Global trade in services, jobs, and incomes

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Chapter 5

From trade in value added to trade in income

ABSTRACT

This paper investigates how much value added generated in a country translates into income gains for this country's residents as opposed to income gains for foreign suppliers of capital and labor.

First, we deconstruct the GDP of 42 countries plus an aggregate for the rest of the world in the year 2014 into bilateral transfers of income by making novel use of the Balance of Payments, national accounts, and data on cross-border investment positions. The resulting matrix indicates the share of GDP that is contained in the same country's national income and indicates what shares end up as part of the national income of partner countries. The relation between GDP and GNI reveals that highly developed countries are the main beneficiaries of income transfers, receiving much income from developing and emerging countries.

Second, we use the constructed GDP-GNI matrix and supplemental trade in value added data to estimate the income of a country contained in the final demands of other countries. We compare the income generated by the final demands of all other countries, what we call exports of income, with the more conventional exports of value-added measure. We find that US exports of income (i.e., the contribution of foreign final demand to US GNI) were US$ 763 billion higher than US exports of value-added (i.e., the contribution of foreign final demand to US GDP). Furthermore, we find that the US had almost no trade deficit in income in the year 2014. The US trade balance of income was -0.2% as compared to the US trade balance of value-added of -2.5% (as shares of US GDP) and as compared to the US balance of gross trade of -2.8%.

The results across all countries show that the discrepancy between GDP and GNI matters for who ultimately gains from income transfers and from the final demand exerted by foreign countries. The national income implications of international integration should thus be given greater attention by trade economists and policymakers.

This chapter is co-authored with Steven Brakman and Erik Dietzenbacher.

5.1 Introduction

US President Trump frequently points to US trade deficits with China, Japan, Germany, and other countries in justifying new trade tariffs and his complaints of unfair trade practices. Trump proclaimed in May 2019 that the US "has been losing, for many years, 600 to 800 billion Dollars a year on Trade". [88] He has cited similar trade deficit figures more than 50 times since 2015 (Qiu, 2018). Although the numbers are exaggerated (reflecting the US trade deficit in goods but not the US trade surplus in services), it is true that the US has long had large trade deficits with its most important trading partners.[89] The overall US trade deficit and its bilateral deficits continue to play a prominent role in political discourse and US policymaking.

However, policymakers and the public can be misled by bilateral trade balances if they interpret the data as relating to the net income a country gains from its trade partners. This may not be correct. Consider the classic example of China's exports of iPhones to the US. China uses intermediate inputs from Japan and South Korea in the iPhones it assembles for export. This means that US imports from China do not only embody value added created in China. The money that China receives from the US for its exports overstates the actual value-added benefit of these exports to China's economy. Furthermore, part of the value added generated by the exports of iPhones or their components goes as profit to Apple, which may be repatriated to the US. Hence, there may be misleading inferences regarding China's iPhone exports and who gains the income. These developments are closely related to the well-documented rise of global supply chains, but so far, the resulting cross-border transfers of income have not been analyzed to the same degree (due to a lack of data). This is an important motivation for the paper.

In general, it is necessary to make two corrections to assess how much income the US truly loses to (or gains from) China and other countries due to trade. The first correction is assessing trade from the standpoint of value added instead of gross exports. The trade in value added literature has revealed that gross exports overstate to varying degrees the domestic value-added generated from trade (Johnson, 2014). This is attributed to the growing use of foreign inputs in the production process, double counting of intermediate inputs in global trade data, and globalization patterns, which have made the world more interconnected. As a result, bilateral trade balances based on trade in value added, measured by the domestic value-added contained

[88] https://twitter.com/realdonaldtrump/status/1125356705787850753
[89] The Department of Commerce reported a total trade deficit of more than $627 billion in 2018, which includes a trade surplus in services: https://www.bea.gov/data/intl-trade-investment/international-trade-goods-and-services

in the final demands of another country, differ from trade balances based on gross exports. The bilateral US trade deficit with China is reduced when this is calculated using value-added data.[90]

The second correction involves moving beyond value added to consider so-called exports of income. We define exports of income as income generated in a country that is attributed to purchases of final products in other countries. In motivating this next step, consider the more general, related issue: how much value added of a country translates into income gains for this country's residents as opposed to income gains for foreign suppliers of capital and labor? In the past, this distinction was not as consequential because factor incomes generated from value-added production generally corresponded to income for this country's residents. However, cross-border investment complicates this relationship. This is characterized by the growth of global value chains (to a large extent driven by multinational firms), foreign-owned capital, and profit-shifting strategies. Moreover, the increasing mobility of people and regional initiatives such as the EU's Schengen Area have resulted in more cross-border workers. The income earned by these workers does not stay in the country to which they are contributing value added. These developments result in income transferred abroad. Therefore, a country's gross domestic product (GDP) does not correspond to its gross national income (GNI).

Income transfers from one country to another may be related to trade, but not necessarily. Consider the iPhone example. China's exports of value-added related to the assembly of iPhones may generate US income via profit shifting by US multinational firms operating in China. However, if Apple sells iPhones produced in China to final consumers in China, there may be no exports of value-added, but China could still be transferring income to the US. This implies that final demand from China may generate US income in the absence of a direct or even indirect trade relationship between the two countries. In a second example, a cross-border worker may only be involved in the non-traded sector of another country but repatriate his/her income, which also generates transfers of income. Financial globalization and global interconnectedness could lead the US to depend more on the final demand of other countries in terms of generating its income than value added. It is also plausible that the US could have a lower trade deficit in terms of income than in terms of value-added when bilateral income linkages through the investment, employment, and trade channels are fully accounted for.

[90] The bilateral US trade deficit with China was 15% lower in value-added terms than in gross terms in 2014. China's exports of value-added to the US does not include inputs from third countries that are embodied in China's bilateral gross exports. It does, however, include the value of Chinese inputs in other countries' bilateral gross exports to the US. The trade gap is narrowed in part because differences in the former exceed the latter. *Source*: World Input-Output Database (Timmer et al., 2015).

While this concept is simple, data on bilateral transfers of income do not currently exist and it is difficult to obtain the numbers on a country-by-country basis. The first part of this paper fills this gap by creating a matrix that relates countries' GDP to their GNI (the 'GDP-GNI' matrix). We decompose the GDP's of 42 countries and a 'Rest of World' aggregate for 2013 and 2014 into two components: a national income component and a bilateral income component, representing the transfers of income. Transfers of income are essentially what the System of National Accounts (SNA) defines as primary incomes payable to non-resident units. The GDP-GNI matrix answers the question "how much income generated domestically leaves a country?". This refers to the value added of a country that goes to the national income of another country. It also addresses the question "where does the income that leaves end up?" This helps to identify to whom income is transferred due to repatriation. The second part of this paper (the analysis) combines these insights with input-output analysis to derive and cast light on the income that is generated in a country due to foreign final demand. We ask: "how much income (as a share of GNI) do different countries export?".

To do the decomposition in the first part, we make novel use of the Balance of Payments (BoP) and national accounts data, focusing on the primary income accounts part of the current account. We also draw upon databases from the IMF and World Bank to proxy the bilateral shares of income transfers that are attributed to returns on direct investments, portfolio investment holdings, and employee compensation. As part of this process, we use a new type of foreign direct investment statistics (where available) that identifies the 'ultimate' investor. Data by ultimate investor captures the ultimate beneficiary of returns on FDI, including FDI that might otherwise be attributed to investors from tax havens in conventional bilateral FDI statistics. Hence, our analysis accounts for all MNE profit shifting activities, also including payments for the use of intellectual property. These data are available from central banks, national statistical offices, and the OECD International Direct Investment Statistics database.

To do the analysis in the second part, we construct a new matrix of trade in income (the 'GNIX' matrix), which we derive from the GDP-GNI matrix by using additional trade in value added data from world input-output tables. The GNIX matrix indicates the income that is earned by a country due to domestic and foreign final demand. As compared to transfers of income in the GDP-GNI matrix, exports of income involve linkages that are less tangible. Hence, French gross exports to final users in Japan generate Chinese value added and US income.

The GDP-GNI matrix reveals certain bilateral dependencies of countries. While income transferred by the European Union (EU15) and the US mainly ended up in the EU15 and the US themselves, other regions generated a lot of national wealth, via transfers of income, in the

EU15 and the US. Overall, while geographical proximity played a role in explaining where transfers of income went to, the EU15 and US received a disproportionate amount of income from other countries. About a third of all exported income transfers in 2014 worldwide were by emerging countries and the Rest of World aggregate, which mostly includes developing economies. More than half of this income ended up in the GNI of the EU15 or US. Hence, one can conclude that poorer countries are earning the money for rich, developed countries like the US.

The role of the US as a large net receiver of income is reflected by a higher dependence of the country on income induced by foreign final demand than on exports of value-added induced by foreign final demand. We estimate that the US earned US$ 763 billion more national income due to foreign final demand in 2014 than domestic value-added in the US generated by foreign final demand. The discrepancy may partly be attributed to US investment in foreign countries that leads to repatriated income even when no US exports of value-added are generated (e.g., value-added production by US subsidiaries in a foreign country that is consumed by the host-country). Another key finding is that the US was not an exception: every country in our sample exported a higher share of their GNI than their GDP. This suggests that the world is more globalized in terms of a country's dependence on foreign final demand from the new exports of income perspective than is the case for value-added exports. Finally, we show how (bilateral) trade balances of income differ from (bilateral) trade balances of value-added, which lead to a reconsideration of bilateral positions between countries. The results indicate that the US had almost no trade deficit in income (as compared to a considerable trade deficit in value-added). Although most countries exported more income than value added, the US alongside other highly developed countries benefited most from this new perspective in relative terms. Hence, while conventional trade balances might misleadingly suggest that the US loses (much) more income to other countries than it gains due to higher imports relative to exports, our balance of income measure shows that, when accounting for income transfers, this is much less the case.

The paper is structured as follows. Section 5.2 motivates the analysis by highlighting the current statistical challenges in greater detail and using the issue of trade in value added as an illustration. Sections 5.3 and 5.4 present the methodology and data sources for creating the GDP-GNI matrix. Sections 5.5.1 and 5.5.2 discuss and interpret the GDP-GNI matrix: the diagonal values of the matrix (i.e., the value added that goes to the national income of the same country), and the off-diagonal values of the matrix (i.e., value added of a country that becomes part of the national income of another country). Sections 5.5.3 and 5.5.4 build on the previous findings by formalizing the trade in income concept. First, we explain how the GNIX matrix of

trade in income is derived and how exports of income differ from transfers of income. This is followed by an analysis of the income implications of foreign final demand with respect to countries' exports of incomes and trade balances of income.

5.2 Statistical challenges: three questions

One feature of globalization, which we characterize as the increasing cross-border movements of goods, services, labor, and capital, is the fragmentation of production. This was facilitated by greatly reduced transportation and communication costs in the last few decades and is related to the emergence of so-called global value chains (GVCs), which now dominate world trade. There are at least three empirical questions concerning trade that are raised by these new developments, which are briefly introduced in this section. These issues present statistical challenges that have only partially been addressed in previous research. They are an important motivation for creating the GDP-GNI and GNIX matrices to document income flows. Note that while the first part of this section is focused on the relationship between income and the trade of goods and services to illustrate key issues, transfers (and exports) of income involve not just trade related activities. For example, they may involve the income earned by cross-border workers for providing a non-tradable service. Or they may involve income earned by residents on portfolio investments abroad. The scope of the trade in income concept is thus broader.

The first question is: what are a country's exports of value-added (as opposed to its gross exports)? In part related to the rise of GVCs, a country's gross output contains a rising share of foreign inputs. A high dependence of a country on gross exports as a share of GDP is perceived as a sign of export success and a country's competitiveness in international trade. This is especially the case when the exports involve high-tech products, such as iPhones exported by China to the US. However, this can lead to misleading inferences if the share of foreign value-added in gross exports is large and domestic contributions, which could primarily involve low-skilled tasks, do not add much to the exporter's GDP. Moreover, production inputs passing through more than one country are double counted in the aggregate in international trade statistics. This poses a statistical problem and distorts the true nature of interconnectedness between countries. Input-output analysis and the recent development of global input-output databases provide researchers with tools to determine how much direct and indirect domestic value-added a country generates in the production for foreign final consumption (Johnson, 2014). These are known as the exports of value-added. A large and growing research field has emerged to consider these issues. For details on methodological aspects, we refer to Ahmad et

al. (2017). This is a guide for measuring trade and fragmentation in global production networks using both gross export- and value-added-based approaches.

The second question is: how much income do countries gain from their domestic value-added production? This statistical challenge is subtler but none less important. Not all domestic value-added generated in a country becomes part of its national income and ultimately benefit its people. Consider for example the rise of GVCs, which tend to involve multinational enterprises (MNEs) that make large direct investments abroad. A recent report published by the OECD found that MNEs accounted for more than one-half of international trade, almost one-third of global output and GDP, and one-fourth of total employment in 2014 (Cadestin et al., 2019). Furthermore, it is estimated that MNE-coordinated GVCs in 2010 accounted for 80% of world trade in gross terms (OECD et al, 2013). At the same time, a large and growing share of MNE generated income involves intangible capital (e.g., intellectual property rights), which is less easily attributable to a specific country (Chen et al., 2018).

These developments raise the question of where the profits of MNE activities go to. About 50% of all returns earned by foreign affiliates are reinvested in foreign markets (UNCTAD, 2018). This occurs when income that is transferred home is sent back to the host country as FDI. Other profits may never leave the host country if there are strict capital controls. But the high presence of MNEs and foreign-owned capital in many countries suggests that profit shifting activities occur as well that result in income being repatriated or permanently transferred from one country to another. In the context of trade, a country may export value-added but gain little income or, conversely, gain income from the exports of value-added of another country. This is one way in which the domestic value-added in a country induced by foreign final demand may differ from the (GNI) income induced in the same country. This issue has not been resolved by the growing availability of statistics on trade in value added, which are all based on GDP, because data are lacking.

The third question is related to the first two: where does domestic value-added (including the share that is exported) that is not contained in the same country's national income due to repatriation of income end up? Tracing the income that a country does not retain from domestic production is not a trivial exercise due to limitations of BoP statistics. This issue is detailed below for the general case involving the distinction between GDP and GNI, which involves all value added - not just the part contained in another country's final demands.

GDP and GNI are used as benchmarks to summarize the performance and magnitude of an economy. GDP is typically defined according to the production approach, expenditure approach, and income approach (CBS, 2017). The production approach sums up the gross value

added at each stage of production (at basic prices) from all institutional units residing in the economy, plus taxes and less subsidies on products. Value added refers to output minus intermediate use (the sum of required inputs of goods and services). The expenditure approach sums up all final uses of goods and services by resident institutional units (final consumption and gross capital formation), plus exports and minus imports of goods and services. The income approach compiles GDP as the sum of primary incomes generated in the production process that are distributed by resident producer units (EC et al., 2009). GNI is based on the location of owners of income. GNI indicates the sum of the primary incomes (wages and salaries, profits, net receipts of interest and dividend) earned by the residents of a country, whether originating within or outside of its borders (CBS, 2017). GNI equals GDP minus primary incomes payable to non-resident units plus primary incomes receivable from non-resident units (EC et al., 2009). That is, GNI is GDP plus the balance of net primary incomes received from and paid to residents in all other countries (the 'world').

GDP and GNI data are readily available for almost all countries. But data on primary incomes, which account for the discrepancy between GDP and GNI, are aggregated across all partner countries. This aggregation masks differences in incomes payable and receivable between counterpart economies and thus the relative importance of partner countries to the aggregated (net) primary income balance. This bilateral part is not typically provided by statistical agencies. Only a handful of countries provide publicly an official, geographical disaggregation of the BoP, including the primary income account component. These differ in coverage (in terms of geographical detail), years (typically only a few) and most importantly method (income sent to intermediary entities may play a role, creating issues with so-called pass-through income. Pass-through income is discussed in Section 5.3). Hence, even for the few countries that do release fragmentary data on the bilateral part, such as the Netherlands, it is based on different sources. The data are not easily comparable, and it is difficult to discern the assumptions and modelling that were employed. This is to some extent also confidential.

On the aggregate, global GDP equals gross world income (or global GNI). However, GDP and GNI only coincide on a country-level in two improbable cases. In the first case, this can occur if a country prevents all movement of capital across its borders. This would imply that there are no foreign investments and no cross-border workers. In the second case, this can occur when all income that residents earn in foreign countries and repatriate home (= primary income credits) precisely matches all income earned by non-residents domestically and repatriated abroad (= primary income debits). But even in the second case, it is still interesting to know where the transfers of income go to in order to shed light on the interconnectedness between

countries. In addition, countries like Ireland have a large foreign MNE presence and pay considerably more income to non-residents than the incomes they receive from abroad. Hence Ireland's GNI was 14.7% smaller than its GDP in 2014 (according to World Bank World Development Indicators).

Therefore, this paper focusses on the bilateral part involving transfers of (primary) incomes. This involves splitting up the BoP data on a from-whom-to-whom basis to create a matrix that relates countries' GDP to their GNI. The novel GDP-GNI matrix of income transfers is used together with trade in value added data to derive a second matrix showing countries' trade in income. Note the important distinction between *transfers* of income (first matrix) and *exports* of income (second matrix). Transfers of income involve the tangible repatriation of income from one country to another and are not necessarily induced by foreign demand. Exports of income are less tangible and measure the income of a country embodied in the final demands of another country. Sections 5.3 and 5.4 focus on deriving bilateral transfers of income. The analysis in Section 5.5 addresses both transfers and exports of income.

5.3 Methodology

The novel aspect of this study is the relation of GDP to GNI by creating a matrix of bilateral trade in income containing a breakdown of GDP in the rows and GNI in the columns.

We consider a world that consists of N countries and the relation between GDP and GNI is shown in Table 5.1. The rows show "where does GDP go to?" and the columns show "where does income come from?". GDP_i is country i's gross domestic product; GNI_i is country i's gross national income; $\mathrm{GDP}_{i,i}$ is the value added of i that is also part of i's GNI; and $\mathrm{GDP}_{i,j}$ is the value added of i that goes to j becomes part of j's GNI. Note that $\mathrm{WORLD} = \sum_i \mathrm{GNI}_i = \sum_j \mathrm{GDP}_j$.

Table 5.1. GDP embodied in home and foreign country GNI

		Destination country							
Origin country		1	…	i	…	j	…	N	Total
	1	$\mathrm{GDP}_{1,1}$	…	$\mathrm{GDP}_{1,i}$	…	$\mathrm{GDP}_{1,j}$	…	$\mathrm{GDP}_{1,N}$	GDP_1
	…	…		…		…		…	…
	i	$\mathrm{GDP}_{i,1}$	…	$\mathrm{GDP}_{i,i}$	…	$\mathrm{GDP}_{i,j}$	…	$\mathrm{GDP}_{i,N}$	GDP_i
	…	…		…		…		…	…
	j	$\mathrm{GDP}_{j,1}$	…	$\mathrm{GDP}_{j,i}$	…	$\mathrm{GDP}_{j,j}$	…	$\mathrm{GDP}_{j,N}$	GDP_j
	…	…		…		…		…	…
	N	$\mathrm{GDP}_{N,1}$	…	$\mathrm{GDP}_{N,i}$	…	$\mathrm{GDP}_{N,j}$	…	$\mathrm{GDP}_{N,N}$	GDP_N
	Total	GNI_1	…	GNI_i	…	GNI_j	…	GNI_N	WORLD

Data for GDP_i and GNI_i are publicly available. The first task is to calculate $\mathrm{GDP}_{i,i}$ with the help of publicly available Balance of Payments (BoP) data from the World Bank (WB) and by making an adjustment for so-called pass-through income. This is explained in step 1 (Section 5.3.3). This implies that we then have an estimate for $\sum_{j\neq i}\mathrm{GDP}_{i,j}$. The second task is to determine $\mathrm{GDP}_{i,j}$, which is the novel aspect and main aim of the exercise, separately. This will be done by making use of additional information on bilateral investment positions and employee compensation, as will be explained in step 2 (Section 5.3.4). Before proceeding with the two steps we provide background principles in Section 5.3.1 and discuss our general strategy, which involves two preliminary steps, in Section 5.3.2.

