

# Measuring Economic Activity in the Presence of Superstar MNEs

Philip Economides<sup>a,\*</sup>

Giorgi Nikolaishvili<sup>a</sup>

<sup>a</sup>Department of Economics, University of Oregon, Eugene, OR 97403

## Abstract

In 2015, changes to Irish tax legislation, known as the “2015 Finance Act”, coincided with a 26% annual increase in real gross domestic product. We show evidence confirming the conclusions of existing literature, which suggests 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.

**Keywords:** Tax haven; multinational firms; national accounting; dynamic factor models

**JEL Classifications:** F23; C38; E01; H26; O34

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\*Corresponding author. E-mail addresses: [peconomi@uoregon.edu](mailto:peconomi@uoregon.edu) (P. Economides), [gnikolai@uoregon.edu](mailto:gnikolai@uoregon.edu) (G. Nikolaishvili).

# 1 Introduction

This study considers the presence of large multinational enterprises (MNEs) in a small open economy and the unanticipated influence that the international tax planning strategies of these firms can have on national accounting measures. We focus on the case of the Republic of Ireland, in which MNEs' strategic relocation of intangible assets has introduced difficulties in interpreting key aggregate economic measures. Ireland's introduction of a Capital Allowances for Intangible Assets (CAIA) tool, in tandem with adjustments to tax legislation, resulted in 'stateless' tax entities switching in status to Irish residency.<sup>1</sup> This coincided with a 26.3% increase in Ireland's real GDP in 2015. 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 (Fitzgerald, 2018). While these issues are not unique to Ireland, this case is particularly pronounced (Avdjiev et al., 2018).

Moulton and van de Ven (2018) find that the effects of globalization can make national data difficult to interpret, and may even be considered a distorting influence on the data. In Ireland's case, it is argued that these tax-optimization strategies of a select few superstar MNEs has led to a 'distortion' in GDP as a measure of domestic activity. When assessing the factors that contributed to the extreme growth of Irish GDP in 2015, the majority are largely uncorrelated with the state of the domestic economy (Fitzgerald, 2015; Lane, 2017; Fitzgerald, 2018; Honohan, 2021). For example, contract manufacturing has now become a far greater aspect of the quarterly national accounts measure of exports.<sup>2</sup> While these manufactured goods never once interact with the Irish border, they continue to contribute to GDP. For policymakers in Ireland, conventional models used to predict short to medium term growth are notably less accurate when forecasting GDP, which in turn introduces challenges with respect to calibrating fiscal budgets and motivating those decisions.

Our study verifies claims that these unorthodox aspects of GDP growth do not reflect variation in domestic economic activity. Additionally, we present an alternative measure of GDP that excludes the influence of foreign MNE tax-restructuring activity from existing measures of aggregate output using a dynamic factor modeling (DFM) framework. Upon assessing this impact on the national accounts, we find that excluding distortionary IP-related MNE activity reduces the effective GDP measure by an average of 18% between 2015Q1 and 2020Q4. This implies a 12.9

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<sup>1</sup>This tool allows firms to access tax allowances for any intellectual property (IP) relocated to Ireland as well as accrue tax benefits based on the depreciation of these assets.

<sup>2</sup>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.

percentage point higher debt-to-GDP ratio and greatly improves Ireland’s position as a contributor to the EU-27 fiscal budget. This evidence of overstated GDP supports recent findings that IP-related tax restructuring and profit shifting by large MNEs has contributed to an understatement of US GDP (Guvenen et al., 2022). Furthermore, we find that there is no evidence of significant spillover effects between shocks to our domestic and foreign MNE factors, respectively.

Our findings suggest that GDP in Ireland is heavily distorted, if used to gauge the performance of the domestic economy by conventional standards. These results validate the expressed concerns of Irish policymakers and add to support for further modernization of international national accounting standards in response to increased digitization and globalization of MNE activity. The remainder of the paper is organized as follows. Section 2 details our methodology. Section 3 provides a brief discussion of our raw data and the necessary transformations. Section 4 details our results and section 5 concludes the paper.

## 2 Methodology

We use a dynamic factor model 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 IP-related actions. We then decompose Irish GDP growth as a linear combination of domestic and foreign factors and generate an adjusted GDP measure that partials-out foreign distortions.

