



**Irish Fiscal  
Advisory Council**

# **Demystifying Ireland's national income: a bottom-up analysis of GNI\* and productivity**

Kevin Timoney

Working paper no. 21  
June 2023

Suggested reference:

Timoney, K. (2023). "Demystifying Ireland's national income: a bottom-up analysis of GNI\* and productivity". Irish Fiscal Advisory Council Working Paper Series No. 21. Dublin. Available at: [www.fiscalcouncil.ie/working-papers/](http://www.fiscalcouncil.ie/working-papers/)

# Demystifying Ireland's national income: a bottom-up analysis of GNI\* and productivity

Kevin Timoney<sup>1</sup>

June, 2023

## Abstract

Modified gross national income (GNI\*) is a more appropriate measure of Ireland's economy. However, a shortcoming is that it is constructed in a top-down way. Starting with gross domestic product, it involves some large and occasionally opaque adjustments to get to GNI\*. This leaves many in the dark as to what exactly makes up GNI\*.

This paper makes two contributions. First, we try to take some of the mystery out of GNI\* by constructing it from the bottom up, using the expenditure, income, and output approaches to presenting Ireland's national accounts. We show that GNI\* mainly reflects the income of domestic sectors, though wages and corporation tax paid by foreign-owned multinationals have become increasingly important. Second, we explore what this tells us about productivity in the Irish economy. When assessed on this basis, Ireland's productivity growth is closer to other European countries.

Keywords: Macroeconomics, national income, productivity

JEL No. E01, E10, E2, O47, D24, J24

© Irish Fiscal Advisory Council 2023

This report can be downloaded at [www.FiscalCouncil.ie](http://www.FiscalCouncil.ie)

---

<sup>1</sup> The author is an Economist at the Irish Fiscal Advisory Council and an Adjunct Lecturer at the University of Limerick. Email: kevin.timoney@fiscalcouncil.ie. The opinions expressed and arguments employed in this paper do not necessarily reflect the official views of the Fiscal Council. The author would like to acknowledge the helpful feedback received from John FitzGerald, Chris Sibley, Brendan O'Connor, and members of the Council and Secretariat of the Fiscal Council.

## 1. Introduction

Trying to understand Ireland's macroeconomic performance has long been bedevilled by outsized flows due to the activities of multinational entities. This has been particularly evident in recent years in very large values for standard economic aggregates such as gross domestic product (GDP). These distortions have greatly complicated efforts to interpret productivity developments in the Irish economy.

A traditional solution to get away from the distortions in GDP was to emphasise either gross national product (GNP), gross national income (GNI), or simply domestic demand. FitzGerald (2020) notes that GNI was a preferred measure of the Irish economy from the late 1970s.

Since the early 2010s, understanding Ireland's economy got even more complicated with retained earnings of re-domiciled PLCs (FitzGerald, 2013). This continues to affect how GNI is interpreted, as the re-domiciled firms' profits do not flow out of Ireland as part of net factor income (FitzGerald, 2016).

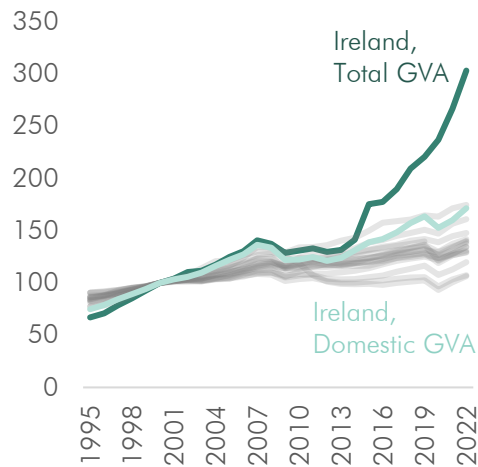
Then, more significantly, the onshoring of intellectual property in 2015 caused a level shift in Ireland's measured exports. A corresponding jump was also seen in business profits within gross value added (GVA). This related to "contract manufacturing" (Connolly, 2017) — essentially one overseas entity manufacturing goods on another's behalf — and a move to new national accounting standards (ESA 2010), for which activity is counted on an ownership basis, rather than based on where the benefits of the activity accrue. This resulted in an upward revision to 2015 real GDP growth from a preliminary rate of 7.8% to over 26%, and Ireland's national accounts, balance of payments, capital stock, and productivity data all became the subject of considerable scrutiny.

The level shift in Ireland's volume of total GVA in 2015 is shown in Figure 1A. In seven years since, Ireland's total GVA has grown rapidly at 7% a year on average, far faster than a range of other European countries at 0.8–2.1% a year. Even when sectors with turnover dominated by foreign-owned multinationals are excluded — shown with "domestic GVA" — Ireland's growth since 2015 was 2.7% a year. Despite this growth performance, the trend for domestic-GVA-based multifactor productivity has been declining since 1999, as shown in Figure 1B. This surprisingly weak result requires further investigation.

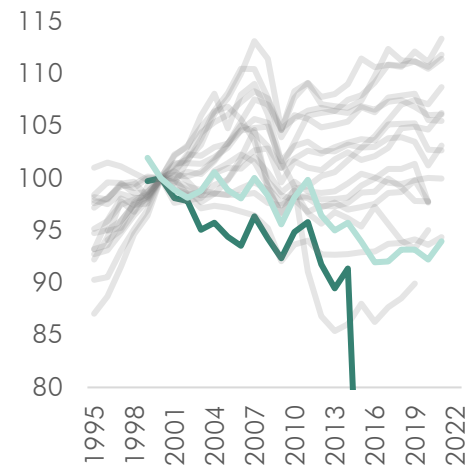
**Figure 1: Ireland’s domestic GVA has grown more rapidly than total GVA in other European countries, but its multifactor productivity has been weaker**

2000 = 100

A. GVA volumes, 1995–2022



B. Multifactor productivity, 1995–2021



Sources: Eurostat; CSO; OECD; and author’s calculations.

Notes: Domestic GVA for Ireland is published by the CSO and it excludes sectors with turnover that is dominated by foreign-owned multinationals. For panel B, the Y axis is truncated due to the large decline of 34% in multifactor productivity for Ireland’s total GVA in 2015 — the difference between labour productivity growth of 18% and a capital deepening contribution of 52%.

In response to the 2015 results, the CSO convened the Economic Statistics Review Group (ESRG), to broaden its deliberations on the challenges to interpreting Ireland’s national accounts due to the impact of globalisation.<sup>2</sup> Lane (2016) provided the ESRG with a national accounting framework for economies in which global firms are prominent. He noted that GNI typically represents resources that are available to the domestic population, and that a stable measure of economic performance should be robust to alternative accounting approaches, including the mechanisms by which foreign-investor returns are paid out. He illustrated this with a simplified framework where all production is carried out by a domestically-headquartered firm that is owned entirely by foreign investors. An adjusted form of GNI can be presented either as a top-down calculation (GDP less the foreign-owned firm’s post-tax gross operating surplus), or with a bottom-up form (labour earnings plus domestic corporation tax paid by the firm). In line with a bottom-up approach, FitzGerald (2016) proposed that an official measure to track domestic-firm GVA and foreign-firm wages plus corporation taxes would be helpful for understanding developments in Ireland’s national income.

<sup>2</sup> Then-Governor of the CBI Philip Lane chaired the ESRG, and members included representatives from the CSO, ESRI, UCC, Fiscal Council, TCD, Department of Finance, IIEA, IBEC, SIPTU, and the NTMA. The Group also received submissions from former CBI Governor Patrick Honohan, the Revenue Commissioners, Eurostat, and the OECD.

The report of the ESRC (2016) proposed a new modified level indicator of the Irish economy: modified GNI (GNI\*), which was first published in July 2017. Beginning with GDP, the approach derives a more meaningful measure of the economy by subtracting various distortions — in line with the first formulation by Lane (2016). Overall, this has been an important step forward for Ireland’s macroeconomic statistics.

As emphasised by the Fiscal Council (2021), GNI\* is a far more useful aggregate for understanding the Irish economy than GDP. It is informed by expert assessments of the drivers of Irish economic activity. It is also better at explaining so-called “real-economy variables” such as employment, and it has a closer relationship to overall government revenue. GNI\* is therefore better at assessing the public finances for sustainability. For macroeconomic and fiscal policy, this highlights how important it is that GNI\* and its components are better understood.

However, the top-down approach to estimating GNI\* has major drawbacks. Beginning with GDP and then subtracting large amounts to reach GNI\* means that there is considerable mystery as to what makes up the aggregate. GNI\* also lacks a corresponding framework for analysing productivity. This paper attempts to demystify GNI\* by using relevant components that do not require later adjustment, and assessing the productivity implications of this bottom-up framework.

Various bottom-up decompositions of GNI\* are presented in Section 2, covering the expenditure, income, and output approaches to the national accounts. Section 3 develops the income approach further, including analysis of real GNI\*, the modified current account, a measure of quarterly GNI\*, and the contribution of foreign-owned multinationals to GNI\*. Productivity developments in the Irish economy are then assessed in Section 4 using on the bottom-up income approach to estimating GNI\*. Section 5 summarises and concludes.

## 2. A bottom-up framework of the national accounts consistent with GNI\*

The expenditure, income, and output approaches to national accounting are three conceptual frameworks for aggregate demand in an economy. The expenditure approach focuses on final expenditure on goods and services comprising GDP, the income approach adds up flows of national income, while the output approach derives GVA as the difference between gross output less intermediate consumption (that is, goods and services used up in a production process, rather than for final consumption). The income approach implies a separate derivation of GVA by combining the compensation of employees and profits of firms.

GDP is shorthand for aggregate demand in most economies, and GNI is similar to GDP for most countries (as shown in Figure C3 in Fiscal Council, 2021). This section presents adjusted components in each approach to add up GNI\* rather than GDP. In so doing, the framework will aim to clarify which specific components of GDP require modification for consistency with GNI\*.

### 2.1 Expenditure approach

A bottom-up presentation for expenditure on GNI\* is illustrated below, building on the main expenditure components of GDP. This idea is similar to the “trimmed GDP” suggestion by Honohan (2016), who suggested splitting the activities of a manageable set of the largest firms affecting the problems of interpretation into “onshore” and “offshore” components. This approach would require analysis of granular data at company level, whereas the analysis in this paper relies on less-detailed published series. As such, scope remains for further development of a bottom-up expenditure approach to GNI\* using more granular data.

The path to GNI\* begins with modified total domestic demand, and this is made up of reasonably intuitive and well-understood components. These are personal consumption expenditure (C), net government consumption (G), and modified gross capital formation (I\*) — which includes modified gross fixed capital formation and the value of physical changes in stocks.<sup>3</sup> However, as shown in Figure 2 for the

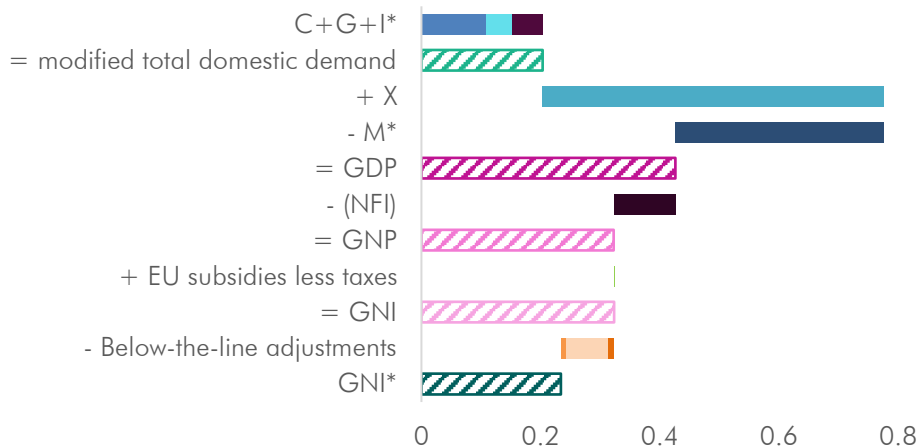
---

<sup>3</sup> Modified gross fixed capital formation includes all building and construction, but it excludes investment spending on aircraft for leasing from machinery and equipment, and research and development (R&D) intangibles and trade in intellectual property (IP). This is due to their large size, high import content, and limited linkages to activity in Ireland; FitzGerald (2018) noted that “these forms of capital are excluded because they are almost all used to produce output outside Ireland”. Modified imports exclude the same elements, meaning they are GDP-neutral adjustments.

latest-available 2021 data, the picture quickly becomes complicated from there. A large amount for exports (X, €573 billion) is partially offset by modified imports (M\*, –€350 billion), net factor income from abroad (NFI, –€104 billion), and below-the-line adjustments (–€90 billion). At €426 billion, GDP was 82% larger than GNI\* at €234 billion.

**Figure 2: The top-down expenditure approach to calculating GNI\***

€ trillion, current prices for 2021



Sources: CSO; and author's calculations.

Note: Within exports in 2021, contract manufacturing exports were estimated at €114 billion.

By relying on top-down adjustments to estimate GNI\*, this leaves the aggregate exposed to the vagaries of GDP. In other words, the adjustments to get to GNI\* are determined by all of the distortions contributing to GDP. However, the nature of the distorting amounts — broadly, the after-tax profits and depreciation of assets owned by multinational firms — should not have a noticeable presence in Ireland's GNI\*. Without a bottom-up understanding of what is going on, it is impossible to coherently explain GNI\* developments in intuitive, real-economy terms.

Lennon (2022) showed contributions to nominal growth in GNI\* from modified domestic demand, stocks, net current transfers, CA\*, and the statistical discrepancy. Similarly, equation 1 shows that the modified current account (CA\*) can be included as a component of GNI\*.<sup>4</sup> Substituting this into the top-down expenditure approach to calculating GNI\* results in a much-simplified expression for GNI\* in equation 2, illustrated in Figure 3.

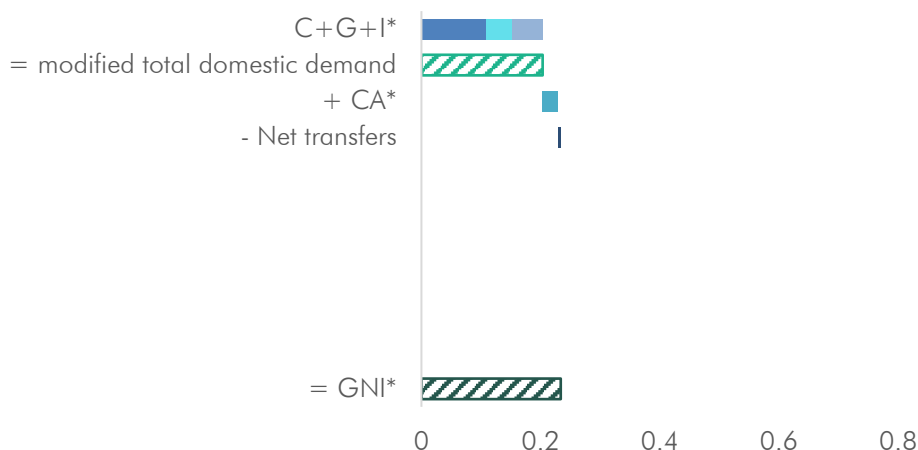
<sup>4</sup> Table 15 in the *Annual National Accounts* derives the unadjusted current account, and this is where the series for net transfers is introduced. As noted in Section 3 analysis of CA\*, net transfers are equivalent to economy-wide taxes less subsidies (a component of gross disposable income).

$$1) CA^* = X - M^* - (NFI) - \text{below-the-line adjustments} + \text{EU subsidies less taxes} + \text{net transfers}$$

$$2) GNI^* = C + G + I^* + CA^* - \text{net transfers}$$

**Figure 3: A bottom-up expenditure approach to calculating GNI\***

€ trillion, current prices for 2021



Sources: CSO; and author's calculations.