5.3.1 Background principles

From Table 5.1 we have:

$$\mathrm{GDP}_{i,i} = \mathrm{GDP}_i - \sum\nolimits_{j\neq i}\mathrm{GDP}_{i,j} = \mathrm{GDP}_i - \mathrm{PID}_i \tag{5.1}$$

$$\mathrm{GDP}_{i,i} = \mathrm{GNI}_i - \sum\nolimits_{j\neq i}\mathrm{GDP}_{j,i} = \mathrm{GNI}_i - \mathrm{PIC}_i \tag{5.2}$$

where PID_i (=$\sum_{j\neq i}\mathrm{GDP}_{i,j}$) are country *i*'s total primary income debits and PIC_i ($=\sum_{j\neq i}\mathrm{GDP}_{j,i}$) are country *i*'s total primary income credits. Primary income debits are incomes earned in country *i* and payable to residents in another country (i.e., "exported transfers of incomes"). Primary income credits are incomes received by residents of country *i* from another country (i.e., "imported transfers of incomes"). Combining (5.1) and (5.2) gives

$$\mathrm{GDP}_i - \sum\nolimits_{j\neq i}\mathrm{GDP}_{i,j} = \mathrm{GNI}_i - \sum\nolimits_{j\neq i}\mathrm{GDP}_{j,i} \tag{5.3}$$

which reflects the definitions in the System of National Accounts. That is, GNI_i equals GDP_i plus the balance of primary incomes ($\mathrm{GNI}_i = \mathrm{GDP}_i + \mathrm{PIC}_i - \mathrm{PID}_i$).

The estimation of $\mathrm{GDP}_{i,i}$ would be simple and would follow from (5.1) if data for PID_i were available. This is not the case. Information on primary incomes is available in the IMF's BoP and International Investment Position (IIP) statistics. We will indicate these data by PID_i^{IMF} and PIC_i^{IMF}. The main difference with PID_i and PIC_i is that the IMF data include possible pass-through incomes (described below). To account for this, our method in step 1 (Section 5.3.3) corrects IMF information on primary incomes for pass-through incomes.

Pass-through incomes are closely related to the internationalization of capital markets, which has made it easier for individuals and firms from country *k* to make investments in country *j* indirectly via intermediary entities in a third country *i*. This implies that the returns on these investments (which are primary incomes) run from *j* to *k*, via *i*. The transfer from *i* to *k* (which is included in PID_i^{IMF}) is not contained in GDP_i. It is therefore not included in $\mathrm{GDP}_{i,k}$ and in PID_i. In the same fashion, the transfer from *j* to *i* is part of PIC_i^{IMF} but does not wind up in GNI_i. It thus should not be included in $\mathrm{GDP}_{j,i}$ and in PIC_i. This is an example of income debits and income credits that pass through country *i* but have no effect on the real economy (i.e., the GDP and GNI) of *i*. They should thus be removed from the IMF data.

In general, pass-through income is defined as income that originates outside of the country and ultimately ends up outside of the country. Pass-through income shows up as income on both the credit (PIC_i^{IMF}) and debit (PID_i^{IMF}) sides of a country's primary income account. Their values are identical and offset each other.[91] For instance, suppose a German resident receives interest income on a Spanish bond held in an account in Luxembourg. For Luxembourg, the external nature of the source and destination of the transactions means that any income related to them are part of PID_{LUX}^{IMF} and PIC_{LUX}^{IMF}, but do not factor into GDP_{LUX} and GNI_{LUX}.

Therefore, the IMF information on primary incomes is corrected for pass-through incomes by subtracting pass-through incomes from the IMF data. That is,

$$\mathrm{PID}_i = \mathrm{PID}_i^{IMF} - \mathrm{PT}_i \tag{5.4}$$

where PT_i is estimated pass-through income in country *i*.

5.3.2 Road map

In order to be able to calculate the diagonal ($\mathrm{GDP}_{i,i}$) elements in Table 5.1, which are necessary to estimate the off-diagonal elements ($\mathrm{GDP}_{i,j}$), we begin with two preliminary steps. The first preliminary step is to attribute all primary (factor) incomes to labor and capital on the basis of IMF data. The reason is that issues involving pass-through income mainly involve the capital part. Our second preliminary step is to estimate the capital and labor components of GDP_i and GNI_i.This means that Table 5.1 can be split into a version for labor and a version for capital. Also, the identities in Section 5.3.1 apply for labor and for capital. Step 1 (Section 5.3.3) uses information derived from these two preliminary steps to estimate the diagonal elements for

[91] For this reason, the net income credits and debits (i.e., the balance of primary incomes) is unaffected by pass-through income.

capital and labor separately. Step 2 (Section 5.3.4) explains how we estimate the off-diagonal elements, again separately for capital and labor. The last parts of steps 1 and 2 combine the capital and labor components (e.g., $\mathrm{GDP}_{i,i} = \mathrm{GDP}_{i,i}^{L} + \mathrm{GDP}_{i,i}^{K}$).

Preliminary step 1

To calculate $\mathrm{GDP}_{i,i}^{L} = \mathrm{GDP}_{i}^{L} - \mathrm{PID}_{i}^{L}$, our first preliminary step is to estimate $\mathrm{PID}_{i}^{IMF,L}$ (and also $\mathrm{PID}_{i}^{IMF,K}$) on the basis of IMF data. If we then correct this for pass-through income we have—according to (5.4)—our estimate for PID_{i}^{L} (and thus $\mathrm{GDP}_{i,i}^{L}$).

The IMF distinguishes three categories of primary incomes. These are the raw data that we start with: primary capital income debits, denoted $\mathrm{PID}_{i}^{IMF,K,raw}$; primary labor income debits, denoted $\mathrm{PID}_{i}^{IMF,L,raw}$; and other primary income debits, denoted $\mathrm{PID}_{i}^{IMF,OPI,raw}$.[92] Capital income debits relate to the returns on foreign investment. For example, this could be the income generated by US-owned capital in China that is repatriated. Labor income debits relates to the compensation of cross-border employees. (See Annex I for a more detailed discussion of the relevant subcomponents included in the primary income account).

The common strategy to compile estimates of GDP in national accounts data is to allocate all factor incomes to capital and labor. We use a similar strategy to estimate PID_{i}**.** Because no other information is available on $\mathrm{PID}_{i}^{IMF,OPI,raw}$, the component other income is subsumed into the other two. This component is either zero or very small as a share of all debits for most countries. (See Annex II for the shares of $\mathrm{PID}_{i}^{IMF,L,raw}$, $\mathrm{PID}_{i}^{IMF,K,raw}$ and $\mathrm{PID}_{i}^{IMF,OPI,raw}$ in their total, for 42 countries based on the reported IMF data.) Hence, $\mathrm{PID}_{i}^{IMF,L,raw}$ and $\mathrm{PID}_{i}^{IMF,K,raw}$ are increased proportionately to incorporate $\mathrm{PID}_{i}^{IMF,OPI,raw}$ whenever $\mathrm{PID}_{i}^{IMF,OPI,raw}$ is non-zero. This yields for the estimates of the primary labor and capital incomes from the IMF:

$$\mathrm{PID}_{i}^{IMF,L} = \mathrm{PID}_{i}^{IMF,L,raw}\left(\frac{\mathrm{PID}_{i}^{IMF,L,raw} + \mathrm{PID}_{i}^{IMF,K,raw} + \mathrm{PID}_{i}^{IMF,OPI,raw}}{\mathrm{PID}_{i}^{IMF,L,raw} + \mathrm{PID}_{i}^{IMF,K,raw}}\right) \tag{5.5}$$

$$\mathrm{PID}_{i}^{IMF,K} = \mathrm{PID}_{i}^{IMF,K,raw}\left(\frac{\mathrm{PID}_{i}^{IMF,L,raw} + \mathrm{PID}_{i}^{IMF,K,raw} + \mathrm{PID}_{i}^{IMF,OPI,raw}}{\mathrm{PID}_{i}^{IMF,L,raw} + \mathrm{PID}_{i}^{IMF,K,raw}}\right) \tag{5.6}$$

The same procedure also yields $\mathrm{PIC}_{i}^{IMF,K}$, which is used in preliminary step 2.

[92] The category 'other income' is necessary because it exists in the data published by the IMF. Otherwise there is no full accounting of PID_{i}.

Preliminary step 2

Our second preliminary step is to estimate GDP_i^L and GNI_i^L, and GDP_i^K and GNI_i^K. The Conference Board (CB) publishes data for the ratio α_i^{CB}, which we use to derive these four components. Although this ratio is termed by the CB as 'labor share of GDP' (suggesting $\mathrm{GDP}_i^L/\mathrm{GDP}_i$) it actually is calculated as $\mathrm{GNI}_i^L/\mathrm{GDP}_i$. The separate information on the GNI_i^L and GDP_i used by CB is not available though. Therefore, we combine the ratios α_i^{CB} with GDP data from the World Bank (WB) to estimate the GNI components for labor and capital. That is,

$$\mathrm{GNI}_i^L = \alpha_i^{CB}\mathrm{GDP}_i^{WB} \text{ and } \mathrm{GNI}_i^K = \mathrm{GNI}_i^{WB} - \alpha_i^{CB}\mathrm{GDP}_i^{WB} \tag{5.7}$$

Next we use the 'labor-version' and the 'capital-version' of equation (5.3) in connection with the estimates determined in preliminary step 1. This yields

$$\mathrm{GDP}_i^K = \mathrm{GNI}_i^K + \mathrm{PID}_i^{IMF,K} - \mathrm{PIC}_i^{IMF,K} \text{ and the residual } \mathrm{GDP}_i^L = \mathrm{GDP}_i^{WB} - \mathrm{GDP}_i^K$$

5.3.3 Step 1: estimation of the diagonal elements of the matrix

Diagonal labor income elements

From equation (5.4) we know that the estimate $\mathrm{PID}_i^{IMF,L}$ needs to be corrected for pass-through income (i.e., $\mathrm{PID}_i^L = \mathrm{PID}_i^{IMF,L} - \mathrm{PT}_i^L$). We assume that there is no pass-through component in the case of labor incomes (i.e., $\mathrm{PT}_i^L = 0$). This seems a reasonable assumption because labor income relates to the earnings of cross-border workers. The income debits that arise from German residents earning income in France is, by definition, part of the French GDP and cannot originate from another country's GDP. Similarly, income credits that arise from German residents earning income in France are unlikely to end up in another country's GNI than the German (because these are the earnings of private citizens and not MNE- or investment related). Given that labor income (compensation of employees, including the earnings of cross-border workers) typically only make up a small share of a country's primary income account, but a considerable share of its GDP, this component of GDP is mostly expected to stick to the local economy and become part of its GNI. Hence primary labor income is usually not pass-through even in countries with large capital movements. This implies that our estimate for the total primary labor income debits is given by $\mathrm{PID}_i^L = \mathrm{PID}_i^{IMF,L}$. The estimate for the diagonal elements (in the case of labor) is given by $\mathrm{GDP}_{i,i}^L = \mathrm{GDP}_i^L - \mathrm{PID}_i^L$.

Diagonal capital income elements

The 'capital-version' of equation (5.3) is

$$\mathrm{GDP}_i^K + \mathrm{PIC}_i^K = \mathrm{GNI}_i^K + \mathrm{PID}_i^K \tag{5.8}$$

As was mentioned earlier, pass-through income shows up in equal size on both the credit and the debit side of a country's primary income account. This means that we can add pass-through income on the left- and the right-hand side of (5.8), which yields

$$\mathrm{GDP}_i^K + \mathrm{PIC}_i^K + \mathrm{PT}_i = \mathrm{GNI}_i^K + \mathrm{PID}_i^K + \mathrm{PT}_i \tag{5.9}$$

Adding pass-through income to country *i*'s total primary income debits gives the primary income debits of the IMF. That is, $\mathrm{PID}_i^K + \mathrm{PT}_i = \mathrm{PID}_i^{IMF,K}$ and $\mathrm{PIC}_i^K + \mathrm{PT}_i = \mathrm{PIC}_i^{IMF,K}$. This yields

$$\mathrm{GDP}_i^K + \mathrm{PIC}_i^{IMF,K} = \mathrm{GNI}_i^K + \mathrm{PID}_i^{IMF,K} \tag{5.10}$$

The two sides of (5.10) give the total primary capital income flows of country *i* (TPCIF_i). The left-hand side takes the perspective of the capital inflows. That is, TPCIF_i consists of the capital that is earned on the territory (GDP_i^K) plus the capital inflow from abroad ($\mathrm{PIC}_i^{IMF,K}$, which includes pass-through income). The right-hand side takes the perspective of the capital outflows. That is, TPCIF_i consists of the capital that goes to domestic capital owners (GNI_i^K) plus the capital that flows abroad ($\mathrm{PID}_i^{IMF,K}$, which includes the same pass-through income).

The share of all capital flows (TPCIF_i) that goes to domestic capital owners is $\mathrm{GNI}_i^K/\mathrm{TPCIF}_i = \mathrm{GNI}_i^K/(\mathrm{GNI}_i^K + \mathrm{PID}_i^{IMF,K})$. We assume that the same share applies to the capital earnings that stay within the country (as a share of all the capital earnings GDP_i^K). That is, we assume

$$\frac{\mathrm{GDP}_{i,i}^K}{\mathrm{GDP}_i^K} = \frac{\mathrm{GNI}_i^K}{\mathrm{GNI}_i^K + \mathrm{PID}_i^{IMF,K}} \tag{5.11}$$

We therefore have now the diagonal element in the case of capital: $\mathrm{GDP}_{ii}^K = (\mathrm{GNI}_i^K \times \mathrm{GDP}_i^K)/(\mathrm{GNI}_i^K + \mathrm{PID}_i^{IMF,K})$.

Combined diagonal labor and capital elements

Combining the two cases yields

$$\mathrm{GDP}_{i,i} = \mathrm{GDP}_{i,i}^{L} + \mathrm{GDP}_{i,i}^{K} = (\mathrm{GDP}_{i}^{L} - \mathrm{PID}_{i}^{L}) + \frac{\mathrm{GNI}_{i}^{K}}{\mathrm{GNI}_{i}^{K} + \mathrm{PID}_{i}^{IMF,K}} \mathrm{GDP}_{i}^{K} \tag{5.12}$$

Its complement (which is distributed in the next subsection over the countries of destination) is given by

$$\mathrm{PID}_{i} = \sum\nolimits_{j \neq i} \mathrm{GDP}_{i,j} = \mathrm{GDP}_{i} - \mathrm{GDP}_{i,i} = \mathrm{PID}_{i}^{L} + \frac{\mathrm{PID}_{i}^{IMF,K}}{\mathrm{GNI}_{i}^{K} + \mathrm{PID}_{i}^{IMF,K}} \mathrm{GDP}_{i}^{K} \tag{5.13}$$

5.3.4 Step 2: estimation of the off-diagonal elements of the matrix

The next task is to obtain the off-diagonal elements $\mathrm{GDP}_{i,j}$ of the matrix relating GDP to GNI. Each is divided into labor and capital components, $\mathrm{GDP}_{i,j} = \mathrm{GDP}_{i,j}^{L} + \mathrm{GDP}_{i,j}^{K}$. We know that $\sum_{j \neq i} \mathrm{GDP}_{i,j}^{L} = \mathrm{PID}_{i}^{IMF,L}$ as estimated in (5.6) and from (5.13) it follows that

$$\sum\nolimits_{j \neq i} \mathrm{GDP}_{i,j}^{K} = \mathrm{PID}_{i}^{K} = \frac{\mathrm{PID}_{i}^{IMF,K}}{\mathrm{GNI}_{i}^{K} + \mathrm{PID}_{i}^{IMF,K}} \mathrm{GDP}_{i}^{K} \tag{5.14}$$

The next task is to allocate $\sum_{j \neq i} \mathrm{GDP}_{i,j}^{L}$ and $\sum_{j \neq i} \mathrm{GDP}_{i,j}^{K}$ to the separate countries of destination (i.e., determine $\mathrm{GDP}_{i,j}^{L}$ and $\mathrm{GDP}_{i,j}^{K}$).

Off-diagonal labor income elements

For labor, the allocation is done on the basis of data on compensation of employees. The share of the total compensation paid by country *i* that is received by country *j* is given by $\mathrm{CE}_{ij} / \sum_{j \neq i} \mathrm{CE}_{ij}$, where CE_{ij} denotes compensation of employees residing in country *j* and paid for by country *i*. This implies

$$\mathrm{GDP}_{i,j}^{L} = \frac{\mathrm{CE}_{ij}}{\sum_{j \neq i} \mathrm{CE}_{ij}} \mathrm{PID}_{i}^{IMF,L} \tag{5.15}$$

Data on CE_{ij} are drawn from a bilateral database on remittances. These remittances include: compensation of employees (= primary labor incomes); worker' remittances; and migrants' transfers. (Further details are given in Annex III).

Off-diagonal capital income elements

For capital, (5.14) states that $\sum_{j \neq i} \mathrm{GDP}_{i,j}^{K} = \mathrm{PID}_{i}^{K}$, where PID_{i}^{K} is estimated using $\mathrm{PID}_{i}^{IMF,K}$. In its turn, $\mathrm{PID}_{i}^{IMF,K}$ is estimated in (5.6), using $\mathrm{PID}_{i}^{IMF,K,raw}$. These are data on capital primary

incomes and are obtained directly from the IMF. $\mathrm{PID}_i^{IMF,K,raw}$ consists of three components: income from returns on direct investments (DI), on portfolio investment (POI), and on other investments (OI). That is, $\mathrm{PID}_i^{IMF,K,raw} = \mathrm{PID}_i^{IMF,DI} + \mathrm{PID}_i^{IMF,POI} + \mathrm{PID}_i^{IMF,OI}$. We split $\mathrm{PID}_i^{IMF,K,raw}$ into a DI-part and a POI-part on the basis of their sizes and we assume that the same split also applies to PID_i^{K}. That is,

$$\mathrm{PID}_i^{DI,adapt} = \frac{\mathrm{PID}_i^{IMF,DI}}{\mathrm{PID}_i^{IMF,DI} + \mathrm{PID}_i^{IMF,POI}} \mathrm{PID}_i^{K}$$

$$\mathrm{PID}_i^{POI,adapt} = \frac{\mathrm{PID}_i^{IMF,POI}}{\mathrm{PID}_i^{IMF,DI} + \mathrm{PID}_i^{IMF,POI}} \mathrm{PID}_i^{K}$$

Note that $\mathrm{PID}_i^{DI,adapt} + \mathrm{PID}_i^{POI,adapt} = \mathrm{PID}_i^{K} = \sum_{j \neq i} \mathrm{GDP}_{i,j}^{K}$. The reason to subsume the OI-part of $\mathrm{PID}_i^{IMF,K,raw}$ under the other two parts is that bilateral data are available for the investment positions of DI and POI, but not for OI. This bilateral information will be used to allocate $\mathrm{PID}_i^{DI,adapt}$ and $\mathrm{PID}_i^{POI,adapt}$ to countries of destination.

The component $\mathrm{PID}_i^{DI,adapt}$ is allocated on the basis of data on foreign direct investment positions. Let DI_{ji} denote the value of country *j*'s direct investment in *i* and $\sum_{j \neq i} \mathrm{DI}_{ji}$ gives the total stock of foreign direct investment in country *i*. Then we assume that the income from returns are allocated accordingly. That is, if for instance 10% of all direct investments in country *i* are by country *j* ($\mathrm{DI}_{ji} / \sum_{j \neq i} \mathrm{DI}_{ji} = 0.1$), then it is assumed that 10% of country *i*'s transfers of direct investment income consists of income payments sent to investors in *j*. Hence,

$$\mathrm{GDP}_{i,j}^{K,DI} = \frac{\mathrm{DI}_{ji}}{\sum_{j \neq i} \mathrm{DI}_{ji}} \mathrm{PID}_i^{DI,adapt} \tag{5.16}$$

Data on PID_i^{DI} is available from the IMF. Data on DI_{ji} are available from bilateral FDI statistics (Further details are given in Annex IV).

Finally, component $\mathrm{PID}_i^{POI,adapt}$ is allocated on the basis of data on foreign portfolio holdings. Let POI_{ji} denote the value country *j*'s portfolio holdings in country *i* and $\sum_{j \neq i} \mathrm{POI}_{ji}$ gives the total foreign portfolio holdings in country *i*. Then we assume that the income from returns are allocated accordingly. That is,

$$\mathrm{GDP}_{i,j}^{K,POI} = \frac{\mathrm{POI}_{ji}}{\sum_{j \neq i} \mathrm{POI}_{ji}} \mathrm{PID}_i^{POI,adapt} \tag{5.17}$$

Data on PID_i^{POI} is available from the IMF. Data on POI_{ji} are available from a global database on bilateral portfolio holdings. (Further details are given in Annex V).

