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Report

Impacts of the US economy on Ireland: A Quantitative and Qualitative Analysis

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Impacts of the US economy on Ireland

Summary

- Ireland has been a beneficiary of globalisation in recent decades. It has positioned itself as being open to trade, capital and immigration, in particular from the US. This policy has been a major driver in employment and living standards in Ireland since the 1990s.

- However it also opens Ireland up to volatility. It is critical then that we understand the economic linkages that exist between the US and Ireland.

- This paper describes the degree to which US companies are involved in the Irish economy, how Ireland has inserted itself in many global supply chains and the level of jobs and tax revenues that are created in Ireland from US activity.

- The risks to Ireland from the US are either cyclical or structural. The cyclical risks can be estimated using a Bayesian Vector Autoregression model (BVAR). Given the distortions present in Ireland's national accounts we estimate elasticities for the domestic sector versus multinational dominated sector. We find that the more domestically oriented sector (elasticity of 0.8) is less sensitive to US GDP shocks than the multinational sector (1.32).

- It would be wrong to assume that Ireland's relationship with the US can easily be reduced to one model however. For more structural or Knightian risks we discuss qualitatively the threats Ireland faces from the US. They include withdrawal of investment or a sharp slowdown in trade from protectionism.

Introduction

Ireland has been a beneficiary of globalisation in recent decades. It has positioned itself as being open to trade, capital and immigration. At the heart of this openness are two relationships: Ireland's membership in the European Union and the outsized relationship Ireland has with the US. In encouraging deep relationships with both trading partners Ireland has become a bridge between the two. Ireland in several sectors is an integral part of global supply chains. This policy has been a major driver in the increase in employment and living standards in Ireland since the 1990s.

However it also opens Ireland up to volatility. Ireland can often be described as a "high-beta play" on the US economy. When the US economy expands, Ireland expands at a faster rate. Similarly, when the US economy weakens, Ireland's economy again contracts at faster rates. From 1996 to 2014, both the average and the standard deviation of Ireland's annual GDP growth rate were twice the US average while during this period the correlation of the two series was 0.8.

It is critical then that we understand the linkages between the US and Ireland. The purpose of this paper is to highlight the many strands by which the US economy impacts Ireland and seek to analysis them quantitatively and qualitatively.

The paper's structure is as follows. We first explain the economics links between the US and Ireland highlighting the many strands which bind the two countries. There are six main areas of interest:

1. US companies' involvement in the Irish economy
2. Ireland's position in the global supply chain of many US companies
3. The jobs that are created in Ireland from this activity
4. The corporate tax revenues Ireland receives from US companies
5. US capital purchasing Irish assets in recent years
6. Data distortions caused by multinationals of which US companies play a role

After discussing those issues, we look to estimate the impact of a cyclical US shock on the Irish economy using a Bayesian Vector Autoregression model (BVAR). Given the distortions present in Ireland's national accounts we estimate elasticities for the domestic oriented sectors versus those which are multinational dominated. We find that the more domestically oriented sectors are less sensitive to US GDP shocks than the multinational sectors.

Lastly, we qualitatively analyse important structural risks where our modelling would not fully capture the complexity of the threat to Ireland from its economic relationship to the US. They include withdrawal of investment or a sharp slowdown in trade from protectionism.

## 1. US companies' involvement in the Irish economy

The economic links between the US and Ireland begin with foreign direct investment (FDI) from the US into Ireland. Investment by foreign entities into Ireland has been critical to Ireland's success in the last 30 years. The US has been at the heart of this. At the end of 2016, the total stock of Foreign Direct Investment (FDI) stood at €800bn or 423% of GNI*. The US accounted for 29% or €232bn of the total.

Eurostat data on enterprises within countries which are foreign controlled helps illuminate what this FDI has created. The data relates to the business economy defined as the NACE Rev.2 sectors B to N. The business economy includes manufacturing, construction, retail, wholesale, hotels, restaurants, transport, information and communication (ICT), real estate, professional services and leasing services. Importantly it does not include agriculture, financial/insurance services and the public sectors like health and education.

