same pattern as the passthrough with chains method, the inward equity of a directly held affiliate was calculated as the USP's equity position in the affiliate.

[21] Equation 4 is only used when all child affiliates' owners' equity values are of the same sign (i.e., all positive or all negative). If the owners' equity values are not all of the same sign, the equation is modified as follows to prevent the creation of additional dollars of positive and negative equity position,

$$IE_p = PTE_k \times \frac{PctOwnership_p}{\sum_{l=1}^{n} PctOwnership_l}$$

4. New reallocation methods

This paper presents three equity position reallocation methods not previously examined. Table 2 situates these new methods (in bold italics), along with the six other reallocation methods already under consideration, vis-à-vis the three main categories of reallocation methods identified in Brew et al. (2023): push-down, financial structure, and apportionment. Push-down methods—of which first operating affiliate and last affiliate are the main examples—push the direct equity position down the ownership chain until reaching a predetermined stopping point, such as the first operating affiliate or the last affiliate in the chain, and they reassign the entirety of the equity position to the affiliate (or affiliates) at that stopping point. The financial structure methods use company-level financial data, and inferences that can be drawn from that data regarding the financial interrelationships among the entities in the MNE, to reallocate the equity position. Finally, apportionment methods focus on measurements of productive, or operating, activities, seeking to reallocate the USDIA equity position in a manner that is proportional to the level of productive activities undertaken by each affiliate in an MNE (or by all MNEs in each country or industry category, depending on the level of aggregation used).

Table 2. Position Reallocation Methods

Category	1. Push-down	2. Financial structure	3. Apportionment
Sub-type	First operating affiliate	Passthrough with ownership chains	Aggregate
		Parent's equity share of affiliate's assets (PESAA)	***Composite index***
	Last affiliate	***Passthrough minimum***	***Operating assets***
		Hybrid: passthrough-apportionment	

The first of the new methods, termed passthrough minimum or passthrough min, uses, like the passthrough with ownership chains and PESAA methods, information on the financial structure of the MNE to reallocate each directly held equity position. It is in fact a variation of the passthrough with ownership chains method in which the calculation of passthrough equity is adjusted so that it always takes the lowest possible value. The two other new methods fall into the apportionment category. The operating assets apportionment method reallocates each direct equity position in proportion to the size of the operating assets (defined as total assets less equity invested in other foreign affiliates) of each affiliate in the ownership chain. The composite index apportionment method uses a weighted composite of each affiliate's employment, value added, and fixed capital (measured as net property, plant, and equipment) to reallocate each directly held equity position within its respective ownership chain. It bears mentioning that these apportionment methods differ from the apportionment method previously examined in at least one major respect. Whereas the new methods use company-level data to reallocate each directly held equity position among the affiliates in each MNE's ownership chain, the previously examined apportionment method worked at a much higher level of aggregation. The previous method reallocated the worldwide USDIA equity position among countries in proportion to the level of aggregate

productive activities (measured by employment, fixed capital, and sales) of U.S. MNEs in each country.[22] In contrast to the company-level data used by the two new apportionment methods, these aggregate country-level data are publicly available as part of BEA's activities of multinational enterprises (AMNE) statistics.

Passthrough minimum

As outlined above, the passthrough and modified PESAA methods both pass direct investment equity through the direct investment ownership chain in a step-by-step manner until the end of the chain is reached. The two methods differ in that the passthrough method passes along as much equity as possible through to the next affiliate (subject to the constraint that the equity passed along does not exceed the owners' equity of the next affiliate in the chain), while the PESAA method passes only part of that along, with the amount passed through being a function of equity in other affiliates as a share of total assets. For completeness, a "passthrough min" method is considered in which only the minimum possible equity is passed from one affiliate to the next. In other words, an affiliate's inward equity can be considered as either funding ongoing operations or as an investment in the next affiliate down the chain, and this method allocates as much inward equity as possible to funding ongoing operations and only the residual amount of inward equity (if any) is allocated to the next affiliate.

The passthrough min method has a similar relationship to the first operating affiliate method as the passthrough method has to the last affiliate method. Namely, the first operating affiliate method and the last affiliate methods are rough-and-ready approximations of allocations that are produced much more precisely with, respectively, the passthrough min and the passthrough methods. The rough-and-ready methods share a weakness in that they may allocate more direct investment equity to an affiliate than it can accommodate given its owners' equity. (In practice, this weakness is probably more impactful for the last affiliate method than for the first operating affiliate method.)

For ownership chains with positive values of direct investment equity, the passthrough under the passthrough min method is calculated for affiliate *k* as

$$PTE_k = \max\left(IE_k - OA_k, 0\right) \tag{11}$$

for

$$OA_k = Assets_k - OE_k \tag{12}$$

where *IE* denotes inward equity, *OA* denotes "operating assets," and *OE* denotes outward equity. It is worth noting that this definition of operating assets is relatively broad as it includes any asset not associated with equity in child affiliates, and some of these assets may have only a tenuous connection to actual operations. As with the passthrough method, if there are *n* affiliate subsidiaries, affiliate subsidiary *p* receives inward equity from its parent affiliate *k* as calculated using equation 4.

[22] The previous apportionment method could also, in principle, reallocate the worldwide USDIA equity position among industry categories in proportion to the level of aggregate productive activities in each industry category as measured by BEA's AMNE statistics.

Operating assets apportionment

Another approach that is useful to consider can be termed "operating assets apportionment." This approach is relatively simple and it requires fewer constraints than some of the other methods, but unlike the apportionment methods discussed in Brew at al. (2023), it requires some information about each ownership chain.

For this method, within each ownership chain, the difference between the USP's (direct or indirect) ownership interest in the affiliate's total assets and its equity in other affiliates is determined. This can be considered the USP's interest in the affiliate's operating assets. The value of the direct investment equity position apportioned to a given affiliate is calculated as the value of the USP's direct investment equity in the ownership chain multiplied by the ratio of the USP's interest in the affiliate's operating assets to the sum of the USP's interests in all affiliates in the same ownership chain.

$$AdjEqPos_k = USDIAEqPos \times \frac{USPPctOwn_k OA_k}{\sum_{l=1}^{m} USPPctOwn_l OA_l} \tag{13}$$

As will be seen, one difference between the operating assets apportionment method and the composite index apportionment method is that the former is based on a data item that directly reflects all uses (except the ownership of other affiliates) potentially funded by direct investment. In contrast, the composite index apportionment method focuses only on data items directly related to productive activities.

As mentioned above, the first operating affiliate and the last affiliate methods can be viewed as simplified versions of, respectively, the passthrough min and passthrough methods. In a similar manner, the operating assets apportionment method can be viewed as an approximation of intermediate sophistication of the PESAA method. Both methods, in effect, pass through some, but usually not all, of the available direct investment equity down the chain. In addition, for both, the portion of equity passed through depends on the mix between investment in ongoing operations and investment in other affiliates. Further comparison of these methods is provided in section 6, which examines the relative advantages and disadvantages of each method in detail.

Composite index apportionment

Like the other reallocation methods examined in this paper, composite index apportionment reallocates equity position using company-level microdata. Within each ownership chain, equity position is reallocated based on a weighted index of affiliates' value added, employment, and net PP&E (property, plant, and equipment). For each directly held foreign affiliate in which a U.S. parent has an equity position, the equity position (*EqPos*) is reapportioned among the directly held affiliate and the affiliates beneath it in the ownership chain according to the relative size of their productive activities as measured by employment (*Emp*), value added (*VA*), and net property, plant, and equipment (*NetPPE*). For each directly held affiliate whose equity position (*EqPos*) is reallocated among *l* = 1, …, *n* affiliates (which includes the directly held affiliate itself and affiliates beneath it in the ownership chain), the amount reallocated to affiliate *j* is calculated according to the following steps. First, each metric is converted into an index that represents a standardized value.

$$EmpIndex_j = \frac{Emp_j \times USPPctOwn_j}{\sum_{l=1}^{n} Emp_l \times USPPctOwn_l} \quad (14)$$

$$NetPPEIndex_j = \frac{NetPPE_j \times USPPctOwn_j}{\sum_{l=1}^{n} NetPPE_l \times USPPctOwn_l} \quad (15)$$

$$VAIndex_j = \frac{VA_j \times USPPctOwn_j}{\sum_{l=1}^{n} VA_l \times USPPctOwn_l} \quad (16)$$

The reallocated equity position for affiliate *j* (*AdjEqPos*$_j$) equals the composite index (*CompIndex*) for affiliate *j*, which is calculated as the mean of the three individual indexes, divided by the sum of the composite indexes for all *n* affiliates and then multiplied by the original equity position. [23]

$$CompIndex_j = (EmpIndex_j + NetPPEIndex_j + VAIndex_j)/3 \quad (17)$$

$$AdjEqPos_j = EqPos \times \frac{CompIndex_j}{\sum_{l=1}^{n} CompIndex_l} \quad (18)$$

5. Incorporating U.S. Affiliates into Ownership Chains

In the initial version of the project (Brew et al. 2023), the ownership chains used to reallocate USDIA equity position were constructed from data collected on the 2019 USDIA Benchmark Survey. The ownership chains were thus based on data from a survey that collects information on the activities of U.S. parents and their *foreign* affiliates only. As a result, the reallocation of USDIA equity positions performed with these ownership chains did not allow for the possibility that U.S.-based entities might be the ultimate hosts of part of the USDIA equity position or that equity might pass through U.S.-based entities before being ultimately hosted by foreign affiliates farther down the ownership chain. A key innovation in this iteration of the project is to expand the ownership chains used to reallocate the USDIA equity position to include not only U.S. parents and their foreign affiliates but also U.S. affiliates directly owned by one or more of the foreign affiliates.

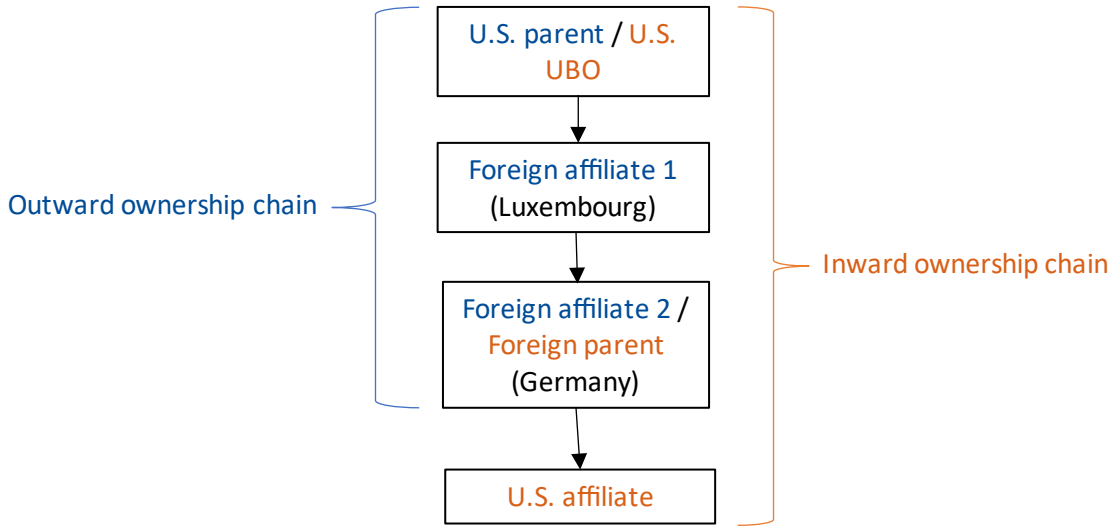
While the inclusion of U.S. affiliates in ownership chains does represent an overall improvement in the methodology for reallocating the USDIA equity position, it bears emphasis that the proportion of the USDIA equity position ultimately hosted by or passing through U.S. affiliates can vary significantly from year to year. An indication of the size of the investment position in U.S. affiliates that is controlled by other U.S. entities through their foreign affiliates is provided by BEA's published FDIUS statistics, which

[23] Complications are introduced by the fact that employment, net PP&E, and value added are not available for all foreign affiliates (or all U.S. affiliates) in all years. BEA only produces value-added data for foreign affiliates that are majority owned by the USP and for U.S. affiliates that are majority foreign owned. In addition, in nonbenchmark years, the components of net PP&E are only collected for foreign affiliates that are majority owned by their USP. If one or more of the *n* affiliates in a given ownership chain is missing either value added or value added and net PP&E because of its ownership status, its composite index is calculated using the available metrics.

provide data by the country of the ultimate beneficial owner (i.e., the entity at the top of the ownership chain) of U.S. business enterprises. In 2019, the total position in U.S. affiliates held by foreign parents whose ultimate beneficial owners (UBOs) were U.S. persons was $81 billion (or 1.8 percent of the total foreign direct investment position in the United States), while in 2020 the number had grown significantly to $250 billion (or 5.4 percent of the total position). In other words, with the addition of 2020 to the time period covered by the analysis, it is now much more important than previously to account for the role of U.S. affiliates as the recipients of investment from abroad that originated with U.S. parents/UBOs.

There are two main types of ownership patterns to consider when incorporating U.S. affiliates into U.S. MNEs' ownership chains. In the first and simpler of the two types, represented by the hypothetical example in figure 1, the U.S. affiliate does not own any foreign affiliates and is thus the endpoint of the ownership chain. For reporting purposes, BEA's direct investment survey program breaks this structure into two distinct parts. Data on the outward ownership chain, which is reported by the U.S. parent and consists of separate forms for the USP, foreign affiliate 1, and foreign affiliate 2, is collected on the USDIA Benchmark and Annual Surveys. Data on the inward ownership chain is collected on the FDIUS Benchmark and Annual Surveys, for which the U.S. affiliate submits one survey form that, in addition to information on its own activities, includes the name, country location, and industry of its foreign parent (i.e., foreign affiliate 2) and UBO (i.e., the U.S. parent). [24]

Figure 1: Hypothetical Ownership Chain with U.S. Affiliate



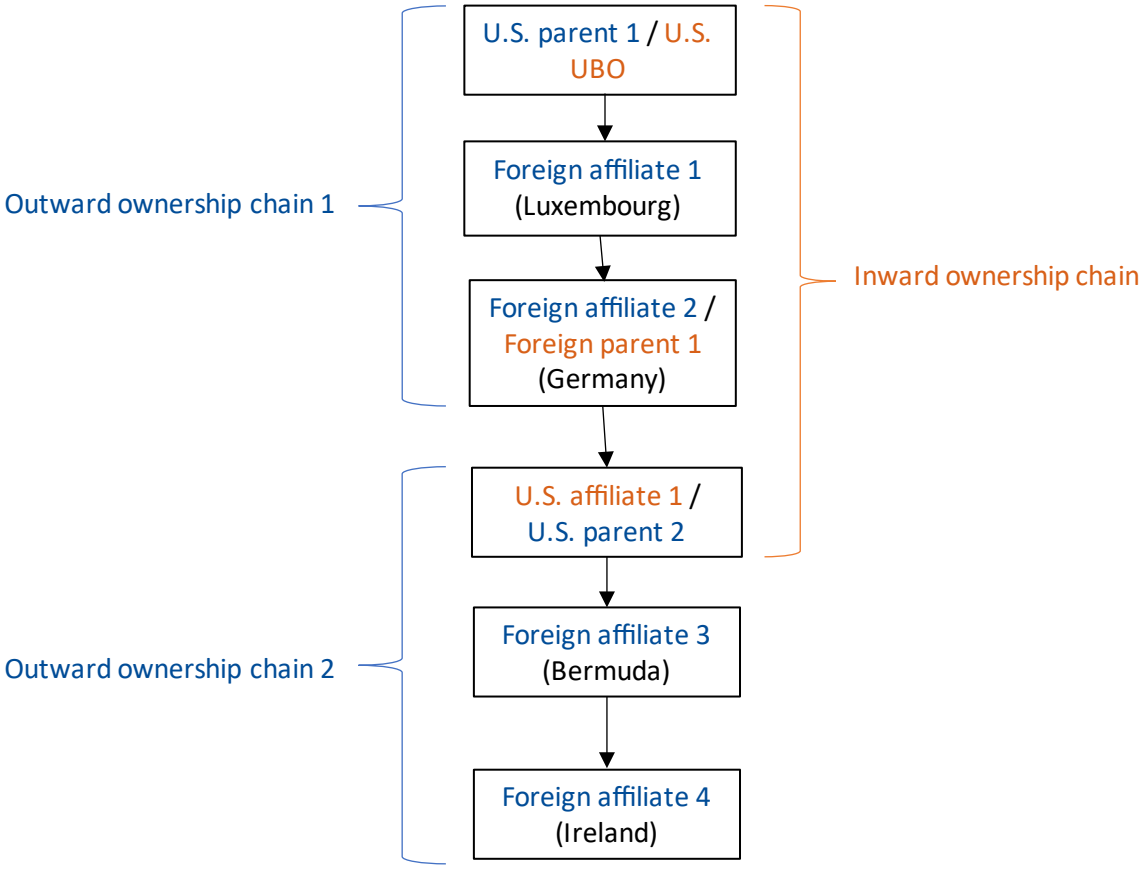
This project represents the first time that BEA has attempted to create combined ownership chains of the type represented in figure 1 from these separate inward and outward chains. Creating combined chains of this type has required, first, developing a matching algorithm to identify pairs of inward and

[24] The FDIUS Benchmark and Annual Surveys only collect data on the foreign parent and UBO, which means they do not collect data on entities that are situated between the foreign parent and the UBO in the ownership chain, such as foreign affiliate 1 in figure 1.

outward chains that can plausibly be linked to one another. In general, this algorithm searches for cases where two conditions are met: (1) an inward foreign parent can be matched to an outward foreign affiliate based on name and country of location and (2) the inward UBO is U.S.-based and its name can be matched to the name of the U.S. parent of the foreign affiliate that meets condition 1. After the algorithm identifies potential links, manual checking is performed to eliminate duplicates and ensure the integrity of the matching results.