To navigate away from the distortions included in the top-down derivation of  $CA^*$ , equation 3 re-states  $CA^*$  as approximately equal to “trimmed exports” ( $X_{trim}$ ) less “trimmed imports” ( $M_{trim}$ ), and this form is used in equation 4.

$$3) CA^* \approx X_{trim} - M_{trim}$$

$$4) GNI^* \approx C + G + I^* + X_{trim} - M_{trim} - \text{net transfers}$$

The Fiscal Council has previously developed a methodology for approximating  $X_{trim}$  and  $M_{trim}$  consistent with  $GNI^*$ .<sup>5</sup> The trimmed variables aim to better reflect developments in Ireland's exports and imports with relevance to  $GNI^*$  — the intention is that  $X_{trim}$  and  $M_{trim}$  are not materially distorted by the activities of multinational entities, similar to the concept described by Honohan (2016).

Exports for a small, open economy heavily depend on imports of its main trading partners, and as noted in Fiscal Council (2020), there is a strong correlation between  $X_{trim}$  and demand for imports abroad. Our approach to “trimming” uses detailed categories of merchandise and services trade and identifies elements that

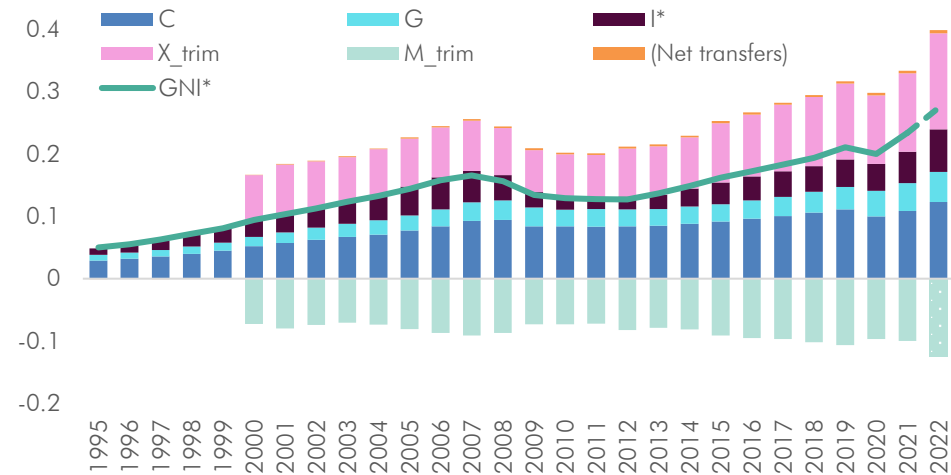
<sup>5</sup> See Box E of the *May 2020 Fiscal Assessment Report* (Fiscal Council, 2020). The Department of Finance has developed a methodology that is similar to that of the Council, and it has used this as a basis for forecasting  $GNI^*$  (Lennon and Power, 2021).



have contributed significantly to the growth Ireland’s measured trade flows over recent decades.<sup>6</sup> These categories are excluded from total exports, leaving  $X_{trim}$  at €122 billion in 2019, rather than €456 billion for total exports.  $M_{trim}$  is then residually determined as €107 billion (given  $CA^*$  was €15 billion in 2019). Figure 4 illustrate magnitudes of more relevant expenditure on  $GNI^*$  since 2000.

**Figure 4: The expenditure approach to  $GNI^*$  with trimmed exports and imports**

€ trillion, current prices



Sources: Eurostat; CSO; and author’s calculations.

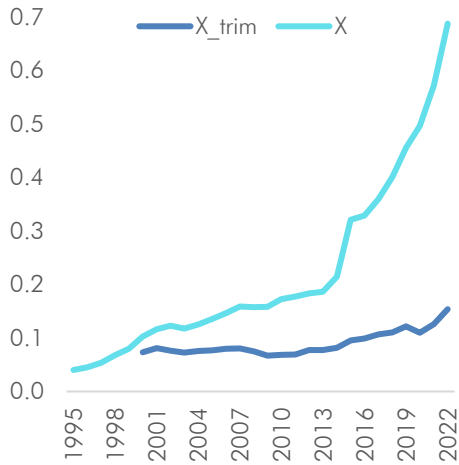
Visually,  $X$  and  $M^* + NFI +$  below-the-line adjustments follow a similar pattern, as shown in Figure 5. Panel A compares  $X$  with  $X_{trim}$  over time, while panel B compares  $M_{trim}$  with  $M^* + NFI$ , and also with  $M^* + NFI +$  below-the-line adjustments. The distortions that are evident in the non-trimmed series are largely offsetting with respect to their net contribution to  $GNI^*$ .

<sup>6</sup> The following categories are excluded from  $X_{trim}$ : all contract manufacturing, chemical compounds (515), medicinal and pharmaceutical products (541), medicaments (542), aircraft (792), computer services, royalties/licences, and all business services. Sub-categories of merchandise trade are excluded where they have high contributions (in the top percentile) to growth in exports and imports since 2000. The same approach is applied to services, but for categories with growth contributions in the top decile, since there is a less-detailed breakdown available for services trade.

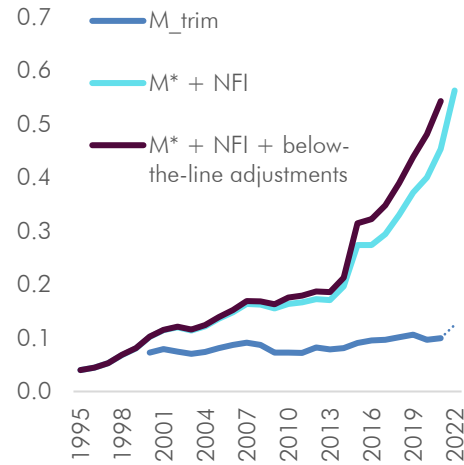
**Figure 5: Trimmed exports and imports remove major distortions from exports, modified imports, net factor income, and below-the-line adjustments**

€ trillion, current prices

A. Trimmed exports and total exports



B. Trimmed imports, total imports, net factor income, and below-the-line adjustments

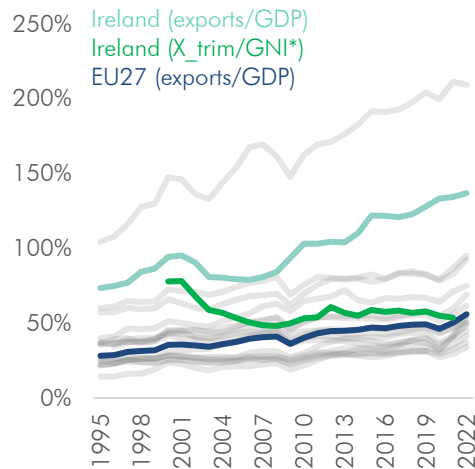


Sources: Eurostat; CSO; and author's calculations.

**Figure 6:  $X_{trim}$  and  $M_{trim}$  are more comparable to exports and imports in the EU27**

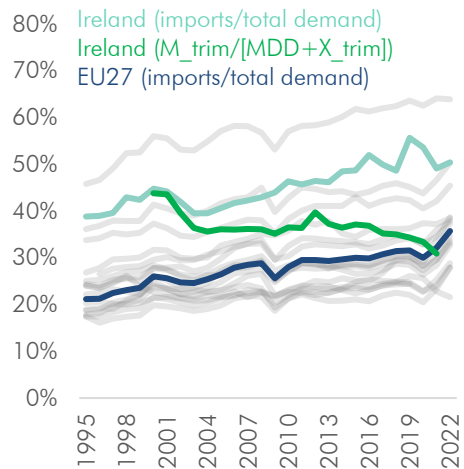
A. Exports

% of aggregate demand



A. Import content

% of final demand



Sources: Eurostat; CSO; and author's calculations.

Despite the presentational advantages of approximating  $X_{trim}$  and  $M_{trim}$ , data limitations mean that there are inevitable shortcomings to any bottom-up presentation of the expenditure approach to GNI\*. As FitzGerald (2020) noted: "Because of the huge gross flows into and out of [Ireland] in the form of goods, services, and factor incomes, it would be exceptionally difficult to carry out the kind of analysis undertaken here for the expenditure side of the National Accounts."

As such, approximating  $X_{trim}$  involves a degree of arbitrary judgement, since  $X_{trim}$  effectively assumes all exports in certain categories do not ultimately

contribute to GNI\*.<sup>7</sup> Furthermore, since  $M_{trim}$  is residually determined, the method does not provide any independent estimate of the level of GNI\*. As such, the decomposition of  $CA^*$  into  $X_{trim} - M_{trim}$  is mainly useful as an approximate illustration of GNI\* as a workable version of “trimmed GDP”. It can also be used as a framework for forecasting GNI\* from the bottom up, without the need to forecast the official components of  $CA^*$  (as listed in equation 1).

There are other important limitations to the above analysis. Some of the exports in the sectors excluded from  $X_{trim}$  should be net contributors to the expenditure estimate of GNI\*, as they are domestic in nature.<sup>8</sup> Interpreting  $M_{trim}$  can also be difficult, given that it is a residual figure. Ideally, a breakdown of services trade to a similar degree of detail compared to detailed merchandise trade would be sufficient to form bottom-up subcomponents of  $CA^*$ .

---

<sup>7</sup> Appendix 1 uses an alternative data source to show an alternative breakdown of exports by sector, although the magnitude of this alternative trimmed exports is broadly similar to  $X_{trim}$  (close to €100 billion). It also refers to a new release by the CSO regarding a breakdown of services trade by enterprise characteristics for 2019, although this data is not yet provided for goods trade.

<sup>8</sup> For example, sales abroad undertaken by technology companies not affiliated with foreign-owned multinationals.

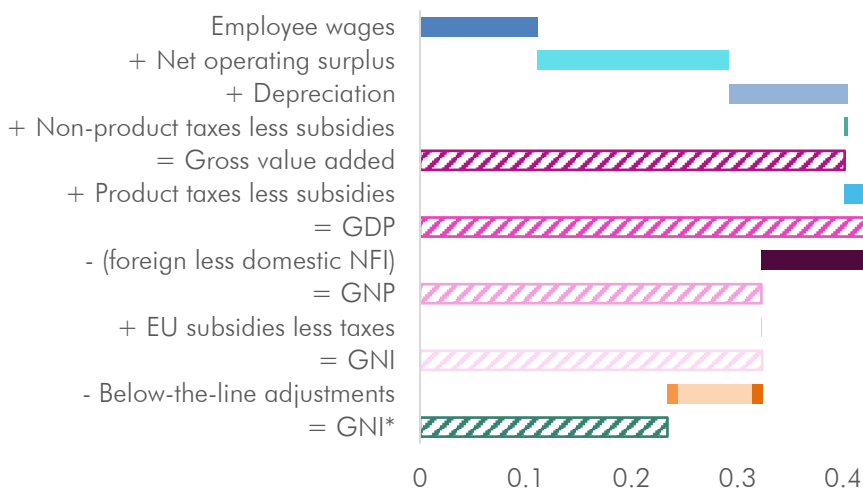
## 2.2 Income approach

An intuitive breakdown of national income is shown by the income approach, which shows a split for different industrial sectors as well as different income categories. This section simplifies some components of the top-down income approach to estimating GNI\*, instead providing a bottom-up estimate of GNI\*.

FitzGerald (2020 and 2021) recently used detailed income data from the CSO’s “Institutional Sector Accounts: Non-Financial” to analyse net national product across sectors. He concludes that the real Irish economy grew about 5% a year between 2013 and 2019, and that around a fifth of this performance could be explained by foreign-owned firms — primarily from domestic wages and corporation tax receipts. The paper also argues that net national product provides a better understanding of what is driving growth in activity in the Irish economy compared to GNI\*, since it excludes all depreciation, and can be shown separately for all activity of foreign firms. Nonetheless, a contribution of this paper is to present approximate bottom-up components of GNI\* by sector.

The main categories of national income are compensation of employees (CoE), corporate/entrepreneurial profits which are termed gross operating surplus/mixed income (GOS), and taxes net of subsidies on production. GOS in turn has two components: consumption of fixed capital (depreciation) and net operating surplus/mixed income (NOS). Figure 7 shows 2021 data for the top-down income components of GNI\* (Appendix 2 provides a full derivation).

**Figure 7: The top-down income approach to calculating GNI\***  
 € trillion, current prices for 2021



Sources: CSO; and author’s calculations.

As noted by Lane (2016), the after-tax NOS of foreign firms typically flows out of GNI through NFI outflows. NFI flows can be broken down into domestic and foreign components, where inflows of domestic NFI include net compensation of employees from the rest of the world (CoE\_ROW) and property income of domestic sectors, and outflows of foreign NFI include property income of foreign sectors.

A key motivation for estimating GNI\* using bottom-up income components is that it can be reasonably approximated without the need for foreign NFI or below-the-line adjustments. This is because including foreign NOS and depreciation, only to subsequently remove them via foreign NFI or below-the-line adjustments, presents a core challenge to interpreting the top-down derivation of GNI\* — especially since foreign NFI is not available by industrial sector. Equation 5 therefore eliminates foreign NFI and below-the-line adjustments in Figure 7 by replacing NOS and depreciation with GNI\*-relevant alternatives: NOS\* and depreciation\*.

$$5) \text{ GNI}^* \approx \text{CoE} + \text{NOS}^* + \text{depreciation}^* + \text{non-product taxes less subsidies} + \text{product taxes less subsidies} + \text{domestic NFI} + \text{EU taxes less subsidies}$$

Equation 6 then defines GVA\* — a key component of GNI\* for discussion of GNI\*-based productivity analysis in section 4 — as the sum of the first four components of GNI\* above. While GVA is mainly a production or output concept, derived as output less intermediate consumption, it can also be represented as a subset of income flows.

$$6) \text{ GVA}^* \approx \text{CoE} + \text{NOS}^* + \text{depreciation}^* + \text{non-product taxes less subsidies}$$

Lennon (2022) used institutional sector accounts data as a basis for a bottom-up estimate of “domestic NOS”, or NOS for domestic sectors. In this section, NOS\* and depreciation\* (combining as GOS\*) are instead estimated based on data for industrial sectors, but adjusted to exclude particular sectors, as explained below.<sup>9</sup> For manufacturing, sectors whose turnover is dominated by foreign-owned multinational firms are detailed in CSO data presented in Appendix 3. The information/communication sector is also identified as a foreign-multinational-dominated sector. Although there is a significant presence of foreign-owned multinational firms in Irish aircraft-leasing activities, the sector is not classified as one whose turnover is overwhelmingly foreign. Nonetheless, depreciation on aircraft

---

<sup>9</sup> Historical NACE A\*64 data for 1995–2020 were published with the 2020 *National Income and Expenditure*, and these estimates are used in this analysis. The historical data have not been updated with the latest *Annual National Accounts*, although data just for 2021 is available [here](#).

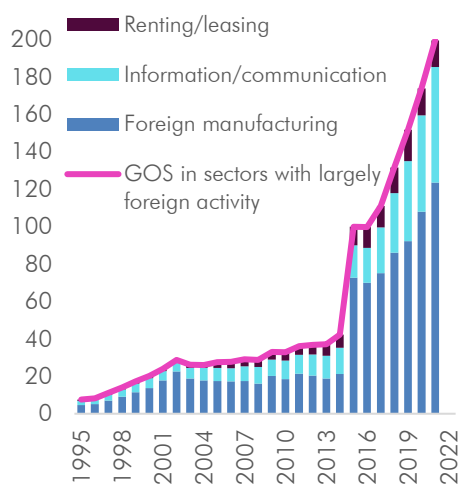
for leasing is a specific component of the below-the-line adjustments in the top-down derivation of GNI\*. Furthermore, aircraft for leasing is also excluded from expenditure on I\* and M\*. Excluding profits for this specific sector involved (renting/leasing) from a bottom-up analysis of Ireland’s GNI\* therefore has some merit, along with profits in foreign manufacturing and information/communication.

Figure 8 shows that GOS for each of the sectors discussed above (shown in panel A) provide a reasonable approximation of the foreign profit flows that are included in GDP but excluded from GNI\* (shown in panel B). A bottom-up approach to approximating NOS\* and depreciation\* can therefore include all sectors except for foreign manufacturing, information/communication, and renting/leasing.

