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**Research Report**

## Re-estimating Ireland's International Innovation Performance

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# National Competitiveness and Productivity Council

## Bulletin 24-1 Re-estimating Ireland's International Innovation Performance



- Ireland's ranking in the Global Innovation Index (GII) stood at 22<sup>nd</sup> in 2023, a marginal improvement on 2022 (23<sup>rd</sup>). Ireland ranked 10<sup>th</sup> among the EU-27. Ireland continues to perform significantly better under innovation outputs (18<sup>th</sup>) compared to innovation inputs (26<sup>th</sup>). Ireland last featured in the global top ten in 2018 (ranked 10<sup>th</sup>) and has a five-year average ranking over 2019-2023 of 18<sup>th</sup>.
- Following a recommendation by the NCPC in *Ireland's Competitiveness Challenge 2023*, this Bulletin re-estimates Ireland's performance in the GII 2023 using GNI\* as a measure of national income. This results in a significantly different ranking of Ireland's performance, namely 12<sup>th</sup> rather than 22<sup>nd</sup>, with the revised rankings for innovation outputs at 14<sup>th</sup> and for innovation inputs at 20<sup>th</sup>.
- When assessed in terms of GNI\*, the gap between Ireland and the best performing countries closes considerably, particularly under 'Business Sophistication' (versus Sweden) and 'Knowledge and Technology Outputs' (versus Switzerland). 'Market Sophistication' remains the most challenging pillar for Ireland.

### INTRODUCTION

In *Ireland's Competitiveness Challenge 2023*,<sup>1</sup> the NCPC recommended that research be undertaken to provide a more robust view of Ireland's performance across the various dimensions of innovation. This recommendation followed detailed analysis of Ireland's innovation performance in the *Competitiveness Bulletin 23-2 – International Innovation Indicators*.<sup>2</sup>

The foregoing cautioned that indices that measure innovation (or competitiveness more broadly) are typically reliant on GDP and that this was likely distorting Ireland's performance. This challenge arises from the fact that there are issues inherent in using GDP as a measure of national income for Ireland. Of the 80 indicators included in the Global Innovation Index (GII) for 2023, 30 are measured, or scaled, in terms of GDP.

In order to better understand the relative performance of Ireland's economy, international indices, such as the GII, should ideally be re-estimated to take account of the impact of globalisation on Irish GDP data. This Bulletin revisits the topic of international innovation indicators and in so doing, it builds on our earlier work. We do so by, first, providing an updated assessment of Ireland's innovation performance using the latest GII data (released in September 2023), and second, by re-estimating the data for Ireland using GNI\* (as a substitute for GDP). This provides a more accurate view of Ireland's innovation performance (relative to other countries).

Innovation is a fundamental driver of economic progress and an important determinant of international competitiveness.<sup>3</sup> It is important, therefore, that the NCPC continues to monitor and assess Ireland's innovation performance relative to international competitors in a way that recognises the specificities of Ireland's economic model.

### IRELAND'S PERFORMANCE IN GII 2023

#### Assessing the unadjusted 2023 data

In the GII 2023, Ireland ranked 22<sup>nd</sup> overall (10<sup>th</sup> among the EU-27), with a significantly stronger performance under innovation outputs (18<sup>th</sup>) compared to inputs (26<sup>th</sup>). Ireland's ranking has improved marginally relative to last year, up one place (from 23<sup>rd</sup>). Table 1 shows that this was driven by improvements in 'Institutions', 'Market Sophistication', and 'Creative Outputs'.

To provide a medium-term view of Ireland's performance, Figure 1 shows the 2023 ranking under each of the seven pillars versus Ireland's five-year average ranking over 2018-2022.<sup>4</sup> As shown, for 2023, Ireland underperformed its five-year average for all pillars except 'Institutions' and 'Business Sophistication'. Despite a marginal annual improvement in 'Market Sophistication' in 2023, Ireland remains significantly below its five-year average ranking.

<sup>1</sup> [Ireland's Competitiveness Challenge 2023](#), NCPC, September 2023.

<sup>2</sup> [Bulletin 23-2 – International Innovation Indicators](#), NCPC, July 2023.

<sup>3</sup> For a more detailed discussion of innovation, and the link between innovation, productivity and competitiveness, see NCPC Bulletin 23-2.

<sup>4</sup> It is important to note that methodological changes can occur year-on-year, meaning that some degree of caution is warranted when interpreting annual changes in performance.