The second, more complex type of ownership chain involving a U.S. affiliate is represented by the hypothetical example in figure 2. In this scenario, the U.S. affiliate is no longer the end point of the ownership chain because it is also a U.S. parent that owns foreign affiliates. Whereas the ownership chain in figure 1 is based on the combination of two sets of survey forms, constructing the chain in figure 2 involves combining three sets of forms. In addition to the inward and outward chains represented in figure 1, figure 2 includes another outward chain that includes the foreign affiliates owned by the U.S. entity at the bottom of the chain in figure 1. It is important to note that in this scenario the U.S. entity labeled "U.S. affiliate 1/U.S. parent 2" in figure 2 is responsible for submitting the data used to construct the inward ownership chain *and* the data for the additional outward ownership chain (i.e., outward ownership chain 2). BEA is thus able to collect information from this respondent on the existence of a link between these two ownership chains, and it is not necessary to use the linking procedure to combine these two chains as was the case when combining outward ownership chain 1 and the inward chain.

Figure 2: Hypothetical Ownership Chain with Intermediate U.S. Affiliate



Ownership chains of the type represented in figure 2, in which there is a U.S. entity that is both an affiliate of a U.S. parent and a U.S. parent itself (referred to below, for convenience, as an intermediate U.S. affiliate), introduce complications to the process for reallocating USDIA equity positions. These complications arise from the combination of two facts. First, some or all of U.S. parent 2's equity position abroad may consist of a portion of the equity position that originated with U.S. parent 1 and has been passed through foreign affiliates 1 and 2 to U.S. parent 2. Second, BEA's direct investment survey program treats the direct equity positions abroad of U.S. parents 1 and 2 as entirely separate from one another.[25] As a result, to accurately estimate the amount of USDIA equity position that should be reallocated to foreign affiliates 3 and 4, it is necessary to exclude from reallocation the portion of U.S. parent 1's equity position abroad that is passed through U.S. parent 2 and that is thus already accounted for in U.S. parent 2's direct equity position. The excluded portion can be labeled "U.S. passthrough," and it is separately identified as such in the country and sector results in section 7.

Except for operating assets apportionment, the reallocation methods use the same broad approach when confronted with an ownership chain with an intermediate U.S. affiliate. The essence of the approach is that the ownership chain is split into two (overlapping) components. The first component, which is used to reallocate the direct equity position of the top-level U.S. parent, extends from the top

[25] In accordance with international guidelines, inward and outward direct investment ownership chains are measured separately to ensure accurate direct investment statistics for each economy.

U.S. parent to the lower-level U.S. parent (USP1 → FA1 → FA2 → USP2, in the case of the example in figure 2). The second part, which is used to reallocate the direct equity position of the lower-level U.S. parent, consists of the lower-level U.S. parent and its foreign affiliates (USP2 → FA3 → FA4, in the case of figure 2). By not allowing USP1's direct equity position to be reallocated to FA3 and FA4 and incorporating a technique (which varies by method) for calculating the proportion of USP1's equity position that can be classified as passing through USP2, this approach avoids the double counting that would arise if USP1's equity position was reallocated along the entire combined ownership chain. It should be noted, though, that to the extent that the value estimated for U.S. passthrough is large relative to the value of USP2's equity position in FA3 that the equity reallocated to FA3 and FA4 is implicitly attributable to USP1's equity position in FA1.

The following discussion provides, for each reallocation method, a detailed explanation of the approach taken to reallocating equity position along ownership chains that include intermediate U.S. affiliates. To simplify the exposition, each method's approach is explained in terms of the hypothetical ownership chain in figure 2.

First Operating Affiliate

First, USP1's equity position in FA1 is reallocated within the top component of the chain (USP1 → FA1 → FA2 → USP2). If there is one or more operating companies among FA1, FA2, and USP2, then the entirety of the equity position is reallocated to the first, or highest, operating affiliate in the chain. Moreover, if USP1's equity position in FA1 is reallocated to an operating affiliate, then the entirety of USP1's equity position in FA1 is categorized as hosted by the affiliate to which it is reallocated, meaning that, in this scenario, none of the equity position is classified as U.S. passthrough. However, if FA1, FA2, and USP2 are all holding companies, then USP1's equity position is reallocated to USP2 and classified in its entirety as U.S. passthrough. After USP1's equity position in FA1 has been reallocated, USP2's equity position in FA3 is reallocated within the bottom component of the chain (USP2 → FA3 → FA4), and this reallocation is conducted according to the standard logic of the first operating affiliate method.

Last affiliate

The essential logic of the last affiliate method is that the equity position in each directly held foreign affiliate is reassigned to the affiliate at the bottom of the directly held affiliate's ownership chain. For the top component of the chain in figure 2, USP1's equity position in FA1 is reallocated to USP2 and categorized in its entirety as U.S. passthrough. This treatment of intermediate U.S. affiliates aligns with the treatment of non-U.S. intermediate affiliates in that the equity position being reallocated is treated as passing through them until it reaches the last affiliate in the chain. For the bottom part of the chain, USP2's equity position in FA3 is reallocated to FA4.

Passthrough with ownership chains and PESAA

For passthrough with ownership chains and PESAA, the approach taken for ownership chains with an intermediate U.S. affiliate is the same. For the top component of the ownership chain, USP1's equity

position in FA1 is reallocated among FA1, FA2, and USP2 according to the passthrough or PESAA methodology, respectively. The part of the equity position reallocated to USP2 is then divided between equity hosted in the United States and U.S. passthrough according to equations 19 to 21:

$$if\ EqPos_{Re} \geq 0\ and\ EqPos_{USP2} \geq 0, then\ USPT = \min(EqPos_{Re}, EqPos_{USP2}); \quad (19)$$

$$else\ if\ EqPos_{Re} \leq 0\ and\ EqPos_{USP2} \leq 0, then\ USPT = \max(EqPos_{Re}, EqPos_{USP2}); \quad (20)$$

$$else\ USPassthrough = 0; \quad (21)$$

where $EqPos_{Re}$ = the part of USP1's equity position in FA1 reallocated to USP2, $EqPos_{USP2}$ = USP2's equity position in FA3, and *USPT* = U.S. passthrough. The reallocated equity position hosted by USP2 ($EqPos_{Hosted}$) is then calculated as:

$$EqPos_{Hosted} = EqPos_{Re} - USPT. \quad (22)$$

For the bottom component of the chain, USP2's equity position in FA3 is reallocated among FA3 and FA4 according to the logic of the passthrough with chains or PESAA method, respectively.

Composite Index Apportionment

Like the first operating affiliate, last affiliate, passthrough, and PESAA methods, the composite index apportionment method splits ownership chains with two U.S. parents into two overlapping components. However, unlike the preceding methods, it calculates the portion of USP1's equity position that passes through USP2 *before* reallocating USP1's equity position among FA1, FA2, and USP2. The reason for the inversion of these steps is that the composite index apportionment method bases reallocation entirely on the level of affiliates' productive activities without considering their financial structure. That is, calculating passthrough equity as a function of the equity reallocated to USP2 would amount to treating passthrough equity as a function of USP2's productive activities, whereas passthrough equity is more appropriately treated as part of USP2's financial structure. For example, if USP2 were a pure holding company with no productive activities, the composite index apportionment method would reallocate none of USP1's equity position in FA1 to USP2 and U.S. passthrough would thus be zero even though the case when USP2 is a holding company is the case when U.S. passthrough is most likely to be a high proportion (if not all) of USP2's equity position abroad.

Instead of calculating U.S. passthrough as a function of the equity reallocated to USP2, U.S. passthrough is calculated as the overlap between USP1's equity position in FA1 and USP2's equity position in FA3 (where the latter is weighted by USP1's ownership interest in USP2). Formally,

$$if\ EqPos_{USP1} \geq 0\ and\ EqPos_{USP2} \geq 0,$$
$$then\ USPT = \min(EqPos_{USP1}, EqPos_{USP2} \times USP1's\ ownership\ interest\ in\ USP2); \quad (23)$$

$$else\ if\ EqPos_{USP1} \leq 0\ and\ EqPos_{USP2} \leq 0,$$
$$then\ USPT = \max(EqPos_{USP1}, EqPos_{USP2} \times USP1's\ ownership\ interest\ in\ USP2); \quad (24)$$

$$else\ USPT = 0; \quad (25)$$

where $EqPos_{USP1}$ represents USP1's equity position in FA1, and $EqPos_{USP2}$ represents USP2's equity position in FA3. After U.S. passthrough is calculated, its value is subtracted from USP1's equity position in FA1, and the remainder is reallocated among the entities in the top component of the ownership chain (FA1, FA2, and USP2) according to the logic of the composite index apportionment method. Then the composite index apportionment method is used to reallocate USP2's equity position in FA3 among FA3 and FA4.

Operating assets apportionment

Like composite index apportionment, the operating assets apportionment method focuses on variables related to affiliates' productive, or operating, activities when determining the proportion of their U.S. parent's direct equity position to reallocate to each. As such, estimating U.S. passthrough as a function of the part of USP1's equity position reallocated to USP2 could lead to misleading results. To address this issue, the analysis experimented with an approach to chains with intermediate U.S. affiliates that is different from the approach used by composite index apportionment. Instead of splitting the ownership chain into two overlapping segments, this approach pools the direct equity positions of USP1 and USP2 and reallocates the pooled quantity, after subtracting an estimate of U.S. passthrough, among all affiliates in the complete ownership chain. More precisely, this approach consists of the following steps:

1. Pool USP1's equity position in FA1 and USP2's equity position in FA3.
2. Estimate U.S. passthrough as the proportion of USP2's owners' equity that is not accounted for by its operating assets, or $\max[0, OwnersEquity_{USP2} - OA_{USP2}]$.
3. Subtract the estimate of U.S. passthrough from the pooled equity position.
4. Reallocate the remainder of the pooled equity position among FA1, FA2, USP2, FA3, and FA4 according to the relative sizes of their operating assets.

An advantage of this pooling approach is that the relative sizes of the affiliates in the two distinct segments of the ownership chain is taken into consideration in determining allotments of reallocated equity. A potential disadvantage (which was found to be minimal in practice for the two years of data examined, 2019 and 2020) is that a portion of USP2's equity position in FA3 could be reallocated upward to FA1 and FA2 (or to USP2 itself).

6. Evaluating the Methods

The analysis in this section focuses on six key reallocation methods: the two push-down methods (first operating affiliate and last affiliate), the two new apportionment methods (operating assets and composite index), and two financial structure methods (passthrough with ownership chains and PESAA).[26] Passthrough minimum is not examined partly due to resource constraints and partly because it is seen as the least attractive of the financial structure methods because it reallocates the minimum amount of the USP's equity position at each step of the ownership chain. Regarding the exclusion of the

[26] While the detailed country and industry results presented in section 7 are based on data that have been infused with noise to protect respondent confidentiality, the results in this section are based on unperturbed data.

aggregate apportionment and passthrough-apportionment hybrid methods from the analysis, a discussion of these methods' shortcomings and of the decision not to pursue further investigation of them is provided in Brew et al. (2023). The empirical results presented in this section were generated by implementing these six methods with data collected by BEA's direct investment survey program for the years 2019 and 2020.

Before evaluating the relative advantages and disadvantages of each reallocation method, it is important to emphasize that there is no single conceptually correct approach to reallocating the USDIA equity position. Even if detailed data on affiliates' finances and operations are available, most ownership chains, if viewed in terms of data from a single time period, permit a variety of equally plausible interpretations as to where the USP's equity investment ultimately resides. Especially if the USP's investment was made at an earlier point in time, subsequent activities of the affiliates, such as borrowing to finance additional operations and/or investments down the ownership chain, can make it impossible to definitively determine where the USP's initial investment is ultimately hosted. As a result, different interpretations provided by different reallocation methods of where the USP's equity investment is ultimately hosted can, in many circumstances, be equally consistent with data collected on the MNE's finances and operations.[27] To be precise, two factors are responsible for the fact that there is no single conceptually correct approach to the reallocation of the direct equity position. First, investment is fungible; an equity investment in an affiliate can be used either to finance further equity investment down the ownership chain, or to fund operations of the affiliate itself, or to do a mix of both. Second, a USP's direct investment can be leveraged by borrowing down the ownership chain to support operations many times in excess of the operations that would be supported by the direct investment itself. (See appendix C for examples of hypothetical MNEs with identical ownership structures and financial and operating data for which the ultimate destination of the USP's equity investment can be reasonably interpreted as varying.)

Although there is not one single correct approach to reallocating direct equity positions, there is still meaningful variation in the level of conceptual accuracy achieved by the different methods. Each method relies on a different implicit model of how a USP allocates its equity investment among its affiliates, and some of these models more accurately reflect actual MNE operations and finances than others. On the low end of the conceptual accuracy spectrum are the push-down methods, first operating and last affiliate, as they do not take into account information on affiliates' finances and operations and instead treat ownership chain location as of primary importance in determining where the USP's equity investment is ultimately hosted. Of these two methods, though, first operating affiliate has higher conceptual accuracy than last affiliate since it also considers whether affiliates are operating or holding companies. On the higher end of the conceptual accuracy spectrum are the two financial structure and the two apportionment methods. Among these four methods, the financial structure methods arguably have somewhat higher conceptual accuracy than the two apportionment methods since the former directly model the process whereby the USP's equity investment is passed from parent affiliates to child affiliates along the ownership chain. In contrast, the apportionment methods take a comparatively indirect approach, focusing on productive or operating activities that are to some extent

[27] A related point is that only in a simplistic sense should UHE statistics be viewed as an analog of ultimate investing economy (UIE) or UBO statistics. In particular, it is *not* the case that if every country produced both UHE and UIE statistics, one country's bilateral UHE statistics would in principle match its partner country's UIE statistics.

the result of the USP's equity investment and attempting to derive the level of USP equity investment in each affiliate from the affiliate's level of productive activities.

From an empirical perspective, evidence regarding the different levels of conceptual accuracy achieved by the different methods can be obtained by investigating the extent to which the reallocations of equity position generated by each method are consistent (or not) with other company-level data collected by BEA's direct investment surveys. In principle, the value of the USP's equity position reallocated to each affiliate should not exceed the affiliate's owners' equity. In practice, however, the reallocation methods tend not to achieve this ideal. The degree to which each method allows affiliates to be reallocated more of the USP's equity position than can be accommodated by their owners' equity provides useful information on the extent to which each method accurately reflects the actual finances and operations of MNEs.

Tables 3 and 4 provide evidence on the extent to which, under each method, affiliates tend to be reallocated quantities of USP equity position that are larger than the affiliates' owners' equity. Table 3 provides, for each method, the percent of all affiliates of all U.S. MNEs for which owners' equity is less than their reallocated, or adjusted, equity position, while table 4 provides evidence on the overall size of the discrepancies between owners' equity and reallocated equity position produced by each method. The percentages in table 4 were arrived at by calculating the difference between reallocated equity and owners' equity for all affiliates for which the former exceeded the latter, summing these quantities across all affiliates, and then dividing the sum by the total USDIA equity position.

The results in tables 3 and 4 are broadly consistent with the conclusions above regarding the relative conceptual accuracy of the different methods. In table 3, the proportion of affiliates with reallocated USP equity that exceeds their owners' equity is largest for the last affiliate method, followed by first operating affiliate, then the two apportionment methods, and finally the two financial structure methods, which have the smallest percentage of affiliates with reallocated equity exceeding owners' equity.[28] The results in table 4 depart somewhat from this pattern, especially regarding the performance of the two apportionment methods. In table 4, operating assets apportionment performs significantly better than composite index apportionment and even slightly better than PESAA, though not better than passthrough with ownership chains. On the other hand, the performance of composite index apportionment in table 4 is comparable to, and actually slightly worse than, that of first operating affiliate, though still significantly better than last affiliate. The divergence in the results for the two apportionment methods in table 4, which is also apparent in table 3 but to a much lesser degree, can be

[28] One reason passthrough with ownership chains performs better than all other methods in tables 3 and 4 is the inclusion of the additional constraint (discussed in section 3) that requires passthrough equity not exceed the reported owners' equity of child affiliates. It should be noted, though, as can be seen from the results for passthrough with ownership chains in tables 3 and 4, that this method still leaves some affiliates with adjusted equity positions that are larger than their owners' equity. The reason for this apparent inconsistency is that, to ensure that the worldwide total adjusted equity position equals the worldwide total pre-reallocation USDIA equity position, the additional constraint for the passthrough with ownership chains method is not applied to the equity that directly held affiliates receive from their U.S. parents. Due to reporting inconsistencies, some directly held affiliates have owners' equity (collected on the Benchmark and Annual Surveys of USDIA) that is smaller than their U.S. parent's direct equity position in them (collected on the Quarterly Survey of USDIA). Moreover, since much of the USDIA equity position remains with directly held affiliates after reallocation (see table 6), some directly held affiliates have adjusted equity positions that are larger than their owners' equity.

thought of as stemming from their differing treatment of financial assets. Consider, for example, the case of a nonpure holding company in which a USP has a direct equity position and that owns both an operating affiliate and other financial assets. Some of the original direct investment equity position is bound up in the other financial assets of the holding company. Using the composite index apportionment method allocates all of the original position away from the holding company to the operating company, even though in reality some of that equity stays with the holding company to hold the other financial assets. In contrast, operating assets apportionment allows a portion of the original position to stay with the holding company since the financial assets meet the definition of operating assets.

