Measuring Economic Activity in the Presence of Superstar MNEs

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Abstract

In 2015, changes to Irish tax legislation, known as the "2015 Finance Act", coincided with a 25 percent annual increase in real gross domestic product. We provide evidence confirming the convictions of existing literature that the presence of large multinational enterprises (MNEs) is likely to have "distorted" Irish GDP, a measure previously considered to be a reliable proxy of domestic economic activity. Furthermore, we provide an alternative method of statistically isolating the variation in GDP growth attributable solely to domestic activity growth to infer the prevailing state of the Irish economy. Our findings imply a 21% lower level of GDP relative to the official measure recorded for 2020. We suggest that our methodology may be applied by policymakers in small open economies to improve the accuracy of growth and business cycle monitoring.

1 Introduction

This study considers large multinational enterprise (MNE) presence in a small open economy and the unanticipated influence that the international tax planning strategies of these firms can have on the economic interpretability of national accounting measures. We focus on the case of the Republic of Ireland, in which MNEs' recent strategic relocation of intangible assets has introduced difficulties in interpreting key aggregate economic measures. These developments were reflected by record annual investment growth of 50% and a spike in the trade surplus of 60%, which contributed to a 25.2% increase in Ireland's real GDP in 2015 – nowadays coined as a case of 'Leprechaun Economics'. These changes largely stem from the emergence of digital commerce, which enables major tech firms to shift profits into low tax countries regardless of where income was originally earned. While these issues are not unique to Ireland, this case is particularly pronounced (Avdjiev et al., 2018).

It is often argued that the scale of these activities by a select number of superstar MNEs has lead to a 'distortion' in GDP.[1] Much of the economic activity attributed to Irish GDP from 2015 onward is considered not reflective of actual domestic economic activity (Honohan, 2021). Our study verifies claims that these unorthodox aspects of GDP growth do not capture variation in domestic economic activity. Additionally, we present an alternative measure of GDP that excludes the influence of a factor representing foreign MNE activity from existing aggregate output through the use of a dynamic factor model approach. This alternative measure seeks to provide a sensible depiction of the state of the domestic economy.

We are not the first to measure the state of an economy through the use of dynamic factor models. Examples of such work dates back to late 1980's, in which Stock and Watson (1989) estimated a coincident index to represent the state of the US economy. Subsequent work has laid out US-state specific real activity indices (Crone and Clayton-Matthews, 2005) and deviated in terms of methodological approach to further its flexible use (Mariano and Murasawa, 2010; Thorsrud, 2020). For Europe and Ireland, similar measures of domestic economic activity have been constructed (Altissimo et al., 2010; Conefrey and Walsh, 2018). We contribute to this literature through the identification and use of a novel latent factor that represents the activity of MNEs engaged in base-erosion and profit shifting (BEPS) activity. Using this pair of factor estimates, we are able to exclude the influence of various unique tax structures and their associated intangible asset vehicles from existing GDP levels in Ireland.

[1] Moulton and van de Ven (2018) find that the effects of globalisation can make national data hard to interpret, and for certain types of analysis may even be considered a distorting influence on the data.

Upon assessing the impact of globalisation on the national accounts, we find that excluding distortionary MNE activity reduced the effective GDP measure by an average of 18% between 2015Q1 and 2020Q3. This implies a 12.9 percentage point higher debt-to-GDP ratio and places Ireland as one of the top contributing members of the EU-27. Furthermore, we find that there is no evidence of significant spillover effects between structural shocks to our domestic and foreign MNE factors, repsectively. These findings suggest that GDP in Ireland is heavily distorted, if used to gauge the performance of the domestic economy by conventional standards. Our findings support expressed beliefs among Irish policymakers and statisticians alike that a there is a need to exclude particular superstar MNE activities from key economic measures. Our findings also lend support to continued efforts internationally of modernizing national accounting in response to increasingly digitalized and multinational firm transactions.

To motivate our analysis, Section 2 provides a brief overview of Ireland's experience with MNE activity and the development of its low-tax environment. Section 3 details our dynamic factor model approach, in which we generate two separate quarterly factors, domestic economic activity and foreign MNE activity, from 1998 to 2020. Section 4 provides a brief discussion of our data sources and transformation approach. Section 5 presents the Kalman Smoother's factor outputs, their implications for prevailing GDP levels and details the structural linkages between our two factors through impulse response functions. Section 6 concludes.

2 Background

As a small open economy, Ireland's GDP is notably reliant on export-led growth combined with substantial foreign direct investment (FDI) inflows. The international competitiveness of Ireland is largely explained by a highly educated workforce, access to the EU single market, and its status as a tax haven (O'Rourke and Ó Grada, 2000; Davies et al., 2018; Nadine, 2018). This section will largely focus on this third item as it has been a major motivating factor in the 2015 level shift in GDP. Though the low-tax environment of Ireland has received increased attention in recent years, this approach dates back to the mid-1950s, during which a newly independent Irish state sought to attract manufacturers through firm-specific tax exemptions. This approach featured tax relief on export profits, which exempted 50% of income associated with exports from tax liability among manufacturers, with rates rising and exemption periods increased by successive governments. Following an intervention by

the European Commission in the late 1970s, the government shifted towards a low corporate tax rate. As detailed by Barry (2012), further changes were made during the 1980s to entice entry by foreign-owned tech firms and broaden the financial services industry, with the corporate tax rate across industries being harmonized to 12.5% by 2003. In contrast the Euro Area average and United States maintain corporate tax rates of 22.7% and 21%, respectively.

From the late 1990s onward, MNEs have persistently alternated from one set of corporate tax loopholes to another. Such globalized tax strategies often span multiple countries and are labelled as base eroding and profit shifting (BEPS) tax schemes. Though commonplace, their influence on Irish national accounting measures had been close to nonexistent prior to 2015. The most commonly used tool in this prior period was the 'Double Irish', which exploits different definitions of corporate residency in Ireland and the US to route profits to tax havens like Bermuda while minimizing tax liability. Since the firm managing and controlling IP based in Ireland is itself based in Bermuda, Ireland considers the company to be a tax resident in Bermuda, while the US considers it to be a tax resident in Ireland. As a result, any royalty payments sent to the company go untaxed as long as the funds are not yet repatriated to the US, allowing firms to act as 'stateless' corporate entities. Following the 2014 Finance Act, an Irish incorporated company was to be regarded as a resident firm for tax purposes in the country. This effective closure of the Double Irish included a 5 year exemption for existing users of the BEPS tool until January 2020.[2]

The most prevalent BEPS tool in Ireland from 2015 onward has been the Capital Allowances for Intangible Assets (CAIA) or 'Green Jersey' BEPS tool. This tool enabled a given foreign-owned Irish resident subsidiary engaged in intrafirm IP purchases to accrue capital allowances that could offset tax liability on any profits associated with the Ireland-based subsidiary. ETRs under this instrument ranged between 0–2.5%, well below the official 12.5% corporation tax rate. Crucially, this new tool differed from the 'Double Irish' in its compliance with new OECD guidelines and by capitalizing IP, and the associated income flows, into the Irish national accounts. This likely explains much of the relocation of foreign intangible assets into foreign-owned Irish resident subsidiaries of major MNEs.[3]

[2]This same period saw a landmark intervention in which the European Commission levied a €13 billion fine on Apple for Irish tax avoidance from 2004 to 2014 through its use of a hybrid Double Irish BEPS tool.

[3]Seamus Coffey highlights the 2015 shift in GDP and associated IP/contract manufacturing/royalties and license fee payments.
Available at: http://economic-incentives.blogspot.com/2018/01/what-apple-did-next.html

When assessing the activities contributing to the extreme growth of Irish GDP in 2015, the majority appear to be largely uncorrelated with the state of the domestic economy (Fitzgerald, 2015; Lane, 2017; Fitzgerald, 2018). This may lead to a misguided perception of developments in the economy. For example, contract manufacturing has now become a far larger aspect of the quarterly national accounts measure of exports.[4] While these manufactured goods never once interact with the Irish border, they continue to contribute to GDP. Similarly, service exports associated with IP-related royalty and license fees contribute to the current account surplus while inflows of the same intangible assets further bolsters the GDP measure. Neither the goods nor services described originate from Ireland, nor is there a value-added contribution, yet both result in significant changes to overall GDP levels, distorting GDP from what would be conventionally desired.