Table 1. Ireland's GII rankings, 2022 vs. 2023

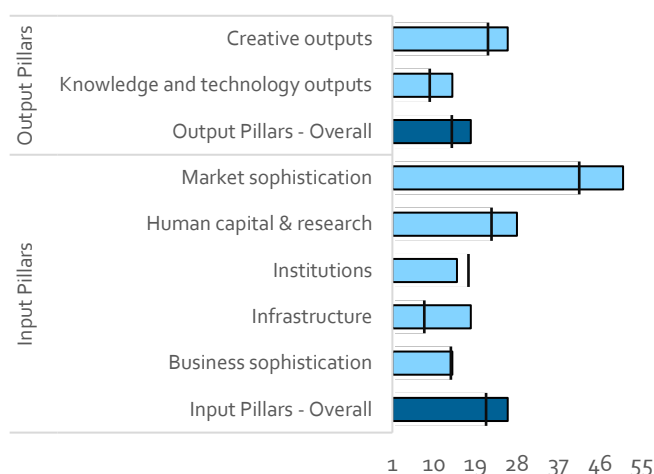
	2022	2023	
<b>GII</b>	<b>23</b>	<b>22</b>	↑
<b>Inputs</b>	<b>25</b>	<b>26</b>	↓
Institutions	16	15	↑
Human capital and research	23	28	↓
Infrastructure	15	18	↓
Market sophistication	55	51	↑
Business sophistication	13	14	↓
<b>Outputs</b>	<b>19</b>	<b>18</b>	↑
Knowledge and technology	14	14	→
Creative outputs	29	26	↑

Source: NCPC based on Global Innovation Index Database, WIPO, 2023.

an assessment of Ireland's performance on international indices such as the GII, having accounted for the impact of globalisation on Irish GDP, for example, by using alternative metrics where appropriate, such as GNI\*.

We proceed by examining the impact on Ireland's performance in the GII 2023, when GNI\* is used as a substitute for Irish GDP data. This involves re-building the index from the bottom-up and re-estimating the affected parameter values using GNI\*, where necessary. This results in amended parameter values across 27 affected indicators (a further three parameters did not require adjustment – two of these had missing values for Ireland in the GII for 2023,<sup>5</sup> while one had already been adjusted at source).<sup>6</sup> Other than these changes, we replicate the methodology used in constructing the original index, including the winsorisation and normalisation processes, and the application of relevant indicator, sub-pillar and pillar weights (see the Appendix for an overview of this process). Figure 2 shows the change in Ireland's ranking, overall, as well as under each of the pillars and sub-pillars, where the GII for Ireland has been re-estimated using GNI\*.

Figure 1. Ireland's 2023 ranking versus the five-year average (over 2018-2022)



Source: NCPC based on Global Innovation Index Database, WIPO, 2023.

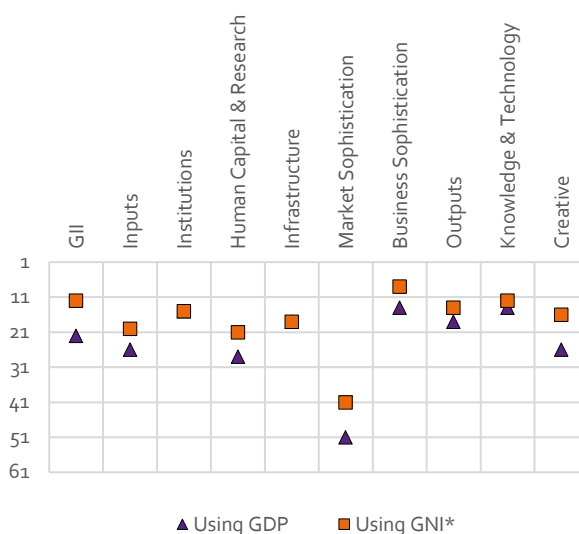
Notes: Vertical lines correspond to the average ranking over 2018-2022.

## RE-ESTIMATING IRELAND'S COMPARATIVE PERFORMANCE

### Re-estimating the GII 2023 with GNI\*

As outlined previously, in *Ireland's Competitiveness Challenge 2023* the NCPC recommended that further research be undertaken to provide a more robust view of Ireland's performance across all dimensions of innovation. The NCPC further recommended that this should include

Figure 2. Ireland's GII 2023 performance, GDP vs. GNI\*



Source: NCPC based on Global Innovation Index Database, WIPO, 2023.