Ireland's reliance on the US is abnormal to other countries in Europe. Figure 1 highlights how Ireland has c. 700-800 US controlled enterprises in its business economy which is 11st most in the EU. However, those companies produce a large amount of Gross Operating Surplus (GOS), an average of €44.4bn from 2011-15.[1] Only the UK has a larger level of GOS accruing from US firms albeit from over six times the number of firms.

Figure 1: Ireland is an outlier in Europe re: Gross Operating Surplus
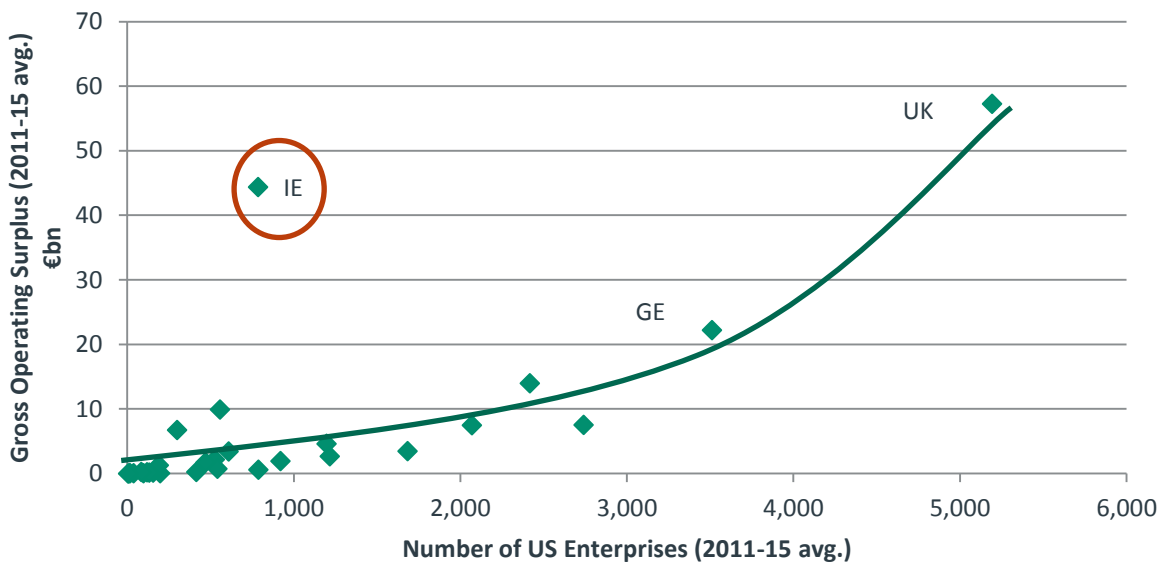
Source: Eurostat   * business economy statistics excludes agriculture, financial services sector and public sectors