This process of 'supersizing' economic output in Ireland does not come without its costs. For policymakers in Ireland, conventional models used to predict short to medium term growth are notably less accurate when forecasting GDP. This makes correctly adjusting fiscal budgets, and motivating those adjustments, more difficult. Additionally, third parties tasked with assessing the stability of the macroeconomic conditions are left with fewer tools to judge by. For example, in the wake of the European debt crisis, the European Commission pursued legislation intended to limit prolonged periods of macroeconomic imbalances among member states. The Macroeconomic Imbalance Procedure (MIP) entered into force in December 2013, providing clear guidance on target ranges for 14 major indicators of macroeconomic activity.[5] The initially proposed design selected these indicators under the assumption that they be of "high statistical quality in terms of timeliness and comparability across countries". From 2015 onward, these measures have neither been timely, given the persistent and volatile revisions initial GDP estimates were prone to, nor comparable across countries, given the unique circumstances driving growth in investment flows and the trade of services in Ireland.

In response to these developments, the Economic Statistics Review Group (ESRG), a collection of key stakeholders[6], was tasked with exploring and recommending solutions. In their own words, they aimed for "supplementary statistics that are more appropriate to the

[4]This process consists of contracting a firm based outside of Ireland to manufacture particular goods, the final products being owned by the contractor, i.e. the foreign-owned Irish resident firm. These goods are subsequently sold and exported by the third party on behalf of the Irish-based subsidiary, which results in the goods being registered as an Irish export due to the ownership status of the goods. See Central Statistics Office (2017), Explaining Goods Exports and Imports 2012-2016, Statistical Note for further details.

[5]These MIP thresholds include – a 3-year moving average of the current account balance within +6% and −4% of GDP, a net international investment position above −35% of GDP, private sector debt (consolidated) as a percentage of GDP of 133% or less, and general government sector debt-to-GDP ratio of 0.6.

[6]The Central Bank of Ireland, the Economic and Social Research Institute and Department of Finance.

measurement of domestic economic activity" and in addition required that the measure be "comprehensible and stable over time".[7] Addressing this expressed need for the development of an additional cyclical indicator, the Central Statistics Office (CSO) provided a modified gross national income measure labelled GNI*. While it somewhat satisfied the first goal of acting as a closer proxy for domestic activity, the measure had some quirks in that it was annual in frequency and initially yielded double digit growth rates, leading to questions of whether it was truly "comprehensible and stable over time".[8] We contribute to this challenge by providing a quarterly series that is reflective of domestic economy activity, consistent & stable over time, and directly comparable to real GDP.

Although this study is focused on the implications of such tax strategies for a given country's national accounts, there exists a wider concern with respect to the underlying risk of a 'race to the bottom' outcome and the further GDP distortions this could introduce among other countries. Under such an outcome, countries may compete for large MNE tax receipts by enabling the creation of new BEPS tools. Providing insight into the scope of this issue, Torslov et al. (2020) estimates that in 2015 more than 40% of US-parented multinational profits ($616bn) were shifted to tax havens globally. Although Ireland maintains the highest estimated share of profit-shift destinations (17.2%), the Netherlands (9.3%), Singapore (11.4%), Switzerland (9.4%) and the Caribbean (15.7%) also all feature prominently.

Without cross-country intervention, there are risks that distortions to GDP and losses in tax revenue bases across various countries could further intensify. Such concerted efforts have gained significant momentum in recent years. The 2013 OECD/G20 BEPS Project has sought to rewrite international tax rules and adapt to the more modern, globalised economy, in order to undermine the widespread prevalence of tax haven transfers. Building upon these efforts, the proposed global minimum corporation tax rate for large multinationals led by the OECD and Biden administration has received backing from 136 countries, including Ireland. This would introduce a minimum corporate tax rate of 15% for companies with turnovers above €750 million and would take effect in 2023. While we would hope that this adjustment disincentivizes future distortionary movements of capital across countries, based largely on tax purposes, it may be some time before these effects are reflected in national accounting measures. In the meantime, and to provide insight into the last six years of GDP turmoil for Ireland, we proceed with the following methodology as described in the next section.

[7] See 'Report of the Economic Statistics Review Group (ESRG)'.
Available at: https://www.cso.ie/en/csolatestnews/eventsconferencesseminars/resrg/

[8] See Stapel-Weber, S. & J. Verrinder (2016), Globalisation at work in statistics — Questions arising from the 'Irish case', Collaboration in Research and Methodology for Official Statistics, Eurostat.
Available at: https://ec.europa.eu/eurostat/cros/content/articles-4_en

3 Methodology

We address the issue of GDP distortion described in the previous sections by estimating separate indices corresponding to the growth of domestic and foreign activity in Ireland. More specifically, we build a dynamic factor model and use it to generate historical estimates of a factor that represents the state of domestic economic growth in Ireland, along with a factor that represents the state of foreign activity growth associated with large MNEs actions that allegedly distorts the GDP measure (e.g. contract manufacturing, IP reallocation and IP-related royalty/license service fee revenue). We then decompose the growth rate of Irish GDP as a sum of the domestic and foreign factors, allowing us to project the GDP measure onto the variation of the domestic factor to generate an adjusted GDP measure that partials out foreign distortions. In other words, our approach allows us to extract the variation in Irish GDP attributable purely to the growth in domestic economic activity.

3.1 Factor Estimation

The domestic and foreign activity growth factors are specified as follows. We first combine a large number of disaggregated macroeconomic series into a single dataset of quarterly frequency. We then partition the data into two groups: the first group contains those series that have significant variation spilling over from the overall growth of domestic activity in Ireland, while the second group contains series that we claim reflect spillovers from the growth of IP-related foreign MNE activity. Next, we specify an approximate dynamic factor model with two factors, such that each factor corresponds with only one of the above-mentioned groups of series. The factor assigned to the first group represents the co-movement among the included series – in other words, it captures a single common source of variation. We refer to this factor as the domestic factor and interpret it as the state of growth of the overall domestic economy, since that is the most obvious source of common variation. Analogously, the factor assigned to the second group reflects the common source of variation within the group of data, which we argue is most likely caused by the activities of large foreign MNEs. Both factors are specified as being generated by a VAR(p) process. The data assigned to the two factors is presented and discussed in the next section of the paper.

To estimate our factors, we carry out a procedure similar to the 2-step DFM estimator most notably used by Giannone et al. (2008) and analyzed by Doz et al. (2011). In the first step, we generate initial estimates of the factors by separately applying principal component

analysis to the 'domestic' and 'foreign' portions of the dataset. For the disaggregated vectors of domestic and foreign activity variables, $\{X_t^D, X_t^F\}$, we calculate the two corresponding variance-covariance matrices S and extract their respective first eigenvectors Q_1.

$$S^k = \frac{1}{T}\sum_{i=1}^{T} X_t^k X_t^{k\prime}$$
$$\widehat{f}_{\text{pca}}^k = \frac{1}{N^k} Q_1^{k\prime} X^{k\prime}, \text{ for } k \in \{D, F\}$$

We treat these initial factor estimates, $\{\widehat{f}_{\text{pca}}^D, \widehat{f}_{\text{pca}}^F\}$ as observations, and use ordinary least squares to estimate a two-dimensional vector autoregression (VAR). The optimal number of lags included in this VAR is determined by the Bayesian information criterion. In the second step we use the parameter values estimated in the first step to impose a data generating process on the factors and express the model in state space form. We then apply the Kalman smoother to the data to extract smoothed historical factor estimates.