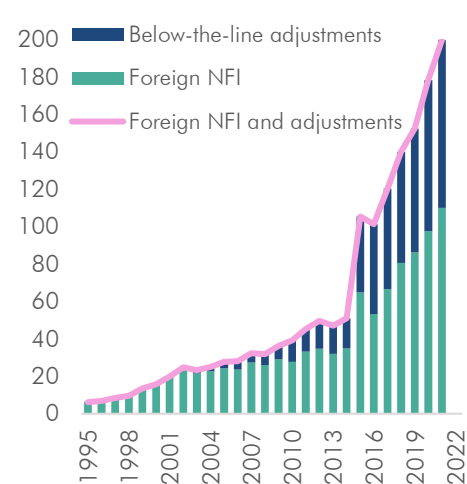
**Figure 8: Approximating the sectors behind foreign profit flows included in GDP**

€ billion, current prices

**A. GOS in sectors with largely foreign activity**



**B. Foreign NFI and below-the-line adjustments**



Sources: CSO; and author’s calculations.

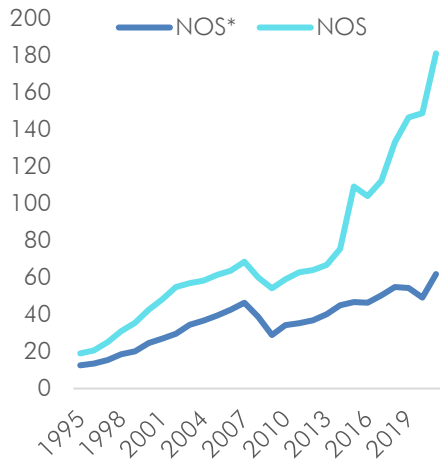
Notes: Foreign NFI is available for 2013–2021 using the CSO’s *Institutional Sector Accounts, Non-Financial*. It excludes wage remittances and property income for domestic sectors, although these amounts are small. Prior to 2013, foreign NFI is assumed to equal total property income.

With the sectors noted above excluded, Figure 9 shows that bottom-up NOS\* and depreciation\* do not exhibit level shifts like their top-down equivalents in GDP.

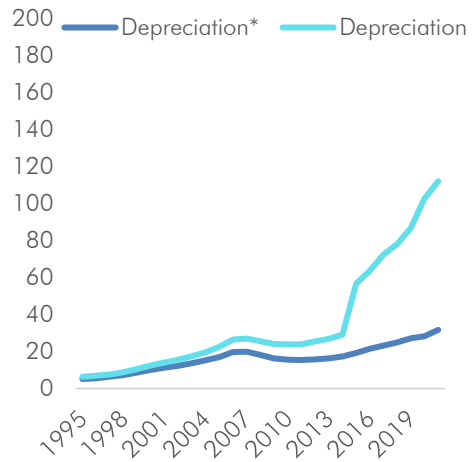
**Figure 9: Comparing NOS\* and depreciation\* with NOS and depreciation**

€ billion, current prices

A. NOS\* compared to NOS



B. Depreciation\* compared to depreciation

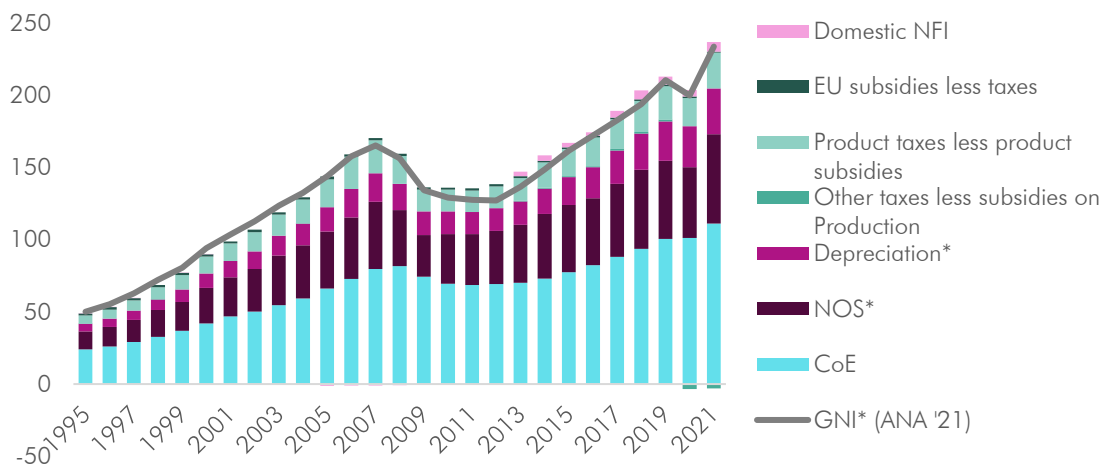


Sources: CSO; and author's calculations.

Following equation 5, Figure 10 combines CoE, NOS\*, depreciation\*, various taxes/subsidies, and domestic NFI as approximate bottom-up components of GNI\*.

**Figure 10: Approximate bottom-up components of GNI\* by income type**

€ billion, current prices



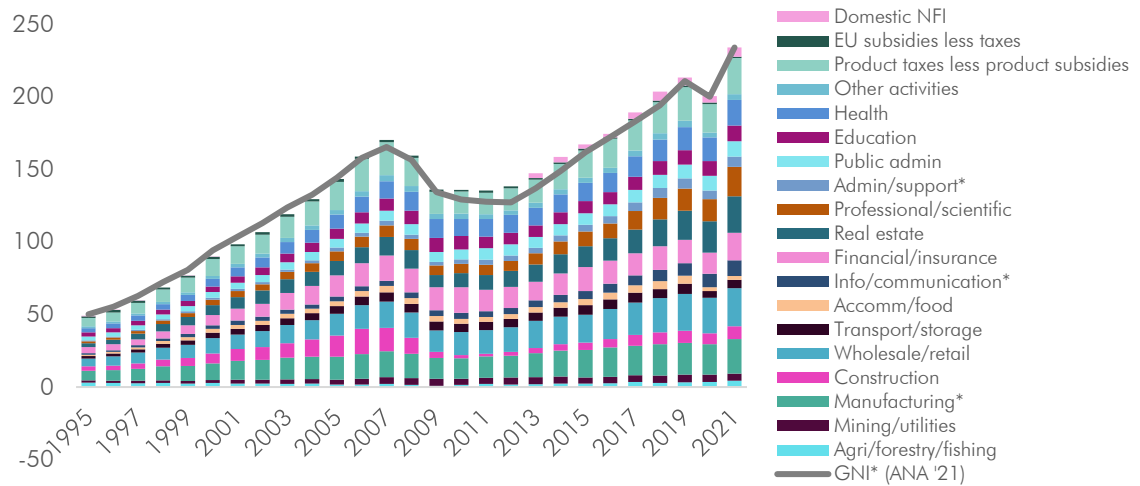
Sources: CSO; and author's calculations.

Figure 11 replicates Figure 10 but showing the contributions of industrial sectors.

There is a reasonably close fit between these approximate components and actual GNI\*.

**Figure 11: Approximate bottom-up components of GNI\* by sector**

€ billion, current prices

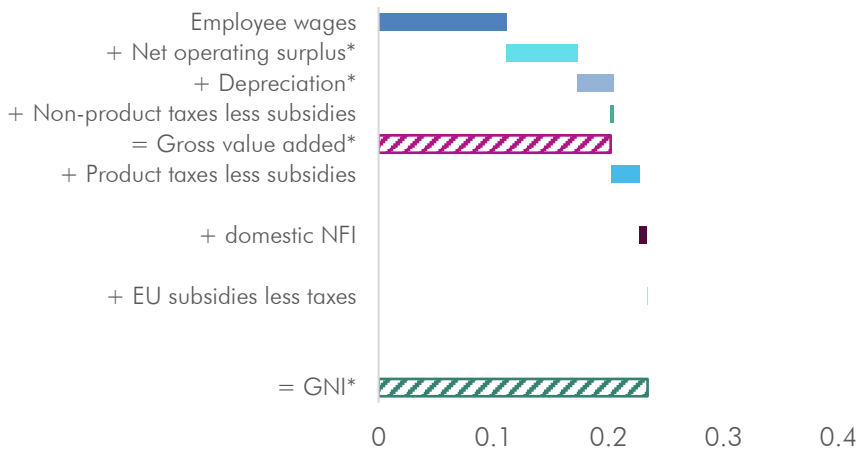


Sources: CSO; and author's calculations.

Figure 12 shows 2021 data for the bottom-down approximations of the income components of GNI\*. Compared to Figure 7, the main component is not corporate or entrepreneurial profits in the form of NOS or depreciation, but rather employee wages.

**Figure 12: The bottom-up income approach to approximating GNI\***

€ trillion, current prices for 2021



Sources: CSO; and author's calculations.

Note: Within exports in 2021, contract manufacturing exports were estimated at €114 billion.



## 2.3 Output approach

The output approach — also referred to as the production approach — is broadly similar to the income approach, in terms of how it is used to estimate the size of an economy. The difference is the emphasis on the value of what is produced (the output), and the value of goods and services used to produce that output known as intermediate consumption (IC). Coffey (2023) identifies IC from various perspectives along a specific value chain: “For the farmer this is the seeds, for the miller it is the wheat, for the baker it is the flour, [and] for the retailer it is the actual loaf of bread.”

GVA based on the output approach is derived as output less intermediate consumption. To get at GNI\* with the output approach, a modified version of both output and intermediate consumption (output\* and IC\*) can help, as stated in equation 7:

$$7) \text{ GNI}^* = \text{Output}^* - \text{IC}^* + \text{product taxes less subsidies} + \text{domestic NFI} + \text{EU taxes less subsidies}$$

As for the income approach, output and IC are also published at detailed sectoral levels, meaning GNI\*-consistent equivalents can be built up using this information.<sup>10</sup> The industrial-sector contributions shown in Figure 11 can therefore be replicated. However, for this replication to be exact, CoE and taxes less subsidies on production for foreign sectors (foreign manufacturing, information/ communication, and renting/leasing) must be exceptionally included as output\*. This is because excluding all output and all IC for foreign sectors is a less nuanced adjustment than can be made for the income approach, and the contribution of foreign sectors to GVA\* would be zero otherwise.

The contraction in Irish economic activity during the global financial crisis period is highlighted by Figure 13, which presents the result of the output approach in equation 7 to estimating GNI\*. It took a full decade for the 2007 peak of output\*

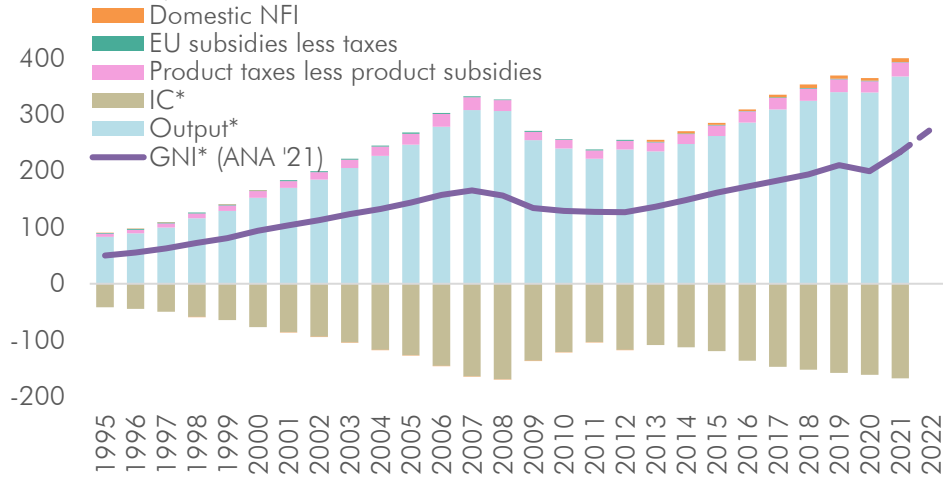
---

<sup>10</sup> The CSO’s *Output and Value Added* release includes a foreign-dominated and domestic split. However, this is not on the same basis as for other releases in the national accounts, and to the extent possible, the national accounts basis is preferred in this section to preserve consistency with analysis of the income approach. Rather than classifying NACE 18.2, 20, 21, 26, 27, and 32.5 as foreign manufacturing (as in the national accounts), the output and IC sectors excluded here for manufacturing are 18–21 and 26–32. All of information/communication (58–63), and renting/leasing (77) are also excluded. However, CoE for each of these excluded sectors is counted as output\*. The net difference in terms of GVA of the additional excluded manufacturing sectors is minor: €1.3 billion or 1.1% on average for 1995–2021.

(in nominal terms) to be exceeded. The industrial sector split of output\* and IC\* are then shown separately in Figure 14.

**Figure 13: Approximating GNI\* with bottom-up output components**

€ billion, current prices

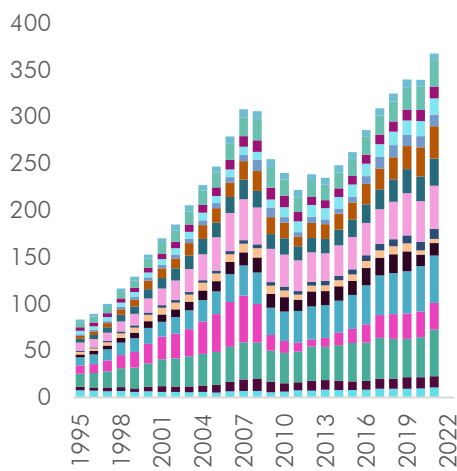


Sources: CSO; and author's calculations.

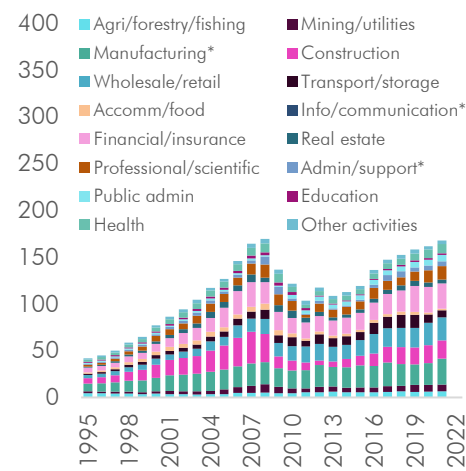
**Figure 14: Breaking down output\* and IC\* by industrial sector**

€ billion, current prices

A. Output\*



B. IC\*



Sources: CSO; and author's calculations.

However, an important shortcoming with the production components in Figures 13 and 14 is that they likely understate the extent of “relevant” output or IC that is required to generate GNI\*. This is because the bottom-up estimates entail the entire absence of foreign activity in the excluded sectors (apart from their CoE).<sup>11</sup> A more complete representation would show a larger contribution by foreign sectors to both

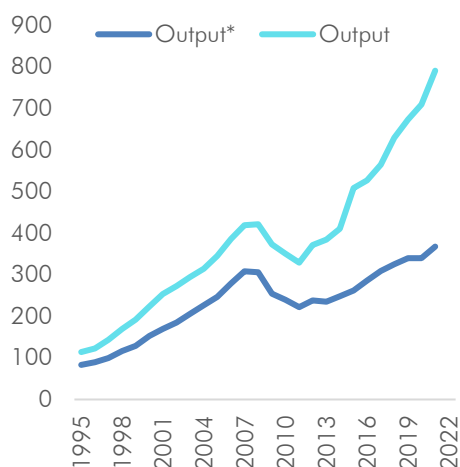
<sup>11</sup> Underestimation of GNI\* components is less of a concern for the presentation of the income approach as in Figure 10, since the bottom-up estimates of NOS\* and depreciation\* appear to be realistic income components of GNI\*, and not ones that rely on offsetting impacts, as seen in both the expenditure ( $X_{trim}$  less  $M_{trim}$ ) and output approaches ( $output^*$  less  $IC^*$ ).

output\* and IC\*. However, the full amounts recorded in the national accounts are too large to be relevant for GNI\*, as illustrated in Figure 15b which compares output\* and IC\* with total output and total IC.