Combined off-diagonal labor and capital elements

The last step, is to add the labor and the two capital components (i.e., compensation of employees, direct investment income, and portfolio investment income) determined in equation (5.15) – (5.17):

$$\text{GDP}_{i,j} = \text{GDP}_{i,j}^{L} + \text{GDP}_{i,j}^{K,DI} + \text{GDP}_{i,j}^{K,POI} \tag{5.18}$$

In estimating the data for $\text{GDP}_{i,j}$ we have chosen to start from the debtor side. The same calculations could—in principle—have also been set-up from the creditor perspective (i.e., estimating $\text{GDP}_{j,i}$), which should in theory provide the same results. In practice, however, this is not the case because of bilateral asymmetries in the data. That is, trading partners report different figures for the same flow (which is also known as the problem of the mirror statistics). Our choice to adopt the debtor perspective is due to the superior quality of data that is available to proxy the bilateral relationships on direct and portfolio investments. The inward positions (i.e., where the owners of foreign asset holdings in the domestic economy reside) are typically reported more comprehensively and accurately by statistical agencies than the outward positions (i.e., where the assets holdings of domestic investors are held abroad). In addition, the preferred data on direct investment stocks are based on the ultimate beneficiary country, which are currently only available for the inward positions. (Further details are given in Annex IV). For this reason, the analysis focusses on the row-elements ($\text{GDP}_{i,j}$, which represents the exported transfers of income) and not on the less accurate column-elements ($\text{GDP}_{j,i}$, representing the imported transfers of income).

5.4 Data sources

The geographical scope of the matrix of transfers of income is determined by data availability and potential applications. Our primary motivation for creating the matrix is to develop an indicator for exports of income. This requires modifications to the trade in value added data derived from world input-output tables (world IOTs). For this paper the World Input-Output Database (WIOD) is chosen as a benchmark or reference point.[93] The most recent version of

[93] This database is freely available online at: http://www.wiod.org/release16. See also Timmer et al. (2015).

the WIOD, released in 2016, contains annual time-series of world IOTs for the period 2000 to 2014. The consistent and harmonized tables include detailed data for 43 countries, including all 28 EU members and several major advanced and emerging economies.[94] The IOTs account for all inter-country and inter-industry transactions in 56 industries, distinguishing between intermediate and final goods and services.

We incorporate all WIOD countries into the matrix except for one: Taiwan, which is excluded from almost all data sources that are drawn upon to construct it. Therefore, the matrix has a dimension of 43×43 (42 countries plus the Rest-of-World aggregate ROW, which now includes also Taiwan) and is constructed for the years 2013 and 2014. This represents a "proof of concept" that can be drawn upon to extend the time-frame in follow-up work. These two years were chosen due to the quality of the available data. The data sources used to construct the matrix, detailed below, contain almost no missing data in these two years for any of the 42 countries.

The source for GDP and GNI data, which give the respective row-wise sums and column-wise sums for every country in the matrix, is the World Development Indicators dataset from the World Bank.[95,96] The BoP data used to compute the main diagonals of the matrix ($\mathrm{GDP}_{i,i}$) is from the IMF's Balance of Payments and International Investment Position (IIP) statistics.[97] The Conference Board (CB) provides the labor shares, i.e., the ratios $\alpha_i^{CB} = \mathrm{GNI}_i^L/\mathrm{GDP}_i$, in the Total Economy Database, which we use to estimate GDP_i^L, GNI_i^L, GDP_i^K and GNI_i^K.[98]

The most data intensive step involves the estimation of the diagonal elements, i.e., the exported transfers of income to partner countries ($\mathrm{GDP}_{i,j}$). The calculations use disaggregated

Alternative reference world IOTs include the OECD/WTO TiVA and Eora databases. The 2018 edition of the OECD/WTO TiVA database has a larger country coverage than the WIOD (64 economies) with a 2005-2015 timeframe. The Eora covers even more countries but relies more on extrapolations and estimations than WIOD.

[94] Non-EU countries in the WIOD include Australia, Brazil, Canada, Switzerland, China, Indonesia, India, Japan, Korea, Mexico, Norway, Russia, Turkey, Taiwan, and the US.

[95] This database is freely available online at: http://data.worldbank.org.

[96] World GDP is reported to be slightly different than world GNI. We ensure that both values are the same in the matrix by basing global totals on world GDP. The only adjustment this implies for the matrix is to ROW's column-wise sum (= ROW's GNI), which we estimate by subtracting the sums of the reported GNIs of the 42 countries from world GDP.

[97] This database is freely available online at: http://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52. For mainland China, only aggregated investment income data are available after 2004 and not the breakdown into direct investment, portfolio investment, and other investment. Therefore, we assume the shares of each category in total investment in the years 2013-2014 are the same as the corresponding shares in the most recent available year (2004).

[98] This database is freely available online at: https://www.conference-board.org/data/economydatabase/. To approximate factor shares for Rest of World (ROW), we sum up the weighted factor shares of all countries in the database but not among the 42 in the GDP-GNI matrix based on α_i^{CB} (the weighted shares are obtained by multiplying the factor shares α_i^{CB} by the GDP of each ROW country). The procedure used to average mainland China, Hong Kong, and Macao's factor shares is similar.

BoP data. The main components of the primary income account include compensation to employees, direct investment income, and portfolio investment income. (See Annex I for details and definitions.) The IMF provides data on primary income debits (PID_i^{IMF}) and credits (PIC_i^{IMF}) for all 42 countries in 2013 and 2014 and, to the extent applicable or available for a given country, data for each of the (sub-) components mentioned in the methodology section: $\text{PID}_i^{IMF,L,raw}$, $\text{PID}_i^{IMF,K,raw}$ $(= \text{PID}_i^{IMF,DI,raw} + \text{PID}_i^{IMF,POI,raw} + \text{PID}_i^{IMF,OI,raw})$ and $\text{PID}_i^{IMF,OPI,raw}$.

We use data from the IMF, World Bank, and national statistical agencies to make the following two approximations. The bilateral shares of PID_i^{L} $(= \text{PID}_i^{IMF,L})$ correspond to employee compensation. The bilateral shares of PID_i^{K} $(= \text{PID}_i^{IMF,K} - \text{PT}_i)$ correspond to direct investment ($\text{PID}_i^{DI,adapt}$) and portfolio investment ($\text{PID}_i^{POI,adapt}$). For these approximations, we employ intercountry databases. These are: the World Bank's Bilateral Remittances Database (WBRM), the IMF's Coordinated Direct Investment Survey (CDIS), and the IMF's Coordinated Portfolio Investment Survey (CPIS). For about half of the countries, we use a new and preferred type of FDI data. When available, this data gives FDI by ultimate investing country. This data is obtained from central banks, national statistical offices, and the OECD International Direct Investment Statistics database. We use it instead of the CDIS to make the calculations for bilateral direct investment shares. See Annexes III-V for details on all databases.

Unique data challenges relate to greater China. While the final matrix combines mainland China, Hong Kong, and Macao into one entity (to be consistent with the WIOD database), all data sources that we use provide only data for each entity individually. The main issue is ensuring that internal income transfers and internal investments/labor payments between the three entities are excluded before making any calculations. For example, if BoP data for the three are summed up with no adjustments, then our approach may erroneously attribute some internal flows (which are part of China's national income, i.e., part of $\text{GDP}_{CHN,CHN}$) as income transfers by greater China to the other 42 countries/ROW. Annex VI explains in detail how we combine data for mainland China, Hong Kong, and Macao into aggregated data for greater China.

A complete matrix also includes a row-vector and a column-vector for the ROW aggregate. It should be noticed that the calculations for the column-vector ROW (the elements contributing to ROW's GNI) are straightforward given that the matrix is constructed from the debtor's perspective. By definition, $\text{GDP}_{i,ROW}$ gives the exported transfers of income that are not already

accounted for by transfers to the other 41 countries. Based on equation (5.15), we define $\mathrm{CE}_{i,ROW} = \sum_{j \neq i} \mathrm{CE}_{ij} - \sum_{j \neq i,ROW} \mathrm{CE}_{ij}$, which then implies $\mathrm{GDP}^{L}_{i,ROW} = \mathrm{PID}^{IMF,L}_{i} - \sum_{j \neq i,ROW} \mathrm{GDP}^{L}_{i,j}$. In the same way we define $\mathrm{GDP}^{K,DI}_{i,ROW}$ and $\mathrm{GDP}^{K,POI}_{i,ROW}$. It should be mentioned that the implication is that ROW is the "sink" of any errors in the bilateral estimations for other countries.

The row-vector ROW poses a different issue. Simply deriving the missing ROW elements $\mathrm{GDP}_{ROW,i}$ as the difference between GNI_i and the column-wise sum (that is, $\mathrm{GNI}_i - \sum_{j \neq ROW} \mathrm{GDP}_{ji}$), leads to negative values of $\mathrm{GDP}_{ROW,i}$ for some countries.[99] Therefore, a different strategy is used. First, we approximate the share of ROW's GDP that is part of ROW's national income, $\mathrm{GDP}_{ROW,ROW}/\mathrm{GDP}_{ROW}$, by taking the simple average of the corresponding shares that were obtained for the largest six emerging countries in the matrix: Brazil, India, Indonesia, Mexico, Russia, and Turkey.[100] These are the countries that best approximate ROW because they share similar characteristics in terms of development status (e.g., GDP per capita).

Instead of taking the average of emerging countries to also proxy the off-diagonal elements $\mathrm{GDP}_{ROW,i}/\mathrm{GDP}_{ROW}$, we use a global database on direct investments developed by Damgaard and Elkjaer (2017). This database provides estimates of the bilateral inward investment positions of 116 countries on an ultimate investing country basis in 2015.[101,102] We start with a 42×74 matrix where the rows represent the FDI stocks of each of the 42 WIOD countries in the 74 ROW countries contained in the database. Next, all columns are collapsed to create a single 42×1 column-vector representing the direct investments of each of the 42 WIOD countries in the ROW (proxied by the 74 ROW countries covered by the database). Normalizing

[99] Negative values for income transfers are not possible. The cases where this occurred were residuals for countries with much pass-through income (e.g., Luxemburg, Cyprus, and Great Britain). This is likely attributed to an overestimation of the incomes transferred to them from non-ROW countries, resulting in an underestimation for the income transferred from ROW (i.e., the residual).

[100] That is, $\frac{\mathrm{GDP}_{ROW,ROW}}{\mathrm{GDP}_{ROW}} = (\frac{\mathrm{GDP}_{BRA,BRA}}{\mathrm{GDP}_{BRA}} + \frac{\mathrm{GDP}_{IND,IND}}{\mathrm{GDP}_{IND}} + \frac{\mathrm{GDP}_{IDN,IDN}}{\mathrm{GDP}_{IDN}} + \frac{\mathrm{GDP}_{MEX,MEX}}{\mathrm{GDP}_{MEX}} + \frac{\mathrm{GDP}_{RUS,RUS}}{\mathrm{GDP}_{RUS}} + \frac{\mathrm{GDP}_{TUR,TUR}}{\mathrm{GDP}_{TUR}})/6$. An alternative approach to derive $\mathrm{GDP}_{ROW,ROW}$ is to subtract the aggregated income debits of all 100+ ROW countries (countries not in the matrix) from ROW's GDP. However, this requires the additional step of removing all income going from ROW countries to other ROW countries from the BoP data (as these would be considered pass-through or internal), which would be nearly impossible to estimate.

[101] See Damgaard and Elkjaer (2017) for details on the methodology used to construct the database.
The data are publicly available here and we assume the data are the same for 2014:
https://www.imf.org/en/Publications/WP/Issues/2017/11/17/The-Global-FDI-Network-Searching-for-Ultimate-Investors-45414

[102] Even if the approximations based on this data relate only to the direct investment component of the BoP, we consider them more detailed and accurate than taking the average of emerging countries to proxy ROW's off-diagonal elements.

this column yields the 42 shares (adding up to 1). Each share tells which part of all ROW income transfers that go to WIOD countries is received by a specific WIOD country. This gives the estimated, offsetting shares of income transferred by ROW to each of the 42 WIOD countries (excluding intra-ROW transfers). Each of the 42 shares is then multiplied by $1 - (\mathrm{GDP}_{ROW,ROW}/\mathrm{GDP}_{ROW})$ to obtain $\mathrm{GDP}_{ROW,i}/\mathrm{GDP}_{ROW}$.[103] These represent shares of ROW's GDP that end up in the national income of each country in the matrix. Finally, each of the 43 shares, now including the diagonal share $(\mathrm{GDP}_{ROW,ROW}/\mathrm{GDP}_{ROW})$, is multiplied by GDP_{ROW} to determine the actual values of $\mathrm{GDP}_{ROW,ROW}$, $\mathrm{GDP}_{ROW,i}$ (for i = 1, …, 42) in the 43rd row.

Finally, although all row-wise sums now correctly add up to the GDP of each country/ROW in the matrix, the column-wise sums do not precisely add up to the GNI of each country/ROW. This is due to reporting discrepancies related to the issue of mirror statistics discussed in Section 5.3. Therefore, a matrix balancing technique is employed (Miller and Blair, 2009). It follows the generalized RAS (GRAS) algorithm from Lenzen et al. (2007) and uses a Matlab program written by Temurshoev et al. (2013). The GRAS variant has the advantage of also being able to make adjustments for rows that have elements with negative signs even if the aggregated constraints are positive, which in some cases is true for our matrix.[104] The balancing technique thus ensures that all rows and columns of the final matrix add up properly.

The balancing procedure is applied to two matrices separately. The GDP-GNI matrix is split into a matrix of transfers of labor income and a matrix of transfers of capital income (including also the diagonals that reflect 'transfers' of income within the same country). The reason the labor and capital parts are separated before applying RAS is that labor income is not subject to significant data problems (i.e., pass-through income). Most of the data problems are contained in the capital side. Therefore, any adjustments by RAS related to the matrix involving only labor components are expected to be smaller than the adjustments by RAS related to the matrix involving capital components.

Note that prior to applying RAS, the row-wise sums of the matrix of transfers of labor income add up to the labor part of GDP of each country, GDP_i^L, and the column-wise sums should (but do not) add up to the labor part of GNI of each country, GNI_i^L. The same applies to

[103] If we denote the 42 shares obtained from normalization by n_i, we have $n_i = GDP_{ROW,i}/\sum_i GDP_{ROW,i}$. Next, note that $1 - \left(\mathrm{GDP}_{ROW,ROW}/\mathrm{GDP}_{ROW}\right) = (\mathrm{GDP}_{ROW} - \mathrm{GDP}_{ROW,ROW})/\mathrm{GDP}_{ROW} = \sum_i GDP_{ROW,i}\,/\mathrm{GDP}_{ROW}$. Hence, $n_i\left[1 - \left(\mathrm{GDP}_{ROW,ROW}/\mathrm{GDP}_{ROW}\right)\right] = GDP_{ROW,i}/\mathrm{GDP}_{ROW}$.

[104] This is possible because of some negative data in the CDIS database used to estimate bilateral shares of direct investment incomes. Negative data can occur when there are negative retained earnings or for other reasons, see: http://datahelp.imf.org/knowledgebase/articles/484342-what-is-the-meaning-of-negative-data-in-the-coordi

GDP_i^K for the row sums and GNI_i^K for the column sums. RAS is then applied separately to each matrix and the results are added.

5.5 Results

The analysis is organized in two parts. The first part uses the matrix that relates countries' GDP to their GNI (i.e., the GDP-GNI matrix) to explore the characteristics of incomes that are transferred. First, we discuss the diagonal elements of the matrix (Section 5.5.1). Then we analyze the off-diagonal elements from the standpoint of understanding the to-whom geography of income transfers (Section 5.5.2). In the second part we derive the global trade in income through GNI exports in the GNIX matrix. The columns of the GNIX matrix show for each country their GNI footprint (i.e., the income imported and consumed by a country, disaggregated by counterpart country) and the rows show for each country the part of their income contained in the final demands of other countries. The analysis compares the share of a country's GNI that is exported (which are the exports of income) with the share of GDP that is exported by the same country (which are the exports of value-added) (Section 5.5.3). Finally, we discuss trade balances of income and how they differ from trade balances of value-added (Section 5.5.4.)

5.5.1 Diagonal elements of the matrix

The diagonal elements of the GDP-GNI matrix indicate the value added generated from domestic production that ends up as part of the national income of the same country ($GDP_{i,i}$). This was computed using equation (5.12) in the methodology section. Table 5.2 displays the diagonal values for each country as a percent share of the country's GDP.

The percent share of countries' GDP that went to their own people was upwards of 90% for all but six countries. High diagonal shares could be expected given that GDP and GNI overlap to a large extent and are often of a similar magnitude. The share of GDP that went to the same country reached more than 98% in four larger economies (China, Japan, Turkey, and Korea). This implies a very large share of the value added of these countries represented income gains for their residents. By contrast, the residual shares were higher (i.e., diagonal values were relatively smaller) in business-friendly economies and tax havens. Luxembourg, Ireland, Cyprus, Malta, and the Netherlands, which are the five countries that had the lowest diagonal shares, are known to attract large numbers of multinational firms and/or foreign investors. Even amongst these four, Luxembourg was an outlier with an exceptionally low share of GDP,

33.3%, that it retained as income. Two-thirds of Luxembourg's GDP thus represented income gains to residents of another country. This is consistent with Luxembourg's integration in international capital markets and its dependence on cross-border workers. Luxembourg is also the largest investment fund center in Europe.[105] Hence, the estimates indicate that a large share of Luxembourg's GDP embodies foreign-owned capital and/or payments to foreign factors.

Table 5.2. The percent share of GDP that is part of the national income of each country, 2014

CHN	98.9	DEU	96.5	PRT	94.7	CZE	91.6
JPN	98.8	LTU	96.5	LTA	94.7	BEL	91.2
TUR	98.7	BGR	96.2	AUS	94.6	GBR	90.9
KOR	98.5	IDN	95.9	NOR	94.4	HUN	90.4
IND	97.8	RUS	95.9	HRV	94.2	CHE	87.2
GRC	97.8	DNK	95.8	AUT	94.2	NLD	80.7
ROM	97.6	ESP	95.7	SWE	94.2	MLT	65.6
BRA	97.5	FRA	95.5	FIN	94.2	CYP	65.0
USA	97.4	SVN	95.1	CAN	94.0	IRL	63.2
ITA	97.2	SVK	95.0	ROW	93.8	LUX	33.3
MEX	96.7	POL	94.9	EST	92.8		

Notes: Calculations are based on: $100(\frac{\mathrm{GDP}_{i,i}}{\mathrm{GDP}_i})$ and are after applying the RAS procedure. See Annex VII for the names of the countries that ISO country codes refer to.

It is noteworthy that the diagonal shares in the years 2013 (not shown) and 2014 were similar for the same country. This supports the robustness of the results and consistency of the data sources used. Percent change in the diagonal shares of a country between these two years (i.e.,$100[(\mathrm{GDP}_{i,i}^{2014}/\mathrm{GDP}_i^{2014})/(\mathrm{GDP}_{i,i}^{2013}/\mathrm{GDP}_i^{2013}) - 1]$) were less than 2% for every country in the GDP-GNI matrix. Large fluctuations between consecutive years might have raised some concerns about the data, but this is not the case. For this reason, only results for the year 2014 will be discussed in the remainder of the analysis (Sections 5.5.1-5.5.4). The changes that did occur to the diagonal shares were, in three-fifths of all countries, negative percentage point changes. Even if this finding is based on two consecutive years only, it is consistent with the idea that globalization and the increasingly complex activities of investors and multinational firms are gradually leading to a less robust relationship between a country's value-added production and the share of income that this generates domestically.

Next, we consider the pass-through income in each country to assess the extent of pass-through investment and its impact on the diagonal shares of the GDP-GNI matrix. Table 5.3,

[105] Source: Central Bank of Luxembourg: https://www.banquedeluxembourg.com/de/bank/corporate/luxembourg-key-advantages-for-investment-funds

column (1) shows the monetary value (in millions) of all income debits reported by the IMF (PID_i^{IMF}, the raw capital income debits plus labor income debits and other income debits). Column (2) shows the monetary value of the income debits after adjusting for pass-through income ($\text{PID}_i^{IMF} - \text{PT}_i = \text{PID}_i$). The adjustments are based on the methodology explained in Section 5.3.3. Column (2) thus shows the row-wise sums of non-diagonal elements representing the transfers of income to other countries. For easier interpretability, each column shows all debits before applying the RAS balancing procedure (hence, $\text{PID}_i^{IMF} - \text{PT}_i \neq \sum_{j \neq i} \text{GDP}_{i,j}$ in the GDP-GNI matrix).[106] Column (3) reports the ratio between the unadjusted and adjusted figures ($= \text{PID}_i^{IMF} / (\text{PID}_i^{IMF} - \text{PT}_i)$). The countries are ranked based on this ratio from low to high.