3.2 Adjusted GDP measure

We use the factor estimates to generate an adjusted GDP growth rate measure that rids the original measure of the distortion caused by foreign activity. Specifically, we consider the manner in which the GDP growth rate can be decomposed into the performance observed in the domestic economy and by IP-related activities among foreign-owned MNEs. To perform this exercise, first consider the following restricted linear model:

$$\%\Delta GDP_t = \alpha + \beta_1 f_t^d + \beta_2 f_t^f + \varepsilon_t\,, \tag{1}$$

where $\%\Delta GDP$ denotes Ireland's quarterly GDP growth rate, α is an intercept, f^d is the domestic factor, f^f is the foreign factor, and ε is a disturbance term. As is highlighted in our results, there was a significant structural change parameter estimates following the large scale introduction of MNEs' intellectual property in 2015. This motivates our estimation of the following unrestricted model,

$$\%\Delta GDP_t = \alpha + \beta_1 f_t^d + \beta_2 f_t^f + \gamma D_t + \beta_3 (f_t^d * D_t) + \beta_4 (f_t^f * D_t) + \varepsilon_t\,, \tag{2}$$

where a post-IP movement dummy variable, D_t, is equal to 1 for periods from 2015 Q1 onward. This interaction allows us to identify whether there was a disconnect between GDP

and the underlying state of the Irish economy from the 2015 period onward as well as measure the extent of this supposed structural break policymakers have speculated upon. Using the pre-2015 relationship between the domestic state of the Irish economy and Irish real GDP, we exclude foreign activity from the growth rate of Irish GDP. This expression represents our adjusted GDP growth rate measure.

$$\%\Delta GDP_t^a = \widehat{\alpha} + \widehat{\beta}_1 f_t^d + \varepsilon_t \,, \tag{3}$$

Given an initial starting period in, we use our adjusted GDP growth rate measure to generate an adjusted historical GDP level series, GDP_t^a, that excludes GDP variation caused by foreign MNE activity.

4 Data

We have gathered a large set of disaggregated series, which capture various measures of macroeconomic activity in Ireland. The data can be grouped into two subsets: monthly domestic and quarterly foreign MNE activity data. The monthly domestic activity data is aggregated to a quarterly set of series in order to maintain a consistent frequency between both factors. A list of the specific series used for both factors is provided for in Appendix A.

4.1 Domestic Factor Variables

In selecting the appropriate set of domestic data for estimating our domestic activity factor, we refer to the common practices of Stock and Watson (1989) and Stock and Watson (2016). Both studies focus on measures of industrial production, personal income, retail sales and employment when estimating a domestic activity factor. In cases where an aggregated series and its disaggregated components are available, we elect to use disaggregated series exclusively.[9] In each set of series' case, we first prepare the data into a quarterly format. We then seasonally adjust the data to avoid capturing the common seasonality of the series as part of the common factor. Lastly, we measure the logged first difference of each series for a stationary set of growth rates, unless otherwise stated.

[9]Stock and Watson (2016) notes that in the context of the DFM, the idiosyncratic term of the logarithm of aggregates is highly correlated with the share weighted average of the idiosyncratic term of the logarithms of its disaggregated components. For this reason, when the disaggregated series are available, these are used but the higher-level aggregate series are excluded.

Our set of industrial production series cover January 1998 to present, using both active and archived datasets from the Central Statistics Office (CSO) industrial production indices. For unemployment we use a measure of persons on the Live Register, the number of individuals registered for unemployment benefits and monthly unemployment levels.Similarly to industrial production measures, our volume-based retail sales indices combine separate data tables for each individual series.

We also include a set of miscellaneous monthly variables that act as reasonable barometers for the well-being of the domestic economy. These include the CSO's monthly series for the number of vehicles licensed for the first time, separately tracking new and secondhand vehicles. Using the Department of Finance Databank, we include total tax receipts for income tax, value-added tax and stamp duty. Lastly, we use KBC's Consumer Sentiment index, specifically the sub-index for Current Economic Conditions.

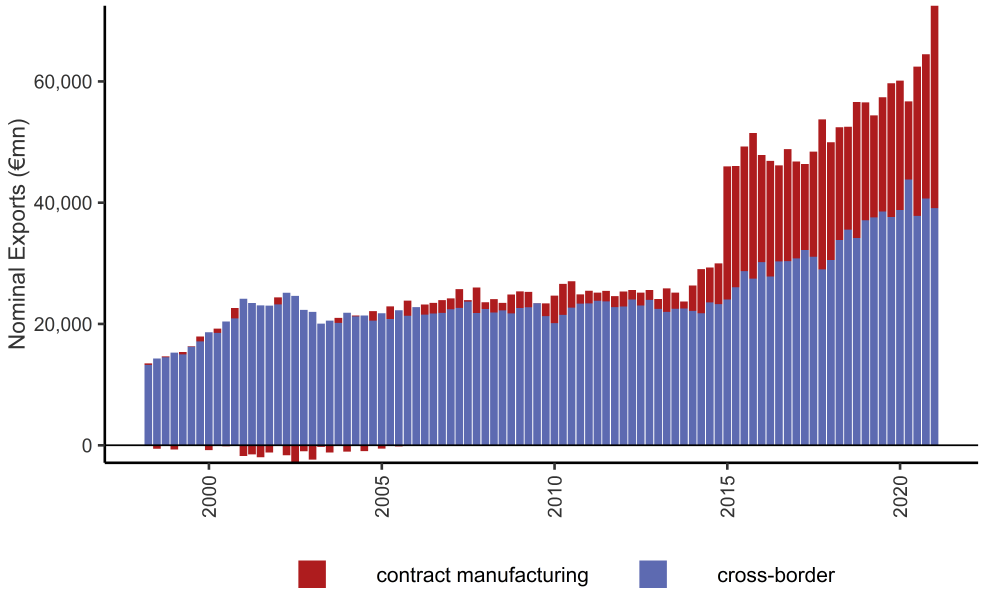
4.2 Foreign Factor Variables

The set of variables used to estimate the foreign MNE factor is informed by our knowledge of the 2015 level shift in GDP and associated types of MNE activities reflected in Section 2. In this setting, the relocation of IP ownership to subsidiaries based in Ireland led to a significant increase in intangible assets as well as a rise in IP-related income flows to these subsidiaries. While most of these variables are readily available from the CSO, in certain cases we have had to rely on inference to obtain estimates of these income flows.

For example, our measure of contract manufacturing relies on differences in two exports series from the CSO. The first export measure uses standardized EU methodology whereas our second export measure is the subset of goods that physically cross the Irish border.[10] The difference between these two series is largely explained by third-party manufacturers abroad receiving orders from foreign subsidiaries based in Ireland. Crucially, the intellectual property required to produce these goods abroad are also owned by the Irish subsidiary. The raw materials used by the third-party manufacturer abroad are owned by the company in Ireland, as is the batch of final products. These goods remain in the third-party manufacturer's country of origin and are sold to customers on behalf of the MNE. As displayed in Figure 1, the surge in contract manufacturing coincides with the a 10 fold increase from 2015 onward.

[10]We use the same approach as McQuinn et al. (2018), in which a deflator for QNA goods exports is used to deflate cross-border merchandise exports. Thereafter, real QNA goods exports less real cross-border merchandise exports yields our estimate of contract manufacturing.

Figure 1: Contract manufacturing estimate



Our estimate of contract manufacturing also includes contributions by the merchanting of goods (reselling of final goods purchased and sold outside of Ireland), purchases of aviation fuel abroad by Irish resident airlines, estimates for illegal cross-border trade, transportation and insurance costs. Based on supplementary notes from the CSO, we assume these additional elements to be negligible in size.[11]

In addition to our contract manufacturing estimate, the foreign MNE activity factor is obtained using current account measures of service exports by industry (communications, financial, computer, royalties & license fees, operational leasing), service imports by industry (communications, royalties & license fees, R&D, operational leasing, other business services), dividends and distributed branch profits, and reinvested earnings. Further effort to capture the major jolt in MNE activity uses variation in corporate tax receipts, gross value added at constant basic prices[12] (industry (excluding construction), information & communication, financial & insurance activities), and imports of organic chemicals, medical & pharmaceutical products, machinery less electrical appliances, and electrical machinery & appliances.