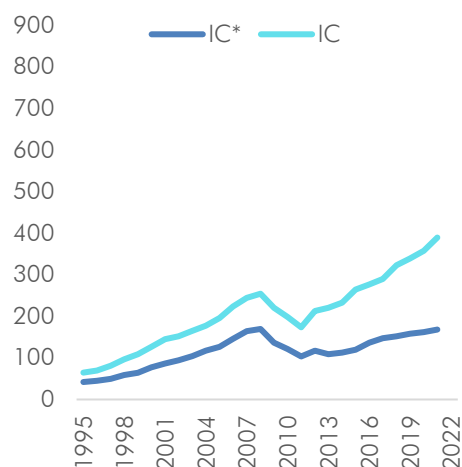
**Figure 15: Output\* and IC\* have increased by far less than output and IC**

€ billion, current prices

A. Output\* and output



B. IC\* and IC



Sources: CSO; and author's calculations.

The supply-and-use tables can also inform the analysis above. In essence, foreign firms use up output from domestic firms to produce their output in the Irish economy, and vice versa, and some of this output is relevant for GNI\*.<sup>12</sup> While these flows are not captured in Figures 13 and 14, the output approach could be useful for estimating GNI\* if output and IC flows that do not ultimately contribute to GNI\* were excluded.

<sup>12</sup> In 2019 the purchasers' prices IC for the domestic sectors (all sectors except NACE 18–21, 26–32, 58–63, and 77) was €188 billion, of which €50 billion was explained by IC of the foreign sectors. This €50 billion is included in IC\* since it is IC by domestic sectors, but it can be considered a missing component of output\*, since the foreign sectors producing this output have been excluded from output\*. Similarly, the 2019 purchasers' prices IC for the foreign sectors was €202 billion, of which €66 billion was explained by IC of the domestic sectors. This €66 billion is already included as part of output\* since it reflects output by the domestic sectors, but it can also be considered a missing component of IC\*, since it is foreign sectors consuming output produced by domestic sectors.

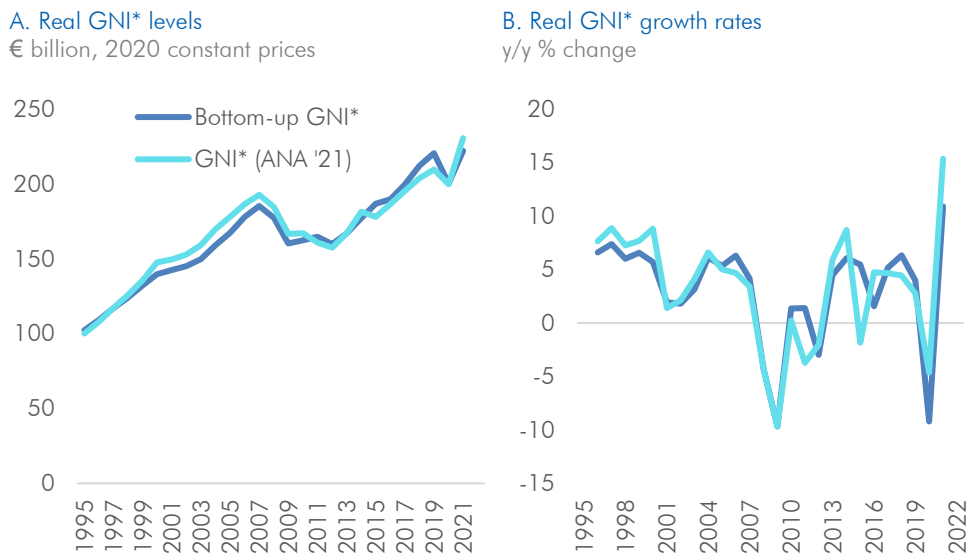
### 3. Further analysis of the income approach to estimating GNI\*

This section further develops the bottom-up income approach to estimating GNI\* described in section 2.2. The topics covered include a bottom-up estimate of real GNI\*, analysis of CA\* in terms of modified savings and modified capital formation, a bottom-up estimate of quarterly GNI\* up to end-2022 and estimating the contribution of foreign sectors to GNI\*.

#### 3.1 A bottom-up estimate of real GNI\* using the income approach

The bottom-up income approach can also be used to estimate GNI\* in constant prices. The CSO currently uses the top-down approach to calculate real GNI\*, but large and partly offsetting gross flows as shown previously in Figure 2 imply a greater risk of measurement error. This is especially the case with respect to deflators for trade, depreciation, and NFI. Figure 16 shows that the bottom-up approach for real GNI\* appears to provide a less erratic profile for growth rates.<sup>13</sup>

**Figure 16: A bottom-up income estimate for GNI\* in constant prices**



Sources: CSO; and author's calculations.

Notes: Appropriate sector-level deflators are used based on the *Annual National Accounts (ANA)*.

<sup>13</sup> For example, the latest outturns show a fall in real GNI\* in 2015 of -1.8%, whereas the bottom-up approach in Figure 9 shows growth of 5.5%; conversely, 2021 growth of 15.4% in the official release is 10.9% in the bottom-up approach.

### 3.2 GNI\* and CA\* by institutional sector

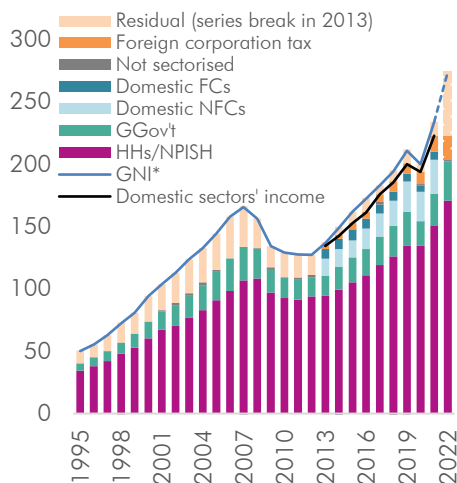
While the bottom-up approximations of GNI\* in Figures 10 and 11 are useful in terms of illustrating the broad structure of the Ireland’s national income, they also have some shortcomings. One omission is corporation tax emanating from the sectors with excluded NOS, the absence of which means that NOS\* and the sectors with excluded NOS are shown with understated contributions to GNI\*.<sup>14</sup> Appendix 4 compares sector-level GOS\* included in Figure 11 with GOS of domestic firms for 2013–2021. This exercise may indicate where GOS\* in a sector is overstated by foreign profits, although some of this could be explained by corporation taxes.

The same granular data used in Appendix 4, from the annual *Institutional Sector Accounts, Non-Financial*, can be used to build up GNI\* for domestic institutional sectors.<sup>15</sup> This source underpins the analysis of net national product by FitzGerald (2020 and 2021). Sector amounts are shown in Figure 17a, and Figure 17b is split by income type.

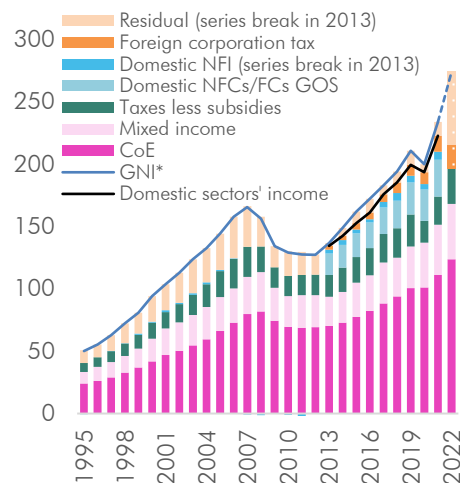
**Figure 17: Since 2013, GNI\* is nearly fully explained by domestic sectors’ national income, when foreign corporation tax is included**

€ billion, current prices

A. GNI by institutional sectors



B. GNI by income type



Sources: CSO; and author’s calculations.

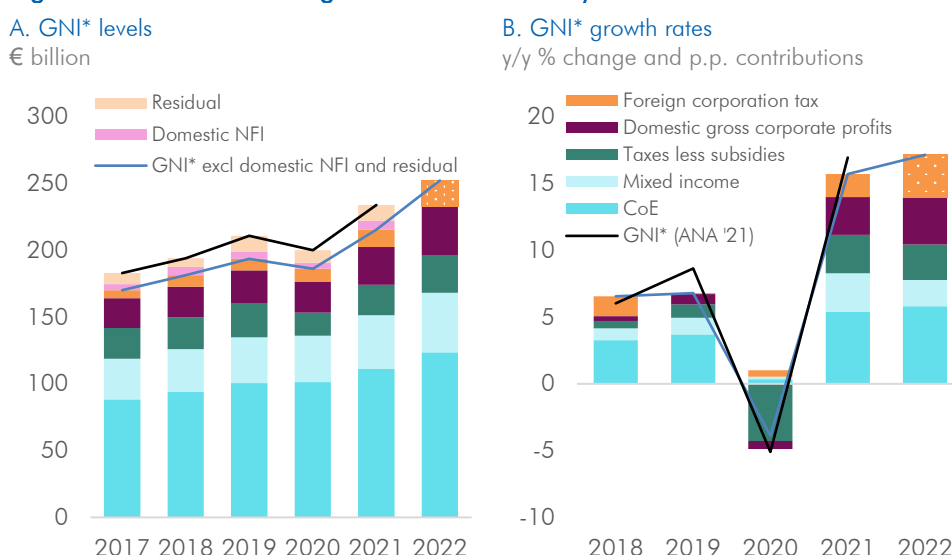
The domestic sectors are households/non-profit institutions serving households (HHs/NPISH), general government (GGov’t), domestic non-financial corporations

<sup>14</sup> McCarthy (2023) shows that €15.5 billion of corporation tax was paid by firms in manufacturing, information/communication, and administration/support sectors. However, Revenue data for corporation tax payments are not published at NACE A\*64 level, nor are they split between payments by domestic and foreign firms, as required to address this shortcoming.

<sup>15</sup> This dataset allows NOS and depreciation of all foreign-owned firms to be excluded, but to retain their total corporation tax payments (albeit not as a sectoral split).

(NFCs), and domestic financial corporations (FCs). As discussed in the framework presented by Lane (2016), foreign corporation tax — specifically, taxes on income and wealth paid by foreign corporates — is an additional income flow since only after-tax NOS should flow out of GNI.<sup>16</sup> The income split shown in Figure 17B can also be presented for 2017–2022 using a new CSO series published for domestic corporate gross profits as a proxy for domestic firms’ GOS and NFI (Figure 18A). Figure 18B shows contributions to annual growth in GNI\* excluding the items that are not currently available for 2022 (domestic NFI and the residual), although the available components grew in nominal terms by 17% in 2022. The analysis of 2022 in this paper assumes that this will be the outturn when the ANA 2022 release is published.

**Figure 18: Nominal GNI\* growth in 2022 is likely to be around 17%**



Sources: CSO; and author’s calculations.

The bottom-up “domestic sectors’ income” measure in Figure 17 is somewhat lower than GNI\* (4.5% on average for 2013–2021). As discussed below in the Box that analyses CA\*, this discrepancy can be interpreted as modified gross savings of foreign sectors remaining in GNI\*. The Box presents an alternative bottom-up formulation for CA\* compared to equation 3, based on a combination of the income and expenditure approaches, in which CA\* is shown to be equivalent to modified savings less modified capital formation.

<sup>16</sup> Foreign corporation tax is part of GNI\* despite being primary income (pre-tax NOS) for foreign firms. Although foreign corporation tax is more intuitively considered as government revenue, this is a secondary distribution of income, and it is therefore not included in GNI of the GGov’t sector since this mainly comprises product taxes (including VAT) net of product subsidies.

### Box: Blending the income and expenditure approaches to analyse CA\*

Combining the income and expenditure approaches can shed light on the extent to which CA\* can be explained by domestic resources. Equations i) – vi) below describe the distribution of GNI\*, culminating in modified gross national savings (S\*) in the current account of the *Institutional Sector Accounts, Non-Financial*, and showing its relationship to CA\*.

Equation i) re-states equation 2 for the expenditure approach, defining GNI\* with CA\* as its external component. Equation ii) then expands net transfers, and equations iii) and iv) define modified gross disposable income (GDI\*) as equivalent to GNI\* before subtracting net transfers.

i)  $GNI^* = C + G + I^* + CA^* - \text{net transfers}$

ii)  $\text{Net transfers} = \text{net taxes on income and wealth} + \text{net social contributions} + \text{net social benefits} + \text{net other transfers}$

iii)  $GNI^* + \text{net transfers} = GDI^*$

iv)  $C + G + I^* + CA^* = GDI^*$

Equation v) then re-arranges the components of GDI\*, subtracting C and G to obtain S\*. This conforms with the straightforward accounting identity that savings equals after-tax income less consumption.<sup>17</sup> Subtracting I\* from S\* therefore equals CA\*, as stated in equation vi).

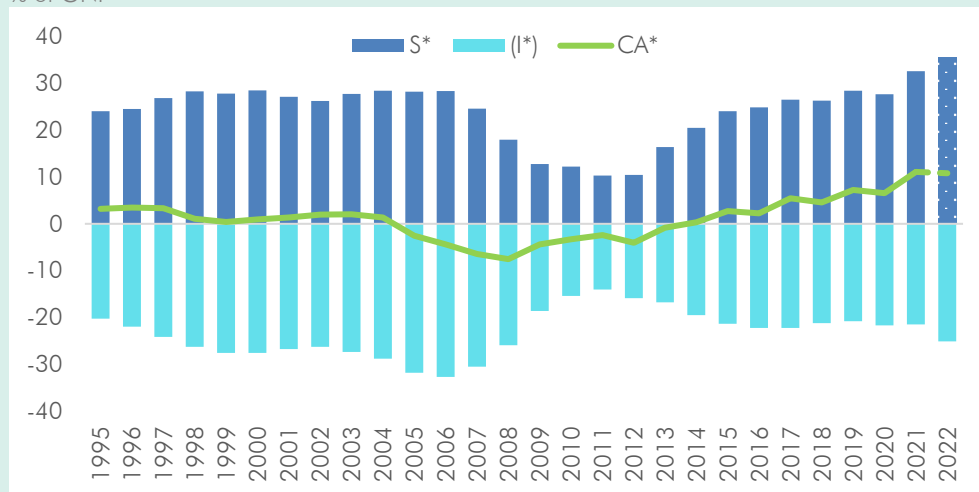
v)  $I^* + CA^* = GDI^* - C - G = S^*$

vi)  $CA^* = S^* - I^*$

This CA\* decomposition illustrates cyclical developments in the Irish economy (Figure B1). A CA\* deficit beginning in 2005 continued until 2013, although economy-wide levels for S\* and I\* more than halved during this period. Since 2014, the upward trend for CA\* has been characterised by higher S\* exceeding a relatively flat I\*, which remains considerably lower than its share of GNI\* during the early-to-mid 2000s. However, as noted below, the level of both S\* and CA\* could be overstated for 2020–2022.

**Figure B1: The rising CA\* surplus is due to higher S\* alongside flat I\***

% of GNI\*



Sources: CSO; and author's calculations.

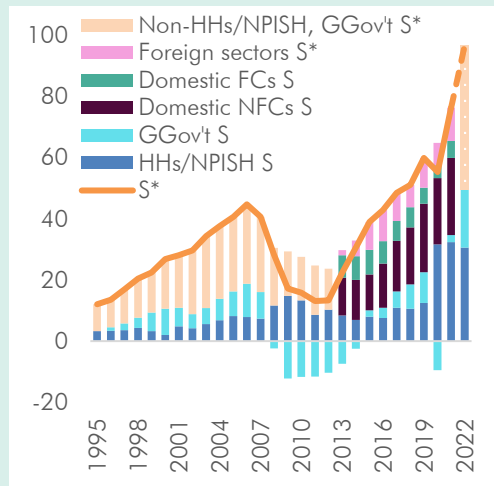
<sup>17</sup> "Consumption" here is final consumption expenditure of HHs/NPISH, plus individual/collective consumption of GGov't. Since NFCs and FCs do not consume final goods and services — rather, intermediate consumption of goods and services — the contribution of NFCs and FCs to S\* is GDI\* less taxes on income and wealth, net insurance premiums, and miscellaneous transfers.