Using a set of disaggregated series, we partition the quarterly data into two groups: the first group contains series that share significant variation with the overall growth of domestic activity in Ireland. In selecting the set of data for estimating our domestic activity factor, we refer to Stock and Watson (1989) and Stock and Watson (2016), which recommend the use of industrial production, personal income, retail sales, and employment series in their most disaggregated forms available. The second group contains series that reflect variation in the growth of IP-related foreign MNE activity. Our selection relies on institutional knowledge provided by (i) members of the Economic and Social Research Institute’s macroeconomics division (Fitzgerald, 2018; Egan, 2022) and (ii) former governors of the Central Bank of Ireland (Lane, 2017; Honohan, 2021). These studies attribute GDP distortions to not only the reallocation of intellectual property into Irish subsidiaries, but also each asset’s associated financial flows.<sup>3</sup> Our set of chosen variables is intended to reflect

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<sup>3</sup>Monthly domestic data uses X-13 seasonal-adjustment of the US Census Bureau and is aggregated to quarterly series in order to maintain a consistent frequency between both factors. Index-based (level) series take the average (sum) of each monthly value for a given year-quarter. We then convert both seasonally-adjusted quarterly blocks of

both the movement of these assets and associated flows consisting of international income flows, tax payments, and depreciation.

Next, we specify a dynamic factor model with two factors, such that each factor corresponds with only one of the above-mentioned groups of series – for the domestic and foreign factors, respectively. The factors follow a VAR( $p$ ) process. To estimate our factors, we carry out a procedure similar to the two-step DFM estimator most notably used by [Giannone et al. \(2008\)](#) and asymptotically analysed by [Doz et al. \(2011\)](#). We use the factor estimates to generate an adjusted GDP growth rate measure that rids the original GDP growth rate measure of the distortion caused by foreign activity. Given the exceptional circumstances which have brought into question the ability of Irish GDP to reflect the state of the domestic economy, we estimate the following model:

$$\% \Delta GDP_t = \alpha + \beta_1 f_t^d + \beta_2 f_t^f + \gamma D_t + \beta_3 (f_t^d D_t) + \beta_4 (f_t^f D_t) + \varepsilon_t, \quad (1)$$

where  $t$  ranges from 1998Q1 to 2020Q4,  $\% \Delta GDP$  denotes Ireland's quarter-on-quarter real GDP growth rate,  $f^d$  is the domestic factor,  $f^f$  is the foreign factor, a post-2015 IP movement dummy variable,  $D_t$ , is equal to 1 for periods from Q1 2015 onward, and  $\varepsilon$  is a disturbance term. The inclusion of the dummy interaction terms allows us to eliminate any contribution of the structural break in the relationship between GDP growth and domestic factor variation. The pre-2015 subsample provides a reliable estimate of the relationship between the domestic activity factor and the GDP growth rate, whereas the post-2015 period is subject to potential bias due to the sudden and enlarged repositioning of intellectual property into Irish national accounts. The following expression yields our adjusted GDP growth rate measure based on the parameters estimated using the regression model specified in Eq. (1):

$$\% \Delta GDP_t^a = \hat{\alpha} + \hat{\beta}_1 f_t^d + \varepsilon_t. \quad (2)$$

### 3 Results

Upon estimating the model, we identify a common component of domestic economic activity as well as one for foreign multinational activity in Ireland, as displayed in Figure 1. Each of these factors are normalized, hence any deviation above or below zero would be considered a deviation from long-run average growth rates.

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data into their respective quarter-on-quarter growth rates via logged first-differencing. A list of the specific series used for both factors and their respective summary statistics are reported in the Appendix.