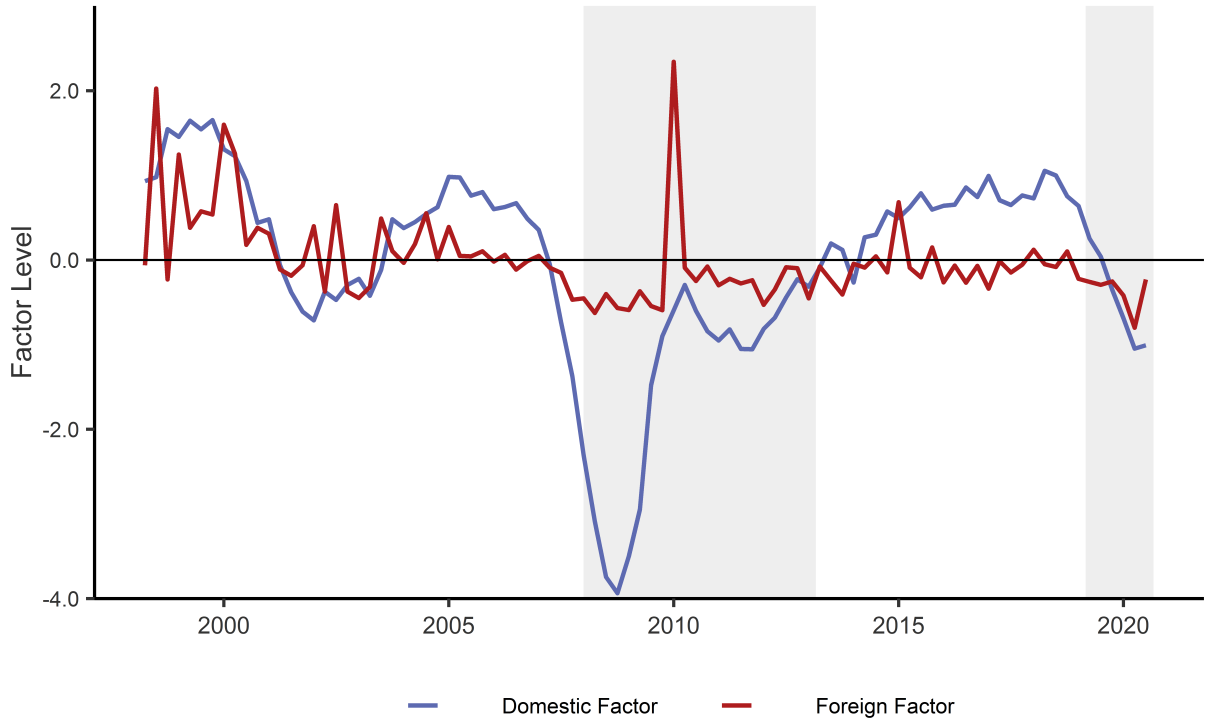
[11]See 'Explaining Goods Exports and Imports 2012-2016', which largely motivated this approach. Contract manufacturing represented 89.4% and 88.3% of the difference between QNA goods exports and cross-border goods exports in 2015 and 2016, respectively.We assume a similarly negligible share of these other items for the following years. Available at: www.cso.ie/en/releasesandpublications/in/geid/explaininggoodsexportsandimports2012-2016/

[12]Gross measures incorporate depreciation introduced by intellectual property. Consumption of fixed assets is the difference in gross and net value added measures by industry, but this is not publically available.

5 Results

Upon estimating the dynamic factor model, we identify a common component of domestic economic activity as well as one for foreign multinational activity in Ireland. For brevity, we refer to these two items displayed in Figure 2 as the domestic and foreign factors, respectively. Each of these factors are normalized, hence any deviation above or below zero would be considered a deviation from long-run average growth rates.

Figure 2: Domestic and foreign factor estimates



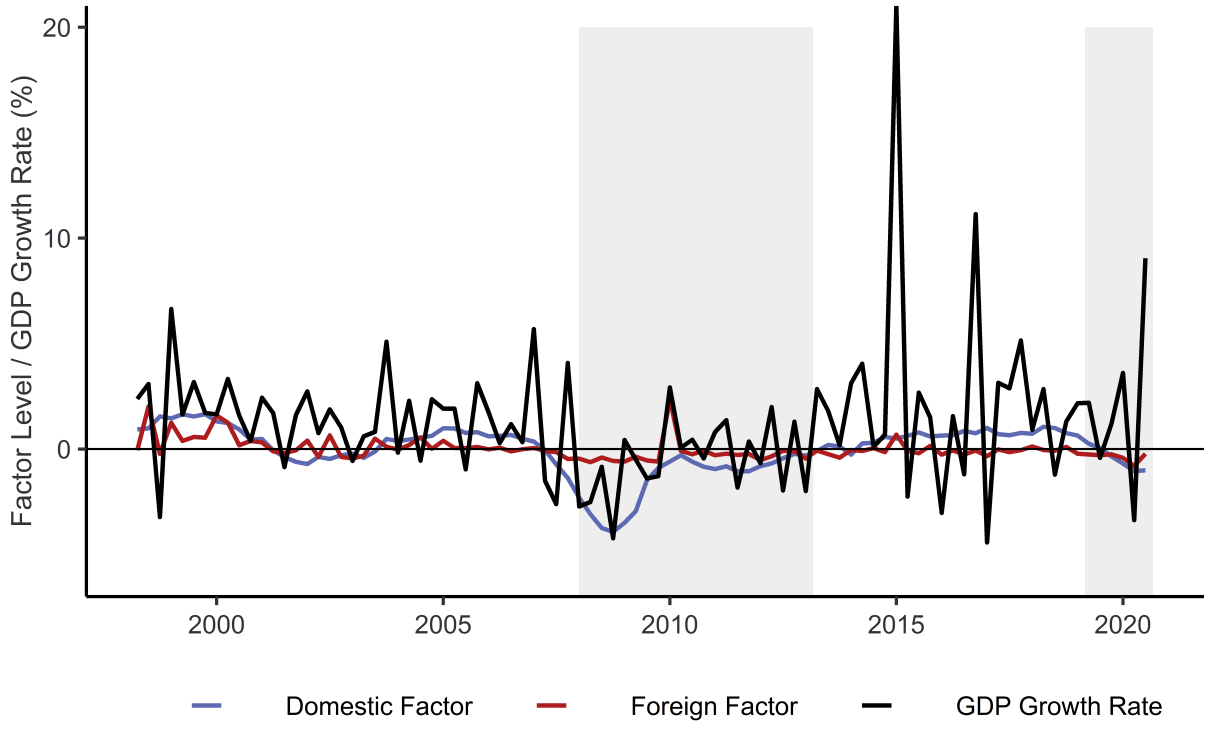
A number of events appear to be well captured by both factor estimates. In the case of the domestic factor, the Celtic Tiger period from 1994 to 2007 appears to be well represented, along with the temporary downturn between 2001 and 2003 following large blows to the IT and agricultural sectors. The domestic series also captures the Great Recession, which in Ireland's case involved a particularly severe property market crash followed by the European Debt crisis. Following a prolonged recovery period, the series suggests a rather smooth and lengthy period of prosperity between 2013 and 2019.

In contrast the foreign factor suggests a less intense impact following the Great Recession on global MNEs relative to the domestic economy. The significant elevations in activity

overlap notably with respect to the introduction of CAIA BEPS tools in 2010 and the closure of the 'Double Irish' in 2015, which is believed to have motivated a further adoption of CAIA BEPS tools across this cohort of MNEs. Though there is a sharp increase in MNE activity in 2015, the trend in domestic growth remains persistent relative the periods prior and after. Both measures reflect the effects of COVID rather similarly, which lines up plausibly with the aggregate shock nature of the pandemic.

Comparing against trends in seasonally adjusted real GDP growth rates (quarter-on-quarter), trends in the domestic factor appear to reflect much of the Celtic Tiger and Great Recession periods. As displayed in Figure 3, the two measures diverge sharply from 2015 onward, with GDP becoming significantly more volatile.

Figure 3: Factors and real GDP growth (q-on-q, %)



Examining the correlation between GDP and our domestic factor, the 0.48 correlation coefficient drops to -0.07 post-2015, suggesting a degradation in the ability of the prevailing GDP measure to reflect the state of the domestic economy. In contrast, the foreign factor becomes highly correlated with GDP, supporting the proposition that it is activities linked to foreign-owned Irish resident firms that has steered GDP growth in recent years.