To give further insight into developments in  $S^*$ ,  $I^*$ , and  $CA^*$ , these series can also be assessed in terms of contributions from institutional sectors. The sharp rise in 2020 for gross savings by HHs/NPISH (Figure B2A) could be overstated as a result of under-estimated household consumption, as discussed in Timoney (2022b). Alternative estimates of household consumption would be consistent with lower  $S^*$  and  $CA^*$  levels by €9–10 billion in 2021 and 2022. Figure B2B suggests that  $S^*$  of foreign sectors — that is, foreign NFCs, foreign FCs, and re-domiciled PLCs — is equivalent to the gap between  $GNI^*$  and domestic GNI, as discussed above regarding Figure 17.

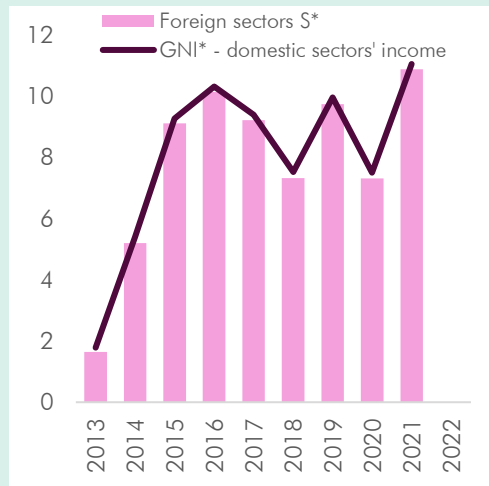
**Figure B2:  $S^*$ ,  $I^*$ , and  $CA^*$  by institutional sectors**

€ billion, current prices

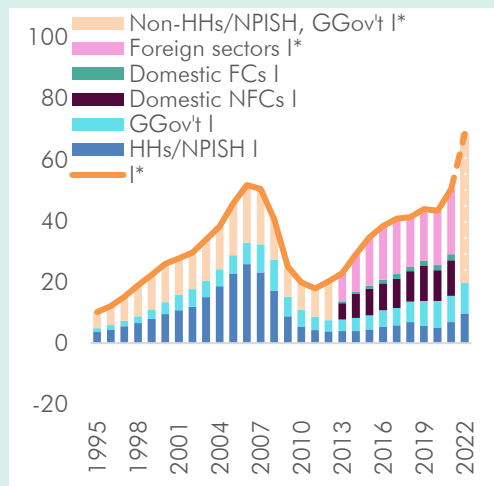
**A.  $S^*$  has increased significantly since 2012**



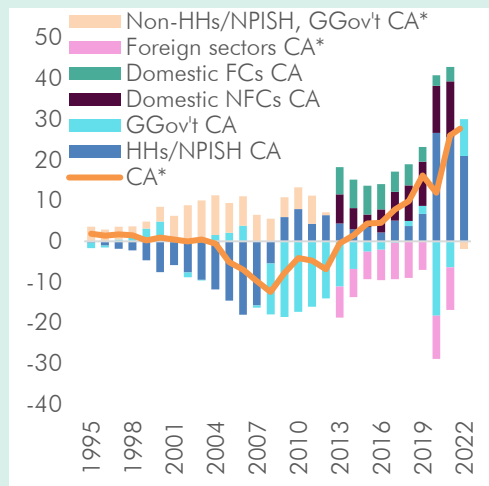
**B.  $S^*$  of foreign sectors in  $GNI^*$  since 2013**



**C. About two-fifths of  $I^*$  is by foreign sectors**



**D. The  $CA^*$  surplus has risen substantially**



Sources: CSO; and author's calculations.

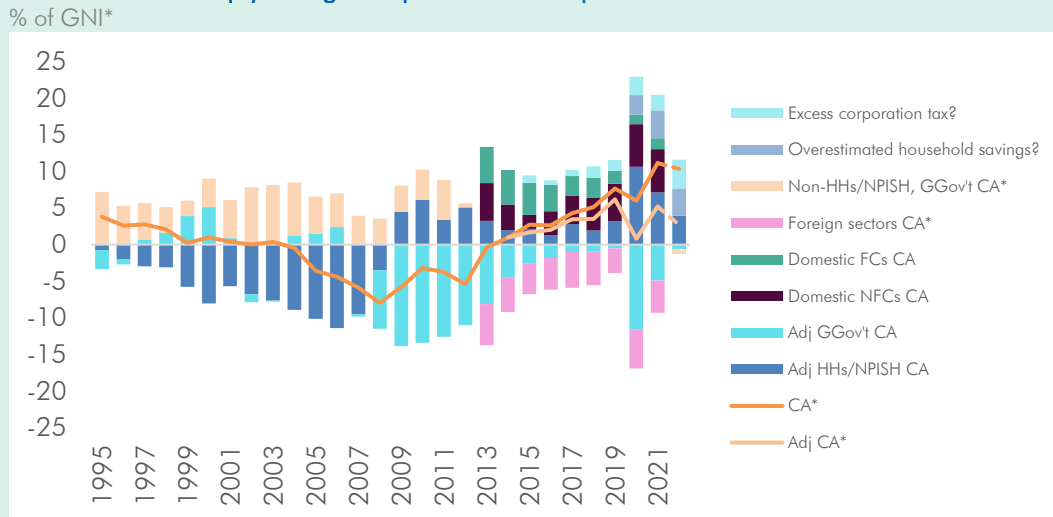
About two-fifths of  $I^*$  expenditure in the Irish economy has come from foreign sectors since 2013, and this reached 9% of  $GNI^*$  in 2021. In Figure B2C,  $I^*$  by foreign sectors has been derived by applying the adjustments in modified investment to their gross capital formation.



Combining  $S^*$  less  $I^*$ , Figure B2D shows  $CA^*$  contributions.<sup>18</sup> Whereas the pandemic resulted in a large negative contribution to  $CA^*$  from the general government sector in 2020, and a smaller negative contribution in 2021,  $CA^*$  has nonetheless remained in a significant surplus as a result of surpluses for HHs/NPISH and domestic firms.

Updated analysis from Timoney (2022) suggests that  $CA^*$  is overstated by about €9–10 billion in 2021 and 2022 as a result of underestimated household consumption. Excluding this amount, and estimates of excess corporation tax receipts, would leave a comparably large adjusted  $CA^*$  surplus to the pre-pandemic level of over 5% of  $GNI^*$ , as shown in Figure B3.

**Figure B3: Excluding potentially overestimated household savings and excess corporation taxes would still imply a large “adjusted  $CA^*$ ” surplus in 2021**



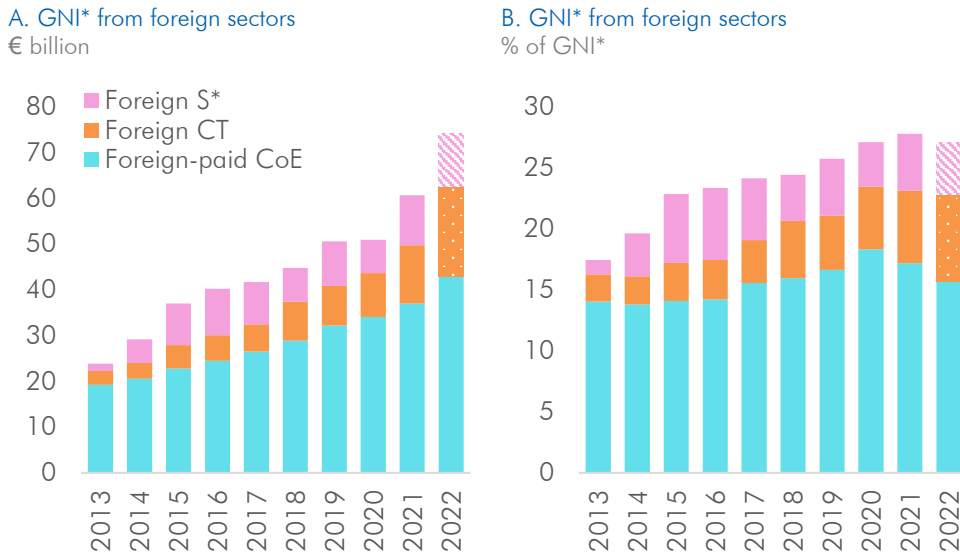
Sources: CSO; and author's calculations.

### 3.3 Estimating the contribution of foreign sectors to $GNI^*$

Overall, the estimates in Figures 10, 11, and 17 provide some reassurance that the level of  $GNI^*$  is well explained without the profits of foreign-owned firms. However,  $GNI^*$  has been boosted considerably in recent years by the rapid growth in wages and corporation tax paid by foreign firms. These sources increased considerably in 2022, as shown in Figure 19, mainly due to an increase of more than 50% in foreign-paid corporation tax. Over nine years between 2013 and 2022, wages and corporation tax paid by foreign-owned multinationals operating in Ireland increased by €40 billion or 7 percentage points of  $GNI^*$ .

<sup>18</sup> This is similar to the presentation by Power and Lennon (2021), although significant data revisions to the domestic-foreign split between the annual 2020 and 2021 releases of the *Institutional Sector Accounts, Non-Financial* have resulted in a much-changed contribution of foreign institutional sectors'  $S^*$ -less- $I^*$  balances to  $CA^*$ . Coffey (2022) also presents  $CA^*$  by domestic sectors, concluding that about €60 billion is available to add to national wealth.

**Figure 19: Between 2013 and 2022, wages and corporation taxes paid by foreign firms have increased by €40 billion or 7 percentage points of GNI\***



Sources: CSO; and author’s calculations.

Notes: For 2022, foreign corporation tax is based on Revenue analysis by McCarthy (2023). The figure for modified foreign savings (foreign S\*) is based on its nine-year average of GNI\* (4%), and this is applied to an estimate of nominal GNI\* for 2022 using data that are available, which indicate a growth rate 17.2% for the year.

The increase in foreign-paid wages is subject to lower risks of reversal than corporation tax, given the significant concentration of corporation tax payments among a small number of firms (recently illustrated by Cronin, 2023). Firms included among the largest payers of corporation tax have a relatively low employment footprint in Ireland, and there is a greater diversification of activities/risk factors affecting employment by foreign-owned multinationals compared to their corporation tax payments.

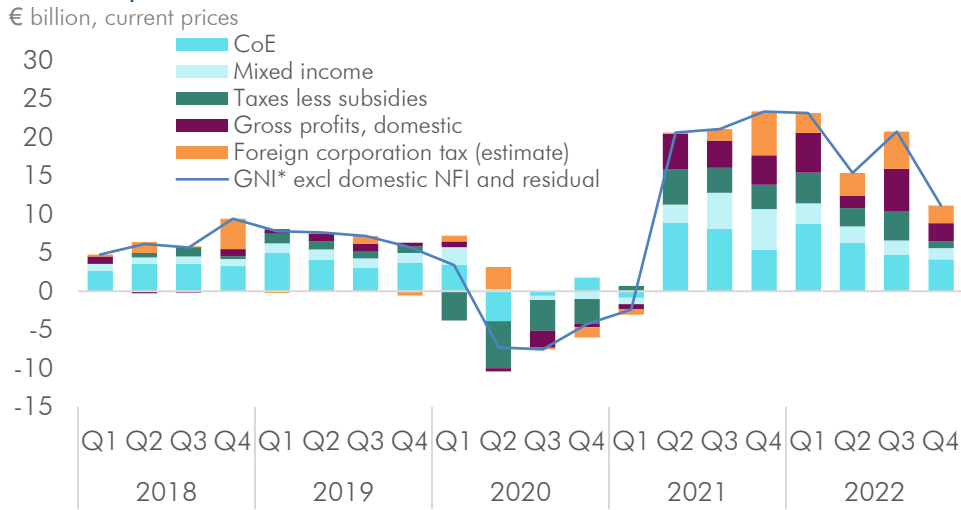
Nonetheless, the data presented in Figure 19 highlight that foreign-owned multinationals operating in Ireland are a vital component of national income, accounting for over one-fifth of GNI\*. This finding is broadly consistent with FitzGerald’s analysis of the contribution of foreign-owned multinationals to net national product, which was 22% for 2019, compared to 26% as shown above.

### 3.4 Towards a quarterly estimate of GNI\*

Using the same data presented in Figure 18, it is possible to construct an approximation of GNI\* at quarterly frequency for Q1 2017 – Q4 2022. One assumption is required regarding the quarterly profile for foreign corporation tax. However, since about 80% of all corporation tax has been paid by foreign-owned multinationals since 2017, it is reasonable to assume that quarterly Exchequer receipts scaled down to the correct annual total will be reasonably close to

accurate. Figure 20 shows this data as year-on-year growth rates, indicating a very rapid recovery from the Covid-19 pandemic, resulting in annual growth rates of around 20%, before declining to around 10% in late 2022.

**Figure 20: A quarterly proxy for GNI\* indicates a very rapid recovery from the Covid-19 pandemic**



Sources: CSO; and author's calculations.

## 4. Productivity implications of the bottom-up framework for GNI\*

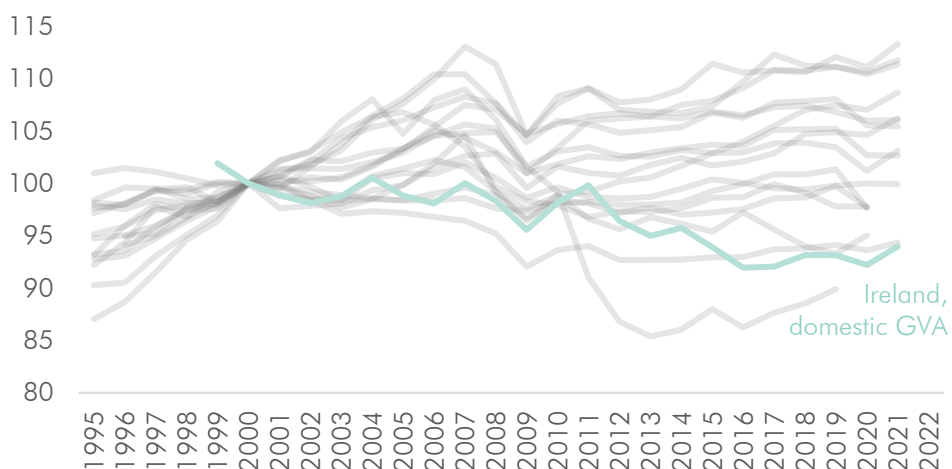
It has long been acknowledged that the presence of foreign-owned multinational firms has distorted productivity indicators for Ireland. An extreme example of this is shown in the CSO's *Productivity in Ireland* analysis of **labour productivity** (real GVA per hour worked) for 2015. The latest CSO estimates for 2015 show labour productivity growth of 18%. This is explained by a contribution of capital deepening of 52%, and MFP growth of –34%. **Multifactor productivity** (MFP) growth is the difference between labour productivity growth and the contribution due to **capital deepening** (capital services volume per hour worked).

The CSO also provides a split for “domestic MFP” — that is, MFP based on domestic GVA, which excludes sectors with turnover dominated by foreign-owned multinational firms. However, as shown below, a more relevant estimate of MFP is one that is based on a bottom-up assessment of GNI\*, where a corresponding approach has been applied to estimating the capital input.

The latest CSO release shows that domestic MFP is surprisingly weak compared to other European countries, as shown in Figure 21 — its long-run average growth rate stands at –0.4% for 2000–2021. This is also considerably weak relative to other European countries. The estimate is the difference between annual domestic labour productivity of 1.7%, and average domestic capital deepening of 2.1%.

**Figure 21: Ireland's MFP for domestic GVA has been far weaker than MFP for total GVA in most other European countries**

2000 = 100



Sources: CSO; OECD; and author's calculations.

Note: MFP for other countries is based on GVA and includes all sectors, whereas Ireland's data is shown for domestic GVA, which excludes information/communication and foreign manufacturing.

While MFP for other countries in Figure 21 is based on total GVA, estimates of economic growth in other European countries have not been subject to comparable distortions in Ireland’s GVA and GDP data since 2015. As domestic GVA removes the sectors causing most of the distortions to measured economic growth, it is plausible to expect that the remainder reflects relevant interactions between Ireland’s labour and capital resources. However, this expectation is not supported by the diverging path for MFP in Ireland based on domestic GVA relative to other European countries. This adds to prior analysis that domestic GVA is an insufficient indicator for understanding macroeconomic developments in the Irish economy.