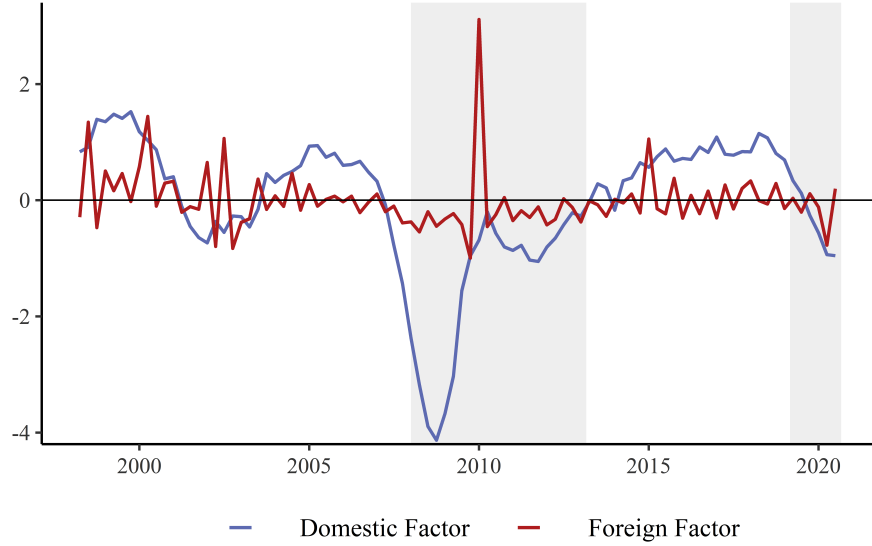


Figure 1: Domestic and foreign factor estimates

A number of events appear to be captured appropriately by the factor estimates. The domestic series captures the Great Recession period. 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 response, following the Great Recession. Furthermore, significant increases in this factor's variation overlap notably with respect to the introduction of specific profit-shifting tax tools in 2010 and 2015.<sup>4</sup> Although there is a sharp increase in MNE activity in 2015, the trend in domestic growth remains persistent relative the periods before and after – in line with our previously expressed priors.

The correlation coefficient between GDP and the domestic factor drops from 0.47 in the pre-2015 subsample to -0.09 in the post-2015 subsample, 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, rising from 0.41 in the pre-2015 subsample to 0.76 in the post-period subsample. These stylized facts support the proposition that IP-related MNE activities have distorted GDP growth in recent years.

We estimate the linear regression model expressed in Eq. (1) to generate a series of adjusted GDP growth rates based on domestic economic performance. In the post-2015 period, a unit increase in the domestic factor variable is associated with a  $-2.2$  percentage point adjustment in the real quarterly GDP growth rate whereas prior to 2015, a  $0.7$  percentage point increase is

<sup>4</sup>We refer to Capital Allowances for Intangible Assets (CAIA) base-erosion and profit-shifting tools, which limit the tax liability of firms with major holdings of intellectual property.

expected. Leveraging use of this pre-2015 relationship, we generate our adjusted GDP growth measure.<sup>5</sup> In Figure 2 we highlight the level of GDP from 2014Q4 onward, should we exclude the influences of distortionary MNE activities and only rely on the adjusted growth rates up until 2020Q3. This highlights a substantial exaggeration of sustained domestic activity growth, which once excluded represents an average GDP level reduction of 14%.

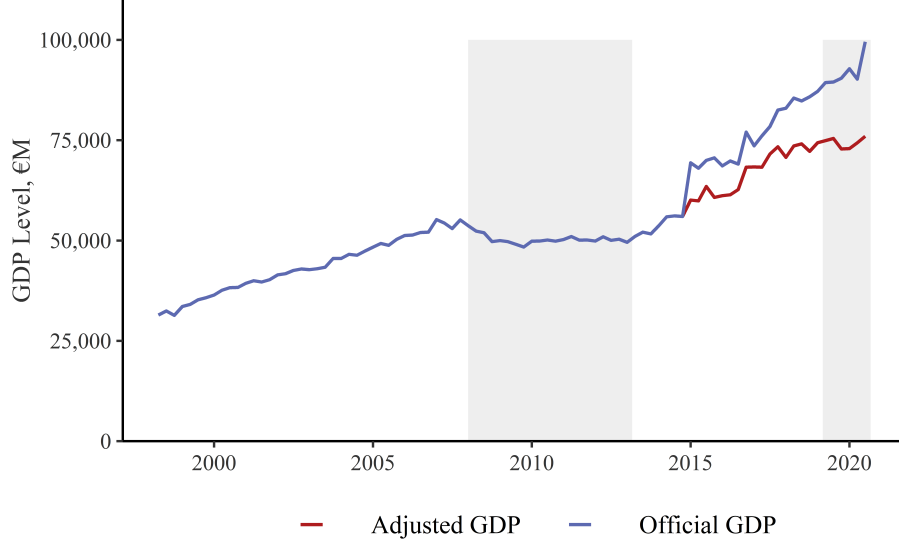


Figure 2: Imputed real GDP

We are also able to address the assertion from policymakers that activities associated with the relocation of IP do not contribute significantly to domestic economic activity in Ireland. We estimate the following VAR using smoothed estimates of the domestic and foreign factors:

$$\begin{bmatrix} f_t^d \\ f_t^f \end{bmatrix} = \alpha + \phi(L) \begin{bmatrix} f_t^d \\ f_t^f \end{bmatrix} + \begin{bmatrix} u_t^d \\ u_t^f \end{bmatrix}, \quad (3)$$

where  $\alpha$  is an intercept vector,  $\phi(L)$  is a lag polynomial, and  $u_t^d$  and  $u_t^f$  are non-orthogonalized shocks to the domestic and foreign factors, respectively. Through a set of impulse response functions presented in Figure 3, we observe the sensitivity of the factors to unit changes in  $u_t^d$  and  $u_t^f$ . A shock to domestic activity has a negligible transitory effect on the foreign factor despite its brief statistical significance, and similarly, a shock to the foreign factor has no significant effect on domestic activity – the two factors are separable.<sup>6</sup> Our results suggest that activities related to

<sup>5</sup>The full set of results for Eq. (1) are reported in Table 4 of the Appendix section.

<sup>6</sup>Recursive identifications of the domestic and foreign shocks yield nearly-identical impulse response functions. We have also performed an additional robustness test in which we estimated a multi-level DFM containing an additional common factor across both data blocks. We found this ‘global’ factor to be insignificant, as it accounts for very little of the overall variation in the data. This implies a lack of common shocks affecting both data blocks, and in turn

commercially sensitive intangible assets of large MNEs in Ireland did not lead to growth spillovers for the domestic economy.<sup>7</sup>

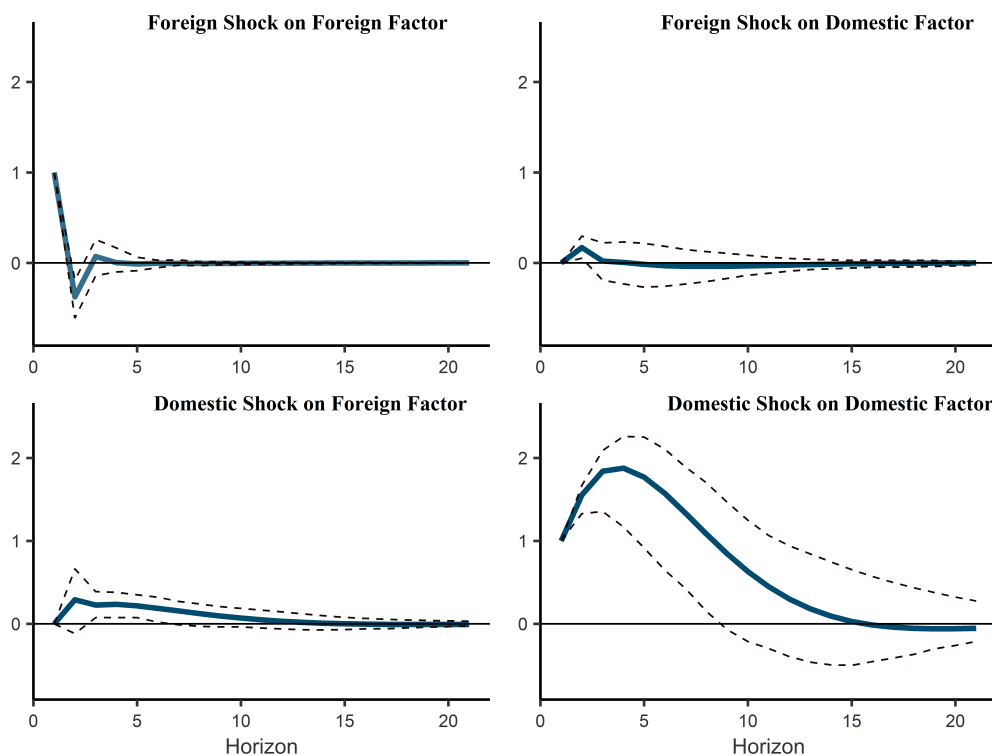


Figure 3: IRFs for reduced-form shocks to foreign and domestic factors

*Note:* The dashed lines represent bootstrapped 95% confidence intervals.