US controlled firms are dominant entities in many Irish sectors. Chief among them are Manufacturing, Information and Communication technology (ICT) and Financial/Insurance Services. Gross Value Added (GVA) figures are distorted by the reclassification of several foreign companies as Irish and the large "onshoring" of intellectual property in 2015 and beyond. However the metric can still offer some insight into the degree to which US firms are the majority of some sectors in Ireland. For example, the GVA of US controlled firms accounted for 62.6% of total Irish manufacturing in 2008-2014. The percentage rises to 76.6% in 2015 due to distortions. A similar pattern can be seen in the ICT sector in Ireland. US controlled companies account for 54.1% of total GVA in the sector for the years 2008-14. The number has likely only grown given the strong growth in the sector in 2016/17.
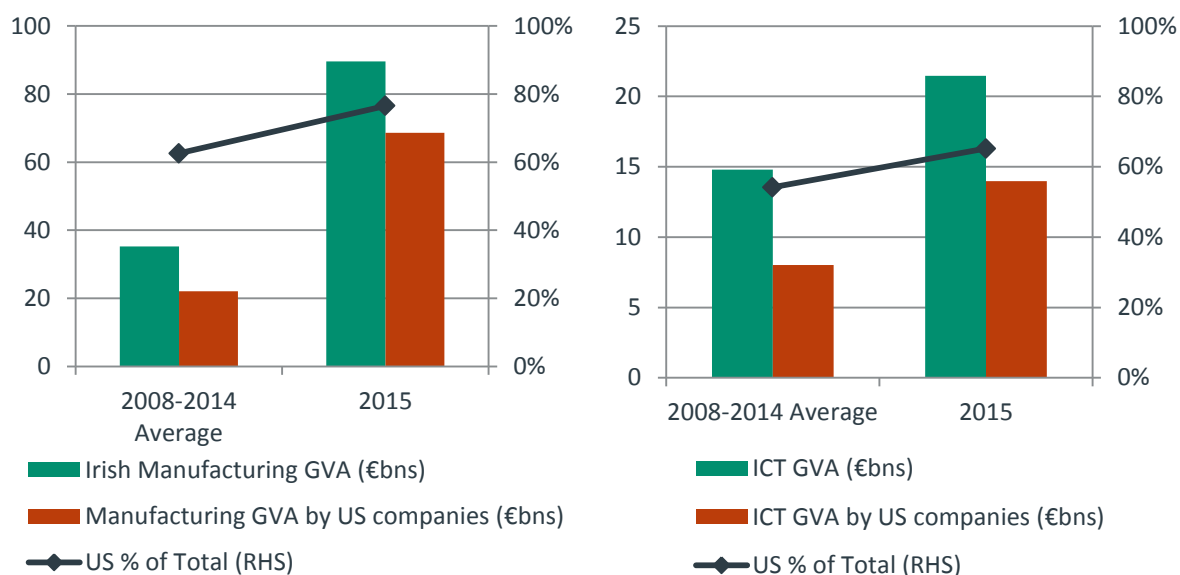
Unfortunately we do not have as detailed foreign company data for the financial services sector in Ireland. It is likely however that a large proportion of the GVA and jobs of the sector come from US financial institutions. In 2017, 107,000 people were employed in the Financial, Insurance and Real

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[1] An average over five years was used as the 2015 figures are inflated in line with the national accounts distortions which are discussed in greater detail in a later section.

estate sector. Companies such as Citigroup, BNY Mellon, State Street, BOA Merrill Lynch, Northern Trust, Goldman Sachs and J.P. Morgan all have a presence in Ireland. We estimate that the larger US financial institutions employ 9,000 people in Ireland, mostly in Dublin. This number can be viewed as a lower bound for the employment in financial services stemming from US financial institutions in Ireland.

Figure 2: 63% of Irish Manufacturing and 65% of Irish ICT is US controlled

Irish Manufacturing GVA (€bns)
Manufacturing GVA by US companies (€bns)
US % of Total (RHS)

ICT GVA (€bns)
ICT GVA by US companies (€bns)
US % of Total (RHS)

Source: Eurostat

2. Ireland is connected into the global supply chain of many US companies
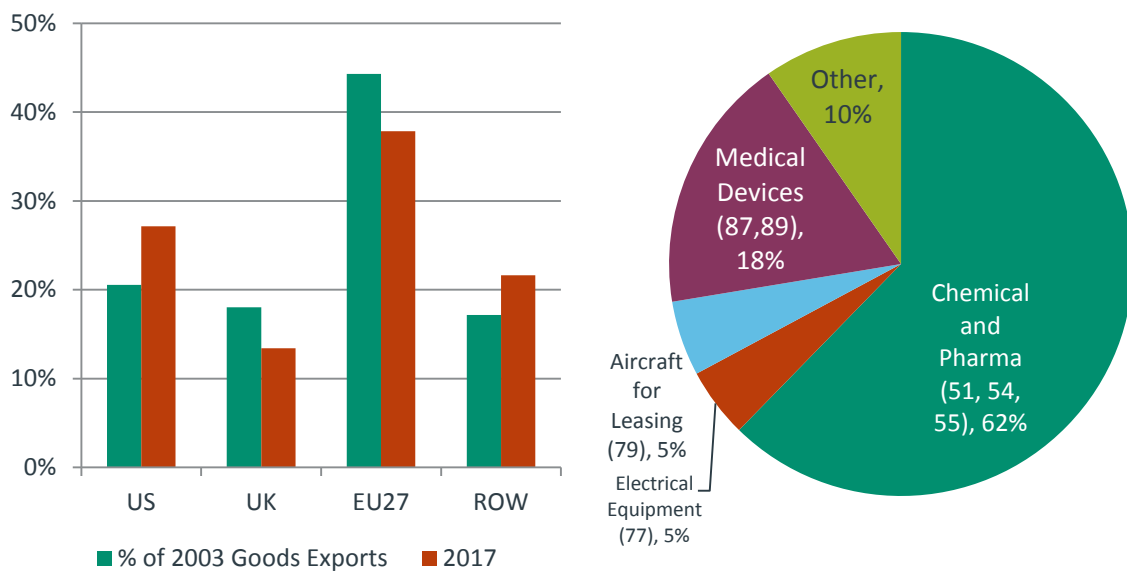
<u>Goods exports</u>