One explanation for the weakness of domestic MFP is that it could be unduly influenced by the renting/leasing sector, given its presence in Ireland’s capital stock has substantially increased in recent years — yet renting/leasing remains included in domestic GVA. Another possible explanation is that domestic GVA excludes wages in fast-growing sectors like foreign manufacturing and information/communication, and this could be having a detrimental impact on labour productivity as measured by domestic GVA, and therefore leading to a weaker performance for domestic MFP. Further analysis of MFP developments based on a measure that is more consistent with GNI\* can help to address these concerns.

Table 1 ranks sectors into three groups on the basis of real GVA per actual hour worked. Grouping sectors in this manner can be a helpful approach to characterising developments in the economy across sectors (see also Timoney, 2022a). Given the impact of the pandemic on the economy in 2020 and 2021, Table 1 uses 2019 data to create three sector groups: Upper, Middle, and Lower.

**Table 1: Ranking real GVA\* per actual hour worked across sectors**

€ gross value added per actual hour worked in 2019, 2020 constant prices

| Upper                   | €     | Middle              | €  | Lower                 | €  |
|-------------------------|-------|---------------------|----|-----------------------|----|
| Real estate activities  | 1,233 | Manufacturing*      | 50 | Transport/storage     | 33 |
| Financial/insurance     | 85    | Public admin        | 47 | Construction          | 32 |
| Mining/utilities        | 78    | Education           | 43 | Other activities      | 25 |
| Professional/scientific | 60    | Admin/support*      | 39 | Accomm/food           | 21 |
| Wholesale/retail        | 54    | Info/communication* | 38 | Agri/forestry/fishing | 13 |
|                         |       | Health/social       | 36 |                       |    |

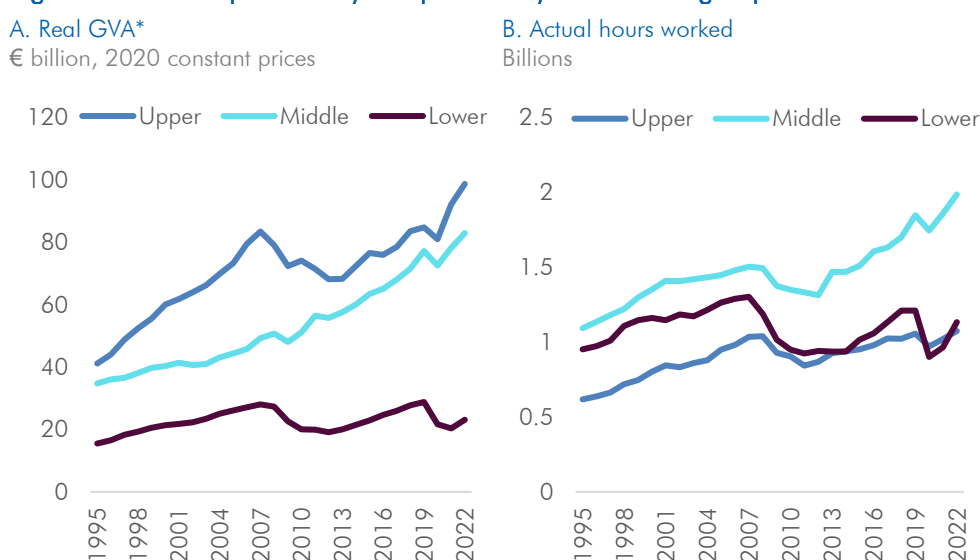
Sources: CSO; and author’s calculations.

Notes: CSO data for actual hours worked are used, but in some cases, more granular NACE Eurostat data for hours worked are used to impute actual hours worked (for example, to separate financial/insurance from real estate). Nominal GVA\* is compiled for NACE Rev 2 sectors as shown in Figure 7, before relevant deflators from the *Annual National Accounts* are applied. GOS is excluded for foreign manufacturing, information/communication, and renting/leasing, but no adjustment is made to actual hours worked, since all labour compensation is included in GVA\*.

GOS is excluded from renting/leasing (a subcategory of admin/support), foreign manufacturing, and information/communication. As a result, these sectors are ranked in the middle group for labour productivity. Hours worked in these sectors remain relevant to labour compensation in GNI\*, and Figure 7 suggests that CoE is the main contribution to national income made by these sectors, rather than pre-tax profits.

Using the groupings in Table 1, Figure 22 shows components of labour productivity: real GVA\* and actual hours worked. Although Upper has had the largest real GVA for 1995–2021, the actual hours worked had been lower the other two groups until 2020, when Covid-19 especially took its toll on employment for Lower. Middle has closed the gap to Upper in terms of real GVA, but actual hours worked for Middle have also increased more rapidly than for the other two groups.

**Figure 22: Labour productivity components by three sector groups**

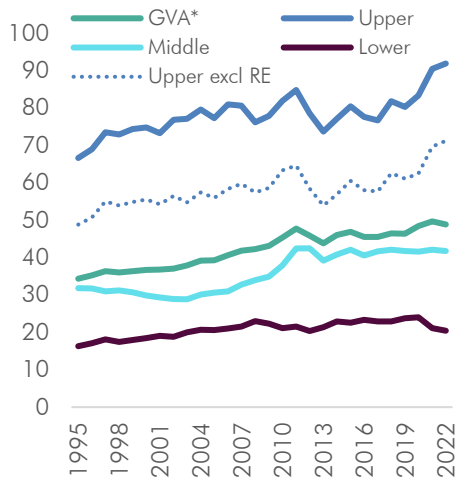


Sources: CSO; and author's calculations.

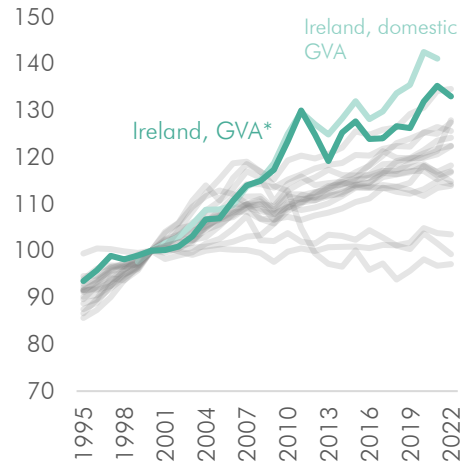
Figure 23 shows **labour productivity levels**, within Ireland across three groups, and compared to other European countries. As Table 1 revealed, real estate has had an unusually large level of real GVA per hour; for comparison, Upper labour productivity is also shown without real estate, although the trend over time remains upward, and largely the same as for Upper. By contrast, Middle has been flat for the past decade, and the long-run path for Lower has also been relatively muted. Overall, Ireland's labour productivity for GVA\* has grown more rapidly than has GDP per capita in most other European countries. Ireland's GVA\* per hour worked has grown 1.4% a year on average for 1995–2021, slower than only Sweden, where GDP per hour worked has grown by 1.7% a year on average.

**Figure 23: Labour productivity**

A. For Ireland, by three sector groups  
€ per hour, 2020 constant prices



B. Compared to other European countries  
2000 = 100



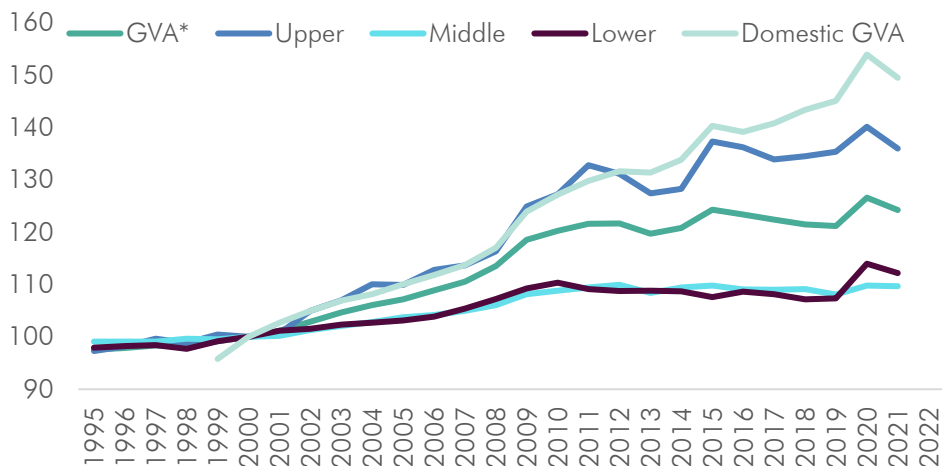
Sources: CSO; OECD; and author's calculations.

Note: Labour productivity for other countries in panel B is based on GDP per hour worked.

As noted above, labour productivity growth can be explained either by MFP growth or the **contribution of capital deepening**. Appendix 5 presents the derivation of  $K^*$  — that is, capital services volume that is broadly consistent with  $GVA^*$  — and its related capital deepening contribution. Capital deepening has risen at the fastest rate for Upper, and this is reflected in capital deepening for  $GVA^*$ . Figure 24 also suggests that the rise in capital deepening in 2020 was due to Lower and Upper, rather than as a result of developments in Middle.

**Figure 24: Capital deepening contributions to labour productivity in  $GVA^*$  have been far lower than in domestic  $GVA$**

2000 = 100



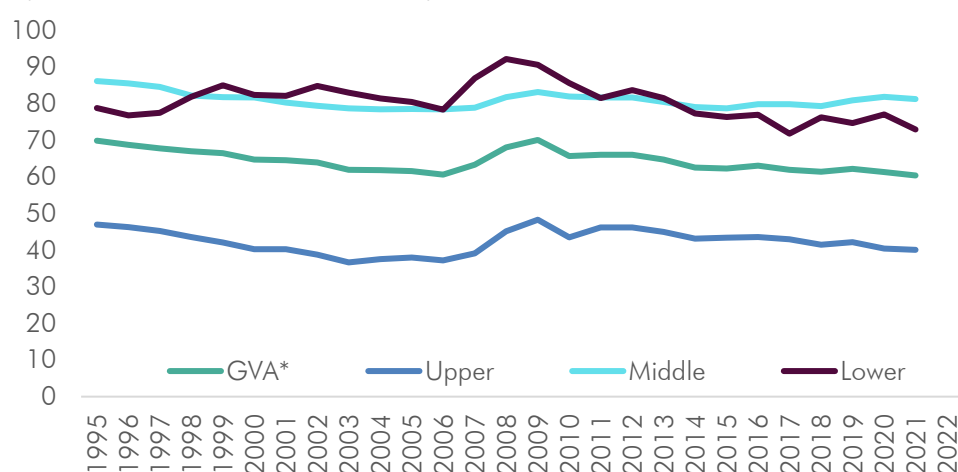
Sources: CSO; and author's calculations.

Notes: Appendix Figure A5 shows that the most appropriate sectors and asset types to exclude in deriving  $K^*$  are intangibles and transport equipment assets for manufacturing, information/communication, and administration/support — since depreciation on these asset types and sectors is very similar to the depreciation adjustments in the official derivation of  $GNI^*$ .

The **labour share** shows the percentage of GVA\* accruing to labour.<sup>19</sup> For total GVA, the labour share has collapsed over time, driven by large and sustained increase in foreign-sector profits. By contrast, the labour share in GVA\* has been far steadier over time, as shown in Figure 25 for three sector groups. Middle generally exhibits the highest labour share since 1995, apart from during the global financial crisis period, when Lower’s profits collapsed.<sup>20</sup> The total for GVA\* has fallen from 68% in 1995 to 59% in 2021, and the upper group has also experienced a similar decline in its labour share since 1995.

**Figure 25: The labour share in GVA\* by three sector groups**

€ per actual hour worked, 2020 constant prices



Sources: CSO; and author’s calculations.

Given real GVA\* (Figure 22A), and combining the inputs of actual hours worked (Figure 22B), labour shares in GVA\* (Figure 25), and capital services volume in GVA\* (Figure A5), the growth rate for MFP\* can be residually determined for the three sector groups (see Appendix 5). Figure 26 presents MFP\* in index form. The long-run trend for MFP\* is considerably stronger than the trend for domestic-GVA-based MFP. This is despite the particularly weak trend for Upper MFP\*, reflecting its greater reliance on capital services to generate real economic growth, especially evident since the global financial crisis period.

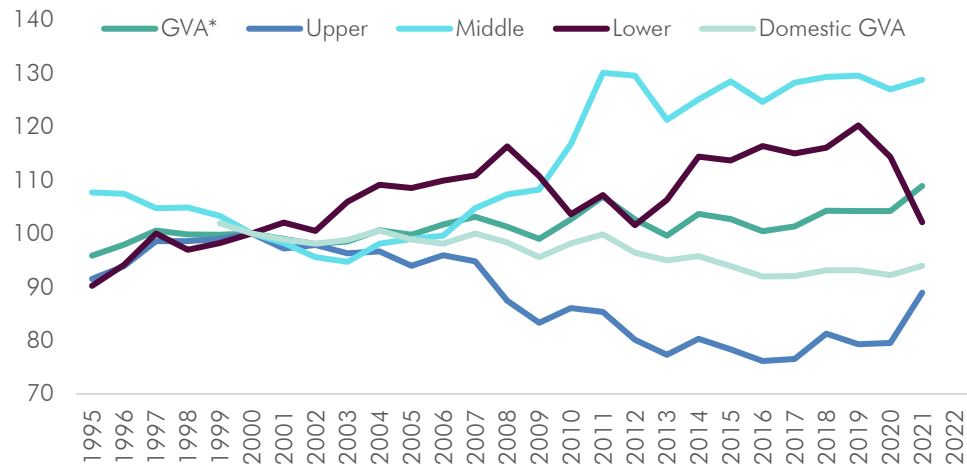
<sup>19</sup> This comprises CoE, plus the labour share of gross mixed income (which is approximated as hourly CoE times self-employed actual hours worked), plus the labour share of taxes less subsidies on production (scaled by CoE plus the labour share of gross mixed income, divided by CoE plus gross mixed income plus GOS).

<sup>20</sup> The public sectors (public admin, education, and health) are included in Middle, and this is a plausible explanation for the higher labour share. However, the GVA\* also excludes GOS by domestic firms involved in foreign-dominated manufacturing, information/communication, or rental/leasing activities. Factoring in domestic-firm GOS in these sectors, this suggests that a slightly lower labour share would be more accurate for Middle.



**Figure 26: MFP\* by three sector groups**

2000 = 100



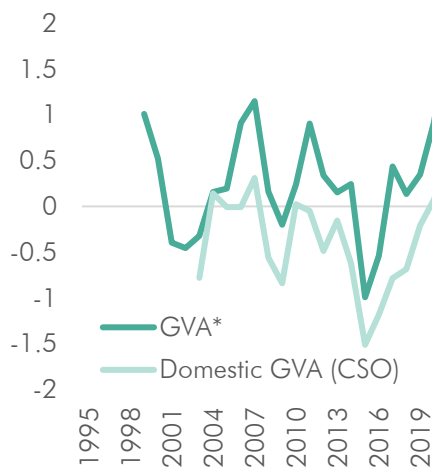
Sources: CSO; and author's calculations.

Compared to domestic MFP, MFP\* growth has been far stronger, as shown in Figure 27A. Rather than a contraction in domestic MFP of  $-0.4\%$  a year over 2000–2021, MFP\* has grown by  $0.4\%$ . The difference between these estimates is  $0.8$  of a percentage point, and this could have important implications for long-term economic projections for Ireland. Lastly, Figure 27B replicates Figure 21, but with MFP\* also shown. This analysis suggests that Ireland's MFP performance has not been weak relative to other European countries when an appropriate measure of Ireland's economy is used. It suggests a relatively strong performance over time, with MFP\* growth averaging  $0.5\%$  for 1995–2021: fifth in the sample behind the UK and Germany ( $0.6\%$ ), Sweden ( $0.75\%$ ), and Finland ( $0.95\%$ ).