As shown in Figure 2, Ireland's overall performance improves by ten places, from 22<sup>nd</sup> to 12<sup>th</sup>. Underlying this, there was an increase of six places for inputs (to 20<sup>th</sup>), and four places for outputs (to 14<sup>th</sup>). Ireland improves in all but two sub-pillars: the rankings for 'Institutions' and 'Infrastructure' remain unchanged.

<sup>5</sup> These are indicators 4.1.3 – loans from microfinance institutions (% of GDP), and 7.1.2 – trademarks by origin (bn PPP\$ GDP).

<sup>6</sup> Indicator 6.2.1 – growth rate of GDP per person employed (% of GDP, five-year average).

The most significant improvement is under 'Creative Outputs' and 'Market Sophistication' (in which Ireland has underperformed significantly in recent years) – Ireland moves up ten places in each of these sub-pillars, to 16<sup>th</sup> and 41<sup>st</sup> respectively. For 'Business Sophistication', Ireland enters the top ten performing countries (improving from 14<sup>th</sup> to 8<sup>th</sup>). Under 'Human Capital and Research', Ireland improves seven places, rising to 21<sup>st</sup>.

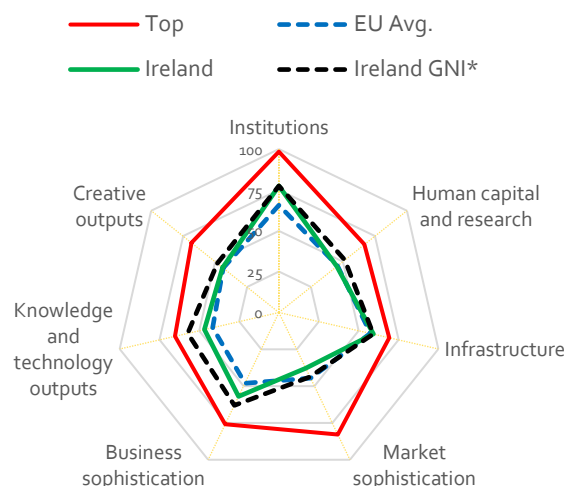
Of all seven pillars, the weakest performance for Ireland in 2023 (as in 2022) was under 'Market Sophistication' – and this holds across both GDP and GNI\*. This pillar covers the availability of credit, and supportiveness of the environment for investment, access to the international market, competition and market scale. It contains three sub-pillars: 'Credit', 'Investment' and 'Trade, Diversification, and Market Scale'. At the indicator level, Ireland scores particularly poorly in domestic credit to the private sector (as a percentage of GDP),<sup>7</sup> and market capitalisation (as a percentage of GDP). In the case of the latter, the true position for Ireland is also likely understated given the propensity for Irish-domiciled entities to be listed in another jurisdiction.<sup>8</sup>

While re-scaling for GNI\* significantly improves Ireland's score for these two indicators (by 101% and 62%, respectively), this pillar remains a drag on overall performance (with a revised pillar ranking of 41<sup>st</sup>). Ireland also performs very poorly under industry diversification,<sup>9</sup> reflecting a relatively concentrated composition of industrial (manufacturing) output.

### Benchmarking against the top performers

Figure 3 compares Ireland's performance across the seven pillars of the GII – in terms of both GDP and GNI\* – to the EU-27 average, and the top performing country under each pillar. This "spider diagram" shows the normalised scores under each pillar, with minimum and maximum values of 0 and 100, respectively (for each pillar, lines that are further from the centre of the diagram correspond to a higher score).

Figure 3. Ireland (GDP vs. GNI\*) and top performers



**Source:** NPCC based on Global Innovation Index Database, WIPO, 2023. **Notes:** 'Top' refers to the score of the top performing country under each pillar, while 'EU Avg.' refers to the average score among the EU-27. The top-ranking country for each of the pillars is: 'Institutions' – Singapore; 'Human Capital and Research' – Korea; 'Infrastructure' – Finland; 'Market Sophistication' – US; 'Business Sophistication' – Sweden; 'Knowledge and Technology Outputs' – Switzerland; 'Creative Outputs' – Switzerland.

As shown in Figure 3, when assessed in terms of GDP, Ireland remains below the EU-27 average in 'Market Sophistication' (this gap actually increased in 2023). Ireland has also fallen (marginally) behind the EU-27 average in 'Human Capital and Research'. For all other pillars, Ireland outperforms other EU countries.