Figure 3 shows the importance of the US market to Irish goods exports. America was the destination for 27 per cent of Ireland's goods exports in 2017. This has steadily increased in recent years from just over 20% in 2003. In contrast the percentage for the UK and the EU has fallen in that period as globalisation continued to open new markets to Ireland. A small group of products make up 90 per cent of Ireland's goods trade with the US. On average over the last five years, chemical and pharmaceutical products (in particular SITC groupings 51, 54 and 55) accounted for 62 per cent of the goods exports while medical devices account for another 18 per cent. Aircraft exports (relating to aircraft leasing) and electrical equipment account for five per cent each. The pattern for exports is heavily related to the presence of US multinationals in these sectors.

To fully understand how the US impacts Ireland's trade flows we must consider how US companies in Ireland not only export out of Ireland back to the US but also export to other third countries. We do not have exact data on this issue but in 2017 Ireland's goods exports totalled €122bn. The top

three commodities export groupings were Chemicals and related products (encompassing SITC grouping 51, 54 and 55), Machinery and Transport equipment (includes Aircraft exports (79) and electrical equipment (77)) and Miscellaneous manufactured articles (includes medical devices under SITC grouping 87 and 89). These three commodities grouping accounted for 85% of €122bn Irish goods' exports in 2017 and are directly related to the US companies active in these sectors. Some of the exports went to the US of course but most headed elsewhere. This shows how Ireland is at the heart of several US companies' global supply chains.

Figure 3: 27% of Ireland's Goods exports are to the US; Pharma exports dominate

Source: CSO Goods Exports
*Numbers unaffected Contract Manufacturing

Source: CSO Goods Exports to US from Ireland (5 yr. average)

Services exports

As with goods exports, Ireland's services exports are intertwined with the global market. Services exports are increasingly becoming important for Ireland's economy. In 2003, total services exports for Ireland was €37.1bn. By 2016 (latest figures available), that figure had risen to €141bn, a near four-fold increase. Half of the increase was driven by increases in computer services exports - €52bn of the €104bn. Exports of financial and insurance services, royalties/licences and operating leasing (aircrafts) also saw increases from 2003-2016.

In terms of services exports directly to the US, it accounted for 10.5 per cent of Ireland's €141bn services exports in 2016. Those exports are spread over a wide range of activities. The largest services export is royalties/licences at 31 per cent of all services exports to the US.

However solely looking at the services exports between Ireland and America gives an incomplete picture. Like for goods exports, American multinationals selling into other markets from Ireland plays a dominant role in Ireland's total services exports. The buoyant computer services exports are linked to Facebook, Google and Amazon and other similar entities. selling their products into Europe but also other markets (see figure 4). At the same time, exports of financial and insurance services, royalties/licences and aircraft leasing services are all linked to US companies in Ireland trading across the Europe and the world.

One interesting element of our direct services trade with the US is Royalties/licences exports. These are relatively new phenomena for Ireland. In previous years, multinationals tended to have large import royalties rather than export royalties. The primary reason for this was that the intellectual property underlying the economic activity carried out by the multinational was positioned outside of Ireland. When a sale was booked in Ireland eventually a corresponding payment to the parent was booked as a royalty import. However while many firms still have royalties imports (€71bn in 2016), the large increase in intellectual property held in Ireland by multinationals in recent years has meant royalties exports have emerged in Ireland's balance of payments.