Table 1: Pre-2015

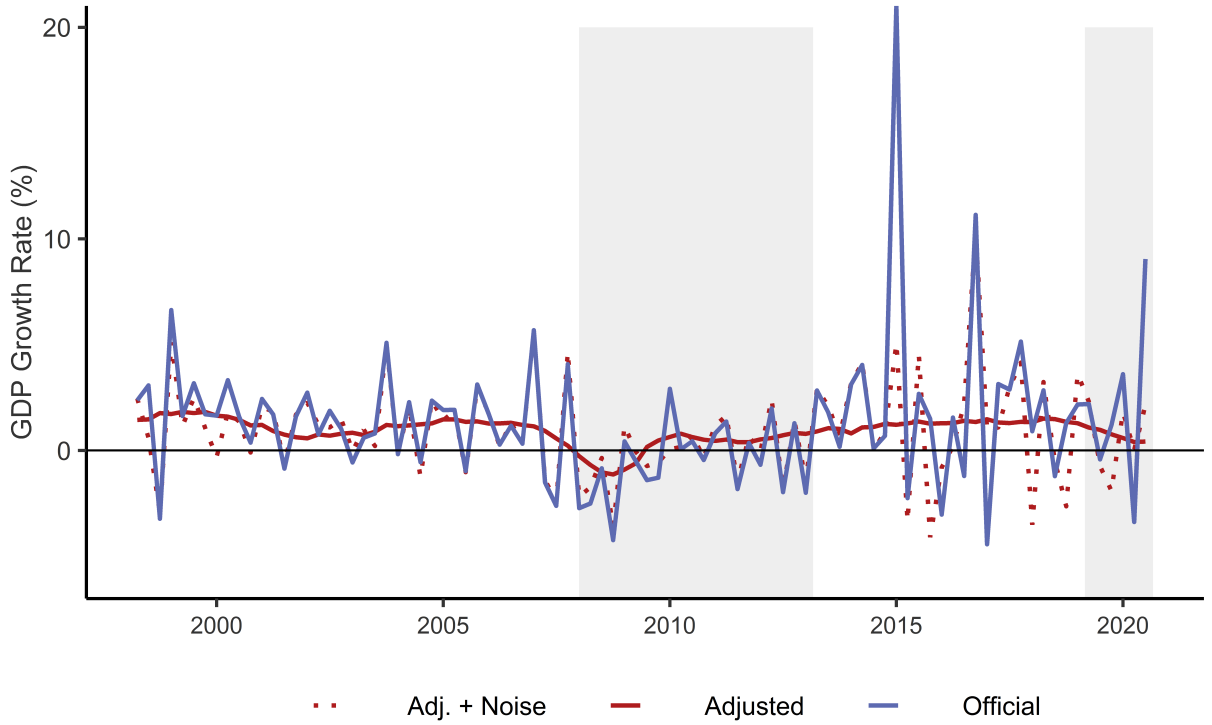
Firm Type	GDP	domestic	foreign
GDP	1.0000	-	-
domestic	0.4797	1.0000	-
foreign	0.4905	0.5033	1.0000

Table 2: Post-2015

Firm Type	GDP	domestic	foreign
GDP	1.0000	-	-
domestic	-0.0731	1.0000	-
foreign	0.6490	0.4967	1.0000

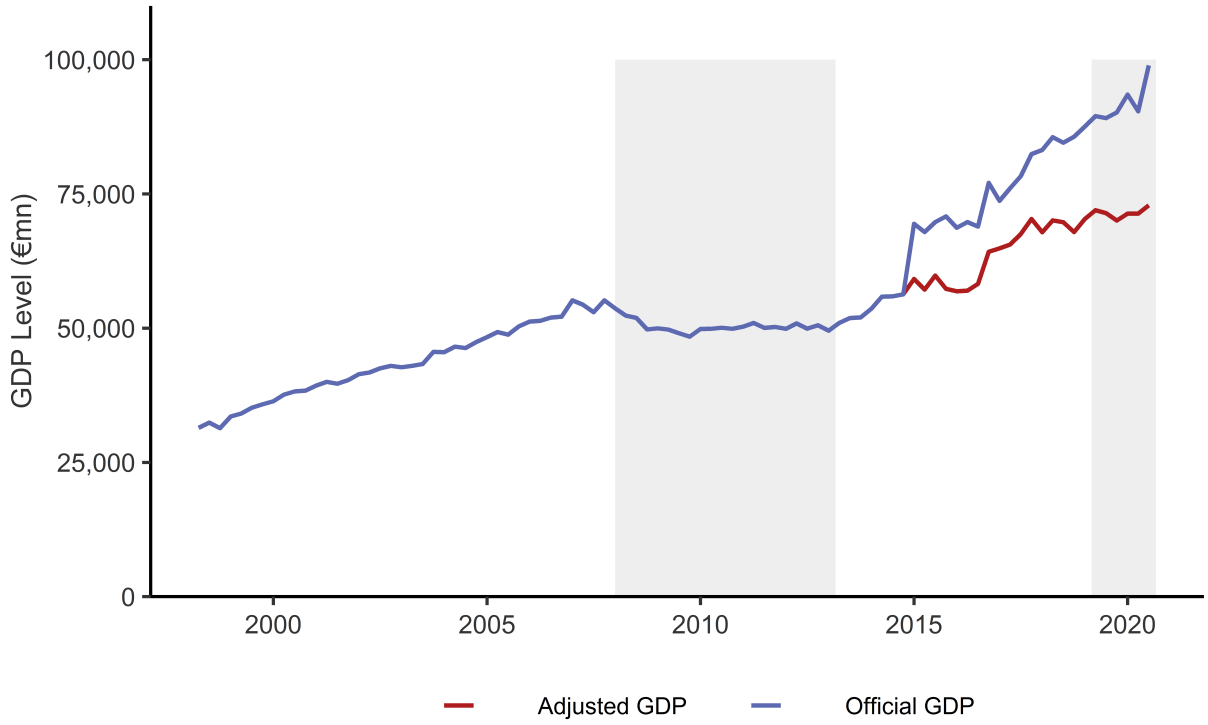
Using these estimates, we apply a simple linear regression to impute GDP growth rates from a given factor level. Given the signs of there being a structural break in the relationship between the factors and real quarterly GDP growth rates, we estimate our unrestricted model outlined in Equation (2). For a measure of GDP that reflects the state of the domestic economy in Ireland, we use the pre-2015 coefficient, β_1, to construct an adjusted measure. This inherently assumes that this relationship between GDP and our domestic factor was not disrupted following events from 2015 onward. Our resulting imputed GDP growth measure, which excludes distortionary foreign factor activity levels, is represented by $\Delta\%GDP_t^a = \alpha + \beta_1 f_t^d + \varepsilon_t$. As displayed in Figure 4, the imputed GDP growth rate suggests a persistent and positive period of growth in Ireland from 2015 onward, with a downward trend during the COVID pandemic.

Figure 4: Imputed real GDP growth (q-on-q, %)