To assess our adjusted GDP measure, we compare it to alternative measures of domestic economic activity that are frequently used by Irish policymakers. These series, provided by the Central Statistics Office, consist of Modified Domestic Demand (MDD) and Modified Gross National Income (GNI\*).<sup>8</sup> As displayed in Figure 4, our measure performs favourably. Firstly, while none of these series use GDP as an input, our adjusted measure maps most closely to the prevailing real GDP level up to 2014. Additionally, although none of these series indicate excessively high levels of growth in 2015, our measure refutes an unreasonably long post-recession recovery process suggested by MDD and GNI\*.

a lack of common shocks to the domestic and foreign factors.

<sup>7</sup>Although evidence of positive MNE spillovers exists, such evidence is often limited to scenarios in which the investing firms are incentivized to reduce their costs through backward supply linkages (Javorcik, 2004).

<sup>8</sup>Neither of these corrective approaches involve statistical inference. Instead, they omit disaggregates from national accounting measures. MDD computes the sum of consumption, government spending and investment less R&D service imports, trade in IP, and capital attributed to aircraft leasing. GNI\* is gross national income minus depreciation of IP, net factor income of redomiciled private limited companies, and proceeds from aircraft leasing operations.

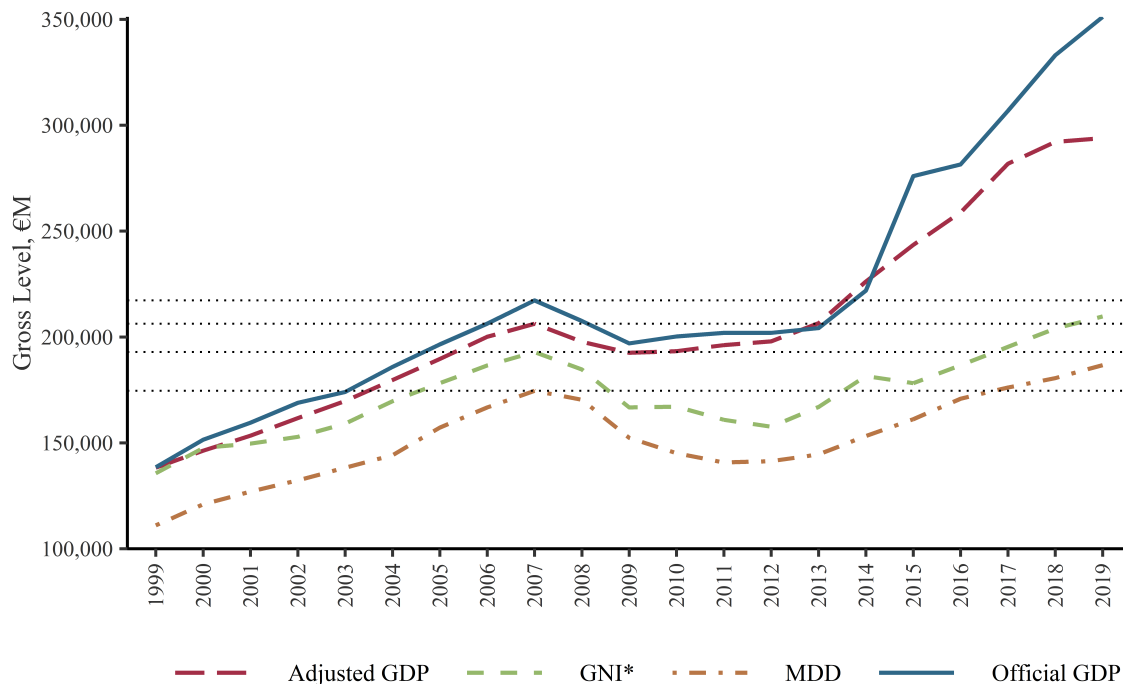


Figure 4: Comparing Annualized Domestic Measures

*Note:* Levels are compared to real GDP from 1999 to 2019. Adjusted GDP and MDD (GNI\*) share a positive correlation of 87.1% (88.4%). The dotted black lines highlight the periods at which each series reported the Irish economy returning to levels of activity last observed in 2007.