Figure 4: Ireland's Services exports dominated by sectors with heavy US presence

Total Service exports

Computer Service exports by destination
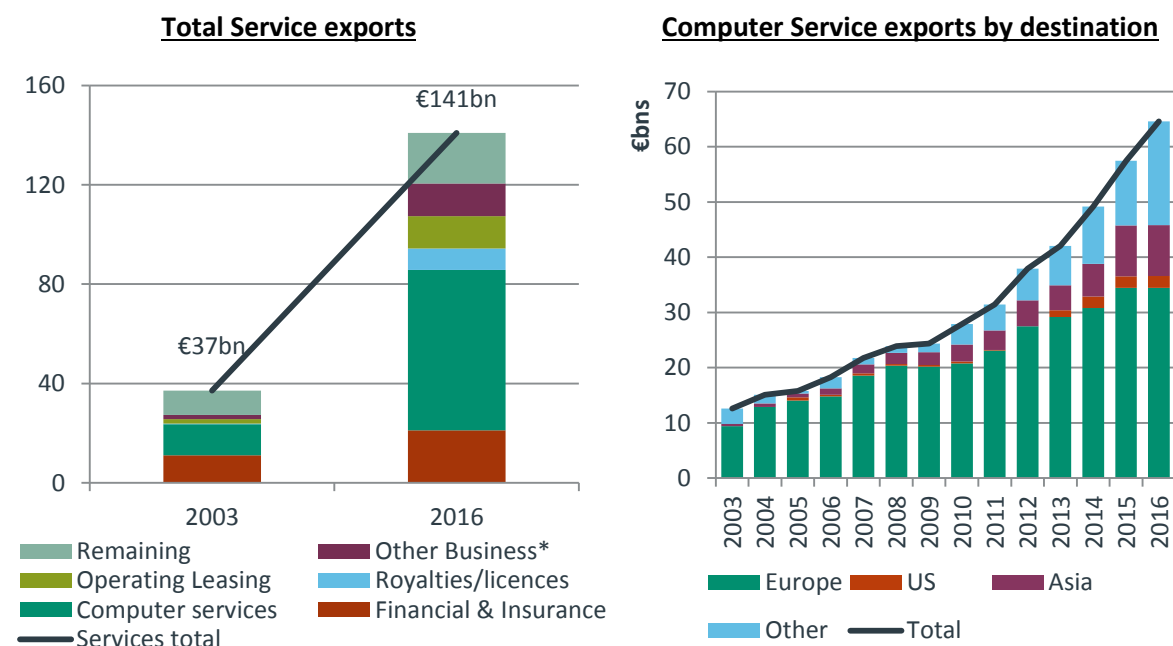
Source: CSO total services exports

Source: CSO

* Other Business Services include Merchanting, Advertising, marketing research, legal, accounting, management services.
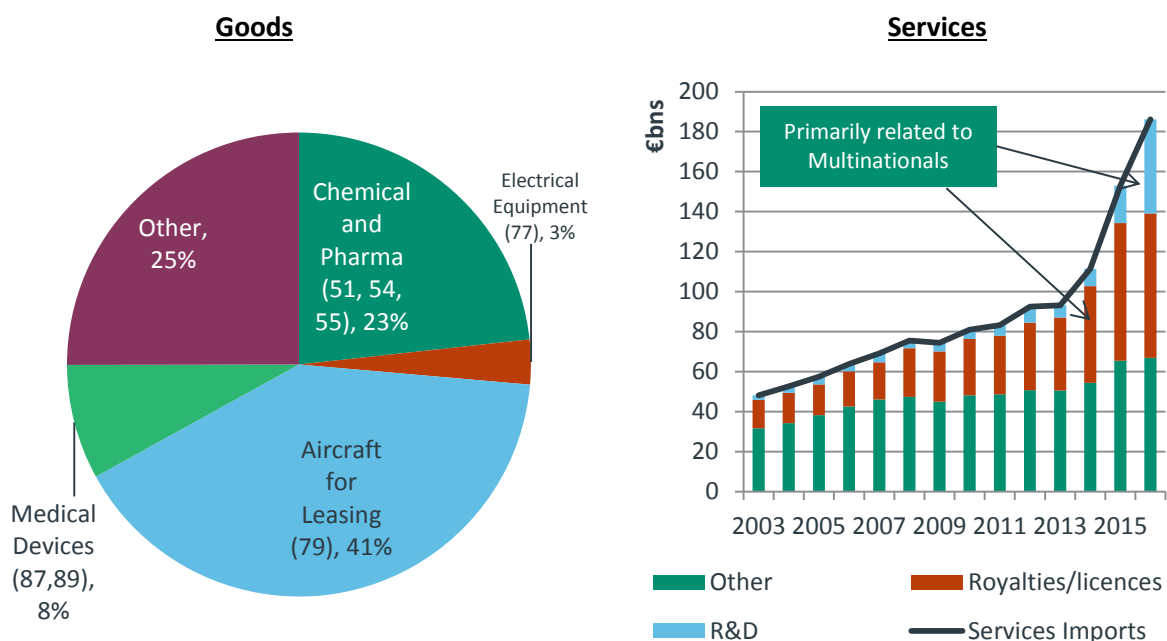
Imports