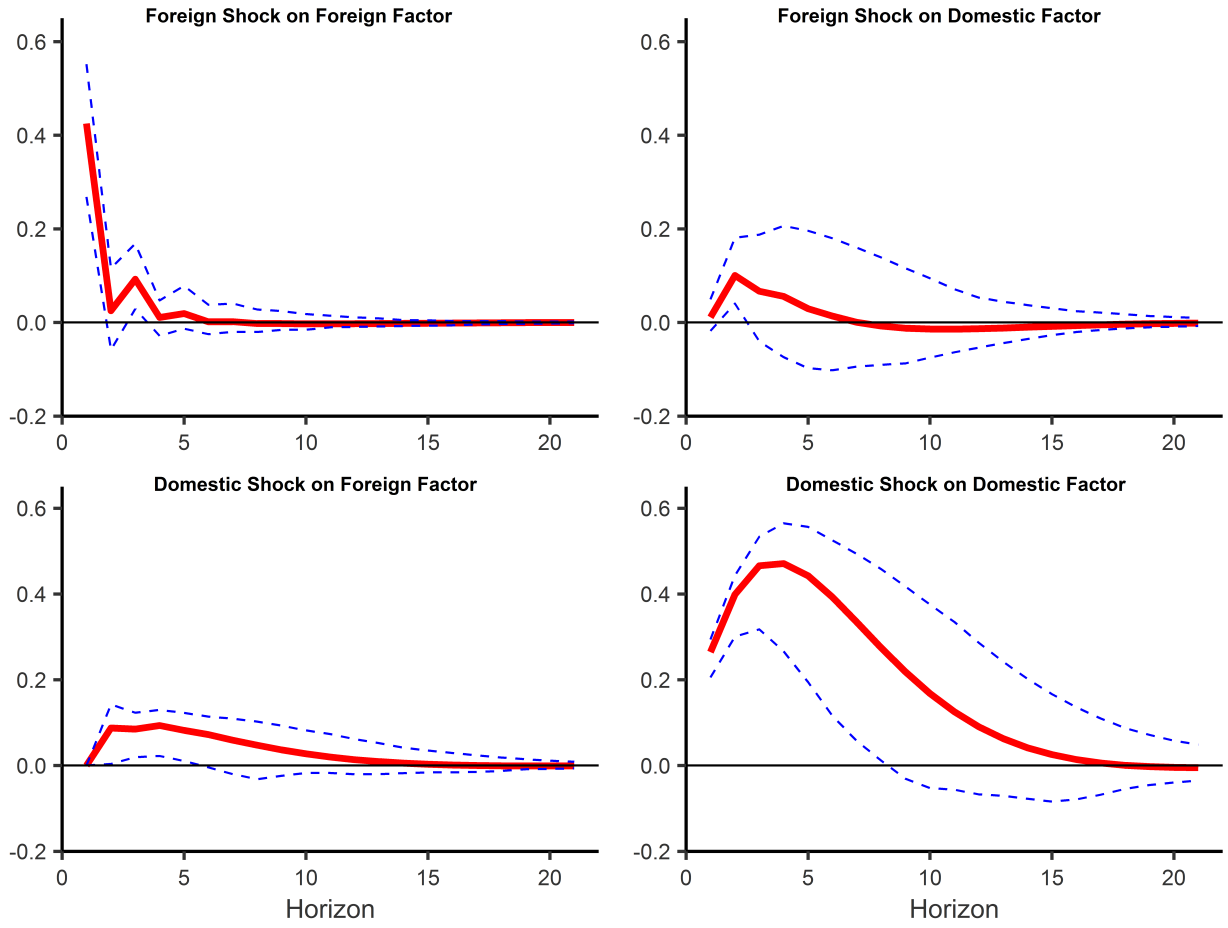
We use these imputed growth rates to calculate the corresponding adjusted GDP level from any given date. In the figure displayed below, we highlight the level of GDP from 2014 Q4 onward, should we ignore the influences of distortionary multinational firm activities and instead rely upon the imputed growth rates up until 2020 Q3. This highlights how the prevailing GDP measure for Ireland implies a substantial exaggeration of sustained domestic activity growth. This reflects an average difference post-2015 of 18%, if excluding the influence of elevated intangible asset activity among MNEs.

Figure 5: Imputed real GDP level



With these estimates, we are also able to address the assertion from policymakers and national accounting practitioners alike that activities associated with the reallocation of intellectual property has little to do with domestic economic activity in Ireland. Through a set of impulse response functions, we are able to observe the responsiveness of the factors to structural shocks in both foreign and domestic activity. As highlighted in Figure 6, the two factors do appear to be significantly separable. A structural shock to domestic activity in Ireland has little to no transitory effect on the common component of foreign-owned Irish resident firm activity, and likewise any shock in this foreign factor also contributes no significant changes in domestic activity.

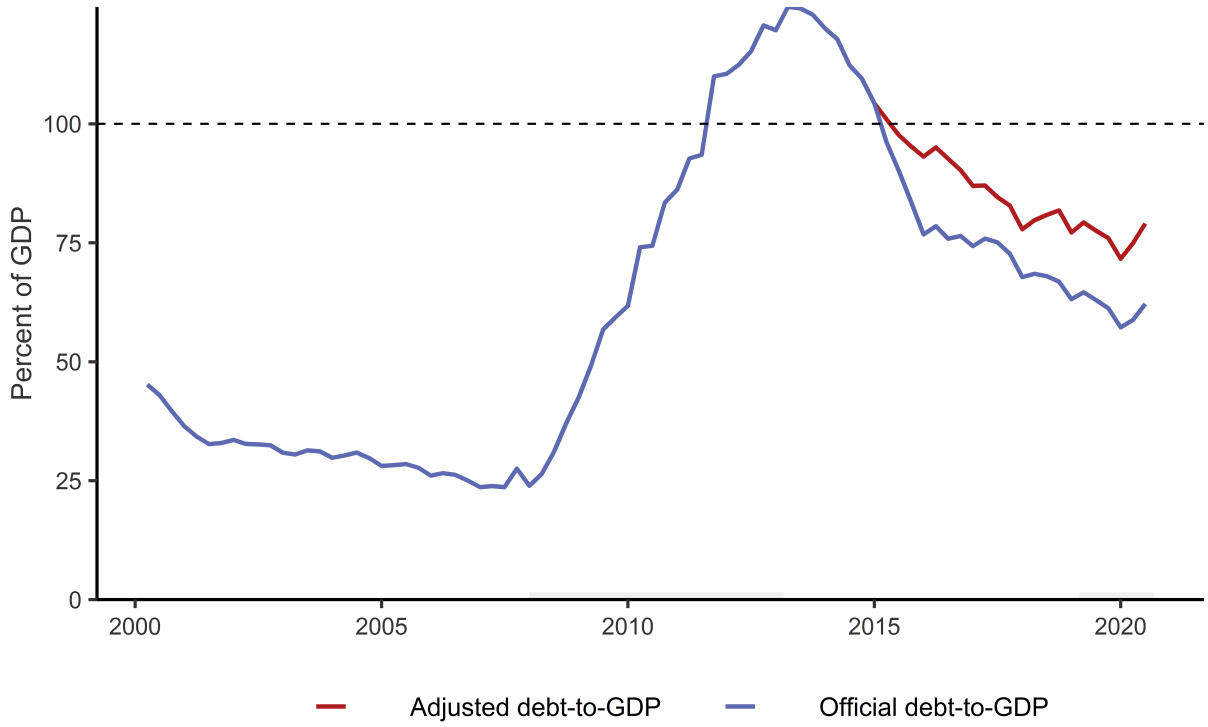
Figure 6: IRFs for structural shocks in foreign and domestic



Given our quarterly measure of GDP from 2015 onward, we can reassess the position Ireland is in with respect to national debt and EU budget contributions. To measure a quarterly debt to GDP ratio, we summate quarterly measures of nominal GDP and adjusted GDP using the four most recent observations for any given period and compare against Gross Government Debt.[13] From 2015Q1 onward, Figure 7 displays an average percentage point increase in the debt position of 12.9 percentage points. The most recent 2020Q3 difference of 16.9 percentage points implies debt represents 79.1 percent of adjusted GDP, which remains considerable below the EU-27 average of 90.1% even when taking intangible asset ownership inflation into account.

[13] Given that our adjusted values represent 'real' or volume-based activity, we use the inflator associated with the difference between real and nominal GDP measures available via the CSO's PxTable NQQ49. Gross Government Debt is provided by the Government Finance Statistics unit of the CSO, using PxTable GFQ13.