Given our quarterly measure of adjusted GDP from 2015 onward, we can reassess the fiscal position of Ireland. Figure 5a displays an average percentage point increase in the debt position of 12.9 percentage points. The most recent difference of 16.9 percentage points implies debt represents 79.1% of adjusted GDP, which remains considerably below the EU-27 average of 90.1%. This correction also implies Ireland has been contributing more generously to the EU budget than previously thought. As displayed in Figure 5b, Ireland ranked as the 4th lowest contributor to the 2018 EU budget as a percentage of GDP, whereas according to our adjustment Ireland ranks moderately at 15th place. This exercise also highlights that other low ranked countries are common culprits with respect to a large MNE influence on national accounts. 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. While these countries could also see their GDP adjusted, to present a more reasonable ranking of EU countries, we leave such efforts for future research.



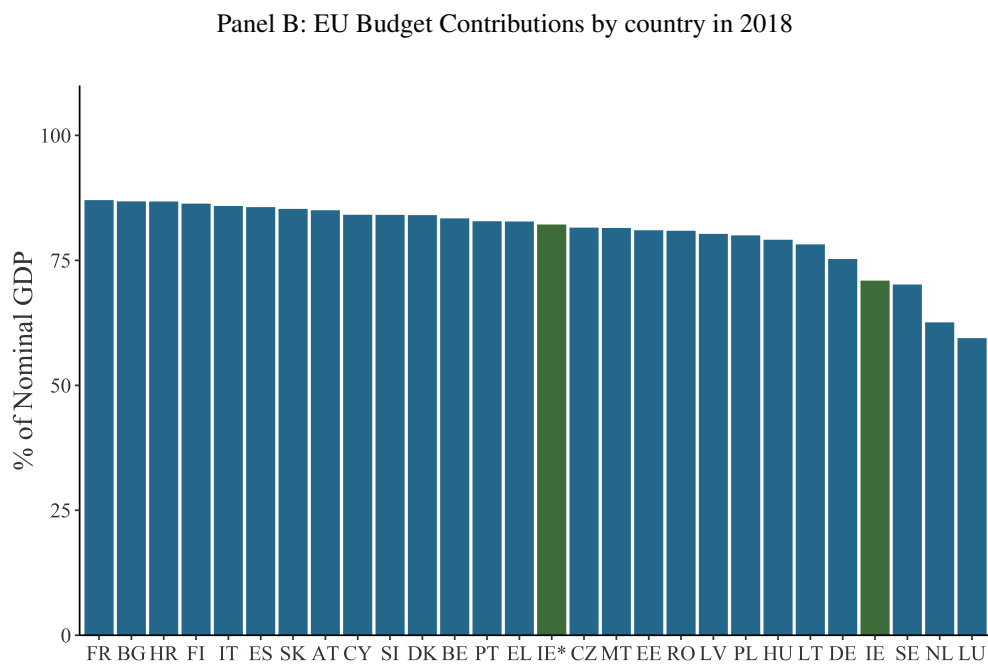
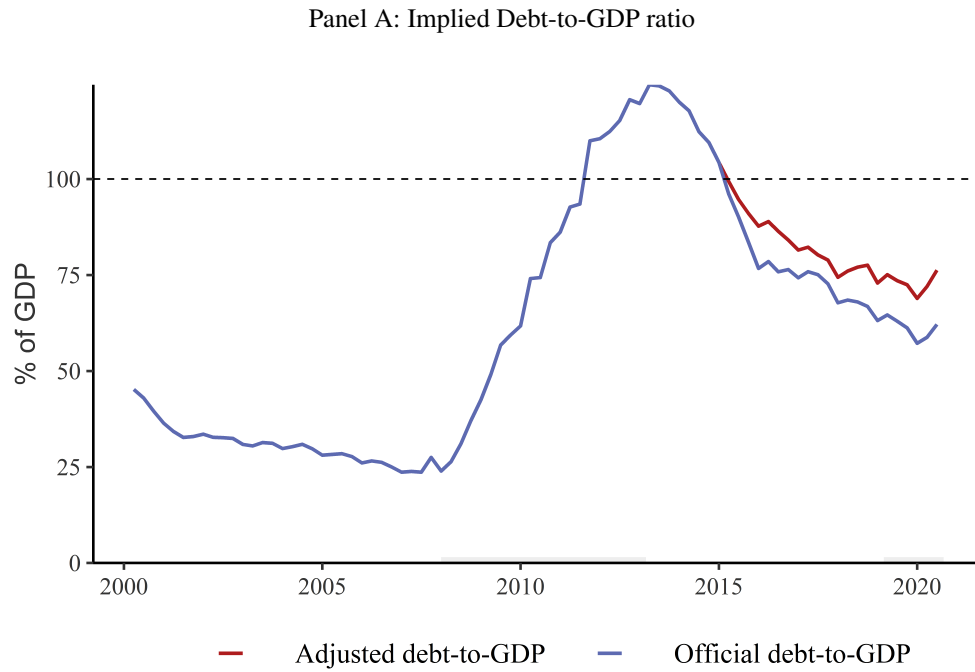