The pattern on imports from the US is similar to that of exports. The sectors that are most prominently influenced by US companies account for large proportions of the trade flows. For goods

imports, 75 per cent of all imports from the US are covered by the same small group of products in the chemical, medical devices and aircraft sectors. Aircraft imports account for 41% of the all goods imports. These imports are at the heart of the aircraft leasing industry in Ireland. The chemical imports relate to the production and subsequently export of finished pharmaceutical products.

Royalties imports dominate service imports. Some 38 per cent of all services import relates to royalties payments. In recent years, the import of research and development assets into Ireland has grown rapidly. From €8.7bn in 2014, R&D imports grew to €47.1bn in 2016. This influx is centred on multinational firms moving large amounts of their intellectual property into Ireland as mentioned above.

Figure 5: Ireland's US Imports are again dominated by sectors occupied by US Companies

Goods

Services

Source: CSO Good imports from US   `   Source: CSO Services imports

3. Seven per cent of Irish employment is from US controlled companies

The main benefit of Ireland's openness to US multinationals and multinationals in general is the large employment it creates. While an official figure on the number of people employed by US firms in Ireland is not available, the American Chamber of Commerce Ireland estimates it to be close to 155,000. That equates to seven per cent of all employment in Ireland. We do have figures for the business economy in Ireland – which accounts for 60% of all employment. Of those employed in the business economy nearly seven per cent were employed by US controlled enterprises in Ireland (average from 2013-15 see figure 6). This is the highest percentage in the EU over the period. We can add to this our estimate that larger US controlled financial firms employ approximately 9,000

people in Ireland or close to 7% of that sectors' employment. This would suggest that estimates by the American Chamber of Commerce Ireland are reasonable.

The sectors that we have discussed above entail high-skill well paid employment. ICT and financial services for example have the highest average earnings for any sectors in Ireland – both above 55,000 earnings per employee in 2017. It is likely that US companies in Ireland paid between €6-9bn in wages in 2017 with several billion of that flowing to the exchequer in the form of income tax, social insurance, VAT and excise duty.

Figure 6: US controlled firms employ seven per cent of Irish business economy

Figure 7: Pay in US dominated sectors is above average
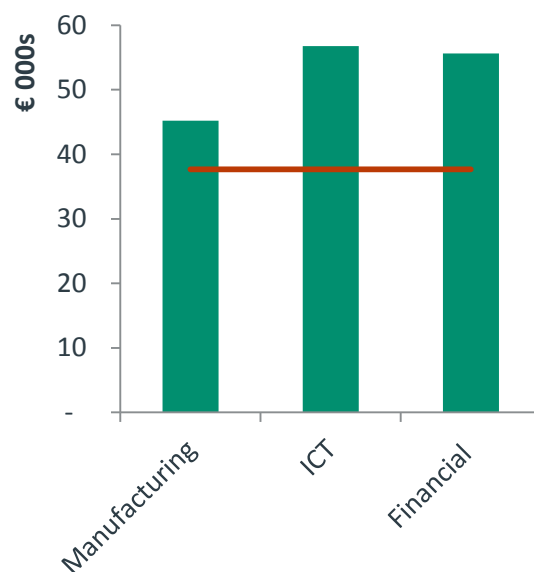
Source: Eurostat, CSO *employment in business economy. Excludes agriculture, financial services and public sectors