Table 3. Percent of Affiliates for Which Owners' Equity < Adjusted Equity Position

Reallocation method	2019	2020
First operating affiliate	40.83	61.95
Last affiliate	47.73	65.65
Passthrough with ownership chains	19.56	37.13
PESAA	27.87	45.48
Operating assets apportionment	29.79	45.92
Composite index apportionment	37.92	55.67

Table 4. After Reallocation, Percent of Total USDIA Equity Position Not Accounted for by Affiliates' Owners' Equity

Reallocation method	2019	2020
First operating affiliate	30.13	32.43
Last affiliate	45.65	47.97
Passthrough with ownership chains	4.95	7.03
PESAA	15.93	19.01
Operating assets apportionment	13.56	15.88
Composite index apportionment	30.35	33.92

While relative conceptual accuracy is a clear advantage of the financial structure and apportionment methods, this conceptual accuracy is also associated with drawbacks in terms of these methods' greater difficulty of implementation and interpretation and their greater dependence on detailed microdata. Due to the complex organizational structure of many MNEs, the development of the programs that implement the financial structure and apportionment methods tends to be a resource intensive process, which is especially the case for the financial structure methods due to the iterative, or step-by-step, nature of the calculations that they involve. In contrast, the relative conceptual simplicity of the push-down methods makes them easier to implement. Similarly, the greater complexity of methods that

more accurately model actual MNE operations and finances tends to make them more difficult to interpret. Among the already complex financial structure methods, PESAA even has an additional layer of interpretive complexity since the concept of parents' equity share of affiliates' assets is a more complex way than USP's percent ownership interest to represent the USP's interest in each of its affiliates.

In addition, while the use of affiliate-level operating and financial data makes possible the greater conceptual accuracy of the financial structure and apportionment methods, it also means that these methods can only be successfully implemented to the extent that the microdata required by them is available, accurate, and complete. BEA is fortunate to have a direct investment survey program that collects the detailed microdata necessary to implement these methods. However, even with the rich microdata collected by BEA's surveys, there are certain limited cases where these methods face obstacles to reallocating the equity position in a directly held affiliate due to incomplete, invalid, or inconsistent data in submitted survey forms. These kinds of data limitations affect all of the reallocation methods to some degree, but they are a more significant issue for the apportionment and especially the financial structure methods due to their greater reliance on a variety of affiliate-level microdata.

The information in table 5 provides one perspective on the extent to which each method is affected by data limitations. This table provides the percent of the total USDIA equity position in each year that could not be reallocated away from directly held affiliates due to limitations in the data collected by BEA. These figures do not include equity positions that were not reallocated for valid methodological reasons—such as directly held affiliates without child affiliates or, in the case of the first operating affiliate method, directly held affiliates that are operating companies. These figures also do not necessarily represent the full extent of the data limitations faced by each method. Especially in the case of the methods that involve calculating passthrough equity at each step in the chain (i.e., the financial structure methods), shortcomings in the data for affiliates other than the directly held affiliate and its children could affect how far down the chain the USP's equity position can be reallocated. Finally, it should also be noted that, as equity positions can be either positive or negative, the figures in this table are based on the net value of equity positions not reallocated.[29]

Table 5. Percent of Total USDIA Equity Position Not Reallocated Due to Data Limitations

Reallocation method	2019	2020
First operating affiliate	0.95	1.26
Last affiliate	2.68	2.63
Passthrough with ownership chains	5.64	5.52
PESAA	5.51	6.06
Operating assets apportionment	4.00	3.90
Composite index apportionment	4.00	3.90

[29] Direct investment positions are usually positive but can be negative. A negative position means that U.S. parent companies are in a net liability position vis-à-vis their foreign affiliate(s). This can occur because the USPs' foreign affiliate(s) have incurred sufficiently large losses or the parent has removed equity in excess of their investment. More information on negative direct investment positions is available on BEA's website.

The results in table 5 provide support for the conclusion that the two push-down methods are the methods least affected by data limitations. In both 2019 and 2020, the proportion of the total USDIA equity position that could not be reallocated away from directly held affiliates because of data limitations was lower for these two methods than for any of the other methods. The main data limitation affecting these methods was lack of information on the ownership chain to which a directly held affiliate belongs. An important difference between the two push-down methods, though, is that the first operating affiliate method does not need ownership chain data when the directly held affiliate is an operating company (see section 3). As a result, the proportion of the USDIA equity position that could not be reallocated due to data limitations was lower in both years for first operating affiliate than for the last affiliate method.

As table 5 indicates, the two apportionment methods occupy a middle position between the push-down methods and the financial structure methods regarding the extent to which data limitations prevented the reallocation of the USDIA equity position away from directly held affiliates. The main data limitations that affected the apportionment methods were lack of information on the ownership chain and lack of information on the USP's percent ownership interest in the directly held affiliate. The financial structure methods were, as expected, the methods that were constrained most by data limitations in their ability to reallocate equity position away from directly held affiliates. The main data limitations affecting these methods were the two faced by the apportionment methods plus cases where the directly held affiliate's equity investment in its child affiliates was either reported as zero or had a different sign than the directly held affiliate's inward equity. In other words, these are cases where the data reported for a directly held affiliate was inconsistent with the data reported for its child affiliate (or affiliates), and the inconsistency prevented the reallocation of the direct equity position away from the directly held affiliate.

The reallocation methods can also be affected by data limitations other than those that prevent the reallocation of equity positions away from directly held affiliates. Due to the financial structure methods' reliance on the step-by-step calculation of passthrough equity, data inconsistencies between parent and child affiliates can have a distortionary impact on these methods' reallocations at any point in the ownership chain, not only at the link between directly held affiliates and their children. For example, one relationship that should hold for a parent affiliate, *k*, and its children affiliates, *j*, is:

$$OE_k = \sum_{j=1}^{n} PctOwnership_j \times owners' \; equity_j. \tag{26}$$

In the simplest case, with 100 percent ownership all through the ownership chain, this relationship becomes:

$$OE_k = owners' \; equity_j. \tag{27}$$

Unfortunately, the reported data do not always conform to this relationship. It is not possible to quantify the distortionary impact of the reporting errors revealed by these data inconsistencies. However, these

errors will tend to have the largest impact on the financial structure methods because an error at one step of the ownership chain can feed into misestimates at either one step up the chain or any lower step. Methods without the step-by-step calculation of passthrough (i.e., the push-down and apportionment methods) will tend to be less sensitive to these errors. It bears emphasis, though, that the additional constraint for the passthrough with ownership chains method described in section 3 should help to reduce some of the distortionary impact of these data inconsistencies by ensuring that an affiliate's inward equity cannot be greater than its owners' equity (see equation 5). The distortionary effects of the reporting errors associated with data inconsistencies cannot be entirely overcome, though, through the introduction of additional constraints on the calculation of passthrough equity. In addition, it is important to recognize that the introduction of this additional constraint comes at a cost: it reduces the proportion of the USDIA equity position that can be reallocated away from directly held affiliates by the passthrough with chains method.

Another weakness of the financial structure methods is that their results are not robust to the location in the ownership chain at which borrowing from unaffiliated lenders occurs. As noted at the beginning of this section, borrowing by MNE affiliates after the USP's initial direct investment can make it difficult to definitively determine the ultimate host of the USP's investment. This problem has an additional dimension in the case of the financial structure methods as the location in the ownership chain at which the borrowing occurs—which should arguably be irrelevant to identifying the ultimate host of the USP's investment—can affect the methods' reallocation results. Consider, for example, a simple ownership chain with three affiliates (USP → Aff1 → Aff2 → Aff3) where each of the affiliates operates capital equipment, the purchase of which was financed at least in part by borrowing. For the push-down and apportionment methods, the location of the borrowing (i.e., the extent to which it was undertaken by Aff1, Aff2, or Aff3) has no impact on the reallocation results since these methods focus on ownership chain location and the extent of productive/operating activities, respectively. However, the financial structure methods are both affected since the location of the borrowing affects the size of the equity investments that Aff1 has in Aff2 and Aff2 has in Aff3 as well as each affiliate's *PESAA* value. The size of equity investments in child affiliates affects the results of both financial structure methods since they both use it as an input, though of course only the PESAA method uses *PESAA* as an input. Concrete examples, with accompanying calculations, are provided in appendix D, but it bears emphasis here that the financial structure methods stand out among the reallocation methods in producing results that are not independent of the location of unaffiliated borrowing.

Another dimension along which it is useful to compare the reallocation methods is their tendency to be either liberal or conservative in the reallocation of the USDIA equity position. In other words, does each method tend to reallocate a relatively large or small proportion of the total equity position away from directly held to indirectly held affiliates?

Table 6 provides the percent of the total equity position ($5.75 trillion in 2019 and $6.02 trillion in 2020) that was reallocated from directly held affiliates to indirectly held affiliates by each method in each year. Reallocated equity includes any part of the position in a directly held affiliate that was reallocated to an indirectly held affiliate.[30] Equity not reallocated includes both equity that could not be reallocated due

[30] Double (or triple, etc.) counting of equity that is reallocated multiple times along a chain in the passthrough with ownership chains and the PESAA methods has been eliminated so that each dollar of equity position is only counted as being reallocated once or not at all.

to data limitations (see table 5) and equity not reallocated for valid methodological reasons, such as the lack of child affiliates. The figures in table 6 (and table 7) are based on the net value of reallocated equity positions.

As table 6 shows, the financial structure methods, passthrough with ownership chains and PESAA, are on the conservative end of the reallocation spectrum. These methods tend to impose relatively strong constraints on the proportion of the equity position that can be reallocated away from directly held affiliates. The next most conservative is the first operating affiliate method, which is relatively constrained in the proportion of the equity position it can reallocate due to many directly held affiliates being operating companies. Toward the more liberal end of the spectrum are the two apportionment methods, though it bears emphasis that composite index apportionment is significantly more liberal than operating assets apportionment, as composite index apportionment reallocated approximately 7 percent more of the total USDIA equity position than did operating assets in both 2019 and 2020. Finally, the last affiliate method is the most liberal of the methods, which is not a surprising finding since the only circumstance in which it does not reallocate an equity position away from a directly held affiliate is when the ownership chain does not include any indirectly held affiliates.

Table 6. Percent of Total USDIA Equity Position Reallocated

Reallocation method	2019	2020
First operating affiliate	41.82	40.90
Last affiliate	58.99	58.55
Passthrough with ownership chains	35.70	36.48
PESAA	36.86	36.03
Operating assets apportionment	43.99	43.51
Composite index apportionment	50.89	50.58

In addition to investigating the tendency of each method to be liberal or conservative in reallocating the equity position away from the directly held affiliate, it is also useful to examine where in the ownership chain (such as the top, middle, or bottom) each method tends to reallocate USP equity when it is reallocated away from directly held affiliates. For each method, table 7 provides information on the proportion of reallocated equity that goes to different steps in the ownership chain, where the steps are identified in terms of their proximity to the directly held affiliate.[31] The table shows that PESAA stands out for its tendency to keep reallocated equity toward the top of the ownership chain. On the other hand, the last affiliate and composite index apportionment methods have a stronger tendency than the other methods to push reallocated equity toward the bottom of ownership chains. That the last affiliate

[31] There are notable differences in the methodologies used to generate tables 6 and 7. In calculating the percentage of the USDIA equity position reallocated for table 6, the denominator includes equity that stays with the directly held affiliate due to data limitations. In contrast, the percentage calculations for table 7 exclude equity position not reallocated due to data limitations from the denominator. In addition, table 7 is affected by the fact that some affiliates belong to multiple ownership chains and can have different positions, relative to the directly held affiliate, in each chain to which they belong. In these cases, the affiliate was assigned the minimum of its ownership chain positions.

method has this tendency is not surprising since reallocating equity to the bottom of chains is built into the logic of the method. That composite index apportionment has a similar tendency to reallocate to the bottom of chains suggests that productive activity tends to take place toward the bottom of ownership chains. The other three methods—first operating affiliate, passthrough with ownership chains, and operating assets—do not have as strong a tendency to put reallocations at either the top or bottom of chains and instead appear to redistribute equity relatively equally throughout ownership chains compared to PESAA, last affiliate, and composite index apportionment.

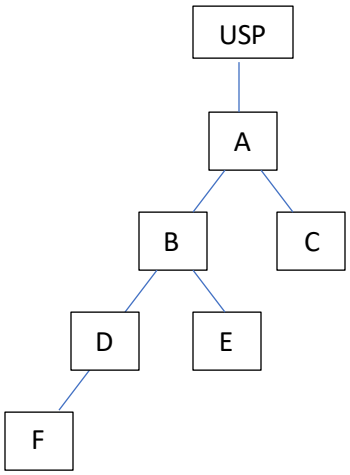
Table 7. Share of Reallocated Equity by Method Relative to Directly Held Affiliate

			2019			
Rank	First op.	Last	Passthrough	PESAA	Op. assets	Comp. index
1 step down	50.18	44.79	50.04	63.38	47.19	41.19
2 steps down	27.75	25.13	25.54	24.01	28.50	28.17
3 steps down	11.68	12.46	11.24	7.12	10.77	12.80
4 steps down	4.41	7.90	7.04	2.96	6.50	7.80
5 steps down	3.28	5.22	2.44	1.41	3.30	4.70
6+ steps down	2.71	4.49	3.69	1.13	3.74	5.33

			2020			
Rank	First op.	Last	Passthrough	PESAA	Op. assets	Comp. index
1 step down	52.80	45.32	49.02	61.86	48.87	43.74
2 steps down	25.48	24.70	25.69	24.89	26.61	24.62
3 steps down	11.77	13.23	13.46	8.27	12.70	14.61
4 steps down	4.39	7.52	6.26	2.81	5.64	7.64
5 steps down	3.76	5.52	2.46	1.35	3.23	5.08
6+ steps down	1.80	3.72	3.12	0.82	2.94	4.31

A potentially surprising result in table 7 is that, in both 2019 and 2020, the composite index apportionment method reallocates a larger proportion of the USDIA equity position to the bottom of ownership chains (i.e., 6+ steps down) than does the last affiliate method. This result is a product of the different ways the methods split the equity position in a directly held affiliate when multiple affiliates meet the criteria to be reallocated a portion of the equity position. Following the approach outlined in Brew et al. (2023), affiliates are defined as "last" in their respective ownership chains when they do not have an ownership interest in any of their respective MNE's affiliates, or, in other words, when there are no affiliates beneath them in the ownership chain. To the extent that an ownership chain contains multiple branches, multiple affiliates in different locations vis-à-vis the directly held affiliate can thus meet the criteria to be "last." For example, in the hypothetical MNE ownership structure in figure 3, affiliates C, E, and F all qualify as last despite the fact that C and E are fewer steps beneath the directly held affiliate, A, than affiliate F. Extrapolating from this example, it is apparent that even when there are one or more last affiliates that are 6+ steps beneath the directly held affiliate, there can be many other last affiliates that are fewer than six steps beneath it.

Figure 3. Hypothetical MNE Ownership Structure



If there are *n* last affiliates, the last affiliate method determines the portion of the direct equity position (*EqPos*) to assign to affiliate *j* as follows,

$$AdjEqPos_j = EqPos \times \frac{PctOwnership_j}{\sum_{l=1}^{n} PctOwnership_l} \quad (28)$$

where *PctOwnership* represents the ownership interest of the directly held affiliate. To the extent that the directly held affiliate has an equal ownership interest in all of the last affiliates (which generally tends to be the case), the equity position will be distributed evenly among all affiliates that qualify as last regardless of the number of "steps" that separate them from the directly held affiliate. Even if many of these last affiliates are 6+ steps beneath the directly held affiliate, there are likely to be many others that are not, with the result that much of the equity position will be reallocated to the latter last affiliates. In contrast, composite index apportionment concentrates reallocated equity among affiliates that are engaged in productive activities. In the case of large and complex ownership chains—i.e., the type of ownership structure where there are many last affiliates that are 6+ steps down but also many that are not—productive activities tend to be undertaken by affiliates that are relatively far from the directly held affiliate, which is to say affiliates that are 6+ steps down the chain. As a result, composite index apportionment has a greater tendency than does last affiliate to reallocate equity position to affiliates 6+ steps beneath the directly held affiliate.