Table 5.3. Income debits (PID_i^{IMF}) and adjustments for pass-through income ($\text{PID}_i^{IMF} - \text{PT}_i$), 2014

	PID_i^{IMF} (1)	$\text{PID}_i^{IMF} - \text{PT}_i$ (2)	(1)/(2) (3)		PID_i^{IMF} (1)	$\text{PID}_i^{IMF} - \text{PT}_i$ (2)	(1)/(2) (3)
IDN	31832	31719	1.0	PRT	15679	14251	1.1
HRV	2987	2976	1.0	CAN	100228	90519	1.1
BRA	57160	56811	1.0	ESP	74852	67526	1.1
TUR	13113	13012	1.0	JPN	72854	65410	1.1
IND	37581	37229	1.0	AUT	29992	26868	1.1
ROM	5899	5823	1.0	USA	606150	541750	1.1
MEX	41905	41336	1.0	HUN	20142	17817	1.1
BGR	2383	2335	1.0	DEU	177694	157027	1.1
LTU	1711	1672	1.0	NOR	31373	27383	1.1
LVA	1679	1634	1.0	FRA	146923	127328	1.2
KOR	22666	21896	1.0	FIN	20232	17468	1.2
POL	34095	32909	1.0	DNK	20528	17631	1.2
SVN	2016	1942	1.0	GBR	302328	256793	1.2
CHN	234515	225872	1.0	SWE	50746	42388	1.2
RUS	115135	110263	1.0	BEL	64223	52118	1.2
CZE	20043	19132	1.0	CYP	6541	4377	1.5
SVK	5909	5614	1.1	CHE	150653	99489	1.5
AUS	79434	74484	1.1	IRL	116897	74582	1.6
ITA	83092	77448	1.1	NLD	342512	183462	1.9
EST	2262	2098	1.1	MLT	14293	4345	3.3
GRC	9391	8591	1.1	LUX	263601	39242	6.7

Notes: own calculations derived from official data from the IMF (see Section 5.3.3). (1) and (2) are in millions. $\text{PID}_i^{IMF} - \text{PT}_i$ would be equal to $\sum_{j \neq i} \text{GDP}_{i,j}$ in the GDP-GNI matrix after applying the RAS balancing procedure.

[106] Note that Table 5.3 is the only part of the analysis that shows data prior to the RAS method. All other results in Section 5.5 are after applying RAS to the GDP-GNI matrix.

The ranking of countries based on the estimations of their pass-through income appears plausible. Luxembourg and Malta, which one would expect to have considerable pass-through income due to their attractiveness to foreign investors, are at the bottom of column (3). This implies that these two countries had the biggest relative discrepancies between the unadjusted values in column (1) and the corresponding adjusted values in column (2). Luxembourg sent income abroad at a magnitude of approximately four times its GDP in the year 2014 (i.e., $\text{PID}_{LUX}^{IMF} = 4 * \text{GDP}_{LUX}$). This also implies that, following equation (5.1), the diagonal element for Luxembourg (giving how much of Luxembourg's GDP goes to itself) would be negative in the case of no adjustments for pass-through income (i.e., $\text{GDP}_{LUX,LUX} = \text{GDP}_{LUX} - \text{PID}_{LUX}^{IMF} \approx \text{GDP}_{LUX} - 4 * \text{GDP}_{LUX} < 0$). The example reinforces the need to correct for pass-through income. At the same time, pass-through income appears, in general, not to be a major or pervasive issue. Most countries had diagonal shares exceeding 90% of their GDP even before adjusting for their pass-through income (not shown in Table 5.3). In addition, all but 7 countries had adjusted values for their diagonals that differed by two percentage points or less from their unadjusted diagonal values.

5.5.2 Off-diagonal elements of the matrix

This section assesses the bilateral part of the GDP-GNI matrix. A subset of the matrix relating countries' GDP to their GNI is shown in Table 5.4 for the European Union (EU15 countries) and in Tables 5.5 and 5.6 for North America and East Asia, respectively. The tables provide the shares (in percent) of all exported income transferred by the row countries to each column country. The percent share of country *i*'s transfers of income to country *j* is obtained with $100(\text{GDP}_{i,j}/\sum_{j\neq i}\text{GDP}_{i,j})$.[107] This is domestic value-added that represents income gains to residents of other countries *j*. The diagonal values $\text{GDP}_{i,i}$, which are not considered exported transfers of income, were taken out of all tables in this analysis. Only shares of the bilateral component of GDP are reported. The full matrix is broken down into regional blocs for easier interpretability. Our application of the data considers to what extent geographical proximity explains transfers of income between countries. It could be that, like the trade of goods and services, gravity is important and there is less income repatriated between countries that are further apart.[108]

[107] To obtain $\text{GDP}_{i,j}$, multiply share $\text{GDP}_{i,j}/\sum_{j\neq i}\text{GDP}_{i,j}$ from Tables 5.4-5.7 with denominator $\sum_{j\neq i}\text{GDP}_{i,j}$ (the pass-through adjusted transfers of income from country *i*). Data on $\sum_{j\neq i}\text{GDP}_{i,j}$, are available from the author.

[108] In the case of labor payments associated with cross-border workers, though accounting for only a small share of total primary income debits, it is almost by design only possible for income to end up in neighboring countries.

We begin by analyzing the situation for the EU15 countries, which form a natural geographic bloc. The first observation is that the average EU15 country sent about half of its transfers of income (49.1%) to another EU15 country. This is obtained by the sum of the income transferred by all members of the EU15 to all other countries in the EU15 as a share of the region's total transfers of income. Geography thus played an important role in determining where Europe's transfers of income went to. That is, half of this income contributed to the national income of other EU15 countries. Returns on direct investment accounted for most of the income that was transferred by countries in the entire matrix of 42 countries plus ROW.[109] Firms exercise caution when making direct investments, which are a deep and sometimes risky form of international commitment. Direct investments in neighboring EU countries may be perceived as relatively safe and uncomplicated in the common market relative to investments in other regions, which could explain the importance of geography in determining where the income of the EU15 ended up.

Table 5.4. European Union (EU15): transfers of income by row-country as share of total transfers of income, 2014 (shares of each country to EU15 + US + Other = 100)

	AUT	BEL	DEU	DNK	ESP	FIN	FRA	GBR	GRC	IRL	ITA	LUX	NLD	PRT	SWE	EU15	US	Other
AUT	-	2.3	28.2	0.4	0.9	0.7	8.7	2.9	0.2	0.8	7.0	0.6	7.2	0.3	0.5	60.7	9.6	29.8
BEL	0.7	-	7.3	0.6	0.1	0.8	28.2	0.7	0.3	0.5	1.3	3.8	32.7	-0.1	2.6	79.4	6.2	14.4
DEU	3.1	1.7	-	1.9	1.9	1.0	7.4	10.1	0.1	1.8	4.4	1.2	7.8	0.4	1.8	44.4	23.2	32.3
DNK	0.5	0.9	9.1	-	0.9	6.8	3.2	4.8	0.0	1.2	0.6	1.0	6.6	0.1	17.7	53.6	23.1	23.3
ESP	0.8	1.9	14.7	0.6	-	0.4	16.6	8.3	0.7	2.2	10.5	1.0	4.9	1.9	1.1	65.5	16.2	18.4
FIN	1.1	0.9	11.0	4.4	0.4	-	4.6	4.9	0.0	1.9	1.1	0.7	10.2	0.2	22.4	63.8	15.8	20.4
FRA	0.9	5.2	14.5	0.7	2.1	0.7	-	9.2	0.1	2.7	5.7	1.3	7.2	0.5	0.8	51.6	20.0	28.4
GBR	0.3	0.7	6.8	0.8	2.0	0.4	7.5	-	0.6	4.8	1.6	0.7	5.8	0.2	1.3	33.6	37.7	28.7
GRC	1.9	2.9	14.6	0.4	1.0	0.3	12.7	19.4	-	1.9	8.6	1.2	6.1	3.7	1.3	76.0	20.5	3.5
IRL	0.4	1.0	5.2	0.6	1.1	0.9	3.7	7.3	0.0	-	3.7	0.5	2.4	0.4	0.6	28.0	59.8	12.2
ITA	1.8	2.4	16.1	0.9	6.3	0.5	21.2	7.2	1.4	4.5	-	1.6	4.7	1.3	0.5	70.4	11.0	18.6
LUX	0.8	17.5	10.2	1.1	1.7	1.1	6.4	5.0	1.2	2.0	7.6	-	6.4	2.3	2.5	65.8	13.2	21.0
NLD	0.6	6.9	12.6	1.8	1.7	0.9	8.8	12.1	0.1	2.5	1.7	1.8	-	0.3	1.5	53.3	19.6	27.1
PRT	1.1	2.5	11.8	1.1	17.1	0.0	13.4	5.9	1.0	2.7	4.8	1.7	15.2	-	0.3	78.7	9.6	11.7
SWE	0.9	0.8	9.2	7.8	0.8	9.9	3.6	9.9	0.0	2.0	0.6	1.6	12.7	0.1	-	59.7	18.3	22.0
EU15	1.0	3.2	9.4	1.3	2.0	1.0	8.5	6.4	0.4	2.7	3.3	1.2	6.5	0.5	1.8	49.1	26.1	24.8

Notes: own calculations based on $\mathrm{GDP}_{i,j}/(\sum_{j\neq i}\mathrm{GDP}_{i,j})$. The average, weighted share of EU15 to EU15 is based on the equation $\sum_{h\neq j,h\in EU}\mathrm{GDP}_{h,j}/\sum_{i\in EU}\sum_{k\neq i}\mathrm{GDP}_{i,k}$, where EU indicates the EU15 region.

Two notable outliers among the EU15 countries were Ireland and Great Britain. Ireland sent only 28.0% of its transfers of income to another EU15 country and 59.8% to the US (more than twice the weighted average of 26.1% for EU15 countries to the US). This can be best

[109] Table 5.A2 (Annex II) shows that direct investment income debits accounted for a plurality (45.3%) of total income debits of the average country in the GDP-GNI matrix (as calculated using raw IMF data before any adjustments to pass-through income).

explained by tax incentives in Ireland that have attracted large numbers of US multinational firms. Great Britain similarly transferred more income to the US (37.7%) than to another EU country (33.6%). This is probably related to the strong historical and cultural ties between the two countries. The contributions of Ireland and Great Britain to other countries' GNIs were thus less influenced by geographical proximity as compared to other EU15 countries because of the key role played by the US.

Geographical proximity mattered less for the transfers of income from North America (defined as the US, Canada, and Mexico). Observe in Table 5.5 that only 21.3% of all income transferred by the three countries remained in the region (60.1% for Canada, 9.0% for the US, and 53.1% for Mexico). North America, and especially the US, seemed lucrative to EU investors – because almost 40% of US transfers of income contributed to the GNI of EU15 countries. Although more than half of Mexico's and Canada's transfers of income went to the US, indicating the importance of US direct investments and US portfolio holdings in the neighboring countries, these investments were dwarfed by those of investors in countries outside of the region (notably Europe) investing in the US. The European influence is thus part of the reason why North America's transfers of income, especially by the US, did not depend as much on geographical proximity.

The US may be an interesting case because two-thirds of all US transfers of income involved returns on portfolio investments. The ratio of transfers of portfolio income to total transfers of income (i.e., $\sum_{j \neq USA} \mathrm{GDP}_{USA,j}^{K,POI} / \sum_{j \neq USA} \mathrm{GDP}_{USA,j}$) was higher for the US than for almost every other country in the GDP-GNI matrix.[110] This is relevant because portfolio holdings are probably less dependent on geography than are direct investments. They do not require the same type of up-front and deep commitments or knowledge of the local market as do direct investments. If most foreign investors holding portfolios in the US reside far away from the US, then US transfers of income representing the returns on these investments necessarily also end up further away (outside the region). This could help to explain why almost all US transfers of income (91.0%) contributed to the national income of countries outside of North America.

[110] Table 5.A2 (Annex II) shows that 63.5% of US transfers of income were considered portfolio investment incomes, which is much higher than the weighted average of 45.5% for all countries in the full matrix.

Table 5.5. North America (NA): transfers of income by row-country as share of total transfers of income, 2014

	CAN	USA	MEX	CHN	EU15	Other	NA	TOT
CAN	-	59.7	0.4	6.1	14.0	19.7	60.1	100
USA	8.2	-	0.7	2.3	39.2	49.5	9.0	100
MEX	2.9	50.2	-	0.5	33.8	12.7	53.1	100
NA	6.4	14.3	0.6	2.9	34.3	41.5	21.3	100

Notes: own calculations based on $\mathrm{GDP}_{i,j}/(\sum_{j \neq i} \mathrm{GDP}_{i,j})$. NA = North America (Canada + USA + Mexico)

Geographical proximity was least important for the transfers of income from Japan and South Korea as compared to countries in the other two regions. Japan and South Korea seem to be heavily dependent on investments from the US and EU because more than one-half (South Korea) and two-thirds (Japan) of all income transferred by those countries ended up in the national income of either the US or EU.

Table 5.6. East Asia: transfers of income by row-country as share of total transfers of income, 2014

	CHN	JPN	KOR	USA	EU15	Other	TOT
CHN	-	9.8	3.3	9.7	13.6	63.6	100
JPN	8.6	-	3.1	44.6	25.7	18.0	100
KOR	10.4	19.7	-	32.2	20.1	17.8	100

Notes: own calculations based on $\mathrm{GDP}_{i,j}/(\sum_{j \neq i} \mathrm{GDP}_{i,j})$.

A key takeaway so far is that the EU15 countries and the US were important recipients of incomes transferred from countries in the three regions. Next, we check whether this finding also holds for incomes sent by countries outside of the three regions. Table 5.7 shows the transfers of income by emerging and developing countries (China, Brazil, India, Indonesia, Mexico, Russia, and Turkey, and ROW). Observe that about 22.5% of all income transfers from those countries went to the EU15 and 38.6% to the US. Furthermore, the full GDP-GNI matrix of 42 countries plus ROW shows that more than a third (35.6%) of all transfers of income worldwide were by the countries contained in Table 5.7. Poorer and emerging countries thus appear to send a relatively large share of their GDP to rich, developed regions like Europe and North America (despite greater geographical distance). The findings show the importance of the US, followed by the EU, as the major players in foreign investment worldwide. This also indicates the global reach of US direct investments and US portfolio holdings abroad, which account for almost all repatriated income.

Table 5.7. Emerging and developing countries: transfers of income by row-country as share of total transfers of income, 2014

	EU15	USA	Other	TOT
BRA	40.0	32.8	27.2	100
RUS	44.3	9.3	46.3	100
IDN	16.8	27.6	55.6	100
IND	23.1	29.7	47.2	100
CHN	13.6	9.7	76.7	100
TUR	41.8	23.0	35.2	100
MEX	33.8	50.2	16.0	100
ROW	19.2	47.8	33.0	100
TOT	22.5	38.6	38.9	100

Notes: own calculations based on $\mathrm{GDP}_{i,j}/(\sum_{j\neq i}\mathrm{GDP}_{i,j})$.

To reinforce the above findings in a different way, suppose that a country's GDP is a crude proxy for its attractiveness to foreign direct and portfolio investments. This is sensible given that the international business literature considers GDP (a proxy of market size) an important determinant of FDI (Dunning, 1993). Then it might be expected that - on average - countries invest in other countries in proportion to the partner country's share in global GDP. This would result in offsetting shares of incomes that are transferred by the country receiving inward investments to the counterpart countries. However, almost all countries in the GDP-GNI matrix sent a higher share of their transfers of income to the EU15 than the share of the EU15 region in global GDP.[111] This also held for income sent from non-EU countries to the US. Australia, Brazil, Canada, Indonesia, India, Japan, Korea, and Mexico all exported a higher share of their transfers of income to the US than the share of the US in global GDP. Also this comparison underscores the outsized importance of the US and EU15 as receivers of income – even from countries that are geographically distant.

In the Asian context, it is striking that most of China's transfers of income ended up in countries other than the US, EU15, Korea, and Japan (= 63.6%), rather than in the EU15 (13.6%) or US (9.7%) (Table 5.6). This is due to the influence of tax havens that are reflected in the data on China. We used the Coordinated Direct Investment Survey (CDIS) to proxy the offsetting shares of China's transfers of direct investment income going to counterpart countries. (the CDIS is discussed in Annex IV). The CDIS shows that in 2014 more than two-thirds (67.5%) of all direct investments in China were by the British Virgin Islands, Not Specified / Confidential, Singapore, Netherlands, Cayman Islands, and Bermuda. The British

[111] The exceptions were Canada, China, Cyprus, Indonesia, Korea, Malta, and ROW.

Virgin Islands, the largest investor, by itself made 38.6% of all direct investments in China. All these countries are well-known tax havens.

Given that nearly all transfers of income by China were attributed to returns on direct investments (see Table 5.A2, Annex II), these tax havens then accounted for a great majority of the income that China sent to 'Other' as reflected in Table 5.6. This shows that tax havens can have a big impact on bilateral investment statistics if the data are based on the immediate investing country. Although we used direct investment shares based on the ultimate beneficiary country for more than half of all countries in the GDP-GNI matrix to minimize the impact of tax havens, such data was not available for China. Hence, it could still well be that the US and EU15 were the biggest investors in China if they operate there indirectly via intermediaries (tax havens). China was the most extreme example of the apparent distortions in the data related to tax havens. Most countries in the study had more reasonable (smaller) shares of their transfers of income going to the 'ROW' countries not separately included in the matrix.

5.5.3 Analysis: exports of GNI

In this section, we use the GDP-GNI matrix to help derive estimates of incomes that are generated in a country due to demand for final goods and services. The analysis covers all types of income contributing to a country's GNI – e.g., the income a country gains from profit-shifting by MNEs, the income sent home by cross-border workers, and the income a country's citizens earn from portfolio investments in another country. The sum of the income generated from all sources of final demand, foreign and domestic, equals the country's GNI. The main contribution of this analysis is to differentiate between income that is induced by domestic final demand and income that is induced by foreign final demand. We consider the income that is generated in a country but induced by final demand abroad to be this country's exports of income or exports of GNI (hence GNIX). As part of the analysis we compare a country's exports of income to its exports of value-added (or VAX). The latter is the domestic value-added induced in one country due to final demand in foreign countries. Exports of income contribute to a country's GNI and exports of value-added contribute to a country's GDP.

The goal of the comparison is to investigate the extent to which a country is more (or less) dependent on foreign consumption of final products in terms of the generation of its own income compared to the generation of domestic value-added. This provides a better portrayal of the income benefits of final demand from abroad to a country's residents than the exports of value-added indicator because part of the value added might be transferred to foreign countries and vice versa.

So, it is important to observe the differences between the different types of exports. These are gross exports, exports of value-added, and exports of income. An example is illustrative. French consumers buy agricultural goods from the Netherlands, the production of which uses German fertilizers. The German fertilizer factory also employs cross-border workers from Poland (i.e., people who work in Germany but reside in Poland). In this case, the delivery of Dutch agricultural products to French consumers are part of the Dutch gross exports to France. These exported Dutch agricultural products also embody inputs of German fertilizers. The labor and capital used in the German fertilizer factory is part of the German value added. Hence, Germany exports value added to France. The earnings of the Polish cross-border workers are part of the German value added but are transferred to Poland and become part of Poland's income (GNI). This means that Poland exports income to France. The possible gross export, value added, and income linkages are illustrated in Table 5.8a.

Note that while exports of value-added and exports of income are the same in the aggregate in Table 5.8a (summed up across the four countries), this is not necessarily the case in every supply chain. The illustration in Table 5.8b now assumes that: i) the Dutch consume all the agricultural goods themselves instead of French people, and ii) a Spanish firm owns the farmland used to grow the agricultural products in the Netherlands, and repatriates part of the profits it makes from selling the goods to Dutch consumers back to Spain. All other assumptions are carried over from the first illustration. Then it is possible, as shown in Table 5.8b, that the aggregated exports of income (from Poland, Germany, and Spain to the Netherlands) exceed the exports of value-added (from just Germany to the Netherlands).

Table 5.8a. Illustration: gross exports, exports of value-added, and exports of income (in $)

	Gross exports (GE_i)	Exports of value-added (VAX_i)	Exports of income ($GNIX_i$)
POL	0	0	2 (POL → FRA)
DEU	5 (DEU → NLD)	5 (DEU → FRA)	3 (DEU → FRA)
NLD	10 (NLD → FRA)	5 (NLD → FRA)	5 (NLD → FRA)
FRA	0	0	0
TOT	15	10	10

Table 5.8b. Illustration: gross exports, exports of value-added, and exports of income (in $)

	Gross exports (GE_i)	Exports of value-added (VAX_i)	Exports of income ($GNIX_i$)
POL	0	0	2 (POL → NLD)
DEU	5 (DEU → NLD)	5 (DEU → NLD)	3 (DEU → NLD)
NLD	0	*5 (internal, NLD → NLD)*	*3 (internal, NLD → NLD)*
ESP	0	0	2 (ESP → NLD)
TOT	5	5	7

Notes: POL = Poland; DEU = Germany; NLD = Netherlands; FRA = France; ESP = Spain.

The two main components in the calculations for exports of income are the 43×43 GDP-GNI matrix, denoted GDP, and a 43×43 matrix with exports of value-added, denoted VAX. The matrix GDP was given in Table 5.1 and was constructed according to Sections 5.3-5.4. Its elements $\mathrm{GDP}_{i,j}$ give the transfer of incomes, i.e., the value added of *i* that goes to *j* and becomes part of *j*'s GNI. The GDP matrix covers only 43 countries (instead of 44) because our definition of ROW includes Taiwan.