**Figure 27: MFP\* has grown faster than domestic MFP, and more in line with other European countries**

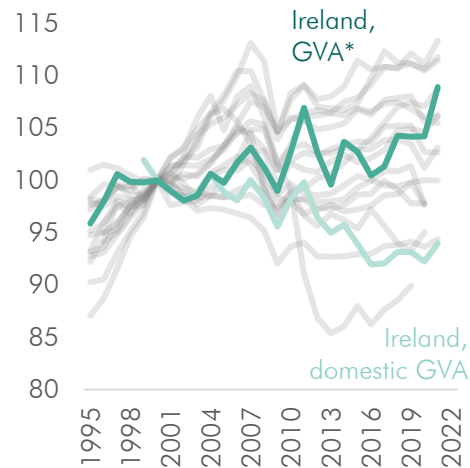
A. MFP growth rates

Four-year average % change



B. MFP levels

2000 = 100



Sources: CSO; and author's calculations.

## Summary and conclusions

The CSO's macroeconomic statistics have progressed significantly over the past number of years. Notable developments include the production of GNI\* and the modified current account. These have been complemented by a greater proliferation of administrative data sources and several related experimental releases. There has also been an ongoing expansion of the range of sectors and categories of activities that are covered in the *Annual National Accounts*, the *International Accounts*, and the *Institutional Sector Accounts*.

Despite these and other improvements, GNI\* is still officially derived as a top-down measure. This limits its usefulness for understanding what is going on in the Irish economy. This paper therefore shows that bottom-up estimates of GNI\* can help to demystify Ireland's macroeconomic and productivity statistics. It adds to existing work examining underlying developments in Ireland's macroeconomic data, which includes contributions in recent years by FitzGerald (2018, 2020, and 2021), Power and Lennon (2021), Lennon (2022), and Coffey (2022).

GNI\* is firstly examined for the expenditure approach using a framework that is similar to "trimmed GDP" as suggested by Honohan (2016). The official derivation of GNI\* involves very large flows for exports, modified imports, net factor income, and below-the-line adjustments. These flows are mostly offsetting, but some of them are opaque in terms of which sectors they involve. As such, the official derivation lacks intuition for understanding Ireland's domestic resources. By contrast, other expenditure flows in GNI\* are far more relevant and intuitive: personal consumption, government net consumption, and modified gross capital formation. Analysis of institutional sectors shows that about two-fifths of modified gross capital formation is paid for by the foreign sectors. Overall, subject to data availability, scope remains for further development of an improved bottom-up expenditure estimate of GNI\*.

The income approach to GDP is distorted by profits of foreign-owned firms, yet these profits appear to bear little ultimate relevance to real economic activity in Ireland. As noted by Lane (2016), the wages and corporation taxes paid by these firms contribute significantly to Ireland's domestic resources. As such, subject to data availability, these amounts should be included in a bottom-up analysis of Ireland's national income. Relative to official outturns, a smoother profile of economic growth

and activity can be estimated based on the bottom-up income approach to estimating real GNI\*.

A bottom-up estimate of GNI\* can also be presented using the output approach, which subtracts a modified version of intermediate consumption from a correspondingly modified version of output. This provides further perspective regarding cyclical developments and sectoral interlinkages in the Irish economy.

Ireland's productivity developments can be analysed on a comparable basis to the bottom-up income approach to estimating GNI\*. This addresses some of the shortcomings of relying on published measures of domestic productivity. Domestic GVA leaves out wages earned in some of the most productive sectors, but all value added of aircraft leasing remains included. These factors weaken domestic labour productivity as well as overstating the degree of domestic capital deepening due to the presence of transport equipment assets for aircraft leasing. It implies a very weak performance for domestic multifactor productivity, when compared to other European countries.

However, the bottom-up income approach to estimating GNI\* means that all wages and hours worked can be included in the analysis of labour productivity. A version of capital deepening can then be derived to be approximately consistent with GNI\*. This results in new estimates of multifactor productivity based on the bottom-up income approach to estimating GNI\*. These estimates are shown to be better aligned to productivity developments in other European countries. As before, more granular data would enable more precise calculations of these estimates.

The broad approach to bottom-up estimation in this paper remains somewhat blunt, as it involves excluding profits of entire sectors where distortions to activity are known to affect the components of GDP. An alternative theoretical framework for understanding macroeconomic developments in small and open economies could be a preferable solution. Absent this, the analysis in this paper shows that a number of modifications are necessary to enable meaningful interpretation of the statistics that matter for understanding Ireland's national income and productivity.

## References

- Casey, E. and J. Hannon (2016). "Challenges Forecasting Irish Corporation Tax". Irish Fiscal Advisory Council, Analytical Note No. 10. September 2016. Available at: <https://www.fiscalcouncil.ie/wp-content/uploads/2015/03/AN-10-Challenges-Forecasting-Irish-Corporation-Tax-Final-Web.pdf>
- Coffey, S. (2022). "What to do with €166 billion of annual gross national savings?". Economic Incentives blog post, November 2022. Available at: <http://economic-incentives.blogspot.com/2022/11/what-to-do-with-166-billion-of-annual.html>
- Coffey, S. (2023). "National Income: 2 – From Production Value to Added Value – Getting to GDP". Irish Economy blog post, February 2023. Available at: <http://www.irisheconomy.ie/index.php/2023/02/09/national-income-2-from-production-value-to-added-value-getting-to-gdp/>
- Connolly, M. (2017). "The Expected and Unexpected Consequences of ESA 2010 – an Irish perspective". Journal of the Statistical and Social Inquiry Society of Ireland, Vol. XLVII, 2017-18, pp39-70. Available at: <http://www.tara.tcd.ie/handle/2262/86012>
- Cronin, B. (2023). "Understanding Ireland's top corporation taxpayers". Irish Fiscal Advisory Council Working Paper Series No. 20. Dublin. Available at: [www.fiscalcouncil.ie/working-papers/](http://www.fiscalcouncil.ie/working-papers/)
- Economic Statistics Review Group (2016). "Report of the Economic Statistics Review Group". Central Statistics Office. Available at: <https://www.cso.ie/en/csolatestnews/eventsconferenceseminars/resrg/>
- FitzGerald, J. (2013). "The Effect of Redomiciled Plcs on GNP and the Irish Balance of Payments". Economic and Social Research Institute Research Note 2013/1/2. Available at: <https://www.esri.ie/system/files/publications/RN20130102.pdf>
- FitzGerald, J. (2016). "Problems with the Irish National Accounts and Possible Solutions". Economic Statistics Review Group Discussion Paper. December 2016. Available at: <https://www.cso.ie/en/csolatestnews/eventsconferenceseminars/resrg/>
- FitzGerald, J. (2018). "National Accounts for a Global Economy: the Case of Ireland". Economic and Social Research Institute, Special Article in *Quarterly Economic Commentary* Summer 2018. Available at: [https://www.esri.ie/system/files/publications/QEC2018SUM\\_SA\\_FitzGerald.pdf](https://www.esri.ie/system/files/publications/QEC2018SUM_SA_FitzGerald.pdf)
- FitzGerald, J. (2020). "Understanding recent trends in the Irish economy". Economic and Social Research Institute, Special Article in *Quarterly Economic Commentary* Summer 2020. Available at: [https://www.esri.ie/system/files/publications/QEC2020SUM\\_SA\\_FitzGerald.pdf](https://www.esri.ie/system/files/publications/QEC2020SUM_SA_FitzGerald.pdf)
- FitzGerald, J. (2021). "Economic growth between 2013 and 2019". Economic and Social Research Institute, Box in *Quarterly Economic Commentary* Spring 2021. Available at: [https://www.esri.ie/system/files/publications/QEC2021SPR\\_0.pdf](https://www.esri.ie/system/files/publications/QEC2021SPR_0.pdf)
- Fiscal Council (2020). "Box E: Forecasting real GNI\* growth rates in place of GDP and GNP". Irish Fiscal Advisory Council, *Fiscal Assessment Report*, May 2020. Available at: <https://www.fiscalcouncil.ie/wp-content/uploads/2020/05/FAR-May-2020-Box-E-Forecasting-real-GNI-Star-growth-rates-in-place-of-GDP-and-GNP.pdf>
- Fiscal Council (2021). "Box C: Department of Finance now making greater use of GNI\* when assessing budgetary sustainability and real economic activity". Irish Fiscal Advisory Council, *Fiscal Assessment Report*, December 2021. Available at: <https://www.fiscalcouncil.ie/wp-content/uploads/2021/11/FAR-Dec-2021-Box-C->

[Department-of-Finance-now-making-greater-use-of-GNI-star-when-assessing-budgetary-sustainability-and-real-economic-activity.pdf](#)

Honohan, P. (2016). "Towards a trimmed-GDP concept". Economic Statistics Review Group Discussion Paper. November 2016. Available at: <https://www.cso.ie/en/csolatestnews/eventsconferencesseminars/resrg/>

Lane, P. (2016). "Notes on the Treatment of Global Firms in National Accounts". Economic Statistics Review Group Discussion Paper. December 2016. Available at: <https://www.cso.ie/en/csolatestnews/eventsconferencesseminars/resrg/>

Lennon, R. (2022). "GNI\* in 2021: Robust economic growth or the fast and the furious?". Department of Finance, Economic Insights – Winter 2022. Available at: <https://www.gov.ie/en/publication/2e14a-economic-insights-winter-2022/>

Lennon, R. and I. Power (2021). "Forecasting GNI\* – detailing the Department of Finance Approach". Department of Finance, December 2021. Available at: <https://www.gov.ie/en/publication/41891-forecasting-modified-gni/>

McCarthy, L. (2023). "Corporation Tax – 2022 Payments and 2021 Returns". Revenue Research. Available at: <https://www.revenue.ie/en/corporate/documents/research/ct-analysis-2023.pdf>

McGuinness, G. and D. Smyth (2019). "Modelling Recent Developments in Corporation Tax". Department of Finance, November 2019. Available at: <https://www.gov.ie/en/publication/29cb12-modelling-recent-developments-in-corporation-tax/>

OECD (2001). "Measuring Productivity, OECD Manual". Organisation for Economic Co-operation and Development. Available at: <https://www.oecd.org/sdd/productivity-stats/2352458.pdf>

Power, I. and R. Lennon (2021). "Assessing Recent Developments in the Modified Current Account Balance". Department of Finance, Economic Insights – Winter 2021. Available at: <https://www.gov.ie/en/publication/79cff-economic-insights-winter-2021/>

Purdue, D. (2016). "Understanding Ireland's Corporation Tax Revenue". National Treasury Management Agency Economics, Research Technical Note. Available at: <https://www.ntma.ie/uploads/publication-articles/UnderstandingIrelandsCorporateTaxRevenueAugust2016F.pdf>

Timoney, K. (2022a). "A bottom-up sectoral assessment of the strength of income tax receipts". Irish Fiscal Advisory Council, Analytical Note No. 16. Available at: [https://www.fiscalcouncil.ie/wp-content/uploads/2022/07/AN16\\_A\\_bottom-up\\_sectoral\\_assessment\\_of\\_the\\_strength\\_of\\_income\\_tax\\_receipts.pdf](https://www.fiscalcouncil.ie/wp-content/uploads/2022/07/AN16_A_bottom-up_sectoral_assessment_of_the_strength_of_income_tax_receipts.pdf)

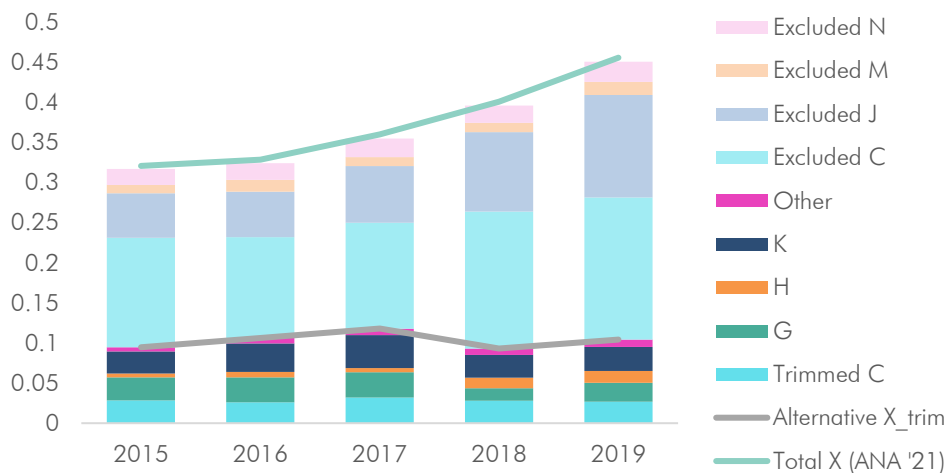
Timoney, K. (2022b). "Household consumption and savings in Ireland since the Covid-19 pandemic". Irish Fiscal Advisory Council, Analytical Note No. 18. Available at: <https://www.fiscalcouncil.ie/wp-content/uploads/2022/11/Household-Consumption-and-Savings-in-Ireland-Since-the-Covid-19-Pandemic-Fiscal-Council-Analytical-Note-18-by-Kevin-Timoney.pdf>

## Appendix 1: An alternative estimate of X\_trim

The estimate of X\_trim shown in Section 2.1 can be cross-checked using a separate exercise involving the supply-and-use tables, as shown in Figure A1. Using the two-digit breakdown of both exports and imports across industrial sectors up to 2019 (the latest year available), the sectors with the largest contributions to Ireland’s external trade can be readily identified.<sup>21</sup> Combined, exports from these sectors increased from €200 billion in 2015 — a year when exports by foreign-owned multinational entities grew very rapidly — to over €350 billion in 2019. Excluding these export categories, X\_trim was about €100 billion 2019, which is similar to the estimate in Figure 3.

**Figure A1: Comparing an alternative estimate of X\_trim with total exports**

€ trillion, current prices



Sources: CSO; and author’s calculations.

Recently, the CSO has published a breakdown of services exports and imports in 2019 by domestic and foreign firms.<sup>22</sup> This is a useful development, and in the direction of what FitzGerald (2018) suggested would be necessary to disentangle “the effects of trade on the economic welfare of those living in Ireland”. While the split is shown both for sectors and standard balance-of-payments categories of services trade, corresponding good trade data does not yet appear to be available.

<sup>21</sup> These sectors are manufacturing (NACE codes 19–21, 26, and 28–32), information and communication (58–63), professional/scientific/technical (72–75), and admin/support (77). The rationale for excluding those parts of manufacturing and all of information and communication is aligned with their status as sectors where GVA is dominated by foreign-owned multinational firms, as discussed with respect to incomes. The exclusion of parts of professional/scientific/technical and admin/support is related to their large weight in imports according to the supply-and-use tables — combined, these excluded sectors comprise over 50% of total imports for 2015–2019.

<sup>22</sup> The full release is available [here](#).