However, when assessed in terms of GNI\*, Ireland comfortably outperforms the EU-27 average in all pillars apart from 'Market Sophistication' – for which Ireland performs on a par with the EU. The gap between Ireland and the best performing countries also closes considerably. This is most significant under 'Business Sophistication' (Sweden) and 'Knowledge and Technology Outputs' (Switzerland). The result is driven by significant relative improvements in Ireland's performance at the indicator level. For example, under 'Business Sophistication' Ireland's score for both GERD<sup>10</sup> performed by business, and GERD financed by abroad,

<sup>7</sup> This tracks the financial resources provided by financial corporations, including monetary authorities and money deposit banks, and where data is available, finance and leasing companies, money lenders, insurance corporations, pension funds and foreign exchange companies. This data does not include loan schemes provided to enterprise by the State, for example, in the Irish context, the Microenterprise Loan Fund Scheme and the COVID-19 Loan Scheme.

<sup>8</sup> Market Capitalisation refers to the share price times the number of shares outstanding for domestic-listed companies. The data source used for this indicator for Ireland under the GII is the World Federation of Exchanges, where the latter derives results based on Euronext Dublin (formerly, the Irish Stock Exchange). For Ireland, this result will be influenced by the decision by domestic firms to de-list in Ireland (Euronext Dublin) in favour of larger exchanges in other jurisdictions (e.g. the NYSE). Several large domestic firms have re-listed abroad in recent

years. Further, there is a significant variance between the market capitalisation as per Euronext Dublin and the figures reported under the Securities Issues Statistics series. This issue was previously explored by the Central Bank of Ireland in 2015 (Box B) and 2017 (Box A): see [quarterly-bulletin-no-1-2015.pdf \(centralbank.ie\)](#) and [quarterly-bulletin--no-4-20173494e0134644629bacc1ff0000269695.pdf \(centralbank.ie\)](#).

<sup>9</sup> The data point tracking this indicator for Ireland relates to 2014. This indicator relates specifically to manufacturing output and is based on the Herfindahl-Hirschman Index (HHI), which is calculated as the sum of the squared shares of sub-sectors in total manufacturing output. The HHI is a measure of concentration and can help to determine the extent to which a country's industrial system is diversified across different industrial sub-sectors.

<sup>10</sup> GERD refers to Gross Expenditure on R&D. This includes all R&D spending, regardless of source.

rises significantly – by 70% and 83%, respectively. Under ‘Knowledge and Technology Outputs’, Ireland’s score for software spending, and scientific articles, rises by 81% and 84%, respectively.<sup>11</sup>

Using GNI\*, Ireland’s performance worsens for only two indicators, namely GDP (now GNI\*) per unit of energy use, and domestic market scale. However, these changes are not significant enough to drive a weaker overall performance at the pillar level.

Our analysis shows that, while the GII is useful as a guide in benchmarking Ireland’s performance across key areas of competitiveness, there are several caveats that must be noted when interpreting the results. Of the 80 indicators included in the GII for 2023, 30 are measured or scaled in terms of GDP and a majority of these understate Ireland’s actual performance. This results in an overall poorer result for Ireland in the GII than if an alternative measure is used that better accounts for the size of the domestic economy (i.e., Modified Gross National Income (GNI\*)).<sup>12</sup>

## CONCLUSION

This Bulletin provides an updated assessment of Ireland’s performance in the Global Innovation Index (GII) using the latest available data (published September 2023) and further assess the robustness of Ireland’s performance in the GII using an alternative metric of national income, namely, GNI\*.<sup>13</sup> As outlined in Bulletin 23-2,<sup>14</sup> indices of innovation (and competitiveness more broadly) are necessarily simplified or stylised versions of reality – an attempt to communicate complex information in an accessible and effective way to policy-makers and other stakeholders, and should be interpreted with caution.

While this holds for all countries, there are additional complications when interpreting indicators such as the GII in the Irish context. There are well documented limitations to using GDP as a means of measuring economic activity in Ireland, given the scale of globalisation-related activities and their distortionary effect on national statistics. This Bulletin has shown that standard international indicators typically understate Ireland’s true performance in terms of innovation. Re-estimating the GII in line with GNI\* results in a more accurate assessment of

Ireland’s relative performance and leads to a significant improvement in Ireland’s innovation ranking in an international context.