The VAX matrix is derived in two steps from the 2014 world IOT in the WIOD database. There are 56 industries included in the WIOT for each of the 44 countries.[112] Let v denote the 2464×1 vector of value-added coefficients; A the 2464×2464 matrix with input coefficients; I the 2464×2464 identity matrix; and F is the 2464×44 matrix of final demands. Value added includes wages and salaries, employers' contributions, capital depreciation, indirect taxes, price-decreasing subsidies, and operating surplus or other income. Final demands include private investments, government consumption and investments, and changes in stocks. The full 2464×44 value-added exports matrix is given by

$$VAX^{full} = \hat{v}(I - A)^{-1}F \tag{5.19}$$

where a 'hat' is used to indicate the diagonal matrix based on v. The second term in equation (5.19) is also known as the Leontief inverse (or multiplier matrix). The typical element $\mathrm{VAX}_{i,j}^{full}$ gives the value added generated in country-industry *i* (= 1, …, 2464) necessary for all 2464 final demands by country *j* (= 1, …, 44). The first step is to aggregate the 2464 ($= 44 \times 56$) results for country-industries into the totals for the 44 countries (by summing over the 56 industries for each country). This yields a 44×44 matrix. The second step is to aggregate the results for ROW-TWN and Taiwan, which yields the 43×43 matrix VAX. Its typical element $\mathrm{VAX}_{i,j}$ gives the value added generated in country *i* necessary for all final demands in country *j,* with *i, j* = 1, …, 43 and ROW (which now includes Taiwan) is country 43. The off-diagonal elements of VAX give exports of value-added.

Similar to VAX, the matrix $GNIX$ gives in its off-diagonal elements the exports of income. $GNIX$ is derived as follows. The final demands of country *j* induce value added (and thus a contribution to GDP) in country *i* to the amount of $\mathrm{VAX}_{i,j}$. The share of country *i*'s GDP that becomes part of country *k*'s income (GNI) equals $\mathrm{h}_{i,k} = \mathrm{GDP}_{i,k} / \sum_j \mathrm{GDP}_{i,j} = \mathrm{GDP}_{i,k}/\mathrm{GDP}_i$.

[112] These are the 42 individual countries in the GDP matrix; the 43rd country is Taiwan (included separately); and the 44th country is ROW-TWN. For the purposes of deriving VAX^{full} in equation (5.19) only, the rest of world aggregate exceptionally is not combined with Taiwan.

This share gives the part of an average dollar of GDP in *i* that is transferred to the GNI of *k*. In that case, the income transfer of $\mathrm{VAX}_{i,j}$ as part of GDP in country *i* to the GNI in country *k* equals $\mathrm{h}_{i,k}\mathrm{VAX}_{i,j}$. This gives the GNI in *k* that is due to final demands in *j* and which runs through GDP in *i*. Clearly, country *i* is not the only transmission channel. All GNI in *k* that is due to final demands in *j* is given by

$$\mathrm{GNIX}_{k,j} = \sum_i \mathrm{h}_{i,k}\mathrm{VAX}_{i,j}$$

Using matrix algebra, we have

$$GNIX = H^{\mathrm{T}}VAX \tag{5.20}$$

where H^{T} denotes the transposed matrix of H.

The rows of $GNIX$ refer to income-generating countries and the columns refer to income-consuming countries. The income generated in country *k* that is embodied in all final demands consumed abroad (or total exports of income) is $\sum_{j\neq k}\mathrm{GNIX}_{k,j}$. It can be shown that the sum of row *k* of $GNIX$ equals the GNI of country *k*.[113] The columns of $GNIX$ give GNI footprints and show all pieces of income (and where it comes from) that are consumed by final users. $\sum_{k\neq j}\mathrm{GNIX}_{k,j}$ gives the imported income. It can be shown that the column sums equal the sum of final demands in the corresponding country.[114]

Table 5.9 compares countries' gross exports, exports of value-added, and exports of income in 2014. To facilitate ease of interpretation and to show the relative impact exerted by foreign final demand, all values are divided by GDP_i or GNI_i. We report gross exports as a share of GDP in column (1), $\mathrm{GE}_i/\mathrm{GDP}_i$ ($=\sum_{j\neq i}\mathrm{GE}_{i,j}/\mathrm{GDP}_i$), the share of GDP_i that was exported in column (2), $\mathrm{VAX}_i/\mathrm{GDP}_i$ ($=\sum_{j\neq i}\mathrm{VAX}_{i,j}/\mathrm{GDP}_i$), and the share of GNI_i that was exported in column (3), $\mathrm{GNIX}_i/\mathrm{GNI}_i$ ($=\sum_{j\neq i}\mathrm{GNIX}_{i,j}/\mathrm{GNI}_i$), for each of the 42 countries plus ROW. All shares are multiplied by 100 to express the ratios in percent. Column (4) shows the percentage point difference between (2) and (3), $\left(\frac{\mathrm{GNIX}_i}{\mathrm{GNI}_i}-\frac{\mathrm{VAX}_i}{\mathrm{GDP}_i}\right)*100$, and column (5) shows the ratio

[113] Taking the row sums of VAX^{full} in (5.20) yields the values-added in each country-industry. Taking the appropriate sums for countries implies $\sum_j \mathrm{VAX}_{i,j} = \mathrm{GDP}_i$. Hence $\sum_j \mathrm{GNIX}_{k,j} = \sum_j\sum_i \mathrm{h}_{i,k}\mathrm{VAX}_{i,j} = \sum_i \mathrm{h}_{i,k}\mathrm{GDP}_i = \sum_i \mathrm{GDP}_{i,k} = \mathrm{GNI}_k$ as follows from Table 5.1.

[114] Let e' denote the row summation vector consisting of ones, i.e., $e' = (1, \dots, 1)$. For the value-added coefficients it holds that $v' = e'(I - A)$. Therefore we have $e'VAX^{full} = e'F$, which means that the column sums of VAX^{full} equal the total amount of final demands in each country. Next, $\sum_k \mathrm{GNIX}_{k,j} = \sum_k\sum_i \mathrm{h}_{i,k}\mathrm{VAX}_{i,j} = \sum_i \mathrm{VAX}_{i,j}$, because $\sum_k \mathrm{h}_{i,k} = 1$. $\sum_i \mathrm{VAX}_{i,j}$ equals the sum of all final products consumed in country *j*.

$(\frac{\text{GNIX}_i}{\text{GNI}_i})/(\frac{\text{VAX}_i}{\text{GDP}_i})$. The countries are ranked according to the ratio in the last column from high to low. Gross export figures were obtained from the WIOD database. GDP and GNI figures in the denominators were obtained from the row-sums of the VAX and $GNIX$ matrices, respectively.

Gross exports are the conventional measure of trade, but they do not always correspond to the contribution of trade to GDP of the exporting country. This is due to the use of imported intermediates (embodying foreign value-added), which are also captured in gross exports data. In this case, gross exports contribute less to the exporter's GDP than the reported value of the exports. That can explain the higher dependence of countries on gross exports than on exports of value-added as a share of their GDP. Hence, while gross exports accounted for 72.5% of Dutch GDP in 2014, it is not the case that nearly three-fourths of Dutch GDP came from abroad. The impact exerted by foreign final users, which is measured by the exports of value-added, was only 43.3% as a share of Dutch GDP. However, final demand from abroad generated much more income (54.0% as share of GDP or 54.1% as share of Dutch GNI) than value added.

Countries at the top of Table 5.9 have the largest ratio $(\frac{\text{GNIX}_i}{\text{GNI}_i})/(\frac{\text{VAX}_i}{\text{GDP}_i})$. This means that these are the countries that depend the most on foreign final demand from the perspective of income (as share of GNI) relative to their perceived dependence on foreign final demand from the conventional perspective of value added (as share of GDP). The first country, Cyprus, exported more than half of its income, but less than a third of its value added, to final users abroad. Observe that the top half of Table 5.9 is dominated by rich, developed economies. This suggests that while many emerging countries may appear to benefit from global integration based on their exports of value-added figures, it is the wealthy countries that benefit the most in terms of income.

Luxembourg was the country that exported the highest share of its GNI, more than four-fifths. At the same time, Luxembourg exported two-thirds of its GDP. This was also the most from any country, which is why it is just sixth in Table 5.9. Four other countries (Ireland, Malta, and Netherlands, and Cyprus) likewise exported more than half of their GNI. The countries that exported the most income as a share of their GNI tended to be smaller European countries. These countries are tightly integrated in international capital markets. The countries least dependent on foreign final demand to generate their income were the largest economies (Brazil, USA, India). This is reasonable given that investors and producers in larger countries are more home-country oriented and most production is sold (consumed) in the domestic market. The only five countries that exported less income than value-added (in gross terms) were Luxembourg, Czech Republic, Russia, Indonesia, and Poland.

Table 5.9. Gross exports (% share of GDP), exports of value-added (% share of GDP), and exports of income (% share of GNI), 2014

	GE_i/GDP_i (1)	VAX_i/GDP_i (2)	$GNIX_i/GNI_i$ (3)	(3)-(2) (4)	(3)/(2) (5)
CYP	44.4	30.6	51.4	20.8	1.7
USA	11.1	8.9	13.0	4.1	1.5
MLT	141.9	47.2	63.9	16.6	1.4
JPN	18.4	13.5	17.7	4.1	1.3
GBR	28.2	21.4	27.2	5.8	1.3
LUX	203.3	65.4	82.4	17.0	1.3
NLD	72.5	43.3	54.1	10.8	1.2
FRA	29.9	20.0	24.6	4.6	1.2
CHE	51.8	37.1	45.0	7.9	1.2
IRL	115.4	55.9	67.7	11.7	1.2
FIN	42.8	26.0	31.1	5.1	1.2
NOR	41.9	32.7	38.5	5.9	1.2
SWE	46.4	31.3	36.8	5.5	1.2
ESP	30.9	20.0	23.2	3.2	1.2
DNK	56.8	33.6	38.9	5.4	1.2
GRC	27.0	17.5	19.9	2.5	1.1
BEL	80.4	40.2	45.8	5.6	1.1
AUS	21.2	17.6	20.0	2.4	1.1
CAN	33.6	24.7	28.1	3.4	1.1
AUT	54.1	32.8	36.8	4.0	1.1
PRT	38.0	23.6	26.4	2.8	1.1
DEU	48.3	32.3	35.9	3.5	1.1
ITA	30.6	21.2	23.4	2.2	1.1
LTA	53.0	34.8	38.0	3.3	1.1
ROW	35.5	23.8	26.0	2.2	1.1
HRV	48.3	32.6	35.5	2.9	1.1
HUN	99.8	43.3	46.4	3.1	1.1
EST	78.1	40.9	43.5	2.7	1.1
IND	18.5	13.5	14.3	0.8	1.1
SVN	72.0	41.9	44.4	2.5	1.1
MEX	30.0	19.3	20.4	1.1	1.1
BGR	64.2	36.5	38.4	1.9	1.1
SVK	90.1	42.3	44.4	2.1	1.1
BRA	13.0	10.0	10.5	0.5	1.1
CHN	23.6	18.7	19.6	0.9	1.0
KOR	54.2	32.4	33.6	1.3	1.0
POL	51.9	33.6	34.7	1.2	1.0
IDN	24.2	19.6	20.2	0.6	1.0
ROM	44.0	30.0	30.9	0.8	1.0
RUS	30.4	26.1	26.8	0.7	1.0
LTU	74.8	44.7	45.9	1.2	1.0
CZE	86.8	42.8	43.8	1.0	1.0
TUR	35.1	23.2	23.6	0.4	1.0
SUM-W	27.7	19.3	22.2	2.9	1.2

Notes: Rounded to the nearest tenth. Weighted averages are based on (1) $\sum_i GE_i / \sum_i GDP_i$; (2) $\sum_i VAX_i / \sum_i GDP_i$; and (3) $\sum_i GNIX_i / \sum_i GNI_i$. GE_i are *i*'s gross exports, VAX_i are *i*'s value-added exports, and $GNIX_i$ are *i*'s exports of income.

Observe in Table 5.9 that percentage point differences in column (4) were positive in every country, $\left(\frac{\text{GNIX}_i}{\text{GNI}_i}\right) - \left(\frac{\text{VAX}_i}{\text{GDP}_i}\right) > 0$, and that the related ratio in column (5) always exceeded 1 (including the unrounded ratios of the countries at the bottom displaying a rounded '1.0'). In other words, the share of GNI a country exported was always larger than the share of GDP exported by the same country. Overall, global exports of income exceeded global exports of value-added by 15.0%. This tells us that the world is more globalized and/or interconnected in terms of countries' dependence on foreign demand from the perspective of income exports than from the perspective of value-added exports.

This finding could be explained by the rapid pace of financial globalization. Consider that cross-border direct investment activities can contribute to the exports of income of the investing country via profit shifting whenever income is generated through foreign consumption. Cross-border direct investments increased globally by 18.2% between 2011 and 2014 (source: CDIS database), which are the years following the 2007/2008 financial crisis recovery period. On the other hand, global exports of value-added increased by only 4.8% in the same period (source: WIOD database). This is consistent with an analysis by Timmer et al. (2016) that international production fragmentation only increased marginally since the financial crisis and that the slowdown in global trade may be part of a longer trend. Hence new cross-border investment activities greatly exceeded the pace of increased trade in value added in recent years.[115] This pattern held to a lesser extent also for the longer period from 2001-2014 as cross-border direct investment increased by 239% (source: UNCTAD (2019) bilateral FDI database) and value-added exports increased by 186% (source: WIOD database, 2016 release). These developments suggest that final demand sometimes induced exports of income without inducing any corresponding exports of value-added (e.g., along the lines of the illustration in Table 5.8b where Dutch final demand induced more exports of income than exports of value-added).[116] This is possible when the production processes used by subsidiaries of multinational firms are more capital intensive, involve home-country or cross-border workers, use few foreign inputs, and primarily serve final consumers in the host-country market.

[115] This trend also holds for portfolio investments and remittances. Cross-border portfolio investments increased globally by 23.9% (CPIS database) and remittances increased by 13.7% (WBRM database) in 2011-2014.

[116] Note that the reverse is also possible: exports of value-added that do not translate into exports of income for the same or another country. Suppose a US multinational firm outsources all production to a subsidiary in Ireland (e.g., for tax avoidance purposes or to lower production costs) but markets their products solely to US consumers. This generates Irish exports of value-added that are consumed by final users in the US. Then there may be substantially fewer exports of income than exports of value-added if all profits are shifted to the US (especially if production is capital-intensive). However, given that $\text{GNIX}_{World} > \text{VAX}_{World}$, this type of scenario is less frequent (on balance).

Although all countries depended more on foreigners to generate their income (GNI) than to generate their domestic value-added (GDP), this occurred to varying degrees. The largest percentage point difference in the two indicators, based on column (4), were in Cyprus (+20.8 p.p.), Luxembourg (+17.0 p.p.), Malta (+16.6 p.p.), Ireland (+11.7 p.p.), and the Netherlands (+10.8 p.p.). Note that the big percentage point difference in the case of Luxembourg does not contradict the previous finding that it exported less income than value-added (in gross terms). This is because Luxembourg's GDP was much higher than its GNI, which are the denominators of the shares underlying the calculations in column (4). Meanwhile, the differences for 13 other countries were less than two percentage points.

5.5.4 Analysis: trade balance of income

In this section we use information obtained from the trade in income matrix, $GNIX$, to examine trade balances of income. The goal is to cast more light on the impact of foreign final demand on income by considering a country's (bilateral) income surplus or deficit. We compare trade balances that are conventionally based on gross exports, and more recently analyzed from the perspective of value added, with trade balances of income. Note that the trade in income data used to calculate a country's income balance has the same broad scope as before. That is, exports of income involve not just the income generated by foreign final demand that relate directly or indirectly to the physical cross-border flows of goods and services. The exports may also arise due to profit shifting in relation to domestic supply chains where no intermediary inputs or final products cross the border.

We obtain the trade balance of income as follows:

$$\text{Trade balance of income}_i = \sum\nolimits_{j \neq i} \text{GNIX}_{i,j} - \sum\nolimits_{j \neq i} \text{GNIX}_{j,i} \tag{5.21}$$

Where $\text{GNIX}_{i,j}$ denotes country i's exports of income to country j and $\text{GNIX}_{j,i}$ denotes country i's imports of income from country j. $\sum_{j \neq i} \text{GNIX}_{i,j}$ are country i's exports of income to all countries j ($j \neq i$) and $\sum_{j \neq i} \text{GNIX}_{j,i}$ are country i's imports of income from all countries j ($j \neq i$). The trade balances of value-added and gross exports are constructed similarly (i.e., by replacing GNIX with VAX or GE in equation (5.21).

Table 5.10 shows the trade balances for each country in the year 2014. Column (1) reports the (gross) trade balance for all countries as a share of GDP. Column (2) reports the trade balance in value-added terms as a share of GDP. Column (3) is the novel part, showing the trade balance of income as a share of GDP. For example, Ireland had a large (gross) trade

surplus. Gross exports minus gross imports amounted to 22.7% of Irish GDP. This surplus was 1.4 percentage points smaller from the perspective of value-added exports minus value-added imports (21.3%). Ireland had a much lower trade surplus in income (7.6% as share of GDP). On the one hand, this implies that Ireland exported more income than it consumed from abroad. That is, the income induced by non-Irish final demand that ended up in Ireland exceeded the income Irish consumers sent abroad to satisfy their own domestic final demand. However, the discrepancy between Ireland's value-added and income surpluses is relatively large. This could be explained by the prevalence of multinational activities in Ireland, which results in the repatriation of income and is likely related to the influential role of the US.[117]

Table 5.10. Trade balances (surplus/deficit) as percent share of GDP, 2014

	Gross trade balance (1)	Value-added balance (2)	Income balance (3)		Gross trade balance (1)	Value-added balance (2)	Income balance (3)
AUS	-0.1	-0.1	-2.7	IRL	22.7	21.3	7.6
AUT	4.2	3.9	4.1	ITA	3.6	3.2	3.3
BEL	5.8	4.2	5.0	JPN	-1.6	-1.6	2.1
BGR	-5.8	-6.9	-7.8	KOR	10.5	8.6	9.0
BRA	-2.3	-3.2	-5.2	LTU	5.2	3.7	2.3
CAN	1.1	1.2	-0.3	LUX	27.1	25.2	-9.0
CHE	12.8	12.4	12.2	LTA	-3.1	-2.9	-3.1
CHN	5.7	5.7	5.8	MEX	0.5	0.5	-1.5
CYP	-8.2	-7.8	-14.9	MLT	-1.7	-1.5	-5.6
CZE	10.4	8.0	1.3	NLD	15.6	14.6	14.5
DEU	11.2	10.8	12.9	NOR	13.9	12.8	16.2
DNK	8.9	8.2	12.4	POL	3.9	3.3	0.0
ESP	0.5	0.2	-0.2	PRT	-3.3	-4.7	-6.3
EST	0.7	-0.5	-3.3	ROM	0.2	-0.5	-1.8
FIN	1.3	0.6	1.8	RUS	7.1	6.1	2.9
FRA	-0.7	-1.1	0.4	SVK	7.8	5.1	3.9
GBR	-0.7	-0.9	-2.6	SVN	5.1	3.8	3.3
GRC	-8.7	-8.9	-8.2	SWE	6.2	5.9	8.3
HRV	0.7	-0.3	-1.8	TUR	2.8	1.9	1.1
HUN	9.4	6.4	2.0	USA	-2.8	-2.5	-0.2
IDN	0.9	1.1	-2.3	ROW	-10.6	-9.5	-12.7
IND	-0.1	-1.0	-2.2				

Notes: Rounded to the nearest tenth. (1) reports trade balances based on gross exports, $(\mathrm{GE}_i - \mathrm{GI}_i)/\mathrm{GDP}_i$, where GI_i are i's gross imports. (2) reports trade balance based on value added, $(\sum_{j \neq i} \mathrm{XAX}_{ij} - \sum_{j \neq i} \mathrm{VAX}_{ji})/\ \mathrm{GDP}_i$. (1) and (2) were obtained from the WIOD database. (3) reports trade balances of income, $(\sum_{j \neq i} \mathrm{GNIX}_{ij} - \sum_{j \neq i} \mathrm{GNIX}_{ji})/\ \mathrm{GDP}_i$.