Figure 5: Corrections to Irish Fiscal Position

## 4 Conclusion

Despite our focus on the implications of such tax strategies for a given country's national accounts, there exists a wider concern with respect to GDP distortions across small open economies. [Tørsløv et al. \(ress\)](#) estimates that in 2015 more than 40% of US-parented multinational profits (\$616B) were shifted to tax havens globally. Although Ireland maintains the highest estimated share of profit-shifting destinations (17.2%), the Netherlands (9.3%), Singapore (11.4%), Switzerland (9.4%) and the Caribbean (15.7%) also all feature prominently. While our paper focuses on the case of Ireland, our methodology is applicable to a wider set of countries exposed to similar GDP distortions. We encourage policymakers in small open economies with GDP distortion issues of the same nature as Ireland to use our approach in order to more accurately track the growth states of their domestic economies.

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# Appendix

Table 1: Domestic Data Series

Series	Source
<b>Industrial Production</b>	
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)	
<b>Unemployment</b>	
Persons on Live Register, All ages, Unadjusted	CSO: LRM01
Monthly Unemployment ('000s), 25 - 74 years, Seasonally-Adjusted	CSO: MUM01
<b>Retail Sales</b>	
Motor trades (45)	CSO: RSM03, RSM04, RSM05
Retail sale in non-specialized 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 specialized 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)	
<b>Other</b>	
New Vehicles	CSO: TEM01
Secondhand Vehicles	CSO: TEM01
Tax Receipts, Income Tax	DOF: Databank
Tax Receipts, Stamp Duty	
Tax Receipts, Value-Added Tax	
Consumer confidence indicator	Eurostat: BS-CSMCI-BAL

Note: Central Statistics Office (CSO), Department of Finance (D.o.F). Any terms following CSO are PXtable codes.

Table 2: Foreign MNE Data Series

Series	Source
Gross Domestic Fixed Capital Formation - Intangible Assets	CSO: NQQ49
CA Inflow - Communication Services	CSO: BPCQ1,BPQ19,BPQ20
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 (author calculations)	CSO: TSM10, NQQ49

*Note:* Central Statistics Office (CSO), Current Account (CA), Department of Finance (D.o.F), Gross value added at basic prices (GVA). Any terms following CSO are PXtable codes. GVA values represent the least aggregated national accounting measure that contains depreciation of intangible assets. 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.<sup>9</sup>

<sup>9</sup>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. Available at: <https://www.cso.ie/en/releasesandpublications/in/geid/explaininggoodsexportsandimports2012-2016/> (last accessed: Feb 10, 2023).