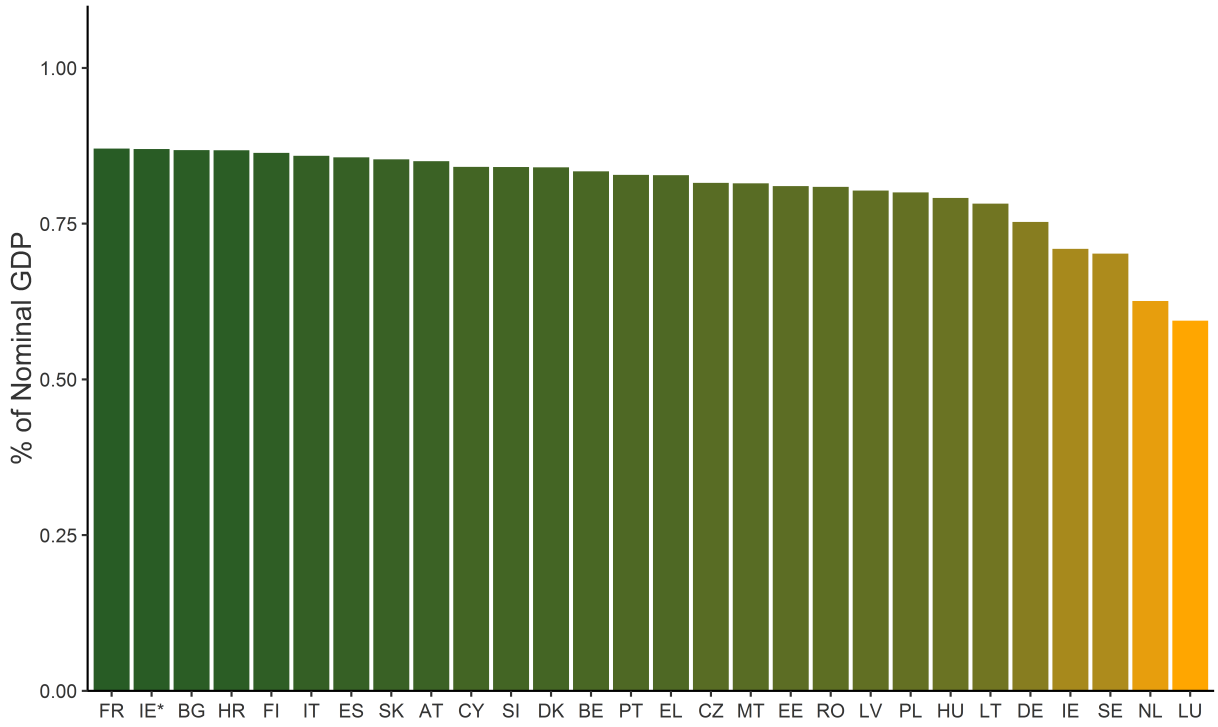
Figure 7: Implied Debt-to-GDP ratio



This correction for intangible asset ownership in our adjusted GDP measure also implies Ireland has been contributing more generously to the EU budget than previously thought. As displayed in Figure 8, Ireland ranked as the 4th lowest contributor to the 2018 EU budget by percentage of GDP, whereas according to our adjustment Ireland ranks the 2nd highest. Depending on the year, the adjusted ranking can range between the absolute highest contributor (2015 & 2016) and the 7th best contributor (2019).

This exercise also highlights that other low ranked countries are common culprits with respect to a large MNE influence on national accounting measures. In the case of Luxembourg and the Netherlands, Damgaard et al. (2019) refer to a similar pattern of major FDI flows passing through empty shells recognized as foreign subsidiary firms of MNEs. As the study puts it, "these shells, also called special purpose entities, have no real business activities. Rather, they carry out holding activities, conduct intra-firm financing, or manage intangible assets—often to minimize multinationals' global tax bill." While these countries would also need their GDP adjusted for to present a more reasonable ranking of EU countries in this setting, the focus of this initial study leaves such efforts up for future research.

Figure 8: EU Budget Contributions by country in 2018



Conclusion

Using common variation in key measures of domestic activity while separately identifying a common factor representative of IP-related MNE activity in Ireland, we are able to directly extract an adjusted GDP measure representative of the state of the Irish economy. This measure suggests GDP to be distorted positively in level by approximately 18 percent, sets Ireland debt at 79.1 per cent of GDP as of 2020Q3 and ranks the small open economy as one of the highest contributors to the European budget.

Our findings suggest that large multinational enterprises can have rather adverse aggregate effects on small open economies, and in cases like Ireland lead to notable distortions in key measures of economic performance. Going forward, we would hope that other exposed economies can be exposed to this two-step dynamic factor approach in order tomitigate the noise these superstar firms would otherwise impose.

Appendix A

Table 3: Domestic Data Series

Name	**Source**
Meat and meat products (101)	CSO: MIM02, MIM03, MIM04
Other foods (102 to 104,108)	
Dairy products (105)	
Bakery and farinaceous products (107)	
Textiles, wearing apparel and leather products (13 to 15)	
Wood and wood products, except furniture (16)	
Paper and paper products, printing and reproduction of media (17,18)	
Rubber and plastic products (22)	
Other non-metallic mineral products (23)	
Basic metals and fabricated metal products (24,25)	
Transport equipment (29,30)	
Electricity, gas, steam and air conditioning supply (35)	
Persons on Live Register, All ages, Unadjusted	CSO: LRM01
Monthly Unemployment ('000s), 25 - 74 years, Seasonally-Adjusted	CSO: MUM01
Motor trades (45)	CSO: RSM03, RSM04, RSM05
Retail sale in non-specialised stores with food, beverages or tobacco	
Department stores (4719)	
Retail sale of hardware, paints and glass (4752)	
Retail sale of furniture and lighting (4759)	
Retail sale of food (4711,4721 to 4729)	
Non food products, excluding motor trades, automotive fuel and bars	
Retail sale of food, beverages and tobacco in specialised stores	
Retail sale of household equipment (4741 to 4743,4752,4754,4759)	
Retail sale of electrical goods (4741 to 4743,4754)	
Retail sale of books, newspapers, stationery and other goods	
Other retail sales (4753,4763 to 4765,4776 to 4778)	
Retail sale of pharmaceutical, medical and cosmetic articles (4773 to 4775)	
New Vehicles	CSO: TEM01
Secondhand Vehicles	CSO: TEM01
Tax Receipts, Income Tax	DOF: Databank
Tax Receipts, Stamp Duty	
Tax Receipts, Value-Added Tax	
Index of Current Economic Conditions	KBC Bank

Table 4: Foreign MNE Data Series

Name	**Source**
CA Inflow - Communication Services	CSO: MIM02, MIM03, MIM04
CA Inflow - Financial Services	
CA Inflow - Computer Services	
CA Inflow - Royalties & License Fees	
CA Inflow - Operational Leasing	
CA Outflow - Communication Services	
CA Outflow - Royalties & License Fees	
CA Outflow - Research & Development Services	
CA Outflow - Operational Leasing	
CA Outflow - Other Business Services	
CA Outflow - Dividends and Distribution of Branch Profits	
CA Outflow - Reinvested Earnings	
Corporation Tax Receipts	D.o.F Databank
GVA - Information and Communication Services	CSO: NQQ43
GVA - Industry	
GVA - Finance and Insurance Activities	
Imports - Organic Chemicals	CSO: TSM10
Imports - Medicinal and Pharmaceutical Products	
Imports - Machinery less Electrical Machinery	
Imports - Electrical Machinery	
Contract Manufacturing	CSO: TSM10, NQQ45

Note: Central Statistics Office (CSO), Current Account (CA), Department of Finance (DF), Gross value added at basic prices (GVA). Any terms following CSO are PXtable codes.