In general, the more developed economies had a higher income surplus (or a lower income deficit) relative to their value-added surplus (or deficit). The opposite was true for many

[117] The role of the US in terms of Ireland's income exports was demonstrated by the GDP-GNI matrix, which showed that 59.8% of Ireland's exported income transfers ($=\sum_{j \neq IRL} \mathrm{GDP}_{IRL,j}/\mathrm{GDP}_{IRL}$) went to the US in 2014.

emerging and developing countries. The ROW aggregate for all countries not in the GNIX matrix, which arguably demonstrates this pattern the best, had not only the largest deficit in value-added terms (-9.5%) but, after Cyprus, also the largest deficit in terms of income (-12.7%) as share of GDP. This represents (for ROW) an income deficit that was US$ 354bn larger than its value-added deficit. These patterns make sense given that developed countries tend to invest more in developing countries than the other way around. Returns on investments, which account for much of the discrepancy between the GNIX and VAX indicators, result in higher net exports of income for those wealthier countries. Compared to the trade balances of value-added (which in most cases did not differ much from the corresponding gross trade balances for each country), the trade balances of income not just in Ireland but also Luxembourg, Cyprus, and the Czech Republic were much less positive and/or more negative.

As mentioned in the introduction, US President Trump often complains about the bilateral US trade deficit in goods with other countries and cites this as a justification for tariffs and other protectionist measures. However, the analysis thus far portrays a story that may counter such concerns about 'fairness' by showing how much the US truly lost (or benefitted) from an open trade and investment climate vis-à-vis counterpart countries. First, US investors are major players in foreign investment worldwide. This is related to the analysis of the GDP-GNI matrix in Section 5.5.2, which indicated that a large share of many countries' transfers of income ended up in the US, even from countries that are geographically distant from the US. The US had a positive primary income balance with a GNI that exceeded GDP. Second, the analysis in Section 5.5.3 indicated that US exports of income (US$ 2308bn) were nearly 50% higher than its exports of value-added (US$ 1545bn), and higher too than its gross exports (US$ 1927bn). Although most countries exported more income than value-added, none (except for Cyprus) exported so much more as a percent difference in the export volumes. Thus, the US benefitted more in terms of the income it earned from foreign consumption than in terms of the value added that was generated.

The data in Table 5.10 shows that the US trade deficit in income was much lower than its trade deficit in value-added. The US income deficit was only 0.2% as share of US GDP. This compares to a 2.5% deficit in value-added trade and a 2.8% deficit in gross exports trade as shares of US GDP. Thus, the US income generated after accounting for all activities that US workers, firms, and investors were involved in to satisfy foreign final demands, irrespective of whether those activities generated value added in the US, almost matched the income the US paid to foreigners to satisfy its own final demands. The US income deficit was US$34bn, which was US$ 394bn smaller than its deficit in value-added (= US$ 428bn). Any arguments for

protectionism to hinder the cross-border movements of labor, capital, goods and services are thus weaker if not misleading given the large amounts of income the US is earning. At the same time, it is worth noting a caveat to the results that applies not just to the US. The (investment) income generated from final demand is not equally distributed over all citizens but might end up in the hands of only a few. This ties into the discussion on rising income equality within countries, which is observed worldwide, and which has also become a key political issue.

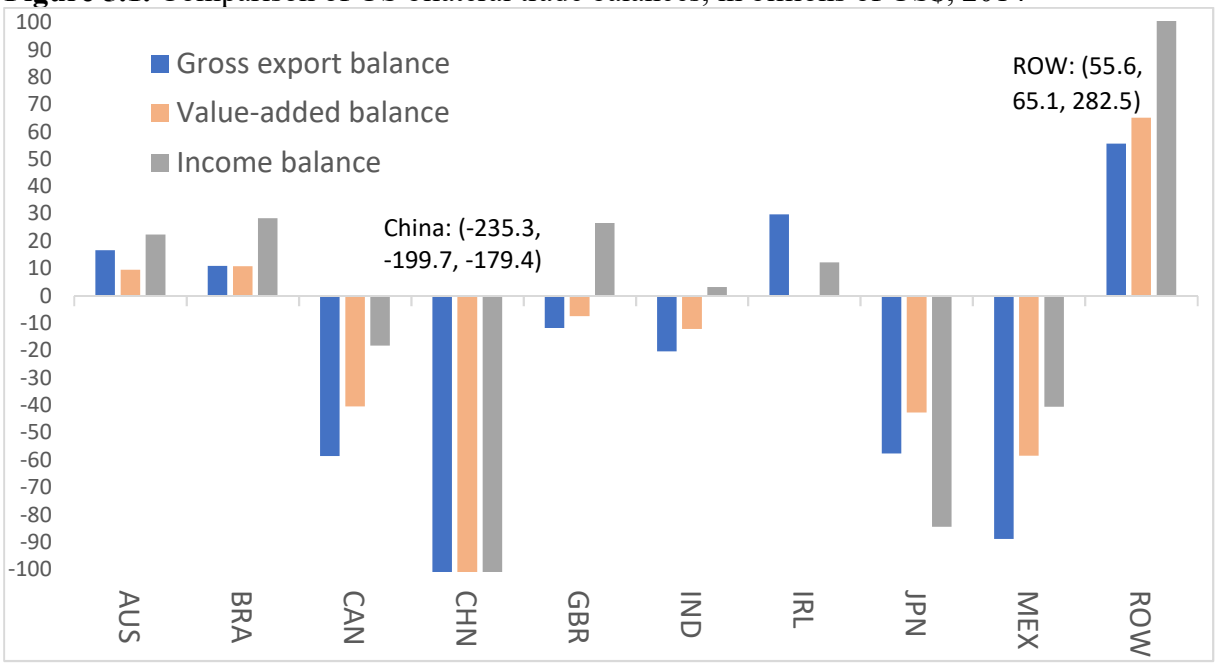
Figure 5.1 compares the bilateral US trade balances in gross terms, value-added terms, and income terms with the ten countries with whom the latter two balances differed the most. Bilateral US trade balances in income are defined as exports of income from the US to each 'trading' partner minus the trading partner's exports of income to the US. This is obtained by selecting only one element in the row-vector and one element in the column-vector of a given country in the GNIX matrix that pertain to the same counterpart country. A long-standing debate in the public and policy circles concerns who benefits the most from bilateral trade in the US-Mexican trade relationship, and about what can be done to make trade more 'balanced'. The US had a US$ 88bn bilateral gross trade deficit with Mexico. This deficit was already much smaller in terms of value-added (US$ 58bn), which can partly be attributed to the large amount of intermediate goods that are traded across the border. Mexico imports many intermediates from the US, which may contain US value added, and (re-) exports intermediates to the US, which may then be turned into final products by US workers (Amiti et al., 2017). However, this story is still incomplete. From the perspective of income, the US bilateral trade deficit with Mexico is reduced an additional 30% to just US$ 40bn. The reason is the dominance of US-led supply chains and US-owned production facilities (e.g., US subsidiaries) in Mexico, which not only assemble products that contains US value added, but also repatriate Mexican value added as income to the US. Hence, the bilateral US trade deficit in income is half of the bilateral US trade deficit in gross terms. Trade is thus more balanced than it may appear at first glance.

The data show that the bilateral US income surplus was larger (or the bilateral US income deficit was smaller) than the corresponding value-added surplus or deficit with 38 of 43 countries, including ROW. This included 18 economies with whom the US had a bilateral income surplus whilst having a bilateral value-added deficit.[118] Overall, from the conventional GDP perspective, the US had a bilateral trade deficit in value-added with 31 of 42 countries. In contrast, from the GNI perspective, the US had a bilateral trade deficit in income with only 14 countries. The fact that the US still had a small overall deficit from the perspective of income

[118] Those 18 countries were Bulgaria, Czech Republic, Spain, Estonia, Finland, Great Britain, Croatia, Hungary, India, Ireland, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, and Turkey.

is explained by bilateral deficits with large economic players such as China (US$ -179bn), Japan (US$ -84bn), Germany (US$ -46bn), Mexico (US$ -41bn), and Korea (US$ -26bn), even if they were for the most part less than the corresponding deficits in value-added. For example, the largest bilateral US deficit from both the value-added and income perspectives was with China, though the income deficit with China was US$ 20bn smaller. The one notable exception was the bilateral US deficit with Japan, which was about twice as large in terms of income than in terms of value-added. Hence, the income perspective casts bilateral US trade deficits in a new light and its position vis-à-vis counterpart countries appears much stronger in this way (except for with Japan).

Figure 5.1. Comparison of US bilateral trade balances, in billions of US$, 2014



For China the respective value-added (5.7%) and income (5.8%) surpluses as shares of its GDP were almost identical. This reflects that foreign final demand induced slightly higher levels of income than value added in China. Although the larger surplus in income may come as a surprise given the extent of foreign investment activities in China, there are some possible explanations. First, China was a net receiver of income transfers because its GNI was slightly higher than its GDP. This may be related to China being one of the world's biggest players in outward FDI (UNCTAD, 2018), which would result in a large influx of income from the returns on investment. Thus, profit shifting goes in both directions. Second, notoriously strict capital controls might incentivize foreign multinationals operating in China to reinvest rather than to repatriate more of their profits. Third, 98.9% of China's GDP ended up in China, which was the highest share of any country in the GDP-GNI matrix. This means China had the fewest

transfers of income relative to the size of its economy, which limits the extent to which the subsequent calculations result in exports of income figures that differ from exports of value-added.

Those results are interesting in light of a case study by Duan et al. (2012). The authors found that 85.6% of the domestic value-added generated by China's exports went to China's GNI in 2007. This was attributed to the role of foreign invested enterprises involved in China's exports. Although their method involves a decomposition of gross exports and thus does not directly compare to our final demand approach, the finding suggests that a considerable part of the value added induced in China by trade does not end up in China. However, we show that China's capital income 'losses' to other countries in a broader sense may be offset by income that flows into China from abroad due to final demand in other countries. This depicts a much more favorable perspective for China in terms of how it benefits from globalization.

In summary, the countries that benefitted the most from the income perspective in terms of having a lower income deficit or a higher income surplus relative to the value-added deficit or surplus were, as measured by the percentage point difference in the respective shares in their GDP (and multiplied by 100): Denmark (+4.3 p.p.), Japan (+3.8 p.p.), Norway (+3.4 p.p.), Sweden (+2.4 p.p.), the US (+2.3 p.p.), Germany (+2.1 p.p.), and France (+1.5 p.p.). All of them are highly industrialized countries. The US, followed by Japan, were by far the biggest 'winners' in gross terms, which makes sense given the size of their economies. The data indicates that the 14 'winners' that had higher net exports of income than net exports of value-added, including those 7, were particularly influential because they collectively 'gained' as much (net) income as the other 28 other countries plus ROW collectively 'lost'. This pattern of a large number of developing and emerging countries earning income for a small group of (investors in) highly developed countries can also be interpreted as being consistent with the high levels of income inequality we see today.

5.6 Conclusion

The emergence of multinational firms is closely linked to (and indeed, is arguably driving) the growing fragmentation of production processes (Cadestin et al., 2018). While the activities of multinational firms and their subsidiaries within global value chains have been instrumental to the increasing levels of cross-border trade and investment around the world, they also raise new questions with respect to the implications for income. What part of value added does a country lose through the repatriation of income to other countries? How much income does a country

gain from value-added production at home and abroad? And more generally, as it relates to trade and investment, what is the impact of foreign demand on a country's GNI?

The focus of recent efforts has been on developing trade in value added indicators. These indicators capture the contributions of foreign final demand to a country's GDP more accurately than gross export statistics. Databases currently used to analyze trade, such as the WIOD, are constructed on a GDP-based framework due to data constraints. However, the value-added indicators do not reveal the impact of foreign final demand in terms of income gains to a country's residents. For example, Mexico's automotive exports to final users in France generate Chinese value added and US income. This distinction between value added and income is relevant in the era of the multinational firm and global value chains, which enable the repatriation of earnings (UNCTAD, 2013). Domestic value-added induced abroad may end up in another country through profit-shifting (e.g., from China to the US), and the income induced by final users (e.g., in France) directly impacts countries' consumption possibilities (GNI) (e.g., of the US). The income measure is thus arguably the more relevant perspective in terms of how much a country relies on (and/or benefits from) foreign demand.

This paper has contributed to the current literature in two ways. First, we constructed a 43×43 GDP-GNI matrix with a breakdown of GDP for 42 countries plus ROW into bilateral transfers of income. This decomposition of value added showed how much of GDP goes to the producing country itself and how much goes to each of the other 42 countries in the matrix. Second, we built on these insights by using supplementary trade in value added data to create a GNIX matrix of trade in income. We then used the GNIX matrix to analyze the income implications of final demand in 42 countries plus ROW.

US President Trump views some aspects of globalization skeptically and points to trade balances to suggest that the US 'loses' much more money than it 'gains' in important bilateral relationships. However, a deeper analysis into the income repercussions of final demand, which incorporates not just trade linkages but also investment linkages, cross-border work, and the resulting capital flows, provides much needed context. We show that conventional indicators understate the extent to which the US benefitted from foreign consumption. The US exported US$ 763bn more income than value-added in the year 2014. The analysis showed that all 42 countries plus ROW depended relatively more on foreign final demand to generate their income (i.e., GNI) than value added (i.e., GDP). This indicates that the world is more interdependent in terms of income than value added, which likely reflects financial globalization. However, no country benefited from the new perspective as much as the US. The large US trade deficits in goods and (to a lesser extent) in value-added vanished almost completely in terms of income (-

0.2% as a share of US GDP). Bilateral US deficits with many countries, including China, were lower from the standpoint of income. At the same time, there is some debate about how the SNA and BoP treat incomes related to intangible capital, which our analysis (based on official data) does not address (Bruner et al., 2018). For example, the incomes of U.S. foreign affiliates related to the use of intellectual property are considered returns on US foreign direct investment abroad and reflected as such in the primary income account. However, if these incomes were reattributed to the US operating surplus and considered US services exports, US output (and GDP) would increase, and the US would receive fewer primary incomes from the rest of the world. This would likely imply a reduction in the US exports of income found in our analysis.

Most other industrialized countries, especially Japan, also earned (much) more income from foreigners than value added. They generally had lower income deficits or higher income surpluses as compared to value-added. Much of this extra net income came from emerging and developing countries, which sent more than half of their exported income transfers to the US and EU15. In contrast to the wealthy regions, poorer countries tended to have lower net exports of income relative to their net exports of value-added.

The paper addresses calls by the WTO and OECD to move beyond 'trade in value added', based on the local of production of income (GDP), towards a 'trade in income' approach that is focused on the location of owners of income (GNI) (Ahmad and Ribarsky, 2014). As our study showed, the income 'captured' by a domestic economy through final demand linkages is not the same as its value-added contribution. Apart from the implications for trade, the paper relates to the literature strand on Global Flow of Funds (N. Zhang, 2015; Errico et al., 2013; Shrestha et al., 2012). It is also in line with recent efforts by the IMF to encourage the collection and dissemination of more from-whom-to-whom cross-border data, with the aim of better tracking cross country investment positions by individual counterpart economy and shedding more light on globalization patterns.[119]

More generally, the data provided in the GDP-GNI and GNIX matrices cast new light on the bilateral interdependencies of countries in times of ever-growing financial interconnectedness. It is beneficial for policymakers to know who they are depending on for investments in their country (whether directly or indirectly via intermediary countries), which may help with the formulation of bilateral policy agreements. A better understanding of bilateral capital flows can help with financial stability monitoring (Cowan, 2013; Milesi-Ferretti et al.,

[119] See Errico et al. (2013) for more information on the efforts of the IMF to break down the aggregate data in the 'rest-of-the-world' account of the national accounts into data by bilateral counterpart country, of which the CDIS and CPIS databases are two of the key initiatives with respect to the international investment position components.

2010). Especially emerging countries depend on capital inflows to finance increased consumption and investment. A better understanding of the interdependencies between countries also can assist researchers to better predict the spillover effects of external shocks on the domestic economy - such as those resulting from an economic crisis abroad.

The quality of the GDP-GNI matrix (which directly impacts the GNIX matrix of trade in income that is derived from it) depends crucially on the data that is available to proxy bilateral transfers of income (e.g., inward FDI positions, portfolio assets, etc.). It is expected that more countries will soon release FDI data by ultimate investing country in line with the recommendations in the 4th edition of the OECD Benchmark Definition of Foreign Direct Investment (BMD4). Given the challenges involving tax havens and SPEs, data based on the ultimate investor would improve the estimates for bilateral transfers of direct investment income. Estimates for the bilateral transfers of portfolio investment income would similarly benefit if data were made available that is based on the ultimate (rather than intermediate) counterpart. Many portfolio investments go through intermediate international financial centers, and this intermediary is often different from the final investment destination. While the databases used in the development of the GDP-GNI matrix represent an important first step, new/different data sources can be incorporated in future work to refine the estimations further and provide an even more precise geographic decomposition. Data limitations also concern the BoP data. Official estimations of pass-through incomes and/or more details about the residual categories ‘other investment income’ and ‘other income’ would improve the respective weighting of these categories and the allocations of income to partner countries.

Data constraints also impacted the scope of the analysis. Although it is theoretically possible to extend the analysis to before the 2013-2014 timeframe, the data are worse and/or incomplete for some countries, especially for the years that entirely predate the CDIS and CPIS databases. GDP-GNI matrix replications for earlier years (and/or efforts to incorporate more countries) would require entirely different databases or methods to proxy the bilateral income outflows. A longer timeframe would nonetheless help to identify trends over a longer period. This might show how much more important pass-through income was in 2013-2014 relative to earlier years, how the role of the US and European countries as beneficiaries of income transfers has evolved, and whether any countries have experienced rapid growth in their exports of income and/or changes to their trade balances of income over time. An even more ambitious extension of the GDP-GNI matrix could involve going beyond the country-level by splitting up the transfers of income to and from different industries within countries.

The GDP-GNI matrix was set up from the debtor perspective. Future research could use similar techniques to construct a matrix from the creditor perspective and estimate more precisely the countries that are responsible for generating a country's GNI (i.e., the imported transfers of income by counterpart country). That would better address the question: how much of GNI can be attributed to transfers of income from different countries? However, due to bilateral data asymmetries in official data, constructing the matrix in this way is much more difficult and is unlikely to result in the same precision as the GDP decomposition in our study.

Finally, we encourage future research to focus more on the mechanisms that underpin income repatriation. Although it is clear that at least some firms and investors repatriate part of the income they earn abroad, what share of all MNEs and investors do repatriate income? Does a small group of influential investors explain most income transfers? And what are the different investor types involved in the repatriation of income? Addressing such questions could help to more accurately distinguish immediate counterpart investors from the ultimate counterparts, as well as to show how susceptible the GDP-GNI relations are to changes to investment behavior and to external economic shocks.

Appendix Chapter 5

Annex I. The primary income account: key definitions

This annex discusses the IMF's Balance of Payments BoP and International Investment Position (IIP) statistics, from which all data on primary incomes was obtained.[120] This dataset provides a year-by-year breakdown of the current account for each country into the trade of goods and services, the primary income account, and the secondary income account (each subdivided into multiple components). That is, the dataset shows for each component all credits received by residents of a country from another country (the "world") and all debits payable by residents of a country to another country, but without a disaggregation by partner country. Table 5.A1 shows these different components and the relationships between them within the context of the current account. Only the primary income account part of the current account, providing the balance of primary incomes, is relevant to the creation of the GDP-GNI matrix. In line with the definitions in the System of National Accounts, this is the only part of the BOP that is relevant with respect to accounting for the difference between GDP and GNI.

Primary income transactions involve the compensation of employees and investment income. Compensation of employees is defined as income for the contribution of labor inputs in the production process (= credits (1) and debits (1) in Table 5.A1). These are the earnings (salaries and benefits) of individuals for work performed in another economy and paid for by residents of the foreign economy. For example, this includes income earned by cross-border workers. Employee compensation is not subject to significant pass-through issues because the country where the individuals reside is typically the main beneficiary. Hence, these workers typically contribute to the labor part of GDP in the country in which they work and to the GNI of their home country. Labor income in equation (5.5) (e.g., $\text{PID}_i^{IMF,L,raw}$) are defined as incomes involving debits (1).

Investment income is the *return* on foreign investments and holdings of financial assets abroad (i.e., not the investments themselves). They include returns on direct investment (credits (2) and debits (2)), portfolio investment (credits (3) and debits (3)), other investment (credits (4) and debits (4)), and reserve assets (credits (5)). Direct investments themselves contribute to the GDP of the country receiving the investment (assuming no pass-through capital). The returns on direct investment, which is the important part reflected in the IMF data, increase the

[120] The data are available for free at: http://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52. For more detailed information about the different components, see the Balance of Payments and International Investment Position Manual published by the IMF (IMF, 2009).

GNI of the country where the ultimate beneficiary owner resides. Portfolio investment incomes reflect the return on debt securities, dividends on equity, and interest payments. Capital income in equation (5.6) (e.g., $\text{PID}_i^{IMF,K,raw}$) are defined as incomes involving debits (2+3+4).

For some countries there is also a 'other primary income' component (= debits (6), or $\text{PID}_i^{IMF,OPI,raw}$). Income in this component is proportionally allocated to $\text{PID}_i^{IMF,L,raw}$ and $\text{PID}_i^{IMF,K,raw}$ in the calculations as explained in the methodology section.