### Further Reading:

The NCPC reports to the Taoiseach and the Government, through the Minister for Enterprise, Trade and Employment, on the key competitiveness and productivity issues facing the Irish economy and makes recommendations to Government on how best to address these issues. The latest NCPC publications can be found at: [www.competitiveness.ie](http://www.competitiveness.ie).

This Bulletin has been issued by the Chair, Dr. Frances Ruane, and was prepared by: Dr. Dermot Coates and Dr. Keith Fitzgerald in the NCPC Secretariat.

<sup>11</sup> While we have “de-globalised” the denominator for affected parameters using GNI\*, further refinements might also be required to adjust certain numerator values to account for globalisation related distortions. For example, this might be relevant for certain output indicators tracking IP patents. However, this is beyond the scope of this current analysis.

<sup>12</sup> See: [National Accounts Explained – Modified GNI](#), CSO. This approach is also more consistent with national targets. For example, the

Government’s research and innovation strategy, [Impact 2030](#), sets a target for gross expenditure on R&D of 2.5% of GNI\* (rather than GDP) by 2030.

<sup>13</sup> It is recommended that this Bulletin be read alongside Bulletin 23-2.

<sup>14</sup> While not repeated here, Bulletin 23-2 provides a thorough assessment of the potential shortcomings of these indices in benchmarking performance.

## APPENDIX: CONSTRUCTING THE GII

Launched in 2007,<sup>15</sup> the Global Innovation Index (GII) aims to provide a statistical benchmark for measuring innovation and for comparing national innovation ecosystems. The GII is comprised of:

- An Innovation Input Sub-Index with **five input pillars** that capture aspects of the economy that facilitate innovative activities (e.g. institutions – the political and regulatory environment; infrastructure, etc.);
- An Innovation Output Sub-Index with **two output pillars** that capture the consequences of innovative activities in the economy (e.g. knowledge creation, impact and diffusion; and intangible assets);
- An **overall GII score** that is the average of the input and output sub-indices (the Output Sub-Index carries the same weight as the Input Sub-Index in calculating the overall score).

The 2023 GII index includes 80 indicators, covering 132 economies. Of the indicators used in the 2023 index, 3.8% are from 2023, 34.7% are from 2022, 34.2% are from 2021, while 27.2% are from pre-2021. These indicators fall into three categories: quantitative data (64 indicators), composite data (11 indicators), and qualitative data (5 indicators).

The GII views data outliers as problematic, where they have an absolute value of skewness greater than 2.25, and a kurtosis greater than 3.5. The indicators with one to five of these outliers are winsorised – that is, the values distorting the distribution are assigned the next highest value, up to the point where the estimated skewness and/or kurtosis reaches the threshold values specified above. The indicators with five or more of these outliers are transformed using the formula below, where “min” and “max” are the minimum and maximum indicator values respectively:

$$\ln \left[ \frac{(\max x f - 1)(economy\ value - min)}{\max - min} + 1 \right]$$

In effect, this formula converts all series into “goods” and scales the series to be within the range [1, max], so that the natural logs are positive, starting at 0. All indicators are then normalised into the [0, 100] range, where higher

scores represent more favourable outcomes, using the min–max method. This ensures that all indicators share the same range. Weights of 0.5 or 1 are assigned as scaling coefficients (rather than importance coefficients) to determine pillar and sub-pillar scores.

To prevent multicollinearity during aggregation, indicators within a sub-index that exhibit an absolute correlation of 0.95, are assigned a weight of 0.5. In 2023, two indicators<sup>16</sup> and two sub-pillars<sup>17</sup> are assigned a weight of 0.5. Each sub-pillar score is then calculated by taking the weighted average of its individual indicator scores. In terms of aggregation, pillar scores are calculated using the weighted average of the relevant sub-pillar scores.

<sup>15</sup> The Global Innovation Index (GII) was launched by INSEAD. Since 2021, the GII has been published by the World Intellectual Property Organisation (WIPO) – in partnership with the Portulans Institute (a nonpartisan research body based in Washington DC), corporate and academic partners, and the GII Advisory Board.

<sup>16</sup> These are 1.2.1 – regulatory quality, and 1.2.2 – rule of law, both of which fall within the ‘Regulatory Environment’ sub-pillar (and the ‘Institutions’ pillar).

<sup>17</sup> These are 7.2 – ‘Creative Goods and Services’, and 7.3 – ‘Online Creativity’, both of which fall within the ‘Creative Outputs’ pillar.