## Appendix 2: The top-down income derivation of GNI\*

The top-down derivation of GNI\* in the income approach is presented in the following six equations (A1–A5). Equation A1 summarises the components of GNI.

$$A1) \quad GNI = CoE + NOS + depreciation + non-product\ taxes\ less\ subsidies + product\ taxes\ less\ subsidies + NFI + EU\ subsidies\ less\ taxes$$

Gross operating surplus/mixed income (GOS) is a national accounting measure of business and entrepreneurial profits, and this can be separated into net operating surplus (NOS) and consumption of fixed capital (depreciation).<sup>23</sup> NFI can also be separated into compensation of employees from the rest of the world (CoE\_ROW) and net property income (NPI), and the CSO's institutional sector accounts since 2013 show property income separately for domestic sectors and foreign sectors. Equations A2 and A3 respectively expand GVA and NFI, and these are substituted into GNI in equation A4.

$$A2) \quad GVA = CoE + NOS + depreciation + non-product\ taxes\ less\ subsidies$$

$$A3) \quad NFI = [CoE\_ROW + domestic\ property\ income] + foreign\ property\ income \\ = \quad \quad \quad domestic\ NFI \quad \quad \quad +\quad \quad \quad foreign\ NFI$$

$$A4) \quad GNI = CoE + NOS + depreciation + non-product\ taxes\ less\ subsidies + product\ taxes\ less\ subsidies + domestic\ NFI + foreign\ NFI + EU\ subsidies\ less\ taxes$$

Equation A5 transforms equation A4 from GNI to GNI\* by including below-the-line adjustments.

$$A5) \quad GNI^* = CoE + NOS + depreciation + non-product\ taxes\ less\ subsidies + product\ taxes\ less\ subsidies + CoE\_ROW + domestic\ NPI + foreign\ NPI + EU\ subsidies\ less\ taxes + below-the-line\ adjustments$$

---

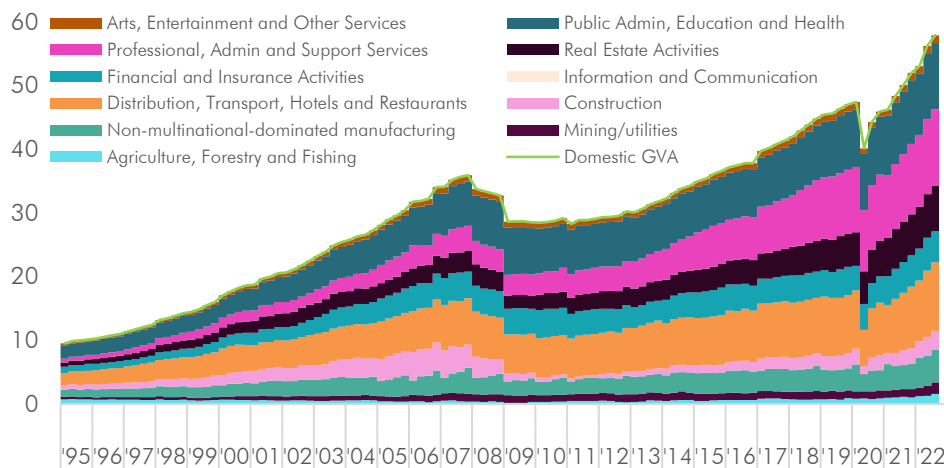
<sup>23</sup> This distinction between GOS and NOS is similar to the difference between operating profit — or EBITDA, which is earnings (i.e. profit) before interest, taxes, depreciation, and amortisation — and EBIT (earnings before interest and taxes). In either case, depreciation and amortisation reduces the firm's taxable profit in recognition of the fact that the firm's capital stock has been utilised (i.e. fixed capital has been consumed) in the process of producing output and profit.

## Appendix 3: Using a published GVA split to separate GVA for domestic and foreign manufacturing

For several years, the CSO has published a quarterly and annual series that is often referred to as “domestic GVA” — that is, GVA excluding “foreign GVA” (for sectors whose turnover is dominated by foreign-owned multinational firms). This implicitly provides GVA for the domestic manufacturing sector for Ireland, as shown in Figure 4. Foreign GVA identifies value added in sectors causing much of the distortion to Ireland’s GDP and GNI. This comprises all GVA for information/communication, and some GVA of the manufacturing sectors.<sup>24</sup>

**Figure A2: Domestic GVA excludes sectors whose turnover is dominated by foreign-owned multinational firms**

€ billion, current prices, seasonally adjusted



Sources: CSO; and author’s calculations.

Domestic GVA therefore does not capture CoE from the foreign-multinational-dominated sectors. However, Ireland’s GNI\* should include CoE in all sectors, and CoE has grown rapidly for the foreign sectors has in recent years, reaching €18.8 billion (17% of total CoE) in 2021. Domestic GVA also excludes GVA accruing to some Irish firms operating in the foreign-multinational-dominated sectors.

Conversely, domestic GVA includes profits of some foreign-owned firms where their turnover does not meet the foreign-dominated classification threshold. This means that domestic GVA is likely to overstate the decline of the domestic economy during the pandemic, when profits of aircraft leasing firms were particularly weak.

<sup>24</sup> NACE sectors 18.2 (reproduction of recorded media), 20 (chemicals and chemical products), 21 (basic pharmaceutical products and preparations), 26 (computer/electronic/optical products), 27 (electrical equipment), and 32.5 (medical and dental instruments and supplies) are manufacturing sectors whose turnover is dominated by foreign-owned multinationals.



## Appendix 4: Comparing GOS\* and domestic GOS

|       | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|-------|------|------|------|------|------|------|------|------|------|
| TOTAL | 15.6 | 18.4 | 19.3 | 16.3 | 19.6 | 22.3 | 17.8 | 16.8 | 27.0 |
| A     | 1.7  | 1.6  | 1.8  | 1.6  | 1.6  | 1.7  | 1.6  | 1.7  | 1.6  |
| D     | 0.0  | 0.0  | 0.1  | 0.2  | 0.2  | 0.3  | 0.2  | 0.5  | 0.3  |
| E     | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | 0.2  | 0.2  | -0.1 |
| F     | 0.1  | 0.2  | 0.2  | 0.3  | 0.3  | 0.4  | 0.3  | 0.5  | 1.0  |
| G     | 5.1  | 4.8  | 5.2  | 5.4  | 6.6  | 7.4  | 8.6  | 8.5  | 8.9  |
| H     | 0.1  | 0.1  | 0.1  | 0.1  | 0.3  | 0.3  | 0.5  | 0.9  | 0.3  |
| I     | 0.0  | 0.0  | 0.1  | 0.1  | 0.2  | 0.2  | 0.2  | 0.5  | 1.1  |
| J     | -0.8 | -0.9 | -1.1 | -1.8 | -0.9 | -0.9 | -0.9 | -1.3 | -1.6 |
| K     | 3.0  | 4.6  | 4.9  | 5.6  | 4.1  | 4.4  | 3.8  | 1.8  | 4.0  |
| L     | -0.3 | -0.3 | -0.3 | -0.3 | -0.7 | -0.4 | -0.4 | -0.1 | -0.1 |
| M     | 0.6  | 1.6  | 2.0  | 1.8  | 2.6  | 3.9  | 3.7  | 3.8  | 7.0  |
| N     | 0.0  | 0.1  | -0.1 | 0.0  | 0.0  | 0.5  | -3.6 | -3.4 | -3.6 |
| O     | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  | 0.0  |
| P     | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  | 0.3  | 0.3  |
| Q     | 0.1  | 0.1  | 0.1  | 0.1  | 0.1  | 0.2  | 0.0  | 0.6  | 0.5  |
| R     | -0.3 | -0.4 | -0.3 | -0.3 | -0.2 | -0.2 | -0.2 | 0.0  | -0.1 |
| S     | 0.4  | 0.4  | 0.4  | 0.4  | 0.4  | 0.4  | 0.4  | 0.3  | 0.5  |
| T     | 0.0  | 0.0  | 0.0  | 0.0  | -0.1 | -0.1 | 0.0  | -0.2 | 0.0  |
| B,C   | 5.9  | 6.7  | 6.4  | 3.2  | 5.1  | 4.5  | 3.2  | 2.0  | 6.9  |

The table above compares € billion amounts for GOS\* less domestic GOS based on the institutional sector accounts, non-financial. The analysis shows sectors where GOS\* could be overstated due to the effects of multinational firms, although an offsetting effect is foreign corporation taxes, which are not available at industrial sector level split by foreign-owned and domestic-owned firms. If made available, this data would enable a fuller presentation of the effective contributions by different industrial sectors to GNI\*.

## Appendix 5: Calculating $K^*$ (capital services volume for $GVA^*$ ) and its capital deepening contribution

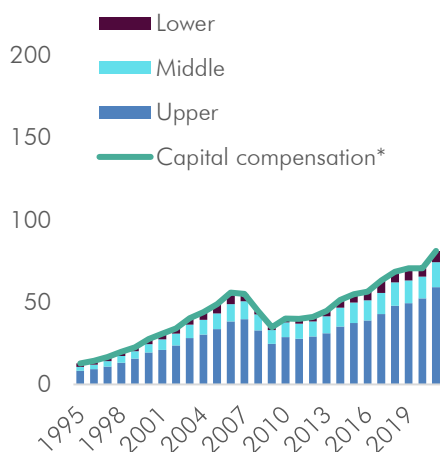
The quantity index for the volume of capital services — henceforth referred to as capital services volume — is the appropriate capital input for productivity analysis, according to the OECD’s methodology. This is distinct from the volume of the net capital stock of fixed assets, which is not reliable as a capital input for this purpose, since it does not factor in user costs, amongst other methodological differences. Box 4 in OECD (2001) shows that historical growth in capital services in the US has been considerably faster than the net capital stock.

The CSO uses six components of the net capital stock of fixed assets: cultivated assets, dwellings excluding land, intangible assets, other buildings and structures, other machinery and equipment, and transport equipment. These are also available split by contributions from NACE Rev 2 industrial sectors. The CSO interacts these components with sector-level data for capital compensation (equivalent to  $GVA^*$  less labour compensation), and sector- and asset-level data for depreciation and deflators for the capital stock, to calculate user cost weights. These weights are in turn used in a Tornqvist index to estimate capital services volume. The CSO’s methodology can be used to produce capital services volume for  $GVA^*$  ( $K^*$ ). One input is sector-level data for capital compensation\*, which is broadly consistent with the bottom-up income derivation of  $GNI^*$  in Figure 7. Figure A3 presents capital compensation\* ( $GVA^*$  less labour compensation) and  $GVA^*$  by three sector groups.

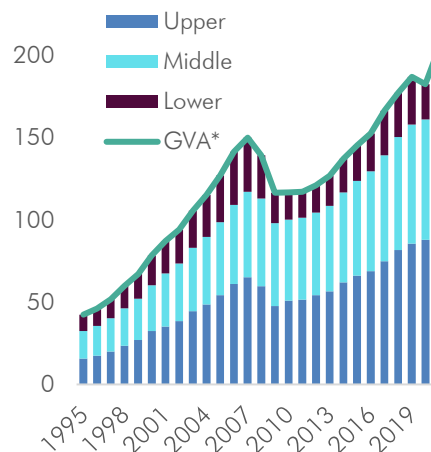
**Figure A3: Capital compensation\* and  $GVA^*$  by three sector groups**

€ billion, current prices

A. Capital compensation\*



B.  $GVA^*$

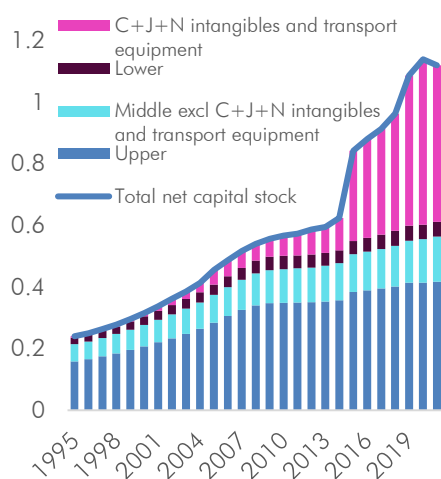


Sources: CSO; and author’s calculations.

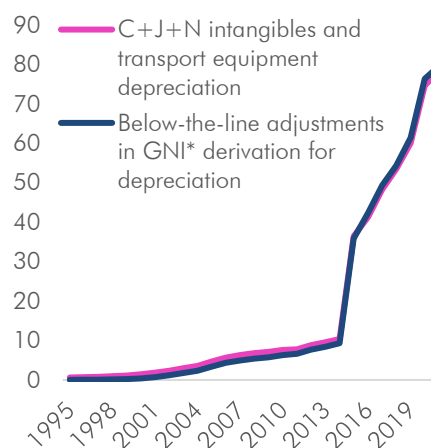
Deriving  $K^*$  further requires both sector- and asset-level data (also broadly consistent with GNI\*) for the net capital stock, the net capital stock deflator, and depreciation. From examination of the six components of the net capital stock of fixed assets at sector level (Figure A4A), the distortions since 2015 arise due to intangibles and transport equipment of manufacturing (C), information/communication (J), and administration/support (N). Figure A4B then shows that depreciation in intangibles and transport equipment assets by these sectors is a very close match for the below-the-line depreciation adjustments required in the top-down derivation of GNI\*. This suggests a reasonable estimate of  $K^*$  should exclude intangibles and transport equipment of these three sectors from the net capital stock of fixed assets, the net capital stock deflator, and depreciation.

**Figure A4: Distortions to Ireland’s capital stock are from intangibles and transport equipment of manufacturing, information/communication, and admin/support**

A. Net capital stock of fixed assets  
€ billion, 2020 constant prices



B. Consumption of fixed capital  
€ billion, current prices



Sources: CSO; and author’s calculations.

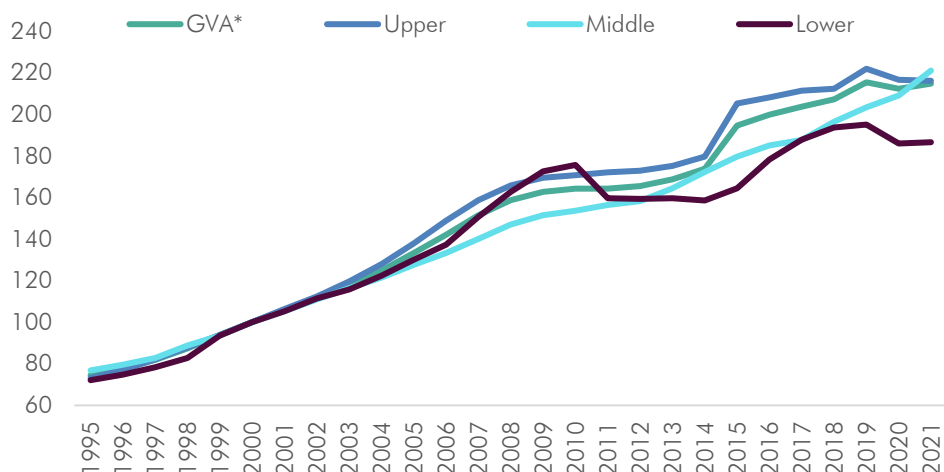
Using the sector-level data behind Figure A3 and the sector- and asset-level data behind Figure A4, four series for capital services volume can be calculated as shown in Figure A5.<sup>25</sup> Overall, the capital services volume in GVA\* is still subject to an upward shift in 2015 (by 16%). However, this is not to the same extent as for the total economy, which jumped by 84% according to the CSO. The Upper group of sectors increased sharply, driven by professional/scientific/technical activities, where

<sup>25</sup> Details about the CSO’s methodology are available here: <https://www.cso.ie/en/releasesandpublications/ep/p-pii/productivityinireland2020/appendix/>

capital services volume nearly quadrupled in 2015.<sup>26</sup> Over time, capital services volume for the Middle group has increased in a relatively stable manner, while it has been considerably weaker for the Lower group since the global financial crisis period. This is particularly evident in weak capital stock volumes related to the construction sector.

**Figure A5: Capital services volume in GVA\* by three sector groups**

2000 = 100



Sources: CSO; and author's calculations.

Capital deepening contributions to labour productivity growth are calculated by the CSO as follows:

$$A6) \quad \text{Capital deepening contribution} = \exp \{ \text{capital share 2-yr average} * [\ln (K_t^* / K_{t-1}^*) - \ln (Hours_t / Hours_{t-1})] \} - 1$$

Note that the capital share above is equal to 1 minus the labour share, assuming a production function exhibiting constant returns to scale. See Figure 16 and the related paragraph for a description of how the labour share is calculated.

Finally, MFP\* growth is calculated as the difference between labour productivity growth and the capital deepening contribution:

$$A7) \quad \text{MFP* growth} = \exp \{ \ln (GVA_t^* / GVA_{t-1}^*) - \ln (Hours_t / Hours_{t-1}) \} - 1 - \text{capital deepening contribution}$$

<sup>26</sup> This likely indicates that a more precise bottom-up exercise for GNI\* and productivity, with more granular access to data for the capital stock, should ideally also exclude some elements of the capital stock and GOS for this sector. As GOS for NACE 69-70 (Legal and accounting activities; head offices and management consultancy activities) reached €7.6 billion in 2021, more than treble its 2014 level, this sector is likely to include a substantial amount of foreign pre-tax profits.