According to the accounting identities discussed in Section 5.3.1, $\text{GNI}_i = \text{GDP}_i + \text{PIC}_i - \text{PID}_i$ (the balance of primary incomes) and, in following, $\text{GDP}_i - \text{PID}_i = \text{GNI}_\text{i} - \text{PIC}_i$. The statistical discrepancies with respect to the left-hand-side and right-hand side of these two identities when using IMF data (i.e., PIC_i^{IMF} and PID_i^{IMF}) are very small. In fact, when using GDP and GNI data from the World Development Indicators in combination with the reported BOP data from the IMF, the statistical discrepancies in the second identity were less than one percent for 35 of 42 countries in the GDP-GNI matrix in 2014 (and less than four percent for the remainder).[121]

[121] Though in theory the discrepancy should be zero, the discrepancies could be due to the WDI's GDP and/or GNI data not being perfectly harmonized with GDP/GNI data the IMF uses to match to the BoP (possibly due to different methods of converting GDP into US dollars). The IMF does not publish GNI data.

Table 5.A1. Current account – overview and proxies for bilateral relationships

<table>
<tr><td rowspan="7">Current account</td><td colspan="4">Goods and services</td></tr>
<tr><td rowspan="6">Primary income account</td><td colspan="2">Compensation of employees

(proxy: World Bank remittances database. See note*)</td><td>Credits (1)
Debits (1)</td></tr>
<tr><td rowspan="4">Investment income

(proxy: IMF CDIS and CPIS databases; FDI statistics by ultimate investor; OECD statistics. See note**)</td><td>Direct investments</td><td>Credits (2)
Debits (2)</td></tr>
<tr><td>Portfolio investments</td><td>Credits (3)
Debits (3)</td></tr>
<tr><td>Other investments</td><td>Credits (4)
Debits (4)</td></tr>
<tr><td>Reserve assets</td><td>Credits (5)</td></tr>
<tr><td colspan="2">Other primary income

(proportionately allocated to the other two components.)</td><td>Credits (6)
Debits (6)</td></tr>
<tr><td colspan="4">Secondary income account</td></tr>
<tr><td>TOTAL (Primary income account)</td><td colspan="4">PIC_i^{IMF} = Credits (1+2+3+4+5+6)
PID_i^{IMF} = Debits (1+2+3+4+6)

Net = $\text{PIC}_i^{IMF} - \text{PID}_i^{IMF}$
$\text{GNI}_i = \text{PIC}_i^{IMF} - \text{PID}_i^{IMF} + \text{GDP}_i$</td></tr>
</table>

*The proxy in the case of compensation of employees are the bilateral shares of all remittances sent by a country, which we use to estimate the allocation of primary labor income debits over the destination countries. See equation (5.15).

**The proxy in the case of investment income are the bilateral shares of different countries in total foreign investment in a country, not the investments themselves, which we use to estimate the allocation of primary investment income debits (i.e., the returns on these investments) over the destination countries. See equations (5.16) and (5.17).

***Note that the secondary income accounts are not relevant for this analysis. They would only be incorporated if constructing a GDNI (gross disposable national income) based matrix. Reserve assets are provided on a gross basis and include all fees and interest payments. The IMF reports reserve assets only as credits or, if not available for publication, includes them under other investments (Credits (4)).

Annex II. The primary income account: IMF data

Table 5.A2 summarizes the IMF's BoP data with respect to shares of primary incomes corresponding to labor income (i.e., compensation of employees), capital income (i.e., direct investment, portfolio investment, and other investment), and other primary income for all 42 countries in 2014.[122] Columns (1) - (5) show the shares before correcting for pass-through income and are based on the raw IMF data. Columns (7) – (9) show the shares after correcting for pass-through income and reflect the scaled-up shares of columns (1) – (3) for compensation of employees, direct investment income, and portfolio investment income. This means that the last columns also incorporate the residual components 'other investment income' (from column 4) and 'other primary income' (from column 5), as described in Section 5.3 (methodology). All numbers are in percent.

The weighted average of each category in Table 5.A2 (W-AVG) is obtained by summing up the income debits corresponding to this category for all 42 countries and dividing by the total income debits of the 42 countries, e.g., for column (1): $\mathrm{W-AVG} = 100(\sum_i \mathrm{PID}_i^{\mathrm{L}} / \sum_i \mathrm{PID}_i)$. The simple average of each category (S-AVG) is obtained by summing up the percent shares of all 42 countries in the corresponding column and dividing by 42.

This depiction of primary income shares indicates which components are particularly important and deserve the most attention when estimating the bilateral part. It also shows whether the lack of a proxy for the bilateral part of the residual categories in columns (4) and (5) may pose an issue. Observe that income debits attributed to the compensation of employees accounted for 4.1% of all income debits for the average country (column 1). The largest category was direct investment income debits, accounting for 45.3% of all income debits (column 2). Portfolio investment income debits accounted for 40.7% (column 3); other investment income debits for 9.0% (column 4); and other primary income debits for 0.9% (column 5) of all income debits in the average country. The residual categories in columns (4) and (5) constituted only small shares of all income debits. The lack of suitable proxies for these categories is thus seen as less of a concern.

[122] The actual debits corresponding to the shares in Table 5.A2 can be determined as follows: the column of interest with shares in Table 5.A2 is multiplied by the column of total debits in Table 5.3 (Section 5.5.1). Columns (1)-(5) in Table 5.A2 would be multiplied by column (1) in Table 5.3. Columns (7)-(9) would be multiplied by column (2) in Table 5.3.

Table 5.A2. Primary income account– component debits as percent share of all income debits (2014)

	$\frac{\text{PID}_i^L}{\text{PID}_i}$ (1)*	$\frac{\text{PID}_i^{DI}}{\text{PID}_i}$ (2)*	$\frac{\text{PID}_i^{POI}}{\text{PID}_i}$ (3)*	$\frac{\text{PID}_i^{OI}}{\text{PID}_i}$ (4)*	$\frac{\text{PID}_i^{OPI}}{\text{PID}_i}$ (5)*	Sum (1-5) (6)	$\frac{\text{PID}_i^{IMF,L}}{\text{PID}_i^{IMF}-\text{PT}_i}$ (7)	$\frac{\text{PID}_i^{DI,adapt}}{\text{PID}_i^{IMF}-\text{PT}_i}$ (8)	$\frac{\text{PID}_i^{POI,adapt}}{\text{PID}_i^{IMF}-\text{PT}_i}$ (9)	Sum (7-9) (10)
AUS	7.2	38.0	48.1	6.6	0.1	100	7.7	40.8	51.6	100
AUT	13.2	21.9	48.5	14.6	1.8	100	15.1	26.4	58.5	100
BEL	5.9	59.9	26.7	5.0	2.6	100	7.4	64.0	28.6	100
BGR	6.9	63.5	3.3	25.4	1.0	100	7.1	88.4	4.5	100
BRA	0.3	48.8	37.7	13.2	0.0	100	0.3	56.3	43.4	100
CAN	3.3	47.7	42.0	7.0	0.0	100	3.7	51.2	45.1	100
CHE	17.2	53.3	21.8	7.7	0.0	100	26.0	52.5	21.5	100
CHN	0.2	81.2	4.3	14.3	0.0	100	0.2	94.7	5.1	100
CYP	1.4	50.7	7.0	40.5	0.5	100	2.1	86.1	11.8	100
CZE	4.1	81.7	8.5	4.3	1.3	100	4.4	86.6	9.1	100
DEU	8.7	30.2	44.9	12.9	3.3	100	10.2	36.1	53.7	100
DNK	15.4	32.5	44.5	4.9	2.6	100	18.5	34.4	47.1	100
ESP	0.5	37.3	47.3	12.2	2.7	100	0.6	43.8	55.6	100
EST	3.2	86.4	4.8	3.9	1.8	100	3.6	91.4	5.0	100
FIN	3.8	33.3	54.0	6.0	2.9	100	4.5	36.5	59.0	100
FRA	1.0	19.9	67.3	10.0	1.8	100	1.2	22.6	76.3	100
GBR	0.8	29.2	51.4	16.9	1.6	100	1.0	35.8	63.2	100
GRC	6.9	5.4	30.3	52.3	5.1	100	8.0	14.0	78.0	100
HRV	1.5	38.2	32.8	27.5	0.0	100	1.5	53.0	45.5	100
HUN	3.6	73.3	16.3	5.9	0.9	100	4.1	78.4	17.5	100
IDN	4.4	61.1	25.5	9.0	0.0	100	4.4	67.4	28.1	100
IND	7.7	37.3	19.3	34.6	1.1	100	7.8	60.8	31.4	100
IRL	0.8	45.9	42.8	10.2	0.3	100	1.2	51.1	47.6	100
ITA	3.0	20.2	66.9	6.5	3.3	100	3.3	22.4	74.2	100
JPN	0.3	36.0	53.3	8.9	1.5	100	0.3	40.1	59.5	100
KOR	5.4	52.6	37.3	4.7	0.0	100	5.6	55.3	39.2	100
LTU	9.4	34.3	39.3	10.3	6.7	100	10.3	41.8	47.9	100
LUX	4.8	46.0	46.2	3.0	0.0	100	32.4	33.7	33.9	100
LVA	4.0	63.8	14.5	14.9	2.8	100	4.2	78.1	17.7	100
MEX	0.0	51.3	42.5	6.2	0.0	100	0.0	54.7	45.3	100
MLT	0.6	85.5	0.3	12.8	0.8	100	1.9	97.9	0.3	100
NLD	2.2	71.7	21.1	4.1	0.9	100	4.1	74.1	21.8	100
NOR	18.9	32.2	13.1	35.7	0.0	100	21.7	55.6	22.7	100
POL	5.8	65.4	19.5	7.6	1.7	100	6.1	72.3	21.6	100
PRT	2.3	28.7	41.2	25.8	2.0	100	2.5	40.0	57.5	100
ROU	1.4	42.0	21.2	33.0	2.4	100	1.4	65.5	33.1	100
RUS	12.3	59.6	11.8	16.2	0.1	100	12.9	72.7	14.4	100
SVK	3.2	69.1	20.0	4.8	2.8	100	3.5	74.8	21.7	100
SVN	7.5	-1.3	58.5	12.7	22.6	100	10.1	-2.1	92.0	100
SWE	2.2	49.1	44.0	3.0	1.7	100	2.6	51.4	46.0	100
TUR	6.2	17.9	32.9	42.9	0.0	100	6.3	33.0	60.7	100
USA	2.8	32.6	62.3	2.3	0.0	100	3.1	33.3	63.5	100
W-AVG	4.1	45.3	40.7	9.0	0.9	100	5.3	49.2	45.5	100
S-AVG	5.0	46.0	32.7	14.3	1.9	100	6.5	54.0	39.5	100

*The numerators in columns (1)-(5) reflect the raw IMF data (e.g., $\text{PID}_i^L = \text{PID}_i^{IMF,L,raw}$ and $\text{PID}_i^{DI} = \text{PID}_i^{IMF,DI}$). Columns show shares of income debits from row-countries reflecting: employee compensation (1); direct investments (2); portfolio investments (3); other investments (4); and other primary income (5). Scaled shares (7), (8), and (9) incorporate residual categories (4) and (5) and have been adjusted for pass-through income.

On the creditor's side - not shown in Table 5.A2 – the income shares for the average country were 4.0% for employee compensation; 50.9% for direct investment income; 32.7% for portfolio investment income; and 12.3% of the remainder.[123] Note that the shares on the debtor and creditor sides do not coincide precisely because only income credits and debits for countries in the matrix (not all countries in the world) are reflected in the data in Table 5.A2. Nevertheless, direct and portfolio investment incomes were by far the largest categories from both perspectives and accounted for more than 85% of the discrepancy between GDP and GNI.

Annex III. Allocating labor compensation incomes to partner countries

This annex discusses the World Bank Bilateral Remittance Matrix (WBRM).[124] We allocate transfers of income relating to employee compensation to the GNIs of counterpart countries based on bilateral shares of remittance payments in the WBRM (see equation (5.15) for details).

The WBRM was created to obtain a global picture of the size of remittances flowing from one country to another. Matrices in the WBRM have been constructed annually for the years 2010-2017. These provide the total amount of remittances of each country ($= \sum_{j \neq i} \mathrm{CE}_{ij}$ in equation (5.15)) and the bilateral remittances between country-pairs ($= \mathrm{CE}_{ij}$ in equation (5.15)). The World Bank uses two datasets to derive the data in the matrix (see Ratha and Shaw 2007, upon which the WB methodology is inspired). The first is UN Population Division estimates of migrant stock by country of origin and destination. The second dataset is remittance inflows data. A country's total remittance inflows in a given year were allocated to its emigrant stocks, adjusting for the migrant sending and receiving countries' per capita income. The remittance inflows data that can properly be interpreted as transfers of funds from migrants were constructed as the sum of three components in the IMF's Balance of Payments Statistics: (i) compensation of employees, (ii) workers' remittances, and (iii) migrants' transfers.

The definition of remittances used to construct the WBRM (= i + ii + iii) is thus broader than compensation of employees (= i only). However, compensation of employees (= i) is the only component of the three relevant in terms of analyzing the difference between GDP and GNI. Hence ideally this should be the only part of the data embedded in the WBRM to be considered when allocating labor incomes to partner countries (i.e., $\mathrm{GDP}_{i,j}^{L}$). Workers' remittances (ii), which refer to current transfers between residents of different countries by

[123] A full breakdown of the creditor side is available upon request.
[124] The data is available for free at:
http://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data
For more information, see the *Frequently Asked Questions* document accompanying the database.

migrants who are employed in new economies and considered residents there (nonresidents of the home economy), are technically part of the current transfers in the secondary income account. This goes towards computing gross disposable national income but not gross national income. And migrants' transfers (iii), which relate to capital account changes caused by a change in residence of a household, belong to capital transfers in the capital account.

A disaggregation of the matrix output data into (i), (ii) and (iii) is unfortunately not currently available, but the WBRM should still serve as an adequate representation for the 'compensation of employees' component that is relevant. This assumes the relative importance of these three flows (i), (ii), and (iii) are the same across different country-pairs. For instance, if country *i* sends 20% of its total remittances to country *j* (based on the WBRM), we assume that this approximates the share of *i*'s total labor compensation payments going to *j*. This may not necessarily be the case if workers' remittances and migrants' transfers over-proportionally represent the remittances flows from *i* to *j* for this country-pair and the share of all employee compensation payments from *i* to *j* is less than 20%.

Data from the WBRM on remittances payments is available for all 42 countries contained in the matrix in 2013 and 2014.

Annex IV. Allocating direct investment incomes to partner countries

We allocate transfers of direct investment income to the investing countries based on bilateral shares that are obtained from data on direct investment positions (see equation (5.16) for details). This annex first discusses data issues related to conventional measures of direct investment positions and why they are problematic for the construction of the matrix relating GDP to GNI. Then we explain how our selection of novel and newly released data on direct investment positions based on the ultimate beneficiary investor mitigates or even resolves this issue for most countries. Lastly, we introduce the Coordinated Direct Investment Survey (CDIS) database, which we use as an alternative when the preferred type of data is unavailable.

Data issues

Bilateral breakdowns of inward direct investment (or FDI) are available for nearly all countries from OECD, UNCTAD, Eurostat, and IMF databases.[125] This data is conventionally based on the immediate (or direct) counterpart country, which sheds light on the immediate source of direct investment funding.[126] However, due to the complex behaviors and financing structures of MNEs in a globalized world, it is no longer the case that the immediate investors are also the ultimate investors. This development has been driven by "the need of MNEs to manage global production networks", and their "desire to reduce tax and regulatory burdens" (OECD, 2015). In many cases the immediate counterpart and ultimate investing country (where the beneficiaries of the returns on direct investment reside) is the same. However, the distinction can matter greatly in certain investment relations, especially when the immediate counterpart is a tax haven.

There are two well-known issues related to conventional bilateral FDI statistics (reported on an immediate or direct counterpart basis) (see Damgaard and Elkjaer, 2017 for a thorough discussion of these issues): 1) the role of special purpose entities (SPEs) and of tax havens more generally, and 2) "round-tripping", to be described below. Both SPEs and round-tripping are related to the pass-through income issues discussed in Section 5.3 (methodology). They may indeed go a long way towards explaining the very existence of pass-through capital.

Special purpose entities are firms (or "entities") that typically have few or no employees and little or no physical presence in the country in which they operate. Colloquially called "mailbox" companies, their existence is typically attributed to jurisdictions that provide low or concessional tax rates to foreign investors. MNEs may channel their investments through SPEs before reaching their intended destination. Luxembourg and the Netherlands are two examples of countries that host large numbers of SPEs, but there are many more. Suppose that FDI is reported by the intermediary country, e.g., Luxembourg, as inward investment from the US. Because the investment only "passes through" to, say Germany, then Luxembourg may appear to receive substantial foreign investments when in fact it only plays the role of a conduit to

[125] For example, bilateral FDI statistics from UNCTAD are available for free at:
https://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx

[126] The IMF defines and operationalizes direct investment as follows: "Direct investment arises when a unit resident in one economy, which is called direct investor, makes an investment that gives control or a significant degree of influence on the management of an enterprise that is resident in another economy which is called direct investment enterprise. There is a significant degree of influence when a direct investor owns equity that entitles it to 10 percent or more of the voting power in the direct investment enterprise". This definition is from the *Frequently Asked Questions* document accompanying the IMF's Coordinated Direct Investment Survey database, available at:
http://data.imf.org/?sk=40313609-F037-48C1-84B1-E1F1CE54D6D5&sId=1390288795525

pass-through capital. This pass-through capital could distort the perceived role of FDI on Luxembourg's economy and more generally reduce the analytical interpretability of bilateral FDI data.

The potential for misinterpretation of FDI statistics extends to the country of the intended recipient (Germany), which registers the direct investment as originating from the direct counterpart (Luxembourg) and not the ultimate investor (US). Thereby the perceived role of the intermediary on the German economy is overstated while the perceived role of the ultimate investor is understated. Although the stock of genuine FDI is not inflated in the intended destination (unlike the case of an intermediary country with SPEs), some FDI stocks may be misattributed. Despite having long been identified as a problem by disseminators of FDI statistics, this is an issue that persists in nearly all databases providing bilateral FDI positions. These issues make it difficult for policymakers to discern who is genuinely investing in their country and, crucially for our analysis, where the returns on investment (the primary income) may end up.

The second issue is round-tripping. Round-tripping refers to foreign investments that represent funds that have been channeled abroad by resident investors, such as through SPEs, and returned to the domestic economy in the form of FDI (Aykut et al., 2017). In this circular form of investing, the intended recipient of FDI may be the same country from where the investment originates. Many factors can cause round-tripping, but the most common are tax, regulatory or other incentives provided by a foreign country that encourage an investor to re-locate their company abroad. If the investor still resides and invests from the home country, then this investment may show up as FDI in conventional statistics when in fact it should be regarded as a round-tripping investment (but is not identified as such). Investors may also pursue round-tripping as a reaction to capital market restrictions and inefficiencies at home to gain flexibility, or to conceal their identity.

Round-tripping means that the overall stock of genuine FDI would be overstated for all receiving countries. Round-trip investments should not be considered genuine FDI because receiving countries do not reap any of the additional benefits of FDI (e.g., in terms of finance, knowledge, technology transfers, and access to foreign distribution networks). Round-tripping also contributes to the general multiple counting of cross-border capital flows.

The problem of round-tripping for the creation of the GDP-GNI matrix is essentially the same as the issue of direct investment stocks in countries with SPEs: these investments do not necessarily have an impact on the real economy (GDP and GNI) of the intermediary. Fortunately, pass-through incomes are not a large issue in most countries of the matrix (see

Section 5.5.1, Table 5.3). But the allocations of (pass-through adjusted) transfers of income to partner countries should only consider where the returns of investments ultimately end up. That is, transfers of income should not be attributed as going to an intermediary country if they do not become part of this country's national income (GNI). This distinction is highly relevant for the calculations underlying equation (5.16).

FDI data by ultimate investing country and excluding special purpose entities

Considering the issues involving SPEs and round-tripping, it is best to use bilateral FDI data that excludes SPEs or, even better, identifies the ultimate investing country. Data on inward FDI that distinguishes between SPEs and non-SPEs and/or that is based on the ultimate investing country was almost non-existent before the year 2013. The OECD developed the fourth edition of its Benchmark Definition of Foreign Direct Investment (BMD4) in part to provide more meaningful FDI measures and illuminate more light on the prevalence of pass-through capital and round-tripping. The BMD4 encourages the collection of this type of data and recommends that countries compile statistics on inward FDI by the ultimate investing country. The OECD noted that only a handful of countries provided these statistics by March 2015: Austria, Estonia, Finland, France, Poland, and the United States (OECD, 2015). Since then, more countries released similar statistics and additional ultimate investing country-based data was obtained for Canada, Czech Republic, Germany, Hungary, Iceland, Italy, Lithuania, Switzerland, and Turkey.