Table 3: Summary Statistics, Seasonally-Adjusted Quarter-on-Quarter Growth Rates

Series	Mean	St. Dev	Series	Mean	St. Dev
Meat and Meat Product Production	0.23	4.71	Tax Receipts, Stamp Duty	0.89	14.43
Other Food Production	0.66	6.22	Tax Receipts, Value-Added Tax	1.46	3.65
Dairy Production	0.44	4.79	Consumer Confidence Indicator	0.16	3.71
Bakery and Farinaceous Goods Production	-0.47	5.75	CA Inflow of Communication Services	138.94	61.51
Textiles, Wearing Apparel and Leather Goods Production	-1.60	6.79	CA Inflow of Financial Services	4.08	11.61
Wood and Wood Products, excl. Furniture Production	-0.00	7.39	CA Inflow of Computer Services	4.25	4.23
Paper and Paper Products, excl. Printing Production	-0.51	3.17	CA Inflow of Royalties and License Fees	8.82	36.27
Rubber and Plastic Products Production	-0.27	4.93	CA Inflow of Operation Leasing	8.30	40.29
Other Non-Metallic Mineral Products Production	0.01	4.08	CA Outflow of Communication Services	4.19	37.38
Basic Metals and Fabricated Metal Products	0.41	5.00	CA Outflow of Royalties & License Fees	58.98	253.18
Transport Equipment Production	-0.12	7.06	CA Outflow of Research & Development Services	95.96	607.68
Electricity, Gas, Steam and Air Conditioning Production	0.81	3.58	CA Outflow of Operational Leasing	25.51	182.17
Persons on Live Register, All Ages, Unadjusted	0.35	4.38	CA Outflow of Other Business Services	11.31	57.51
Monthly Unemployment, 25-74 years, Seas.Adj	-0.12	7.79	CA Outflow of Dividends and Distribution of Branch Profits	4.63	31.52
Motor Trade Sales	0.97	4.43	CA Outflow of Reinvested Earnings	26.10	181.35
Retail Sales in Non-Specialized Stores with F.B.T.	0.79	1.44	Corporation Tax Receipts	10.10	68.56
Department Store Sales	0.63	2.71	Gross Value-Added: Information and Communication Services	2.98	5.68
Retail Sales of Hardware, Paints and Glass	0.85	3.11	Gross Value-Added: Industry	2.17	12.97
Retail Sales of Furniture and Lighting	1.02	4.47	Gross Value-Added: Financial Services	0.73	4.82
Retail Sales in Specialized Stores with F.B.T.	-0.11	1.14	Imports of Organic Chemicals	2.89	16.97
Retail Sales of Electrical Goods	1.77	3.35	Imports of Medicinal and Pharmaceutical Products	4.01	12.63
Other Retail Sales	0.78	3.05	Imports of Machinery less Electrical Machinery	-0.15	5.38
Retail Sales of Pharmaceutical, Medicinal, Cosmetics	1.13	1.83	Imports of Electrical Machinery	1.96	16.10
New Vehicle Sales	1.25	7.04	Contract Manufacturing	30.55	292.32
Second-hand Vehicle Sales	0.83	9.47	Gross Domestic Fixed Capital Formation - Intangible Assets	29.74	143.73
Tax Receipts, Income Tax	1.37	2.26			

*Note:* In order to avoid either factor being driven by outliers, we set any extreme values equal to the mean of the distribution. We define an extreme value as any value lower than the 25th percentile minus three times the interquartile range (75th percentile - 25th percentile) or higher than the 75th percentile plus three times the interquartile range. Each of these series is normalized prior to their use in the model.

Table 4: Factor Regression

Dep. Variable:	Quarterly Real GDP Growth (%)
Intercept	1.051*** (0.2335)
Domestic Growth	0.657*** (0.1979)
Foreign Growth	1.150*** (0.3021)
Post-2015	2.353*** (0.7804)
Domestic $\times$ Post-2015	-2.863*** (0.8587)
Foreign $\times$ Post-2015	11.544*** (2.851)
Observations	90
R-squared	0.55210

*Note:* The table presents the results of decomposing quarter-on-quarter real output growth rates into contributions by the underlying state of the domestic economy and foreign-owned IP-related activity. Heteroskedasticity-robust standard-errors are reported in parentheses.

Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1.

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