Table 8 summarizes this section's findings by scoring each method on each of the dimensions examined. Based on this comparison, three of these methods have been selected for further evaluation: first operating affiliate, passthrough with ownership chains, and composite index apportionment. The advantages of the first operating affiliate method include ease of implementation, relatively low requirements for detailed microdata, robustness to data inconsistency, and its avoidance of the severe conceptual (in)accuracy issues that affect the last affiliate method. In addition, largely due to the

Table 8. Criteria for Evaluating Methods

Reallocation method	Conceptual accuracy	Ease of implementing	Ease of interpretation	Dependence on detailed microdata	Robustness to data inconsistency	Robustness to location of unaffiliated debt	Liberalness of reallocation	Location in chain of reallocation
First operating affiliate	Low	High	High	Middle	High	High	Middle	Middle
Last affiliate	Unacceptable	High	High	Middle low	High	High	High	Low
Passthrough with ownership chains	High	Low	Middle low	High	Middle	Middle low	Low	Middle
PESAA	High	Low	Low	High	Middle	Low	Low	High
Operating assets apportionment	Middle high	Middle	Middle	Middle	Middle high	High	Middle	Middle
Composite index apportionment	Middle	Middle	Middle	Middle	High	High	Middle high	Low

practical considerations that make it easy to implement without the most detailed microdata, the International Monetary Fund's Direct Investment Task Team has recommended the first operating affiliate method as its method of choice.[32] Thus, another reason for BEA to continue pursuing this method is to ensure the comparability of its experimental UHE statistics with those produced by other national statistical compilers.

The key advantage of the passthrough with ownership chains method is its high conceptual accuracy. To be sure, PESAA also scores relatively high on this dimension, but passthrough with ownership chains performs better overall in terms of all dimensions being considered. Passthrough with ownership chains is somewhat easier to interpret than PESAA. In addition, as shown in tables 3 and 4, PESAA, at least in its current form, is much more likely than passthrough with ownership chains to reallocate a quantity of the USP's equity position to an affiliate that exceeds the affiliate's owners' equity.

The chief merit of the composite index apportionment method is its tendency to align the reallocation of equity position with where production actually occurs. In this regard, it responds to feedback BEA received on the previous version of this project (Brew et al. 2023) that indicated the desirability of an apportionment method based on company-level AMNE data that focuses on redistributing equity position to sites where physical production is located. Operating assets apportionment is also relatively production focused compared to the non-apportionment methods. However, since the latter method's broad definition of operating assets includes financial assets and other assets not directly related to production, its reallocation is less targeted to actual sites of physical production than is composite index apportionment's reallocation.

7. Country and Industry Results

Having evaluated the relative merits of the reallocation methods across a variety of dimensions, one key question remains: how would each method change the USDIA equity position by country and industry statistics published by BEA? This section addresses that question by examining UHE equity position results by country and industry for 2019 and 2020. The discussion focuses on the three methods identified in the previous section as meriting further exploration (first operating affiliate, passthrough with ownership chains, and composite index apportionment), as detailed country and industry data are only presented and examined for these three preferred methods. However, the section also presents and discusses summary data on the extent to which the UHE results produced by each of the six methods examined in the previous section would alter USDIA equity position at the country and industry level.

In interpreting this section's results, it is important to bear in mind that, for any given country or industry, the reallocation methods generally have two countervailing effects: some equity positions are reallocated away from affiliates in the country/industry (to affiliates in another country/industry) while other equity positions (which originate with affiliates in another country/industry) are reallocated to affiliates in the country/industry of interest. In other words, assessing the degree to which UHE reallocations alter BEA's published statistics on USDIA equity position by country and industry requires attention to *net* reallocations of USDIA equity position into or out of countries and industries. The

[32] The D.6 Ultimate Investing Economy/Ultimate Host Economy and Pass-through Funds guidance note from the International Monetary Fund's Committee on Balance of Payments Statistics provides more detail.

analysis in this section thus focuses on the net reallocations of equity position produced by each method. In addition, the section introduces and briefly discusses a dataset (publicly available on BEA's UHE webpage) that provides, for each of the three preferred reallocation methods, the total UHE reallocation in both directions between any two countries (i.e., reallocations from country A to country B and reallocations from country B to country A).[33]

A summary of UHE results by country and industry for all six methods examined in the previous section is presented in table 9.[34] These results measure the degree to which the USDIA equity position at the country and industry level would be altered by each of the six reallocation methods. Each data point provides the ratio of the total net reallocations across all countries, industries, or industry sectors to the total USDIA equity position for the year and method in question.[35] To reflect the fact that all reallocations affect two entities (donor and recipient), total net reallocations for each method and year are calculated as the sum of positive net reallocations and the absolute values of negative net reallocations. As a result of this approach, relative to table 6, which provides the proportion of the USDIA equity position reallocated by each method at the company level, table 9 double-counts each dollar of reallocated equity. Furthermore, since these results are based on net rather than gross reallocations, a degree of caution is required in their interpretation. For example, the fact that the values in the industry column are higher (and often significantly higher) than the values in the country column for every method and year does not necessarily indicate that industry-to-industry reallocation is more prevalent than country-to-country reallocation. Most countries have both inflows and outflows of equity due to UHE reallocation, and these inflows and outflows cancel one another out to a significant degree when calculating net reallocation. In contrast, in the case of industries, equity position tends to flow, in general, from holding companies to operating companies (i.e., companies in non-holding company industries) without counterbalancing flows in the other direction, resulting in larger net reallocations at the industry level than at the country level.

[33] That is, separate values are provided for the total reallocation from country A to country B and for the total reallocation from country B to country A.

[34] While the detailed country and industry data presented below for the three preferred methods are based on data that have been infused with noise to protect respondent confidentiality, table 9 is based on unperturbed data.

[35] The country-level analysis is, for each year, based on the complete set of 196 countries (including the United States) that either had a USDIA equity position or had a non-zero UHE equity position after reallocation by one or more of the three preferred methods. (The same set of 196 countries meet these criteria for 2019 and 2020.) The industry-level analysis is based on the four-digit international surveys industry (ISI) code that corresponds to each affiliate's primary industry of sales. The sector-level analysis is based on regrouping affiliates by primary sector of sales, where sectors represent nine categories of four-digit ISI codes, a complete list of which can be found in tables A3 and A4.

Table 9. Ratio of Reallocated Equity to Total USDIA Equity Position by Country, Industry, and Sector

Reallocation method	2019			2020		
	Country	Industry	Sector	Country	Industry	Sector
First operating affiliate	42.70	83.69	83.56	38.24	81.85	81.70
Last affiliate	54.40	82.02	77.20	53.14	80.55	75.25
Passthrough with ownership chains	25.04	44.02	43.40	24.65	44.67	43.57
PESAA	27.26	44.57	44.29	25.24	45.84	45.04
Operating assets apportionment	35.37	58.31	57.62	31.73	57.69	56.80
Composite index apportionment	53.90	78.93	76.99	49.66	79.42	76.72

Although the results in table 9 are based on net rather than gross reallocations, they still show significant country-to-country and industry-to-industry reallocation for each method and year. Moreover, the relative rankings of the methods in terms of the extent of reallocation at the country, industry, and sector levels is largely consistent with the rankings for company-level reallocation in table 6. The most striking difference with the rankings in table 6 may be that, with regard to the industry-level rankings, first operating affiliate has more reallocation than any other method, including last affiliate.[36] This difference reflects the fact that first operating affiliate is designed so that all reallocations take place between companies in different industries (i.e., between a holding company and an operating company). Another noteworthy takeaway from the table is that since sector-level reallocations are, for each year and method, only slightly lower than industry-level reallocations, industry-to-industry reallocations almost always take place between companies that are also in different sectors. This finding is largely attributable to the fact that industry-level reallocations tend to take place between holding companies and operating companies and holding companies are both a distinct industry and a distinct industry sector.[37]

Detailed Country and Industry Results

Complete country and industry results for the three preferred methods are provided in the tables in appendix A. Charts 1 to 4 provide highlights of these results. Charts 1 and 2 present, for 2019 and 2020 respectively, results for a selection of countries whose net equity position change due to UHE reallocation is relatively large (in either a positive or a negative direction) across all three methods. Charts 3 and 4 present complete UHE reallocation results for each method at the sector level for 2019 and 2020, respectively.

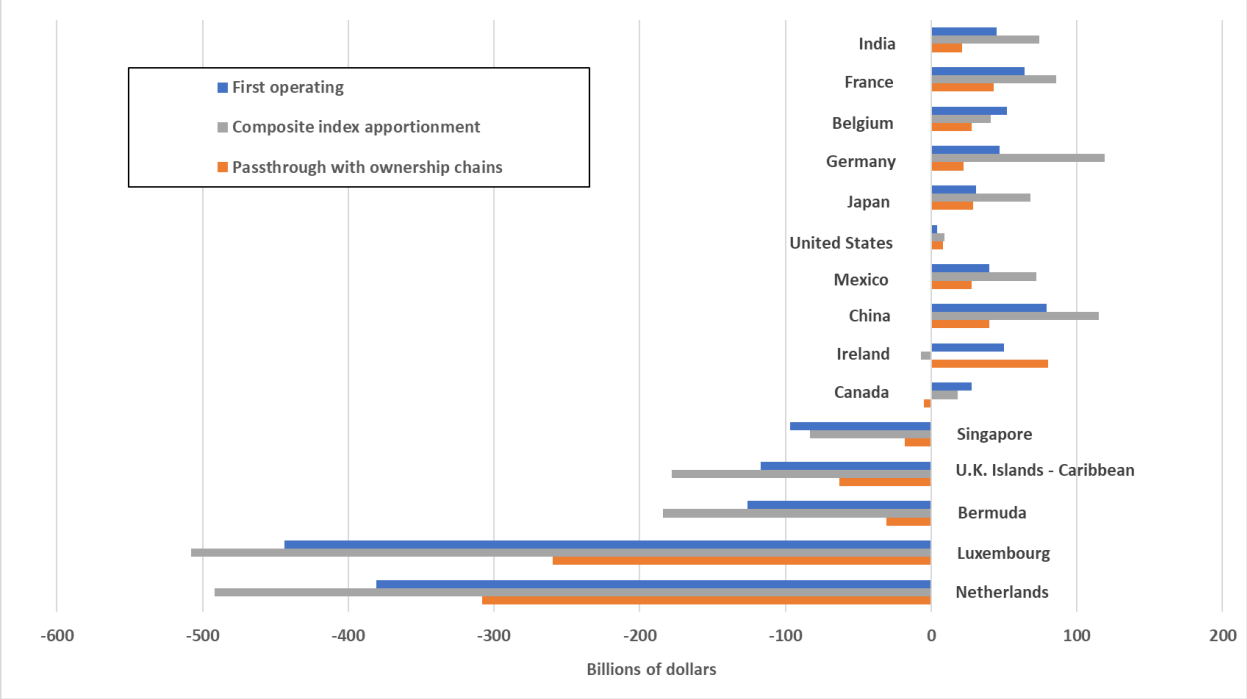
The detailed results presented in this subsection and in appendix A incorporate a version of EZS noise infusion to protect survey-respondent confidentiality. The main advantage of noise infusion relative to BEA's standard approach to disclosure avoidance, which relies on cell suppression, is that it allows the

[36] Also notable is that, in contrast with the company-level reallocations in table 6, operating assets apportionment has less country-level reallocation than first operating affiliate in both 2019 and 2020.

[37] The holding companies sector is composed of two four-digit ISI codes: 5512 (holding companies, except bank holding companies) and 5513 (corporate, subsidiary, and regional management offices). With the first operating affiliate method, there is a small amount of reallocation, in both 2019 and 2020, from entities whose primary industry of sales is 5512 to those whose primary industry of sales is 5513, which explains why the sector and industry columns in table 9 do not have the same value for the first operating affiliate method.

publication of complete data tables.[38] A disadvantage is that the published estimates are slightly distorted.[39] EZS noise infusion multiplies each microdata item by a random noise factor centered around one and uses the resulting perturbed data values as the basis for published estimates, in this case country and industry UHE tables.[40] In these tables (see appendix A) and in the summary tables and charts presented in this subsection, each country or industry's net UHE reallocation is calculated as its noise-infused UHE equity position minus its noise-infused direct equity position. UHE positions are then calculated, for each country or industry in question, as the sum of the net UHE reallocation and the original direct equity position.

Chart 1. Net UHE Reallocation for Selected Countries by Method, 2019



[38] Since BEA's official direct equity position statistics by country and industry rely on cell suppression rather than noise infusion to protect respondent confidentiality, UHE positions for countries or industries suppressed in the official equity position statistics for 2019 and 2020 are suppressed in appendix A to maintain this protection.

[39] For the countries and industries shown in tables A1–A4, the unweighted average absolute percent distortion of UHE positions is 2.41 percent. However, when each cell is weighted by the size of its UHE position, the average absolute percent distortion is only 1.43 percent.

[40] The application of EZS noise infusion to the UHE statistics can be divided into the following steps: (1) assign each equity position in the microdata a random multiplicative noise factor, (2) multiply each (unperturbed) position by its respective noise factor to yield a perturbed position, (3) use the perturbed positions, rather than the unperturbed positions, with the various UHE reallocation methods to produce country and industry UHE estimates. Results are then rescaled so that the global total UHE equity position remains the same after noise infusion. To ensure the comparability of the results across reallocation methods, each position's randomly assigned noise factor is held constant across reallocation methods. For a more complete discussion of EZS noise infusion, including of the tradeoffs between it and cell suppression for a different set of statistics, see Bockrath and Yorgason (2023).