Given that all OECD countries are being encouraged to produce these new statistics, we searched for data from central banks and national statistical offices, including annual investment reports, of all 42 countries in the GDP-GNI matrix to ascertain whether more data by ultimate investing country had been compiled but not (yet) been provided to the OECD. In this way, additional estimations were obtained for Australia, Brazil, Spain, Great Britain, India, Ireland, Japan, and Slovenia. In all, FDI data by ultimate investing country was available for more than half (22/42) of all countries in the matrix. This is the data that was used to determine bilateral stocks of direct investment, DI_{ji}, and total investment positions, $\sum_{j \neq i} \mathrm{DI}_{ji}$, for those 22 countries in equation (5.16).

All countries with FDI data by ultimate investing country are listed in Table 5.A3 along with the source of the data and the years it is available. Table 5.A4 reports the extent of round-tripping in the same 22 countries as a share of total inward investment in 2014 (if available). It should be noticed from Table 5.A4 that round-tripping shares were relatively small in most countries. Round-tripping was less than 10% in all but 2 of the 18 countries that reported data

and less than 5% in 10 of these 18 countries. Yet this still suggests that, in many of the countries reporting round-tripping, one of the largest 'foreign' investors in a country is - indirectly - the same country receiving those investments.

The total investment positions are in principle unaffected when using data by ultimate investing country because the new perspective only (potentially) redistributes inward direct investments based on the direct counterpart to the ultimate investing country. However, FDI that could be attributed to round-tripping based on the ultimate investing country perspective was first taken out of the raw data (in all 18 countries included in Table 5.A4). More specifically, in countries with information on round-tripping, suppose $\sum_j \mathrm{DI}_{ji}$ denotes the reported or 'gross' stock of inward direct investments and DI_{ii} denotes the round-tripping components of these investments (which are the direct investments in *i* that are attributed to *i*). Then $\sum_{j \neq i} \mathrm{DI}_{ji} = \sum_j \mathrm{DI}_{ji} - \mathrm{DI}_{ii}$ (Hence this small modification to the raw data results in the true value of $\sum_{j \neq i} \mathrm{DI}_{ji}$ in these countries).

This correction is necessary because FDI related to round-tripping does not contribute much (if at all) to another country's GNI and should not be used to allocate transfers of income to partner countries (which necessarily increase the GNI of another country). Another consequence of removing round-tripping is that the relative importance of all other countries investing in country *i* increases slightly (that is, share $\mathrm{DI}_{ji} / \sum_{j \neq i} \mathrm{DI}_{ji}$ in the case of country *j* is larger than $\mathrm{DI}_{ji} / \sum_j \mathrm{DI}_{ji}$).

In addition, several countries reported FDI statistics that excluded SPEs. All countries in the matrix for which inward FDI positions excluding SPEs differed from inward FDI positions including SPEs are listed in Table 5.A5 (all data from the OECD). The table provides the inward direct investments in these countries that did not involve SPEs as a share of total FDI (hence, the residual share is likely to reflect pass-through investment). There is also information provided on whether a bilateral disaggregation of FDI data excluding SPEs was available and, if so, for which years. One can see that the influence of SPEs varied widely but was generally small in most countries. SPEs were most influential in the so-called tax havens. Notably, Luxembourg and the Netherlands, which we found to be the countries that had the most pass-through income as a share of the total income debits reported by the IMF (see Section 5.5.1, Table 5.3), recorded 93% (Luxembourg) and 82% (Netherlands) of FDI stocks in their respective countries as going to SPEs. It should be noticed that the countries providing FDI data excluding SPEs were generally the ones most affected by SPEs. OECD statistics indicate that the inward FDI positions of 15 more countries in the matrix did not differ depending on the

inclusion of SPEs. Hence it can be assumed that SPEs play a minor to no role in most of the countries in the GDP-GNI matrix that are not included in Table 5.A5.[127]

Six countries in Table 5.A5 (Estonia, Great Britain, Hungary, Poland, Spain, and Switzerland) also provided the preferred data by ultimate investing country. For this reason, the data excluding SPEs was not needed to proxy the shares of their transfers of direct investment income going to partner countries. Two other countries in the table (Luxembourg and Sweden) did not provide a bilateral breakdown of inward FDI excluding SPEs. Hence this data could not be used. However, six of the countries in the table did provide a bilateral breakdown of inward FDI excluding SPEs but did not provide FDI data by ultimate investing country (Belgium, Denmark, South Korea, Netherlands, Norway, and Portugal). The bilateral inward FDI data excluding SPEs was thus used for allocating the transfers of direct investment income from these six countries to partner countries.

In summary, three types of data are used to proxy the shares of transfers of direct investment income going from one country to another: 1) the first preference is bilateral inward FDI data by the ultimate investing country (i.e., for the 22 countries in Table 5.A3); 2) if bilateral FDI data excluding SPEs existed for a country, but there was no additional data identifying the ultimate investor, then this is used as a second-best solution (for 6 additional countries); 3) in the absence of both FDI data identifying the ultimate beneficiary and FDI data differentiating between SPEs and non-SPEs, the IMF's Coordinated Direct Investment Survey (CDIS) was drawn upon (for the remaining 14 countries). The next section discusses the CDIS database. A complete overview of the sources used for all 42 countries is shown in Table 5.A6.

[127] According to data reported by the OECD, countries where SPEs play little to no role include Austria, Czech Republic, Germany, Finland, France, Greece, Italy, Japan, Lithuania, Latvia, Mexico, Slovakia, Slovenia, Turkey, and the US (OECD International Direct Investment Statistics database).

Table 5.A3. Countries that publish bilateral FDI statistics by ultimate investing country

Country	Source	Years available
Australia	Australian Bureau of Statistics, Economic Activity of Foreign Owned Businesses in Australia, 2014-15.	2014 only
Austria	OECD International Direct Investment Statistics database	2012-2016
Brazil	Central Bank of Brazil, Census of Foreign Capitals	2010-2016
Canada	OECD International Direct Investment Statistics database	2014-2016
Czech Republic	OECD International Direct Investment Statistics database	2013-2016
Estonia	OECD International Direct Investment Statistics database	2013-2016
Finland	OECD International Direct Investment Statistics database	2013-2016
France	OECD International Direct Investment Statistics database	2011-2016
Germany	OECD International Direct Investment Statistics database	2013-2016
Great Britain	Office for National Statistics, Dataset on inward foreign direct investment involving UK companies: inward	2014-2016
Hungary	OECD International Direct Investment Statistics database	2014-2016
India	Independent study by Rao and Dhar (2016)	2014 only
Ireland	Central Statistics Office of Ireland (CSO), Foreign Direct Investment in Ireland 2015	2015 only
Italy	OECD International Direct Investment Statistics database	2013-2016
Japan	Bank of Japan, Ministry of Finance	2015 only
Lithuania	OECD International Direct Investment Statistics database	2015-2016
Poland	OECD International Direct Investment Statistics database	2013-2016
Slovenia	Central Bank of Slovenia (2017)	2014-2016
Spain	Spain's Ministry of Industry, Trade, and Tourism, DataInvex-MINCOTUR database	2010-2016
Switzerland	OECD International Direct Investment Statistics database	2014-2016
Turkey	OECD International Direct Investment Statistics database	2016 only
USA	OECD International Direct Investment Statistics database	2011-2016

Table 5.A4. Round-tripping as percent share of total FDI positions in selected countries, 2014

Country	Share	Country	Share
Ireland	13.15*	Poland	4.17
Lithuania	10.36*	Great Britain	3.62
Finland	9.29	Brazil	3.43
Germany	8.00	USA	2.98
Estonia	6.84	Austria	1.71
Italy	6.67	Slovenia	1.62*
Czech Republic	6.15	Hungary	0.60
France	5.03	Canada	0.82
Spain	4.46	Turkey	0.06*

Notes: Data are based on the sources in Table 5.A3. *The data for Ireland, Lithuania, and Slovenia is from 2015 and data for Turkey is from 2016. **The ultimate investing country data provided by Switzerland is very aggregated and does not provide estimates of round-tripping. Data sources used for Australia, India, and Japan also do not report round-tripping.

Table 5.A5. Ratio of FDI positions excluding SPEs to total FDI positions, 2014

Country	Ratio	Bilateral FDI data excluding SPEs?
Belgium	0.89	Yes, 2013-2016
Denmark	0.77	Yes, 2013-2016
Estonia	0.97	Yes, 2015-2016
Great Britain	0.72	Yes, 2013-2016
Hungary	0.45	Yes, 2011-2016
Luxembourg	0.07	No
Netherlands	0.18	Yes, 2013-2016
Norway	0.99	Yes, 2013-2016
Poland	0.99	Yes, 2013-2016
Portugal	0.86	Yes, 2011-2016
South Korea	0.99	Yes, 2013-2016
Spain	0.98	Yes, 2013-2016
Sweden	0.92	No
Switzerland	0.87	No

Notes: A ratio of 0 means that all reported inward FDI is SPE-related; a ratio of 1 means that none of the reported inward FDI is SPE-related. The source for all countries is the OECD International Direct Investment Statistics database.

FDI data by direct counterpart country (CDIS)

The Coordinated Direct Investment Survey (CDIS) provides inward and outward investment positions by bilateral counterpart country.[128] The data is constructed on the basis of the immediate investor (i.e., direct investment into the reporting economy) and immediate investment (i.e., direct investment abroad by the reporting economy).[129] The IMF considers the database an important tool in capturing world totals and the geographic distribution for direct investment positions in a coordinated matter. This builds on the successes of initiatives such as the UNCTAD, OECD and Eurostat bilateral FDI databases. The IMF conducts the CDIS annually (starting in 2009) across a wide range of countries, uses consistent definitions, and encourages best practices in compiling and disseminating quality, harmonized data on direct investment positions. One advantage of using CDIS data is that the concepts and principles in the sixth edition of the IMF's Balance of Payments and International Investment Position Manual (BPM6) and the fourth edition of the OECD Benchmark Definition of Foreign Direct Investment (BMD4) are used as the basis of compiling data reported in the CDIS. It is therefore better harmonized to the BoP data that we use to create the matrix that relates countries' GDP

[128] The data is available for free at: http://data.imf.org/cdis

[129] For more information on the construction of this database, see the IMF's comprehensive "Coordinated Direct Investment Survey Guide" (IMF, 2015) and accompanying *Frequently Asked Questions* document. These are accessible at: http://data.imf.org/?sk=40313609-F037-48C1-84B1-E1F1CE54D6D5&sId=1390288795525

to their GNI. Investment positions in the CDIS are also broken down into equity and debt instruments. For our purposes the type of instrument is not consequential and only the aggregated data is used.

CDIS data is used to proxy the shares of transfers of direct investment income going to partner countries for the 14 countries identified in Table 5.A6 (which provide neither bilateral FDI positions by ultimate investing country nor bilateral FDI positions that exclude SPEs). Data is available for all 14 countries in 2013 and 2014.

Table 5.A6. Summary: data sources used to proxy bilateral shares of transfers of direct investment income (2014)

Country	Data source	Country	Data source
Australia	UIC**	Italy	UIC
Austria	UIC	Japan	UIC*
Belgium	non-SPE	Latvia	CDIS
Brazil	UIC	Lithuania	UIC*
Bulgaria	CDIS	Luxembourg	CDIS
Canada	UIC	Malta	CDIS
China	CDIS	Mexico	CDIS
Croatia	CDIS	Netherlands	non-SPE
Cyprus	CDIS	Norway	non-SPE
Czech Republic	UIC	Poland	UIC
Denmark	non-SPE	Portugal	non-SPE
Estonia	UIC	Romania	CDIS
Finland	UIC	Russia	CDIS
France	UIC	Slovakia	CDIS
Germany	UIC	Slovenia	UIC*
Great Britain	UIC	South Korea	non-SPE
Greece	CDIS	Spain	UIC
Hungary	UIC	Sweden	CDIS
India	UIC	Switzerland	UIC
Indonesia	CDIS	Turkey	UIC*
Ireland	UIC*	USA	UIC

Notes: UIC refers to direct investments by ultimate investing country (using the underlying sources in Table 5.A4). Non-SPE refers to FDI data that excludes FDI related to SPE activities (using OECD Statistics). CDIS refers to the IMF's Coordinated Direct Investment Survey.

*In Ireland, Japan, Lithuania and Slovenia, UIC data is only available for 2015; in Turkey only for 2016. The bilateral FDI shares are assumed to be the same for these five countries in 2014. **In Australia, UIC data is based on the Australian Taxation Office Businesses Income Tax dataset (ATO BIT). This provides information on the country of ownership on the Ultimate Holding Company (where the ultimate investor of foreign-owned assets is located).

Annex V. Allocating portfolio investment incomes to partner countries

This annex discusses the Coordinated Portfolio Investment Survey (CPIS).[130] We allocate transfers of portfolio income to the investing countries by using information from the CPIS on foreign portfolio holdings (see equation (5.17) for details).

The CPIS is a sister database of the CDIS and is also published by the IMF. It is currently the only global survey available on portfolio investment holdings. The CPIS provides data collected from reporting economies on the holdings of asset stock positions by bilateral counterpart country, as well as derived (mirror) liabilities for all economies.[131] The data is available from 2001 onwards. The type of equity or security is, as is the case with the CDIS, not consequential for the creation of the GDP-GNI matrix. Only the aggregated data is used. The data reported in the CPIS is augmented with data from two companion surveys: Securities Held as Foreign Exchange Reserves (SEFER), and Securities Held by International Organizations (SSIO). SEFER and SSIO provides geographic and instrument detail on securities that are held as reserve assets and held by international organizations, respectively. Data from the CPIS and SSIO surveys provide comprehensive information on holdings of portfolio investment securities. The IMF used data from those two surveys together with data from the SEFER survey to capture better geographic detail and derive estimates of portfolio investment liabilities for every economy. It should be noted that the SEFER data is reported by individual economies but delivered only confidentially to the IMF; these data are released only in aggregate form.

The IMF derives liabilities for all economies - not just those participating in the CDIS survey. Hence the country coverage is particularly wide in scope and bilateral data by economy of liability (which uniquely incorporates data from the SEFER and SSIO) are available for all 42 countries contained in the matrix in 2013 and 2014. Therefore, foreign portfolio holdings by counterpart country (POI_{ji}) and total foreign portfolio holdings ($\sum_{j \neq i} \mathrm{POI}_{ji}$) in equation (5.17) are based on the derived (mirror) liabilities statistics contained in the CPIS.

[130] The data is available for free at: http://data.imf.org/cpis

[131] For more information on the construction of this database, see the IMF's comprehensive "Coordinated Portfolio Investment Survey Guide" (IMF, 2017) and accompanying *Frequently Asked Questions* document. These are accessible here: http://data.imf.org/?sk=B981B4E3-4E58-467E-9B90-9DE0C3367363&ss=1481574691948

Annex VI. Greater China data issues

The GDP-GNI matrix includes Greater China as one country. Greater China represents mainland China (CN-ML), Hong Kong (CN-HK), and Macao (CN-MO). However, GDP and GNI data and data from the IMF, WBRM, CDIS, and CPIS databases used to create the matrix are only provided in disaggregated form for CN-ML, CN-HG, and CN-MO.

GDP and GNI data are summed up for the three entities. Although there may be internal factor payments between CN-ML, CN-HK, and CN-MO, they cancel out when aggregated. Hence Greater China's GDP and GNI are exact functions of the published data and not estimated.

A simple aggregation is more problematic in the case of primary incomes reported by the IMF. Although net income is unaffected through aggregation ("internal" credits and debits offset each other), this approach could lead to an underestimation of the share of Greater China's GDP that is part of the national income of either CN-ML, CN-HK, or CN-MO and an overestimation of Greater China's transfers of income. To see how, suppose for illustrative purposes that there is no pass-through capital income between greater China, which has a GDP of \$100 in this example, and the world. If CN-ML has \$5, CN-HK \$4, and CN-MO \$1 in income debits, then following equation (5.1) the diagonal element is $\text{GDP}_{CHN,CHN} = \text{GDP}_{CHN} - \text{PID}_{CHN} = \$100 - \$5 - \$4 - \$1 = \$90$. However, suppose that reflected in the same income debits are \$3 from CN-ML that end up in CN-HK and \$2 from CN-HK that end up in CN-ML. As internal incomes are still part of greater China's GNI, they should not be included as part of its transfers of income (PID_{CHN}). Therefore, the correct calculation of the diagonal is $\text{GDP}_{CHN,CHN} = \$100 - \$2 - \$2 - \$1 = \$95$.

The approach for Greater China requires an adjustment. We estimate the share of income internal to greater China based on information from the WBRM, CDIS, and CPIS databases. Suppose that all debits in the example above are direct investment incomes and the CDIS shows that total FDI in greater China is \$10, the bilateral investments of CN-HK in CN-ML are \$3, and the bilateral investments of CN-ML in CN-HK are \$2. Then the share of internal direct investments is 0.5 [(\$3+\$2)/10]. To estimate internal income, we multiply 0.5 with the combined debits reported by the IMF, which in the example is $0.5 * (\$5 + \$4 + \$1) = \$5$. Finally, we subtract \$5 from the reported debits of the three entities, $\$10 - \$5 = \$5$, to estimate direct investment income debits that are *not* internal. Using \$5 as the new estimate for PID_{CHN}, we proceed with the standard approach to obtain the diagonal. This is $\text{GDP}_{CHN,CHN} = \$100 - \$5 = \$95$ (which is the same result as above).

The approach of using the WBRM, CDIS, and CPIS databases to determine true shares of off-diagonal elements $\mathrm{CE}_{CHN,j}/\sum_{j\neq CHN}\mathrm{CE}_{CHN,j}$ (equation 5.15), $\mathrm{DI}_{j,CHN}/\sum_{j\neq CHN}\mathrm{DI}_{j,CHN}$ (equation 5.16), and $\mathrm{POI}_{j,CHN}/\sum_{j\neq CHN}\mathrm{POI}_{j,CHN}$ (equation 5.17) (i.e., to ensure that $j \neq CHN$) is also adjusted slightly. Greater China is again treated as a region consisting of CN-ML, CN-HK, and CN-MO. For example, from equation (5.16) we have $\mathrm{GDP}_{i,j}^{K,DI} = (\mathrm{DI}_{ji}/\sum_{j\neq i}\mathrm{DI}_{ji})\mathrm{PID}_{i}^{DI,adapt}$ where j is one of the countries in the matrix and i is Greater China. Then the numerator refers to j's direct investments in greater China. This is the sum of all direct investments by j in CN-ML, CN-HK, and CN-MO. The total stock of direct investments in Greater China, $\sum_{j\neq CHN}\mathrm{DI}_{j,CHN}$, is equal to the sum of direct investments by all countries in CN-ML, CN-HK, and CN-MO *minus* the internal investments between CN-ML, CN-HK, and CN-MO ($\sum_{j\neq CHN}\mathrm{DI}_{j,CHN} = \sum_{j}\mathrm{DI}_{j,CHN} - \mathrm{DI}_{CHN,CHN}$). Therefore, when internal investments are nonzero, the share $\mathrm{DI}_{j,CHN}/\sum_{j\neq CHN}\mathrm{DI}_{j,CHN}$ is larger after removing these investments from the data than before the adjustments (which is similar to the outcome of removing round-tripping investments for other countries, see Annex IV.) Hence, adjustments are made to ensure that the right-hand side of $\mathrm{GDP}_{CHN,j}^{K,DI} = (\mathrm{DI}_{j,CHN}/\sum_{j\neq CHN}\mathrm{DI}_{j,CHN})\mathrm{PID}_{CHN}^{DI,adapt}$ (equation (5.16)) is correct and gives the true $\mathrm{GDP}_{CHN,j}^{K,DI}$.

Annex VII. Names and abbreviations of all countries included in the matrix

AUS = Australia
AUT = Austria
BEL = Belgium
BGR = Bulgaria
BRA = Brazil
CAN = Canada
CHE = Switzerland
CHN = China
CYP = Cyprus
CZE = Czech Republic
DEU = Germany
DNK = Denmark
ESP = Spain
EST = Estonia
FIN = Finland
FRA = France
GBR = Great Britain
GRC = Greece
HRV = Croatia
HUN = Hungary
IDN = Indonesia
IND = India
IRL = Ireland
ITA = Italy
JPN = Japan
KOR = South Korea
LTU = Lithuania
LUX = Luxembourg
LVA = Latvia
MEX = Mexico
MLT = Malta
NLD = The Netherlands
NOR = Norway
POL = Poland
PRT = Portugal
ROU = Romania
RUS = Russia
SVK = Slovak Republic
SVN = Slovenia
SWE = Sweden
TUR = Turkey
USA = United States
ROW = Rest of World