Figure 9: Imputed real GDP level from 1998

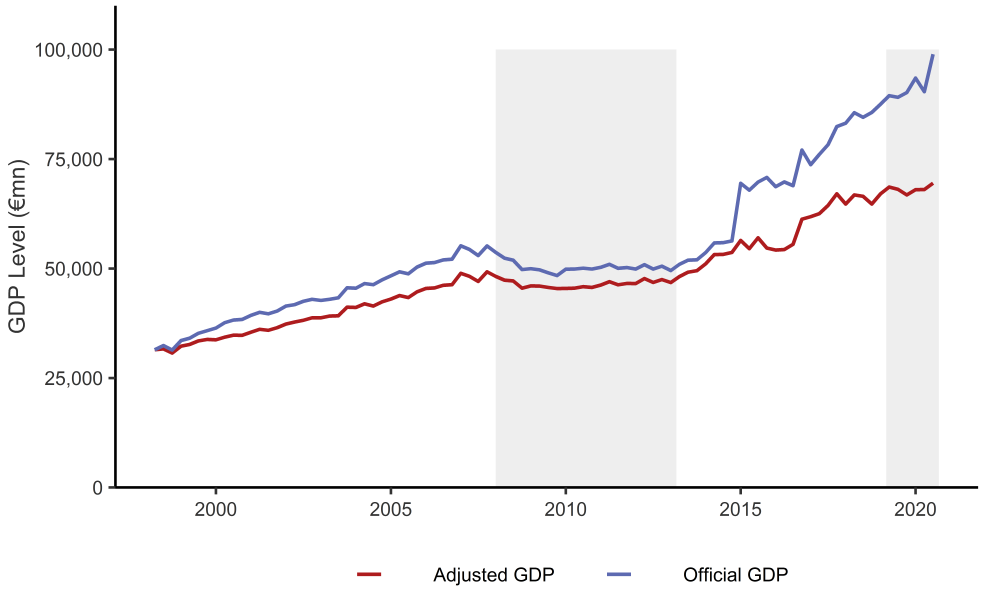


Figure 10: Debt-to-GDP ratio from 1998

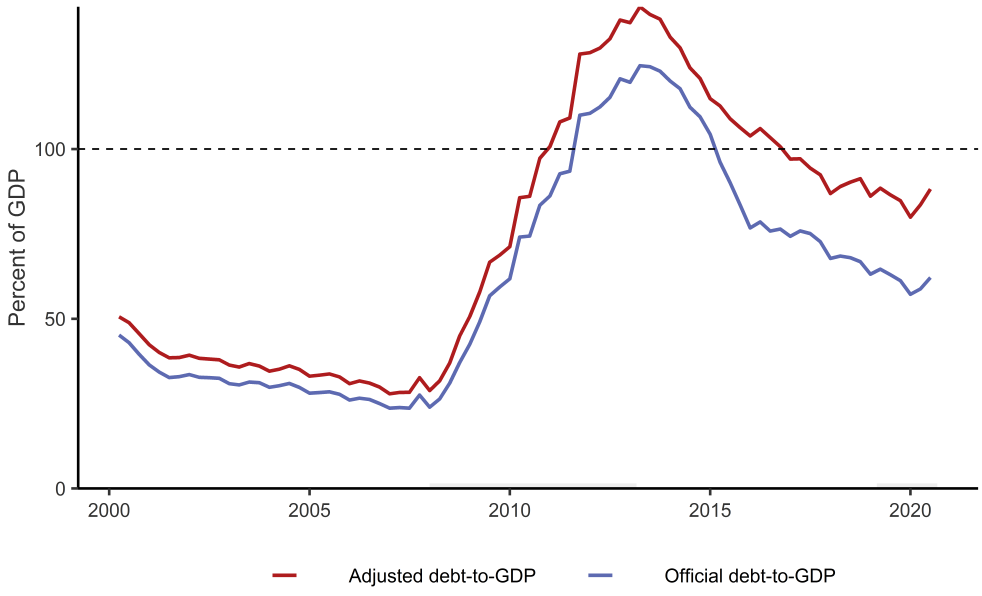
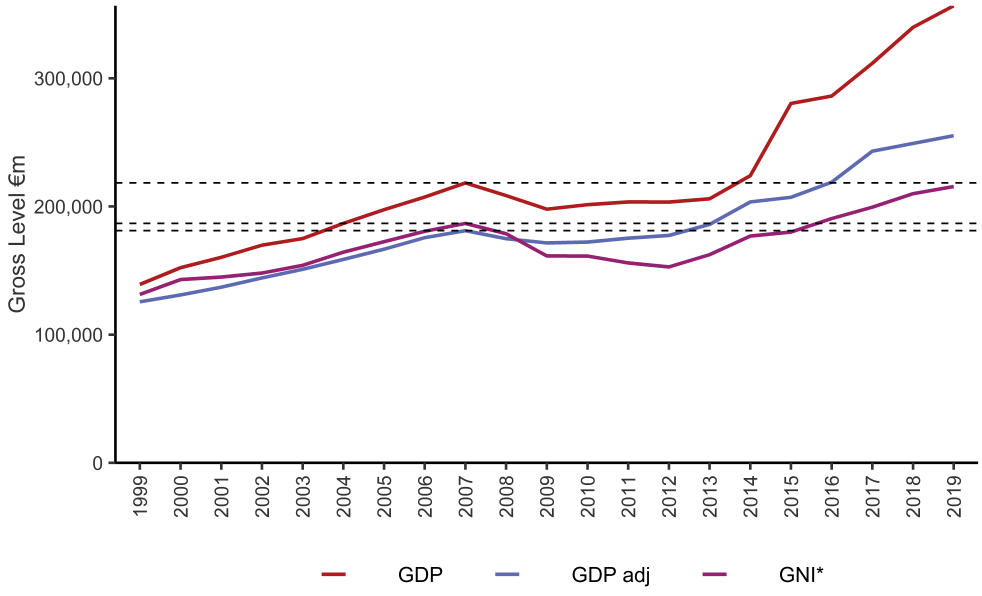


Figure 11: Comparing annualized measures



References

Altissimo, F., Cristadoro, R., Forni, M., Lippi, M., and Veronese, G. (2010). New Eurocoin: Tracking Economic Growth in Real Time. *The Review of Economics and Statistics*, 92(4):1024–1034.

Avdjiev, S., Everett, M., Lane, P., and Shin, H. S. (2018). Tracking the international footprints of global firms. *BIS Quarterly Review*.

Barry, F. (2012). Trade, Investment, Integration: the Economics of Irish Foreign Policy. In *Irish Foreign Policy*, pages 184–202. Dublin: Royal Irish Academy and Gill and Macmillan.

Conefrey, T. and Walsh, G. (2018). A Monthly Indicator of Economic Activity for Ireland. Economic Letters 14/EL/18, Central Bank of Ireland.

Crone, T. M. and Clayton-Matthews, A. (2005). Consistent Economic Indexes for the 50 States. *The Review of Economics and Statistics*, 87(4):593–603.

Damgaard, J., Elkjaer, T., and Johannesen, N. (2019). The rise of phantom investments: Empty corporate shells in tax havens undermine tax collection. *Finance & Development*, 0056(003):A004.

Davies, R., Martin, J., Parenti, M., and Toubal, F. (2018). Knocking on tax haven's door: Multinational firms and transfer pricing. *The Review of Economics and Statistics*, 100(1):120–134.

Doz, C., Giannone, D., and Reichlin, L. (2011). A two-step estimator for large approximate dynamic factor models based on Kalman filtering. *Journal of Econometrics*, 164(1):188–205.

Fitzgerald, J. (2015). Problems Interpreting National Accounts in a Globalised Economy Ireland. *ESRI Quarterly Economic Commentary*.

Fitzgerald, J. (2018). National Accounts for a Global Economy: the Case of Ireland. *Quarterly Economic Commentary: Special Articles*.

Giannone, D., Reichlin, L., and Small, D. (2008). Nowcasting: The real-time informational content of macroeconomic data. *Journal of Monetary Economics*, 55(4):665–676.

Honohan, P. (2021). Is Ireland Really the most Prosperous Country in Europe? Economic Letters 1/EL/21, Central Bank of Ireland.

Lane, P. R. (2017). The Treatment of Global Firms in National Accounts. Economic Letters 01/EL/17, Central Bank of Ireland.

Mariano, R. and Murasawa, Y. (2010). A Coincident Index, Common Factors, and Monthly Real GDP*. *Oxford Bulletin of Economics and Statistics*, 72(1):27–46.

McQuinn, K., O'Toole, C., Economides, P., and Monteiro, T. (2018). *Quarterly Economic Commentary, Spring 2018*. Economic and Social Research Institute (ESRI).

Moulton, B. and van de Ven, P. (2018). Addressing the challenges of globalization in national accounts. In *The Challenges of Globalization in the Measurement of National Accounts*. National Bureau of Economic Research, Inc.

Nadine, R. (2018). Quantifying international tax avoidance: A review of the academic literature. *Review of Economics*, 69(2):169–181.

O'Rourke, K. and Ó Grada, C. (2000). Living standards and growth. Open access publications, School of Economics, University College Dublin.

Stock, J. and Watson, M. (1989). New Indexes of Coincident and Leading Economic Indicators. In *NBER Macroeconomics Annual 1989, Volume 4*, pages 351–409. National Bureau of Economic Research, Inc.

Stock, J. and Watson, M. (2016). Dynamic Factor Models, Factor-Augmented Vector Autoregressions, and Structural Vector Autoregressions in Macroeconomics. volume 2, chapter Chapter 8, pages 415–525. Elsevier.

Thorsrud, L. (2020). Words are the New Numbers: A Newsy Coincident Index of the Business Cycle. *Journal of Business and Economic Statistics*, 38(2):393–409.

Torslov, T., Wier, L., and Zucman, G. (2020). The Missing Profits of Nations. Working papers, HAL.