Chart 2. Net UHE Reallocation for Selected Countries by Method, 2020

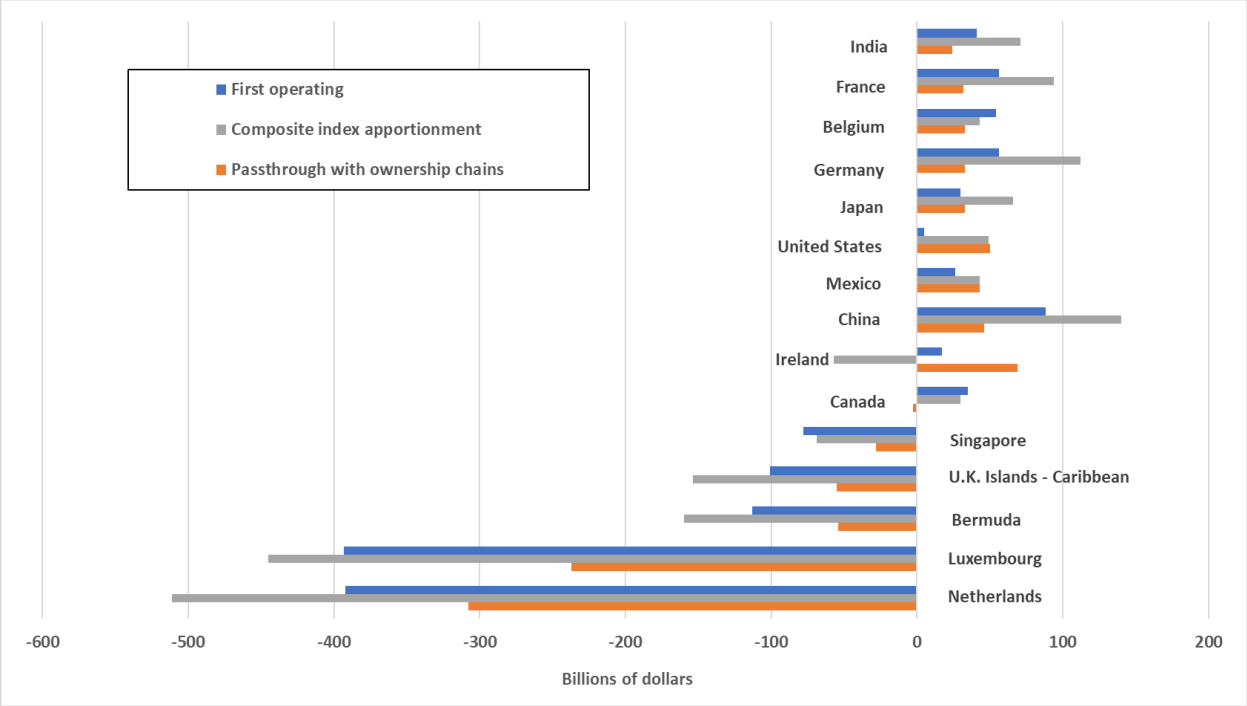


Chart 3. Net UHE Reallocation by Industry Sector and Method, 2019

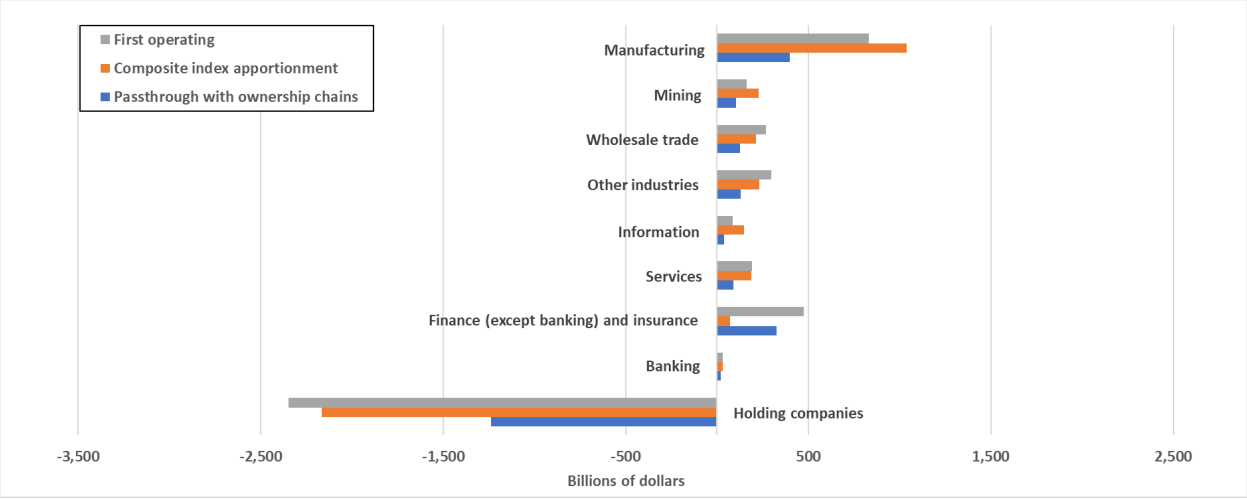
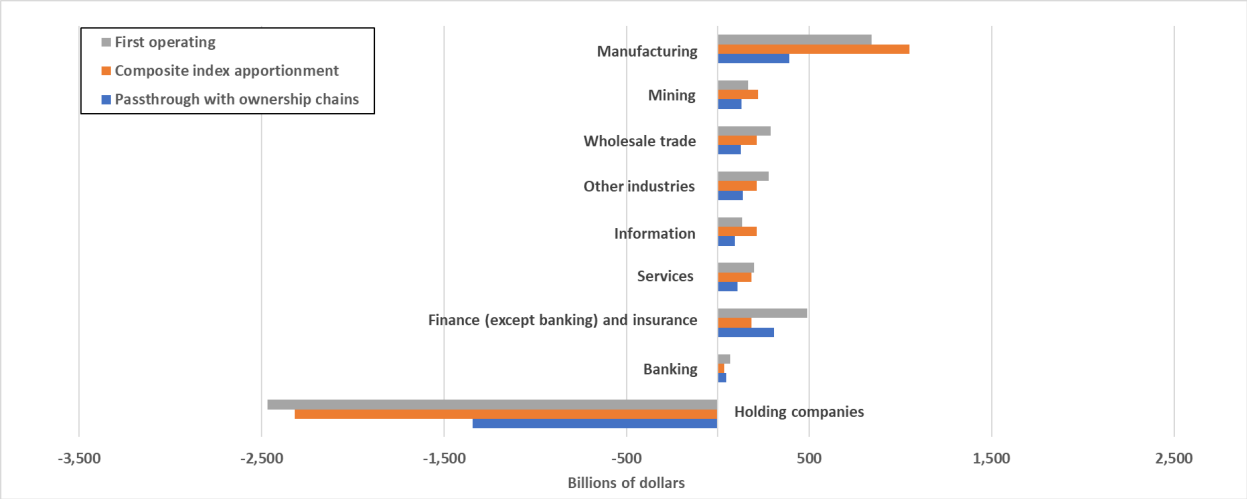


Chart 4. Net UHE Reallocation by Industry Sector and Method, 2020



Regarding the detailed country results, a striking similarity across all methods and both years is that the same five countries tend to have the largest net decreases in USDIA equity position: the Netherlands, Luxembourg, Bermuda, U.K. Islands—Caribbean,[41] and Singapore.[42] The fact that, despite their varying methodologies, these methods all find that these five countries see large net reductions in USDIA equity position due to UHE reallocations in both 2019 and 2020 provides evidence for classifying these countries as among the main financial centers involved in receiving and rechanneling USDIA. That is, the evidence presented here supports the view that, more than other countries, these five countries tend to host entities (which might be holding companies or other special purpose entities) that are the immediate recipients of USDIA equity positions and that pass the equity through to entities in other countries where productive activities are more likely to take place.

There is also notable overlap in the countries identified by each method as the recipients of the largest net increases from the reallocation of the USDIA equity position. For example, in both years, all three methods identify China, France, and Germany as among the 10 countries with the largest net increases in USDIA equity position. The methods thus agree that these countries are especially likely to be the ultimate hosts of U.S. MNEs' equity positions that have been channeled through entities in other countries.

Table 10 presents data on the distribution pattern of net decreases and net increases in equity position across countries.[43] The data indicate that, across methods and years, net decreases from reallocation tend to be relatively concentrated among a small number of countries compared to a more dispersed

[41] "U.K. Islands—Caribbean" is composed of the British Virgin Islands, the Cayman Islands, Montserrat, and the Turks and Caicos Islands.

[42] With one exception, these five countries have the five largest net decreases in direct equity position for all methods and both years. The exception is Singapore in the 2019 passthrough with ownership chains results, where it has the sixth largest net decrease and Bahamas has the fifth largest net decrease.

[43] As with table 9, table 10 is based on the complete set of 196 countries (including the United States) that, in both 2019 and 2020, either had a USDIA equity position or had a non-zero UHE equity position after reallocation by one or more of the three preferred reallocation methods. In contrast to table 9, table 10 is based on noise-infused data.

distribution pattern for net increases. For all countries and years, the number of countries experiencing a net decrease in equity position of at least $1 billion is much smaller than the number of countries with a net increase of at least $1 billion. In addition, for each method and year examined here, the five countries with the largest net decreases always account for at least 90 percent of total net decreases, while the five countries with the largest net increases tend to have a much smaller share of total net increases, between approximately 27 and 39 percent. These findings are consistent with two key facts noted in Brew et al. (2023): (1) USDIA on an immediate basis is highly concentrated in a small number of countries and (2) this concentration is associated with the prevalence of holding companies and other special purpose entities that are set up to take advantage of different tax or regulatory regimes and are used to channel investments to a variety of third (or fourth, etc.) countries.

Table 10. Net Reallocation by Country Summary Statistics

2019				
Reallocation method	Countries with net increase > $1 billion	Countries with net decrease > $1 billion	5 largest net increases as percent of all country net increases	5 largest net decreases as percent of all country net decreases
First operating affiliate	86	8	26.52	97.23
Passthrough with ownership chains	54	9	39.20	95.25
Composite index apportionment	67	11	33.48	95.68

2020				
Reallocation method	Countries with net increase > $1 billion	Countries with net decrease > $1 billion	5 largest net increases as percent of all country net increases	5 largest net decreases as percent of all country net decreases
First operating affiliate	84	10	27.04	96.22
Passthrough with ownership chains	51	11	34.49	93.33
Composite index apportionment	66	14	33.99	90.36

Despite notable similarities in some aspects of their results, it is important to keep in mind that these methods are based on different approaches to reallocating USDIA equity position and thus produce country-level results that differ in important ways. For instance, as can be seen in charts 1 and 2, among the countries with the largest net reallocations, the magnitude of these changes tends to be largest for composite index apportionment, followed by first operating affiliate, and then passthrough with ownership chains—a finding consistent with the country-level reallocation results in table 9. Noteworthy differences can also be found at the level of individual countries, and Ireland is an especially interesting case in this regard. Despite exhibiting much less overall country-level reallocation than the other two

methods (see table 9), passthrough with ownership chains consistently produces a much larger net increase in equity position for Ireland than do the other two methods. In fact, in both 2019 and 2020, the passthrough method produces larger net increases for Ireland (approximately $80 billion and $69 billion, respectively) than for any other country. These large net reallocations to Ireland by the passthrough method are in especially strong contrast to the results produced by composite index apportionment, which generates net *decreases* for Ireland of $7 billion and $57 billion for 2019 and 2020, respectively.[44] These results suggest that foreign affiliates of U.S. MNEs in Ireland are more heavily focused on holding financial or other assets, including intangible assets, than on productive activities.

A more fine-grained perspective on these country results can be obtained by examining UHE reallocations at the level of individual country pairs. BEA has prepared tables that provide the value of the total UHE reallocation within every ordered country pair for the first operating affiliate, composite index apportionment, and passthrough with ownership chains methods for 2019 and 2020. These tables are publicly available on the BEA website. For any pair of countries, A and B, the tables provide separate values for (1) the total reallocation from directly held affiliates in A to indirectly held affiliates in B and (2) the total reallocation from directly held affiliates in B to indirectly held affiliates in A.

As an illustrative example, table 11 provides the reallocations, in both directions, between Ireland and a selection of countries for 2020. It is notable, as shown by the table's first row, that for each method the largest total reallocation is between direct and indirect affiliates that are both in Ireland. In other words, of all the (A, B) country pairs that include Ireland, the pair with the largest reallocation from immediate affiliates in A to indirect affiliates in B is (Ireland, Ireland). The table also sheds light on why composite index apportionment generates a significant net decrease for Ireland in 2020 while the other two reallocation methods produce net increases. The divergence between the methods' results is primarily due to the larger reallocations away from Ireland, as opposed to smaller reallocations into Ireland, produced by composite index compared to first operating affiliate and passthrough with ownership chains. The large reallocations away from Ireland produced by composite index apportionment go to a variety of countries, many of which, such as Germany and France, have little or no equity reallocated to them under the other two reallocation methods.

[44] There are additional cases where the methods produce contrasting results regarding whether a country is a net recipient or a net donor of USDIA equity position. For example, the results for Canada and Switzerland follow this pattern in both 2019 and 2020.

Table 11. Country-Level Reallocations to and from Ireland, 2020 [Millions of dollars]

Country	First operating affiliate		Composite index apportionment		Passthrough with ownership chains	
	To Ireland	From Ireland	To Ireland	From Ireland	To Ireland	From Ireland
Ireland	54,244	54,244	96,446	96,446	48,666	48,666
Netherlands	24,866	4,932	28,186	26,982	41,484	2,142
Bermuda	24,681	0	42,076	33	35,765	498
UK Islands - Caribbean	20,596	2,764	16,313	116	19,178	14
United Kingdom	14,053	26,838	21,151	28,397	17,220	24,306
Luxembourg	8,161	4,061	17,341	656	13,763	1,169
United States	NA	0	NA	41,509	NA	41,509
Norway	0	3,903	0	13,832	0	0
Taiwan	0	0	0	11,410	0	1,455
Germany	0	65	2	10,446	0	224
France	0	50	0	9,867	0	276
China	0	1,116	0	5,889	0	374
India	0	2,764	0	1,915	0	96
All others	7,431	35,829	6,777	38,001	19,429	6,276
Total	154,032	136,566	228,292	285,499	195,505	127,005

NA – Not applicable

Industry results are presented, in appendix A, at the sector level, and, for these results, notable similarities across methods and years can also be seen. For all methods and both years, holding companies are the only sector with a net reduction from the reallocation of the USDIA equity position. This finding should not be surprising since the goal of reallocating USDIA equity position is to move it away from entities without productive or operating activities, which consist largely of holding companies, to entities engaged in such activities. Regarding sectors with net increases in equity position, manufacturing stands out as having the largest net increase in equity position for all methods and years. This finding is attributable to the fact that manufacturing is by far the most common sector for indirectly held affiliates of U.S. MNEs.[45] It is also notable that, despite these similarities across methods, composite index apportionment has larger net increases in manufacturing, in both years, than the other two methods. This latter result can be attributed to the fact that relative to their size—as can be measured,

[45] In both 2019 and 2020, 31 percent of affiliates that were indirectly (and only indirectly) held by the USP were classified, based on their primary industry of sales, as being in the manufacturing sector, whereas the sector with the second largest number of indirectly held affiliates in both years, "other industries," only accounted for 13 percent of all indirectly held affiliates.

for example, by their owners' equity—manufacturing companies tend to have larger values for employment, value added, and physical capital than companies in other sectors.[46]

Another noteworthy difference between the methods' results is that, in both years, the net increase from reallocation for the finance and insurance sector is much lower for composite index apportionment than for the other two methods. This difference can be attributed to variation among the methods regarding both the inward and outward reallocation of equity position vis-à-vis the finance and insurance sector. Entities primarily engaged in financial activities are (relative to their size, as measured by owners' equity) generally unlikely compared to companies in other sectors to have significant employment, value added, or physical capital.[47] Composite index apportionment is thus less likely than the other methods to reallocate significant amounts of equity position to these entities and may in fact reallocate significant equity away from them if they are directly held by their U.S. parent. In contrast, passthrough with ownership chains focuses only on affiliates' financial structure without considering measures of productive activity; and first operating affiliate reallocates equity to any affiliate that is first in its ownership chain regardless of its industry (as long as it is not a holding company) and never reallocates equity away from an affiliate that is not a holding company.

Insights can also be drawn from examining industry results at the more-detailed level of four-digit international surveys industry codes. Regarding similarities among the methods, there are certain industries that all three methods identify as significant net recipients of reallocated equity position. For 2019, seven industries are among the industries with the ten largest net increases for all three methods:

- Securities and commodity contracts intermediation and brokerage (5231)
- Oil and gas extraction (2111)
- Pharmaceuticals and medicines manufacturing (3254)
- Semiconductors and other electronic components manufacturing (3344)
- Computer systems design and related services (5415)
- Drugs and druggists sundries merchant wholesalers (4242)
- Computer and peripheral equipment (3341)

For 2020, there are 3 industries that are among the top 10 largest net increases for all 3 methods (2111, 5415, and 3254), all of which are also among all 3 methods' top 10 net increases for 2019.

A major difference between the methods at the level of four-digit industry codes is that finance industries sometimes have large net increases from reallocation for both passthrough with ownership chains and first operating affiliate but large net reductions for composite index apportionment. This finding is consistent with the sector-level result noted above regarding the propensity of composite index apportionment to have much smaller net increases in finance and insurance than the other two methods. For 2019, "other financial investment activities and exchanges" (5238) is the industry with the single largest net increase for first operating and passthrough with chains ($218 billion and $119 billion,

[46] For example, BEA's AMNE statistics for majority-owned foreign affiliates of U.S. MNEs for 2019 indicate that, in the aggregate, manufacturing companies have relatively high ratios of employment, value added, and net PP&E to owners' equity compared to affiliates in other sectors.

[47] In contrast to the data for manufacturing companies, BEA's AMNE statistics for 2019 show that, in the aggregate, majority-owned foreign affiliates in the finance and insurance sector have low ratios of employment, value added, and net PP&E to owners' equity relative to affiliates in other sectors.

respectively) and the industry with the third largest net decrease for composite index apportionment ($10 billion). A similar pattern arises with "non-depository credit intermediation, except branches and agencies" (5224) in 2020. The net increases in this industry for 2020 for first operating affiliate and passthrough with ownership chains are $105 billion and $40 billion, respectively, while composite index apportionment has a net decrease of $13 billion. In addition, though not a finance industry, it is interesting to note that the same pattern can be observed for "lessors of nonfinancial intangible assets (except copyrighted works)" (5331) in both 2019 and 2020. With composite index apportionment, this industry has the largest net decrease, in both years, of any industry other than holding companies ($37 billion in 2019 and $59 billion in 2020), while it has sizeable net increases with first operating affiliate ($32 billion in 2019 and $31 billion in 2020) and passthrough with ownership chains ($20 billion in 2019 and $24 billion in 2020).

8. Conclusion

This paper has provided an update on BEA's research on the development of ultimate host economy statistics for U.S. direct investment abroad. A series of methodological refinements to BEA's initial research on this topic, described in Brew et al. (2023), have been introduced. These refinements include expanding the number of companies included in the U.S. MNE ownership chains used in UHE reallocation by drawing on data collected on BEA's Quarterly Survey of U.S. Direct Investment Abroad as well as changes to the first operating affiliate, passthrough with ownership chains, and PESAA reallocation methods. Three new reallocation methods—passthrough minimum, operating assets apportionment, and composite index apportionment—have also been introduced, and the paper has described how U.S. affiliates have been incorporated into ownership chains and the methodological adjustments to each reallocation method needed to accommodate the presence of U.S. affiliates in the ownership chains.

Section 6 provided an in-depth analysis, based in part on empirical results, of the relative advantages and disadvantages of six of the UHE reallocation methods (first operating affiliate, last affiliate, passthrough with ownership chains, PESAA, operating assets apportionment, and composite index apportionment). These methods were compared along a variety of dimensions, including conceptual accuracy, ease of implementation and interpretation, dependence on detailed microdata, robustness to data inconsistency, liberalness of reallocation, and location in the ownership chain of reallocation. Based on this analysis, but also taking into account other factors, such as the recommendations of international statistical guidelines, three of the reallocation methods were identified as meriting continued study: first operating affiliate, passthrough with ownership chains, and composite index apportionment.

After presenting a summary of country and industry results for all six methods analyzed in section 6, section 7 examined detailed country and industry results for 2019 and 2020 for the three preferred methods identified in section 6. Departing from BEA's standard approach, these results used noise infusion instead of suppression for disclosure avoidance. These detailed results showed significant similarities across the three methods, such as in the identification of which countries (the Netherlands, Luxembourg, Bermuda, U.K. Islands—Caribbean, and Singapore) and industries (holding companies) have the largest net decreases in USDIA equity position from UHE reallocation. However, there were also important differences in the country and industry-level results produced by the three preferred

methods. For example, composite index apportionment leads to larger overall reallocations of equity between countries than the other two methods, and, regarding industry results, composite index apportionment leads to smaller net increases from reallocation for the finance and insurance sector and larger net increases for manufacturing than do the other two methods.

Appendix A. Country and Industry Results

Table A1. Published USDIA Equity Position, UHE Position, and Net Reallocation by Country and Method, 2019 [Millions of dollars]

Published Equity Position ± Net Reallocation = UHE Position

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
All countries	5,750,160	0	0	0	5,750,160	5,750,160	5,750,160
United States	NA	+3,698	+7,751	+8,704	3,698	7,751	8,704
United States passthrough	NA	+2,912	+10,395	+12,579	2,912	10,395	12,579
Canada	353,856	+28,346	–4,782	+18,389	382,202	349,074	372,245
Europe	3,347,295	–298,633	–178,316	–415,343	3,048,662	3,168,979	2,931,952
Austria	5,894	+13,340	+1,901	+8,636	19,234	7,795	14,530
Belgium	61,206	+51,682	+27,698	+41,234	112,888	88,904	102,440
Czech Republic	5,291	+7,670	+2,067	+8,408	12,961	7,358	13,699
Denmark	14,206	+9,111	+6,079	+7,411	23,317	20,285	21,617
Finland	2,930	+11,504	+5,500	+5,890	14,434	8,430	8,820
France	86,248	+63,925	+42,932	+85,562	150,173	129,180	171,810
Germany	132,577	+47,032	+22,286	+118,553	179,609	154,863	251,130
Greece	264	+4,996	+1,331	+1,832	5,260	1,595	2,096
Hungary	11,724	–745	+2,488	+3,398	10,979	14,212	15,122
Ireland	343,223	+49,676	+79,661	–6,679	392,899	422,884	336,544
Italy	25,166	+27,487	+18,563	+43,441	52,653	43,729	68,607

Table A1 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
Luxembourg	681,550	–444,059	–259,615	–508,069	237,491	421,935	173,481
Netherlands	779,157	–380,921	–307,641	–492,336	398,236	471,516	286,821
Norway	25,969	+2,442	+3,409	–2,356	28,411	29,378	23,613
Poland	9,049	+15,438	+6,605	+24,355	24,487	15,654	33,404
Portugal	2,462	+11,214	+1,963	+3,389	13,676	4,425	5,851
Russia	12,278	+12,257	+5,101	+29,661	24,535	17,379	41,939
Spain	34,519	+34,335	+11,972	+27,917	68,854	46,491	62,436
Sweden	41,170	+22,761	+5,083	+11,011	63,931	46,253	52,181
Switzerland	217,124	–3,708	+36,066	–6,912	213,416	253,190	210,212
Turkey	3,240	+7,578	+3,446	+6,303	10,818	6,686	9,543
United Kingdom	839,211	+72,548	+77,299	+99,799	911,759	916,510	939,010
Other	12,837	+65,804	+27,487	+74,207	78,641	40,324	87,044
Latin America and Other Western Hemisphere	992,944	–103,195	–24,383	–184,806	889,749	968,561	808,138
South America	129,371	+109,512	+32,722	+136,291	238,883	162,093	265,662
Argentina	14,205	+16,534	+2,416	+18,932	30,739	16,621	33,137
Brazil	66,573	+48,542	+16,517	+83,022	115,115	83,090	149,595
Chile	23,894	+12,066	+5,488	+11,428	35,960	29,382	35,322
Colombia	7,796	+12,265	+1,919	+10,595	20,061	9,715	18,391
Ecuador	1,422	+3,895	+193	+669	5,317	1,615	2,091
Peru	6,035	+7,600	+2,623	+6,748	13,635	8,658	12,783
Venezuela	2,252	+4,746	+1,494	+2,805	6,998	3,746	5,057
Other	7,193	+3,865	+2,072	+2,091	11,058	9,265	9,284

Table A1 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
Central America	115,610	+54,317	+30,485	+82,100	169,927	146,095	197,710
Costa Rica	3,015	+5,136	+1,905	+6,695	8,151	4,920	9,710
Honduras	1,078	+1,691	+154	+728	2,769	1,232	1,806
Mexico	102,818	+40,434	+27,530	+72,218	143,252	130,348	175,036
Panama	4,592	+1,603	+534	–131	6,195	5,126	4,461
Other	4,106	+5,454	+362	+2,590	9,560	4,468	6,696
Other Western Hemisphere	747,964	–267,024	–87,589	–403,196	480,940	660,375	344,768
Barbados	41,640	–1,330	+21,325	–9,418	40,310	62,965	32,222
Bermuda	343,710	–126,476	–30,695	–183,984	217,234	313,015	159,726
Dominican Republic	2,321	+124	+312	+1,182	2,445	2,633	3,503
United Kingdom Islands, Caribbean	299,972	–116,820	–62,687	–177,905	183,152	237,285	122,067
Other	60,320	–22,522	–15,844	–33,070	37,798	44,476	27,250
Africa	47,174	+85,137	+23,121	+109,911	132,311	70,295	157,085
Egypt	13,070	+8,136	+1,091	+7,953	21,206	14,161	21,023
Nigeria	5,131	+15,187	+9,398	+27,049	20,318	14,529	32,180
South Africa	7,311	+32,387	+5,973	+42,851	39,698	13,284	50,162
Other	21,662	+29,427	+6,658	+32,057	51,089	28,320	53,719
Middle East	98,600	+35,972	+20,396	+41,512	134,572	118,996	140,112
Israel	33,973	+7,350	+18,581	+23,677	41,323	52,554	57,650
Saudi Arabia	(D)	+6,790	+876	+8,588	(D)	(D)	(D)

Table A1 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
United Arab Emirates	15,964	+12,693	+6,712	+8,418	28,657	22,676	24,382
Other	(D)	+9,140	–5,773	+830	(D)	(D)	(D)
Asia and Pacific	910,291	+245,764	+145,818	+409,055	1,156,055	1,056,109	1,319,346
Australia	106,133	+35,373	+13,711	+49,102	141,506	119,844	155,235
China	101,076	+79,156	+39,698	+114,751	180,232	140,774	215,827
Hong Kong	92,529	+15,342	–4,158	+7,560	107,871	88,371	100,089
India	43,140	+44,505	+20,862	+74,288	87,645	64,002	117,428
Indonesia	18,037	+16,413	+8,011	+31,645	34,450	26,048	49,682
Japan	144,480	+31,344	+29,032	+67,533	175,824	173,512	212,013
Malaysia	10,224	+35,839	+11,796	+32,236	46,063	22,020	42,460
New Zealand	11,174	+6,048	+928	+2,532	17,222	12,102	13,706
Philippines	5,942	+8,564	+3,970	+10,467	14,506	9,912	16,409
Singapore	286,213	–96,691	–17,826	–83,471	189,522	268,387	202,742
South Korea	37,847	+17,198	+10,933	+27,205	55,045	48,780	65,052
Taiwan	24,851	+17,040	+12,195	+28,336	41,891	37,046	53,187
Thailand	14,357	+18,462	+7,269	+26,904	32,819	21,626	41,261
Other	14,289	+17,172	+9,397	+19,967	31,461	23,686	34,256
Addendum:							
European Union	3,089,330	–361,067	–246,194	–498,684	2,728,263	2,843,136	2,590,646

NA – Not applicable.
(D) - Suppressed to avoid disclosure of data of individual companies.

Table A2. Published USDIA Equity Position, UHE Position, and Net Reallocation by Country and Method, 2020 [Millions of dollars]

Published Equity Position ± Net Reallocation = UHE Position

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
All countries	6,022,553	0	0	0	6,022,553	6,022,553	6,022,553
United States	NA	+4,658	+49,501	+49,203	4,658	49,501	49,203
United States passthrough	NA	+2,228	+11,531	+9,815	2,228	11,531	9,815
Canada	357,737	+34,847	–3,157	+30,180	392,584	354,580	387,917
Europe	3,563,599	–341,132	–207,641	–522,225	3,222,467	3,355,958	3,041,374
Austria	4,943	+15,906	+2,119	+9,099	20,849	7,062	14,042
Belgium	66,717	+54,461	+32,934	+43,099	121,178	99,651	109,816
Czech Republic	(D)	+11,348	+2,424	+11,433	(D)	(D)	(D)
Denmark	16,666	+9,665	+5,921	+5,992	26,331	22,587	22,658
Finland	3,557	+11,697	+5,106	+6,280	15,254	8,663	9,837
France	103,692	+56,342	+32,013	+93,656	160,034	135,705	197,348
Germany	152,487	+55,828	+32,523	+112,349	208,315	185,010	264,836
Greece	(D)	+7,515	+1,515	+2,313	(D)	(D)	(D)
Hungary	(D)	+5,093	+5,889	+3,508	(D)	(D)	(D)
Ireland	(D)	+17,467	+68,502	–57,206	(D)	(D)	(D)
Italy	(D)	+33,043	+19,381	+53,165	(D)	(D)	(D)
Luxembourg	632,723	–392,554	–237,100	–444,689	240,169	395,623	188,034
Netherlands	804,608	–391,514	–307,814	–510,942	413,094	496,794	293,666
Norway	17,844	+13,735	+5,713	+22,371	31,579	23,557	40,215

Table A2 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
Poland	11,589	+17,472	+6,504	+29,810	29,061	18,093	41,399
Portugal	2,033	+14,065	+1,618	+4,058	16,098	3,651	6,091
Russia	(D)	+14,058	+5,193	+31,111	(D)	(D)	(D)
Spain	37,120	+21,590	+8,146	+26,412	58,710	45,266	63,532
Sweden	(D)	–7,855	+10,570	–16,906	(D)	(D)	(D)
Switzerland	241,703	+9,332	+40,964	–11,398	251,035	282,667	230,305
Turkey	(D)	+8,960	+3,058	+7,369	(D)	(D)	(D)
United Kingdom	923,585	+17,426	+30,044	–3,225	941,011	953,629	920,360
Other	(D)	+55,786	+17,134	+60,114	(D)	(D)	(D)
Latin America and Other Western Hemisphere	1,022,891	–94,648	–65,007	–177,885	928,243	957,884	845,006
South America	137,821	+102,936	+33,242	+128,772	240,757	171,063	266,593
Argentina	(D)	+17,324	+2,779	+21,735	(D)	(D)	(D)
Brazil	64,427	+47,148	+18,949	+83,843	111,575	83,376	148,270
Chile	(D)	+9,902	+4,375	+7,811	(D)	(D)	(D)
Colombia	(D)	+9,056	+1,921	+4,445	(D)	(D)	(D)
Ecuador	(D)	+4,058	+216	+804	(D)	(D)	(D)
Peru	(D)	+5,986	+1,906	+4,612	(D)	(D)	(D)
Venezuela	(D)	+5,074	+1,885	+1,719	(D)	(D)	(D)
Other	20,076	+4,388	+1,214	+3,803	24,464	21,290	23,879
Central America	115,834	+46,146	+46,710	+54,486	161,980	162,544	170,320
Costa Rica	2,967	+4,963	+2,450	+6,621	7,930	5,417	9,588
Honduras	(D)	+2,842	+268	+1,113	(D)	(D)	(D)

Table A2 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
Mexico	106,760	+26,471	+42,805	+42,863	133,231	149,565	149,623
Panama	2,611	+5,919	+365	+1,285	8,530	2,976	3,896
Other	(D)	+5,951	+821	+2,603	(D)	(D)	(D)
Other Western Hemisphere	769,236	–243,730	–144,959	–361,142	525,506	624,277	408,094
Barbados	55,954	–1,656	–5,854	–11,748	54,298	50,100	44,206
Bermuda	315,585	–112,595	–53,749	–159,861	202,990	261,836	155,724
Dominican Republic	2,232	+555	+309	+989	2,787	2,541	3,221
United Kingdom Islands, Caribbean	339,686	–100,617	–55,208	–154,224	239,069	284,478	185,462
Other	55,779	–29,416	–30,456	–36,297	26,363	25,323	19,482
Africa	44,035	+78,295	+26,232	+113,381	122,330	70,267	157,416
Egypt	(D)	+6,901	+1,161	+7,394	(D)	(D)	(D)
Nigeria	(D)	+15,286	+8,912	+28,271	(D)	(D)	(D)
South Africa	(D)	+32,153	+8,286	+54,890	(D)	(D)	(D)
Other	18,840	+23,954	+7,872	+22,825	42,794	26,712	41,665
Middle East	98,002	+40,880	+29,632	+38,198	138,882	127,634	136,200
Israel	(D)	+8,515	+15,817	+20,398	(D)	(D)	(D)
Saudi Arabia	(D)	+8,348	+762	+4,399	(D)	(D)	(D)
United Arab Emirates	16,510	+15,578	+11,545	+8,056	32,088	28,055	24,566
Other	(D)	+8,440	+1,507	+5,344	(D)	(D)	(D)

Table A2 Continued

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
Asia and Pacific	936,291	+274,871	+158,910	+459,332	1,211,162	1,095,201	1,395,623
Australia	126,834	+32,033	+22,388	+44,849	158,867	149,222	171,683
China	108,820	+87,849	+46,416	+139,690	196,669	155,236	248,510
Hong Kong	92,929	+23,823	–343	+31,654	116,752	92,586	124,583
India	44,557	+40,855	+23,854	+70,798	85,412	68,411	115,355
Indonesia	11,577	+14,593	+7,847	+15,995	26,170	19,424	27,572
Japan	150,256	+29,578	+32,852	+65,957	179,834	183,108	216,213
Malaysia	(D)	+31,466	+11,478	+26,226	(D)	(D)	(D)
New Zealand	11,173	+4,080	+502	+325	15,253	11,675	11,498
Philippines	(D)	9,262	4,183	+11,039	(D)	(D)	(D)
Singapore	293,223	–78,033	–28,409	–69,174	215,190	264,814	224,049
South Korea	(D)	+22,091	+13,063	+36,329	(D)	(D)	(D)
Taiwan	17,724	+21,411	+14,003	+38,323	39,135	31,727	56,047
Thailand	(D)	+18,417	+6,788	+29,257	(D)	(D)	(D)
Other	13,638	+17,446	+4,289	+18,065	31,084	17,927	31,703
Addendum:							
European Union	2,354,297	–437,806	–305,835	–613,552	1,916,491	2,048,462	1,740,745

NA – Not applicable.
(D) - Suppressed to avoid disclosure of data of individual companies.

Table A3. Published USDIA Equity Position, UHE Position, and Net Reallocation by Sector and Method, 2019 [Millions of dollars]

Published Equity Position ± Net Reallocation = UHE Position

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
All sectors	5,750,160	0	0	0	5,750,160	5,750,160	5,750,160
United States passthrough	NA	+2,912	+10,395	+12,579	2,912	10,395	12,579
Depository institutions (banking)	144,681	+32,298	+18,630	+32,860	176,979	163,311	177,541
Finance (except depository institutions) and insurance	939,258	+474,276	+324,662	+73,369	1,413,534	1,263,920	1,012,627
Holding companies (nonbank)	2,642,873	–2,348,358	–1,237,675	–2,166,095	294,515	1,405,198	476,778
Information	274,965	+84,762	+38,479	+147,918	359,727	313,444	422,883
Manufacturing	785,971	+833,075	+396,755	+1,036,706	1,619,046	1,182,726	1,822,677
Mining	161,359	+164,248	+104,794	+226,070	325,607	266,153	387,429
Other industries	407,878	+298,053	+130,753	+232,952	705,931	538,631	640,830
Professional, scientific, and technical services	159,946	+192,534	+87,554	+189,085	352,480	247,500	349,031
Wholesale trade	233,230	+266,199	+125,651	+214,556	499,429	358,881	447,786

NA – Not applicable.

Table A4. Published USDIA Equity Position, UHE Position, and Net Reallocation by Sector and Method, 2020 [Millions of dollars]

Published Equity Position ± Net Reallocation = UHE Position

	Published Equity Position	Net Reallocation			UHE Position		
		First operating	Passthrough	Composite index	First operating	Passthrough	Composite index
All sectors	6,022,553	0	0	0	6,022,553	6,022,553	6,022,553
United States passthrough	NA	+2,228	+11,531	+9,815	2,228	11,531	9,815
Depository institutions (banking)	117,410	+54,633	+34,773	+24,039	172,043	152,183	141,449
Finance (except depository institutions) and insurance	995,718	+473,579	+289,520	+167,096	1,469,297	1,285,238	1,162,814
Holding companies (nonbank)	2,828,995	–2,424,411	–1,302,260	–2,274,509	404,584	1,526,735	554,486
Information	222,862	+131,990	+91,248	+212,286	354,852	314,110	435,148
Manufacturing	904,944	+837,568	+384,575	+1,044,395	1,742,512	1,289,519	1,949,339
Mining	130,718	+166,287	+130,617	+220,407	297,005	261,335	351,125
Other industries	433,758	+264,498	+123,162	+197,964	698,256	556,920	631,722
Professional, scientific, and technical services	144,300	+197,822	+106,545	+181,194	342,122	250,845	325,494
Wholesale trade	243,849	+295,806	+130,289	+217,312	539,655	374,138	461,161

NA – Not applicable.

Appendix B. Example Calculations

This appendix uses a hypothetical MNE to provide example calculations for the seven ownership chain-based reallocation methods discussed in the paper: first operating affiliate, last affiliate, passthrough with ownership chains, PESAA, passthrough min, composite index apportionment, and operating assets apportionment. This hypothetical MNE consists of one U.S. parent (USP) and three foreign affiliates (FA1, FA2, and FA3) with the relationships to one another depicted in the ownership chain in figure B1. The USP has, on an immediate basis, a $1,000 equity position in FA1. Hypothetical values for the data items required for each of the reallocation methods are provided in table B1. In addition, table B2 provides, for comparison purposes, the post-reallocation equity positions of the USP in each of the foreign affiliates for each of the methods examined.[48]

Figure B1. Ownership Chain for Hypothetical MNE

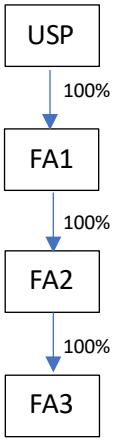


Table B1. Foreign Affiliate Data for Hypothetical MNE

Data item	FA1	FA2	FA3
USP ownership %	100	100	100
Holding company?	Yes	No	No
Owners' equity	1,000	1,000	300
Total assets	1,050	2,000	500
Equity in child affiliate	1,000	300	0
Employment	0	8	2
Physical capital (net PP&E)	0	750	250
Value added	0	1,700	300

[48] It is instructive to observe that if owners' equity equals total assets, several of the methods converge to the same results. For example, let total assets equal 1,000, 1,000, and 300 for FA1, FA2, and FA3, respectively. Passthrough with ownership chains, PESAA, passthrough min, and operating assets apportionment all produce allocations of (0, 700, 300). Difference between these methods' reallocations only arise when sources other than owners' equity are used to fund the pool of assets. When that happens, the methods depart in terms of which funding source to allocate to which asset.

Table B2. Reallocated Equity Positions for Hypothetical MNE

Reallocation method	FA1	FA2	FA3
First operating affiliate	0	1,000	0
Last affiliate	0	0	1,000
Passthrough with ownership chains	0	700	300
PESAA	48	809	143
Passthrough minimum	50	950	0
Composite index apportionment	0	800	200
Operating assets apportionment	22	756	222

First Operating Affiliate

The USP's $1,000 equity position in FA1 is reallocated in its entirety to FA2, despite the existence of another operating affiliate beneath FA2, because FA2 is the first operating affiliate in the ownership chain.

Last Affiliate

The $1,000 equity position is reallocated to FA3 because FA3 is the last affiliate in the ownership chain.

Passthrough with Ownership Chains

The calculations for the passthrough with ownership chains method (as well as the PESAA and passthrough minimum methods) are performed in a step-by-step fashion moving downward along the ownership chain such that the results of the calculations for each affiliate provide a crucial input for the calculations for its child affiliate(s). As shown in table B3, for each affiliate, the value of passthrough equity (*PTE*) is calculated as the minimum of inward equity (*IE*) and outward equity (*OE*) multiplied by the USP's ownership interest (*USPPctOwn*). Moreover, unless the affiliate is directly held, in which case its inward equity is equal to the USP's equity position in it, its inward equity is equal to the passthrough equity of its parent affiliate. Finally, the adjusted equity position (*AdjEqPos*) of each affiliate equals its inward equity less its passthrough equity.

Table B3. Example Calculations for Passthrough with Ownership Chains

Affiliate	Calculations
FA1	$IE = 1{,}000\ (USP's\ equity\ in\ FA1)$ $OE = 1{,}000\ (FA1's\ equity\ in\ FA2)$ $PTE = \min(IE, OE \times USPPctOwn) = \min(1{,}000, 1{,}000 \times 1) = 1{,}000$ $AdjEqPos = IE - PTE = 1{,}000 - 1{,}000 = 0$
FA2	$IE = 1{,}000\ (FA1's\ PTE)$ $OE = 300\ (FA2's\ equity\ in\ FA3)$ $PTE = \min(1{,}000, 300 \times 1) = 300$ $AdjEqPos = 1{,}000 - 300 = 700$
FA3	$IE = 300\ (FA2's\ PTE)$ $OE = 0$ $PTE = \min(300, 0 \times 0) = 0$ $AdjEqPos = 300 - 0 = 300$

PESAA

The calculations for PESAA are similar to those for passthrough with ownership chains with the exception, as shown in table B4, that outward equity is weighted by the USP's equity share of the affiliate's assets rather than the USP's percent ownership interest. For each affiliate, the value of *PESAA* is calculated as inward equity divided by total assets.

Table B4. Example Calculations for PESAA

Affiliate	Calculations
FA1	$IE = 1{,}000\ (USP's\ equity\ in\ FA1)$ $OE = 1{,}000\ (FA1's\ equity\ in\ FA2)$ $PESAA = IE/Assets = 1000/1{,}050 = 0.952$ $PTE = \min(IE, OE \times PESAA) = \min(1{,}000, 1{,}000 \times 0.95) = 952$ $AdjEqPos = IE - PTE = 1{,}000 - 952 = 48$
FA2	$IE = 952\ (FA1's\ PTE)$ $OE = 300\ (FA2's\ equity\ in\ FA3)$ $PESAA = 952/2{,}000 = 0.476$ $PTE = \min(952, 300 \times 0.476) = 143$ $AdjEqPos = 952 - 143 = 809$
FA3	$IE = 143\ (FA2's\ PTE)$ $OE = 0$ $PESAA = 143/500 = 0.286$ $PTE = \min(143, 0 \times 0.286) = 0$ $AdjEqPos = 143 - 0 = 143$

Passthrough Minimum

The calculations for passthrough minimum follow the same general pattern as those for passthrough with ownership chains and PESAA, where, for each affiliate, passthrough equity is calculated and then becomes the inward equity of its child affiliate(s). Passthrough minimum differs from the above two methods in that *PTE* is calculated as the difference between inward equity and operating assets (*OA*).

Table B5. Example Calculations for Passthrough Minimum

Affiliate	Calculations
FA1	$IE = 1{,}000\ (USP's\ equity\ in\ FA1)$ $OE = 1{,}000\ (FA1's\ equity\ in\ FA2)$ $OA = 1{,}050 - 1000 = 50\ (FA1's\ total\ assets\ less\ its\ equty\ in\ FA2)$ $PTE = \max(IE - OA, 0) = \max(1{,}000 - 50, 0) = 950$ $AdjEqPos = IE - PTE = 1{,}000 - 950 = 50$
FA2	$IE = 950\ (FA1's\ PTE)$ $OE = 300\ (FA2's\ equity\ in\ FA3)$ $OA = 2000 - 300 = 1700\ (FA2's\ total\ assets\ less\ its\ equity\ in\ FA3)$ $PTE = \max(950 - 1700, 0) = 0$ $AdjEqPos = 950 - 0 = 950$
FA3	$IE = 0\ (FA2's\ PTE)$ $OE = 0$ $OA = 500 - 0 = 500$ $PTE = \max(0 - 500, 0) = 0$ $AdjEqPos = 0 - 0 = 0$

Composite Index Apportionment

The composite index apportionment method redistributes the USP's direct equity position among all affiliates in a manner that is proportional to the extent of each affiliate's productive activities, as measured by employment (*Emp*), net PP&E (*PPE*), and value added (*VA*). These calculations are usefully divided into four steps.

1. Adjust the value of each metric for each affiliate by weighting it by the USP's ownership interest (*USPPctOwn*) in the affiliate.

$$EmpW_{FA1} = Emp_{FA1} \times USPPctOwn_{FA1} = 0 \times 1 = 0$$

$$EmpW_{FA2} = Emp_{FA2} \times USPPctOwn_{FA2} = 8 \times 1 = 8$$

$$EmpW_{FA3} = Emp_{FA3} \times USPPctOwn_{FA3} = 2 \times 1 = 2$$

$$PPEW_{FA1} = PPE_{FA1} \times USPPctOwn_{FA1} = 0 \times 1 = 0$$

$$PPEW_{FA2} = PPE_{FA2} \times USPPctOwn_{FA2} = 750 \times 1 = 750$$

$$PPEW_{FA3} = PPE_{FA3} \times USPPctOwn_{FA3} = 250 \times 1 = 250$$

$$VAW_{FA1} = VA_{FA1} \times USPPctOwn_{FA1} = 0 \times 1 = 0$$

$$VAW_{FA2} = VA_{FA2} \times USPPctOwn_{FA2} = 1{,}700 \times 1 = 1{,}700$$

$$VAW_{FA3} = VA_{FA3} \times USPPctOwn_{FA3} = 300 \times 1 = 300$$

2. Based on the weighted values from step 1, create a standardized index for each metric that represents the relative size of each affiliate (for the metric in question) relative to the other affiliates in the ownership chain.

$$EmpIndex_{FA1} = \frac{EmpW_{FA1}}{EmpW_{FA1} + EmpW_{FA2} + EmpW_{FA3}} = \frac{0}{0 + 8 + 2} = 0$$

$$EmpIndex_{FA2} = \frac{EmpW_{FA2}}{EmpW_{FA1} + EmpW_{FA2} + EmpW_{FA3}} = \frac{0}{0 + 8 + 2} = 0.8$$

$$EmpIndex_{FA3} = \frac{EmpW_{FA3}}{EmpW_{FA1} + EmpW_{FA2} + EmpW_{FA3}} = \frac{2}{0 + 8 + 2} = 0.2$$

$$PPEIndex_{FA1} = \frac{PPEW_{FA1}}{PPEW_{FA1} + PPEW_{FA2} + PPEW_{FA3}} = \frac{0}{0 + 750 + 250} = 0$$

$$PPEIndex_{FA2} = \frac{PPEW_{FA2}}{PPEW_{FA1} + PPEW_{FA2} + PPEW_{FA3}} = \frac{750}{0 + 750 + 250} = 0.75$$

$$PPEIndex_{FA3} = \frac{PPEW_{FA3}}{PPEW_{FA1} + PPEW_{FA2} + PPEW_{FA3}} = \frac{250}{0 + 750 + 250} = 0.25$$

$$VAIndex_{FA1} = \frac{VAW_{FA1}}{VAW_{FA1} + VAW_{FA2} + VAW_{FA3}} = \frac{0}{0 + 1{,}700 + 300} = 0$$

$$VAIndex_{FA2} = \frac{VAW_{FA2}}{VAW_{FA1} + VAW_{FA2} + VAW_{FA3}} = \frac{1{,}700}{0 + 1{,}700 + 300} = 0.85$$

$$VAIndex_{FA3} = \frac{VAW_{FA3}}{VAW_{FA1} + VAW_{FA2} + VAW_{FA3}} = \frac{300}{0 + 1{,}700 + 300} = 0.15$$

3. Calculate a composite index value for each affiliate that equals the mean of the affiliate's values for the three individual metric indexes.

$$CompIndex_{FA1} = \frac{EmpIndex_{FA1} + PPEIndex_{FA1} + VAIndex_{FA1}}{3} = \frac{0 + 0 + 0}{3} = 0$$

$$CompIndex_{FA2} = \frac{EmpIndex_{FA2} + PPEIndex_{FA2} + VAIndex_{FA2}}{3} = \frac{0.8 + 0.75 + 0.85}{3} = 0.8$$

$$CompIndex_{FA3} = \frac{EmpIndex_{FA3} + PPEIndex_{FA3} + VAIndex_{FA3}}{3} = \frac{0.2 + 0.25 + 0.15}{3} = 0.2$$

4. Calculate the adjusted equity position for each affiliate as the product of the affiliate's composite index values and the USP's direct equity position in the chain (*USPEqPos*).

$$AdjEqPos_{FA1} = USPEqPos \times CompIndex_{FA1} = 1{,}000 \times 0 = 0$$

$$AdjEqPos_{FA2} = USPEqPos \times CompIndex_{FA2} = 1{,}000 \times 0.8 = 800$$

$$AdjEqPos_{FA3} = USPEqPos \times CompIndex_{FA3} = 1{,}000 \times 0.2 = 200$$

Operating Assets Apportionment

The operating assets apportionment method reallocates the USP's direct equity position among all affiliates in a fashion that is proportional to the size of each affiliate's operating assets. This method is also usefully divided into four steps.

1. Calculate operating assets (*OA*) for each affiliate as total assets less equity in child affiliate(s).

$$OA_{FA1} = Assets_{FA1} - OE_{FA1} = 1{,}050 - 1000 = 50$$

$$OA_{FA2} = Assets_{FA2} - OE_{FA2} = 2{,}000 - 300 = 1{,}700$$

$$OA_{FA3} = Assets_{FA3} - OE_{FA3} = 500 - 0 = 500$$

2. Weight each affiliate's operating assets by the USP's ownership interest in the affiliate.

$$OAW_{FA1} = OA_{FA1} \times USPPctOwn_{FA1} = 50 \times 1 = 50$$

$$OAW_{FA2} = OA_{FA2} \times USPPctOwn_{FA2} = 1{,}700 \times 1 = 1{,}700$$

$$OAW_{FA3} = OA_{FA3} \times USPPctOwn_{FA3} = 500 \times 1 = 500$$

3. Calculate each affiliate's relative share of the chain's total operating assets.

$$OAShare_{FA1} = \frac{OAW_{FA1}}{OAW_{FA1} + OAW_{FA2} + OAW_{FA3}} = \frac{50}{50 + 1{,}700 + 500} = 0.022$$

$$OAShare_{FA2} = \frac{OAW_{FA2}}{OAW_{FA1} + OAW_{FA2} + OAW_{FA3}} = \frac{1{,}700}{50 + 1{,}700 + 500} = 0.756$$

$$OAShare_{FA3} = \frac{OAW_{FA3}}{OAW_{FA1} + OAW_{FA2} + OAW_{FA3}} = \frac{500}{50 + 1{,}700 + 500} = 0.222$$

4. Calculate each affiliate's adjusted equity position as the product of its relative share of operating assets and the USP's direct equity position.

$$AdjEqPos_{FA1} = USPEqPos \times OAShare_{FA1} = 1{,}000 \times 0.022 = 22$$

$$AdjEqPos_{FA2} = USPEqPos \times OAShare_{FA2} = 1{,}000 \times 0.756 = 756$$

$$AdjEqPos_{FA3} = USPEqPos \times OAShare_{FA3} = 1{,}000 \times 0.222 = 222$$

Appendix C. Fungibility and Leverage of Direct Investment Equity

This appendix uses a set of four hypothetical scenarios to explore how the fungibility of money and the ability of firms to leverage equity investments create a conceptual challenge for UHE statistics. In particular, due to these two factors there may not be, in many circumstances, a single correct UHE reallocation of a direct investment.

The four scenarios presented here each describe, at three different points in time, the financial and operating activities of an MNE that consists of a USP and three affiliates. In each scenario, the USP makes an investment in time period 1 that is entirely allocated to its affiliates' operations in this initial time period, although the ultimate destination of the investment in the ownership chain varies across the four scenarios. In each scenario in periods 2 and 3, the affiliates take on loans and make additional investments in one another based on those loans, but the initial allocation of the USP's investment from period 1 is not changed. The allocation of the USP's initial investment in period 1 can thus arguably be interpreted as representing, for each scenario, the UHE allocation of the USP's investment.

In each of the four scenarios, the borrowing and investments undertaken by the affiliates in periods 2 and 3 significantly alter the affiliates' values on key financial and operating variables. In fact, by the end of period 3, despite the different patterns of investment across the four scenarios in period 1, the scenarios have converged: each affiliate has identical values on key financial and operating variables across the four scenarios (though the three affiliates do not necessarily have the same values on those variables within each scenario). As a result, if nothing is known about the sequence of events leading to period 3, as is generally the case in practice, the UHE allocation would have to be the same for all four scenarios. This result arises even though each of the four scenarios, viewed in full across the three time periods, points to a different UHE allocation.

After presenting the four scenarios, this appendix compares the (arguably) correct UHE allocation for each scenario, based on the allocation of the USP's investment in period 1, with the UHE allocation derived by each method based on the data from period 3. The analysis shows that when affiliates borrow and invest additional funds after the USP's initial investment, the ultimate location of the initial investment becomes obscured and, as a result, none of the methods is guaranteed to return a result that matches the (arguably) correct UHE allocation. Appendix C then concludes by describing the steps involved in each method's reallocation of the equity position based on period 3 data.

Each scenario assumes 100 percent ownership of each affiliate by the entity immediately above it in the ownership chain. All affiliate borrowing is from host country sources. For simplicity, there are no reinvested earnings and no valuation changes in equity positions.

Scenario 1

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 purchases $1,000 of capital equipment and commences operations.

- At *t* = 2, affiliate 1 borrows $1,000 and establishes affiliate 2 in economy B at a cost of $1,000. Affiliate 2 purchases $1,000 of capital equipment and commences operations. Affiliate 1 continues operations.
- At *t* = 3, affiliate 2 borrows $1,000 and establishes affiliate 3 in economy C at a cost of $1,000. Affiliate 3 purchases $1,000 of capital equipment and commences operations. Affiliates 1 and 2 continue operations.

Scenario 2

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 immediately establishes affiliate 2 in economy B at a cost of $1,000. Affiliate 2 immediately establishes affiliate 3 in economy C at a cost of $1,000. Affiliate 3 purchases $1,000 of capital equipment and commences operations.
- At *t* = 2, affiliate 2 borrows $1,000, purchases $1,000 of capital equipment, and commences operations. Affiliate 3 continues operations.
- At *t* = 3, affiliate 1 borrows $1,000, purchases $1,000 of capital equipment, and commences operations. Affiliates 3 and 2 continue operations.

Scenario 3

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 uses $500 for operations and $500 to establish affiliate 2 in economy B. Affiliate 2 uses $250 for operations and $250 to establish affiliate 3 in economy C. Affiliate 3 purchases $250 of capital equipment and commences operations.
- At *t* = 3, affiliate 1 borrows $1,000, using $500 for operations and $500 to increase its equity in affiliate 2. Affiliate 2 borrows $1,000; it uses $750 of its additional funding (equity investment plus borrowing) for operations and $750 to increase its equity in affiliate 3. Affiliate 3 purchases $750 of capital equipment to expand operations.

Scenario 4

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 uses $333.33 for operations and $666.67 to establish affiliate 2 in economy B. Affiliate 2 uses $333.33 for operations and $333.33 to establish affiliate 3 in economy C. Affiliate 3 purchases $333.33 of capital equipment and commences operations.
- At *t* = 3, affiliate 1 borrows $1,000, using $666.67 for operations and $333.33 to increase its equity in affiliate 2. Affiliate 2 borrows $1,000; it uses $666.67 of its additional funding (equity investment plus borrowing) for operations and $666.67 to increase its equity in affiliate 3. Affiliate 3 purchases $666.67 of capital equipment to expand operations.

Table C1 provides the (arguably) correct UHE allocation for each of the four scenarios. These figures are based for each scenario on the allocation of the USP's investment to affiliates' operations in period 1,

allocations which, as noted above, were not altered in any of the scenarios by the borrowing and investments based on borrowing that occurred in periods 2 and 3. These results can be compared to the results in table C2, which provides the UHE allocations generated by each of the seven reallocation methods for all four scenarios viewed at time period 3. The results in table C2 are the same across all four scenarios because, as previously noted, the three affiliates end up with identical values on key financial and operating variables at period 3 across the four scenarios.[49] Moreover, it bears emphasis that the reallocation methods tend to produce significantly different results for period 3, which should not be surprising given their differing methodological approaches to identifying the UHE (or UHEs).

Table C1. Possible UHE Allocations

Scenario	Aff. 1	Aff. 2	Aff. 3
1	1,000	0	0
2	0	0	1,000
3	500	250	250
4	333.33	333.33	333.33

Table C2. Scenarios 1–4 Reallocation Results at t = 3

Reallocation method	Aff. 1	Aff. 2	Aff. 3
First operating affiliate	1,000	0	0
Last affiliate	0	0	1,000
Passthrough with ownership chains	0	0	1,000
PESAA	500	250	250
Passthrough minimum	1,000	0	0
Composite index apportionment	333.33	333.33	333.33
Operating assets apportionment	333.33	333.33	333.33

A comparison of tables C1 and C2 reveals that, for each of the four scenarios, only one or two of the reallocation methods produces the (arguably) correct reallocation of the USP's direct investment. For scenario 1, only first operating affiliate and passthrough minimum arrive at the arguably correct allocation. For scenario 2, only last affiliate and passthrough with ownership chains produce the result in table C1. Scenario 3 "naturally" corresponds to the PESAA allocation, while scenario 4 naturally corresponds to the allocations produced by the two apportionment methods. These examples reflect two facts—the fungibility of money, and the ability of firms to leverage equity investments—that introduce significant complications to the identification of ultimate host economies and the

[49] In all four scenarios, at the end of period 3 the three affiliates all have $1,000 in owners' equity (from the USP or their parent affiliate) and $1,000 in capital equipment; and, across all four scenarios, affiliates 1 and 2 have $1,000 in debt (from unaffiliated host country sources) and $1,000 in equity in other affiliates. For the purposes of applying the PESAA, passthrough min, and operating assets apportionment methods, it should be noted that affiliates 1 and 2 both have $2,000 in total assets ($1,000 in owners' equity plus $1,000 in liabilities/debt).

interpretation of ultimate host economy statistics.[50] Moreover, the examples show that there may not always be a single conceptually correct UHE allocation of a direct investment abroad.

First Operating Affiliate

Affiliate 1 has operations, as indicated by its $1,000 of capital equipment, so allocate the entirety of the USP's $1,000 investment to affiliate 1.

Last Affiliate

Affiliate 3 is at the bottom of the ownership chain, so allocate the entirety of the USP's $1,000 investment to affiliate 3.

Passthrough with Ownership Chains

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 1{,}000\ (aff.1's\ equity\ in\ aff.2)$ $PTE = \min(IE, OE \times USPPctOwn) = \min(1{,}000, 1{,}000 \times 1) = 1{,}000$ $AdjEqPos = IE - PTE = 1{,}000 - 1{,}000 = 0$
2	$IE = 1{,}000\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PTE = \min(1{,}000, 1{,}000 \times 1) = 1{,}000$ $AdjEqPos = 1{,}000 - 1{,}000 = 0$
3	$IE = 1{,}000\ (aff.2's\ PTE)$ $OE = 0$ $PTE = \min(1{,}000, 0 \times 0) = 0$ $AdjEqPos = 1{,}000 - 0 = 1{,}000$

[50] The fungibility of money is evidenced by noting that the $1,000 of equity in any of the three affiliates could readily be interpreted as fully, partly, or not at all coming from the USP. The ability to leverage equity investment is evidenced by the fact that the USP wholly owns, whether directly or indirectly, foreign affiliates undertaking operations made possible by $3,000 in capital equipment.

PESAA

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 1{,}000\ (aff.1's\ equity\ in\ aff.2)$ $PESAA = IE/Assets = 1000/2{,}000 = 0.5$ $PTE = \min(IE, OE \times PESAA) = \min(1{,}000, 1{,}000 \times 0.5) = 500$ $AdjEqPos = IE - PTE = 1{,}000 - 500 = 500$
2	$IE = 500\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PESAA = 500/2{,}000 = 0.25$ $PTE = \min(500, 1{,}000 \times 0.25) = 250$ $AdjEqPos = 500 - 250 = 250$
3	$IE = 250\ (aff.\ 2's\ PTE)$ $OE = 0$ $PESAA = 250/1{,}000 = 0.25$ $PTE = \min(250, 0 \times 0.25) = 0$ $AdjEqPos = 250 - 0 = 250$

Passthrough Minimum

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 1{,}000\ (aff.1's\ equity\ in\ aff.2)$ $OA = 2{,}000 - 1000 = 1{,}000\ (aff.1's\ assets\ less\ equity\ in\ aff.\ 2)$ $PTE = \max(IE - OA, 0) = \max(1{,}000 - 1{,}000, 0) = 0$ $AdjEqPos = IE - PTE = 1{,}000 - 0 = 1{,}000$
2	$IE = 0\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ FA3)$ $OA = 2000 - 1{,}000 = 1{,}000\ (aff.\ 2's\ assets\ less\ equity\ in\ aff.\ 3)$ $PTE = \max(0 - 1{,}000, 0) = 0$ $AdjEqPos = 0 - 0 = 0$
3	$IE = 0\ (aff.\ 2's\ PTE)$ $OE = 0$ $OA = 1{,}000 - 0 = 1{,}000$ $PTE = \max(0 - 1{,}000, 0) = 0$ $AdjEqPos = 0 - 0 = 0$

Composite Index Apportionment

In this simple example, the three affiliates all have physical assets valued at $1,000 but no value added and no employment. The USP's direct investment of $1,000 is thus divided equally among the three affiliates, leading to an allocation of (approximately) $333.33 of equity position to each affiliate.

Operating Assets Apportionment

The calculations for the passthrough minimum method indicate that each of the three affiliates has operating assets worth $1,000. Thus, as with the composite index apportionment method, the USP's $1,000 equity position is divided equally among the affiliates, leading to an allocation of (approximately) $333.33 to each affiliate.

Appendix D. Location of Borrowing

Appendix C provided examples that demonstrate the role that borrowing (from unaffiliated lenders) by affiliates can play in obscuring the actual ultimate host(s) of the USP's direct investment. This appendix builds on Appendix C by exploring how the location in the ownership chain of borrowing from unaffiliated lenders can affect reallocation results. Two variations of scenario 1 from appendix C are examined. In scenario 1 as presented in appendix C, affiliate 1 borrows $1,000 to finance the purchase of $1,000 of capital equipment for affiliate 2, and affiliate 2 borrows $1,000 to finance the purchase of $1,000 of capital equipment for affiliate 3. In the first variation of scenario 1 presented here, all $2,000 is borrowed by affiliate 1, and in the second variation $500 is borrowed by affiliate 1 and $1,500 is borrowed by affiliate 2. Details for these variants of scenario 1 are provided below.

Scenario 1, Variant 1

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 purchases $1,000 of capital equipment and commences operations.
- At *t* = 2, affiliate 1 borrows $2,000 and establishes affiliate 2 in economy B at a cost of $2,000. Affiliate 2 purchases $1,000 of capital equipment and commences operations. Affiliate 1 continues operations.
- At *t* = 3, affiliate 2 establishes affiliate 3 in economy C at a cost of $1,000. Affiliate 3 purchases $1,000 of capital equipment and commences operations. Affiliates 1 and 2 continue operations.

Scenario 1, Variant 2

- At *t* = 1, USP establishes affiliate 1 in economy A at a cost of $1,000. Affiliate 1 purchases $1,000 of capital equipment and commences operations.
- At *t* = 2, affiliate 1 borrows $500 and establishes affiliate 2 in economy B at a cost of $500. Affiliate 2 purchases $500 of capital equipment and commences operations. Affiliate 1 continues operations.
- At *t* = 3, affiliate 2 borrows $1,500, purchases $500 of capital equipment, and establishes affiliate 3 in economy C at a cost of $1,000. Affiliate 3 purchases $1,000 of capital equipment and commences operations. Affiliates 1 and 2 continue operations.

Table D1 provides the results for each reallocation method under each of these versions of scenario 1 at *t* = 3. (The column headed "Original" reproduces the results for the original version of scenario 1 that are also available in table C2.) The results in table D1 indicate that the only methods whose results are altered when the location of unaffiliated borrowing changes are passthrough with ownership chains and PESAA. Thus, as argued in the main body of the paper, these two methods are not robust to the location of unaffiliated borrowing, a potential drawback since the location of unaffiliated borrowing is arguably irrelevant to identifying the ultimate host of the USP's direct investment.

Table D1. Scenario 1 Reallocation Results with Different Locations of Unaffiliated Borrowing

Reallocation method	Original	Variant 1	Variant 2
First operating affiliate	(1,000, 0, 0)	(1,000, 0, 0)	(1,000, 0, 0)
Last affiliate	(0, 0, 1,000)	(0, 0, 1,000)	(0, 0, 1,000)
Passthrough with ownership chains	(0, 0, 1,000)	(0, 0, 1,000)	(500, 0, 500)
PESAA	(500, 250, 250)	(333.33, 333.33, 333.33)	(666.67, 166.67, 166.67)
Passthrough minimum	(1,000, 0, 0)	(1,000, 0, 0)	(1,000, 0, 0)
Composite index apportionment	(333.33, 333.33, 333.33)	(333.33, 333.33, 333.33)	(333.33, 333.33, 333.33)
Operating assets apportionment	(333.33, 333.33, 333.33)	(333.33, 333.33, 333.33)	(333.33, 333.33, 333.33)

When the location of unaffiliated borrowing in an ownership chain changes (without the location of productive/operating activities also changing), affiliates involved in the change are affected in two ways that are potentially relevant to UHE calculations. For each affiliate involved in the change, the increase or decrease in level of borrowing (i.e., liabilities) leads to changes in both total assets and equity in child affiliates, both of which are of the same direction and magnitude as the change in liabilities. The push-down methods and composite index apportionment do not use assets or equity in child affiliates as inputs, so it should be clear without further examination that reallocations produced by these methods are not affected by changes in the location of unaffiliated borrowing. Passthrough min and operating assets apportionment both involve calculating a value for operating assets, which is defined in this paper as the difference between total assets and equity in child affiliates. This quantity is not affected by changes in the location of unaffiliated borrowing because any change in assets is offset by an accompanying change of the same size and direction in equity in child affiliates.[51] Since the value of operating assets does not change, the reallocations produced by passthrough min and operating assets apportionment are not affected by changes in the location of unaffiliated borrowing.

The calculations for passthrough with ownership chains and PESAA for the two variants of scenario 1 with different locations of unaffiliated borrowing are as follows.

[51] It was seen in appendix C that, in the original version of scenario 1 at $t = 3$, affiliates 1, 2, and 3 all have operating assets worth $1,000. In variant 1, affiliate 1's operating assets are $3,000 in total assets ($1,000 in owners' equity plus $2,000 in liabilities) less $2,000 of equity in affiliate 2, or $1,000; and affiliate 2's operating assets are $2,000 in total assets (all owners' equity) minus $1,000 of equity in affiliate 3, or $1,000. In variant 2, affiliate 1's operating assets are $1,500 in total assets ($1,000 in owners' equity plus $500 in liabilities) less $500 of equity in affiliate 2, or $1,000; and affiliate 2's operating assets are $2,000 in total assets ($500 in owners' equity plus $1,500 in liabilities) minus $1,000 of equity in affiliate 3. In both variants, affiliate 3 has $1,000 in assets (all owners' equity) and no equity in child affiliates, which is equals $1,000 in operating assets.

Passthrough with Ownership Chains (Scenario 1, Variant 1)

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 2{,}000\ (aff.1's\ equity\ in\ aff.2)$ $PTE = \min(IE, OE \times USPPctOwn) = \min(1{,}000, 2{,}000 \times 1) = 1{,}000$ $AdjEqPos = IE - PTE = 1{,}000 - 1{,}000 = 0$
2	$IE = 1{,}000\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PTE = \min(1{,}000, 1{,}000 \times 1) = 1{,}000$ $AdjEqPos = 1{,}000 - 1{,}000 = 0$
3	$IE = 1{,}000\ (aff.2's\ PTE)$ $OE = 0$ $PTE = \min(1{,}000, 0 \times 0) = 0$ $AdjEqPos = 1{,}000 - 0 = 1{,}000$

PESAA (Scenario 1, Variant 1)

Affiliate	**Calculations**
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 2{,}000\ (aff.1's\ equity\ in\ aff.2)$ $PESAA = IE/Assets = 1000/3{,}000 = 1/3$ $PTE = \min(IE, OE \times PESAA) = \min(1{,}000, 2{,}000 \times 1/3) = 666.67$ $AdjEqPos = IE - PTE = 1{,}000 - 666.67 = 333.33$
2	$IE = 666.67\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PESAA = 666.67/2{,}000 = 1/3$ $PTE = \min(666.67, 1{,}000 \times 1/3) = 333.33$ $AdjEqPos = 666.67 - 333.33 = 333.33$
3	$IE = 333.33\ (aff.\ 2's\ PTE)$ $OE = 0$ $PESAA = 333.33/1{,}000 = 1/3$ $PTE = \min(333.33, 0 \times 1/3) = 0$ $AdjEqPos = 333.33 - 0 = 333.33$

Passthrough with Ownership Chains (Scenario 1, Variant 2)

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 500\ (aff.1's\ equity\ in\ aff.2)$ $PTE = \min(IE, OE \times USPPctOwn) = \min(1{,}000, 500 \times 1) = 500$ $AdjEqPos = IE - PTE = 1{,}000 - 500 = 500$
2	$IE = 500\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PTE = \min(500, 1{,}000 \times 1) = 500$ $AdjEqPos = 500 - 500 = 0$
3	$IE = 500\ (aff.2's\ PTE)$ $OE = 0$ $PTE = \min(500, 0 \times 0) = 0$ $AdjEqPos = 500 - 0 = 500$

PESAA (Scenario 1, Variant 2)

Affiliate	Calculations
1	$IE = 1{,}000\ (USP's\ equity\ in\ aff.1)$ $OE = 500\ (aff.1's\ equity\ in\ aff.2)$ $PESAA = IE/Assets = 1000/1{,}500 = 2/3$ $PTE = \min(IE, OE \times PESAA) = \min(1{,}000, 500 \times 2/3) = 333.33$ $AdjEqPos = IE - PTE = 1{,}000 - 333.33 = 666.67$
2	$IE = 333.33\ (aff.\ 1's\ PTE)$ $OE = 1{,}000\ (aff.\ 2's\ equity\ in\ aff.\ 3)$ $PESAA = 333.33/2{,}000 = 1/6$ $PTE = \min(333.33, 1{,}000 \times 1/6) = 166.66$ $AdjEqPos = 333.33 - 166.66 = 166.67$
3	$IE = 166.67\ (aff.\ 2's\ PTE)$ $OE = 0$ $PESAA = 166.67/1{,}000 = 1/6$ $PTE = \min(166.67, 0 \times 1/6) = 0$ $AdjEqPos = 166.67 - 0 = 166.67$

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