The ability to attract high tech jobs in recent years has been at the heart of Ireland's recovery following the crisis. In particular, Ireland has been successful in attracting the world's most recognisable ICT firms to locate some activity in Ireland. Of the so-called FAANGs companies - Facebook, Amazon, Apple, Netflix, and Google - only Netflix does not have a presence in Ireland currently. Between the other four FAANG companies some 17,500 people are currently employed in Ireland with a further 1,000 jobs recently announced at Amazon. That is approximately 11 per cent of all jobs in US companies in Ireland coming from just four companies. It is of course a positive that Ireland has attracted such high-quality jobs to the economy but there is a risk that a slowdown in the technology sector would disproportionately hit Ireland.

Another aspect of the presence of FAANGs in Dublin is the impact on commercial property. Google, Microsoft, Amazon and Facebook accounted for six out of the top ten office deals in 2017. The

growth of the technology sectors' footprint has predominantly happened post-2010, where the amount of space taken has increased four-fold over the period. In an international context, the top five tech companies accounted for a much higher relative footprint in Dublin than London or New York – 4.9% compared with 1.1% and 0.7%, respectively. It is estimated that they currently occupy approx. 180,000 square metres in Dublin collectively.

Table 1: Employment in Ireland by FAANG firms

	Facebook	**Apple**	**Amazon**	**Netflix**	**Google**
Jobs in Ireland	2,000	6,000	3,500*	0	7,000
Jobs Worldwide	25,000	123,000**	560,000	5,500	88,000
% of worldwide	8.0%	4.9%	0.6%	0.0%	8.0%

Source: Various company accounts/websites   * includes 1,000 additional jobs recently announced

** Direct employees only. Figure excludes significant third party employment undertaken by Apple.

4. The corporate tax revenues Ireland receives from US companies

Ireland's reliance on corporate tax receipts is much discussed. Ireland's ratio of corporate tax (CT) to general government (GG) revenue is above the EU average. It was 10 per cent versus the 5.7 per cent EU average (2015-2016). Ireland's CT share of GG revenue increased to closer to 11 per cent in 2017 up from the 7 per cent average for 2010-2014.

There is also substantial concentration within Ireland's corporate tax receipts (table 2). The percentage of total CT paid by the top 10 payers in 2017 was 39.4 per cent. This concentration has increased in recent years. From 2008-12, the annual average CT paid by the top 10 payers was just less than €1bn or 23.8 per cent of total CT receipts. In 2014 that figure jumped 70 per cent to €1.7bn or 37.4 per cent of all CT receipts before further increases in 2015 and 2017. Indeed, CT receipts from the top ten payers have nearly doubled since 2014 (€3.2bn versus €1.7bn).

Foreign owned multinationals play a large part in this concentration risk, in particular US controlled firms. According to Revenue data, 80 per cent of CT receipts in 2017 were from foreign owned multinational firms. Of the top 100 CT paying companies in 2017, 51 were US companies paying €4.25bn in CT – or 52 per cent of all CT receipts. For comparison, just over 10 were Irish companies and they paid only €370m (4.5% of total CT receipts).

There are some foreign owned multinational companies which due to capital allowances currently pay little CT in Ireland. As is common in most tax regimes, companies are entitled to capital

allowances in respect of certain expenditure and these can be set against profits. Figures from Revenue state that around €47 billion (of the €64 billion in plant & machinery capital allowances) was claimed by foreign owned multinational companies in 2016. Foreign owned multinationals accounted for 45 per cent and 99 per cent of tangible and intangible capital allowance claims respectively for 2016. However, from the top 100 CT largest payers, total capital allowances only amounted to €8.6bn of €47bn. This means there are companies with large capital allowances claims which result in less tax paid presently. In time as these capital allowances are used up, further large payers of CT could emerge in Ireland. This is obviously an upside risk for Irish exchequer but would further exacerbate the high concentration of Irish CT receipts.

Figure 8: Corporate Tax Revenue as per cent of General Government Revenue
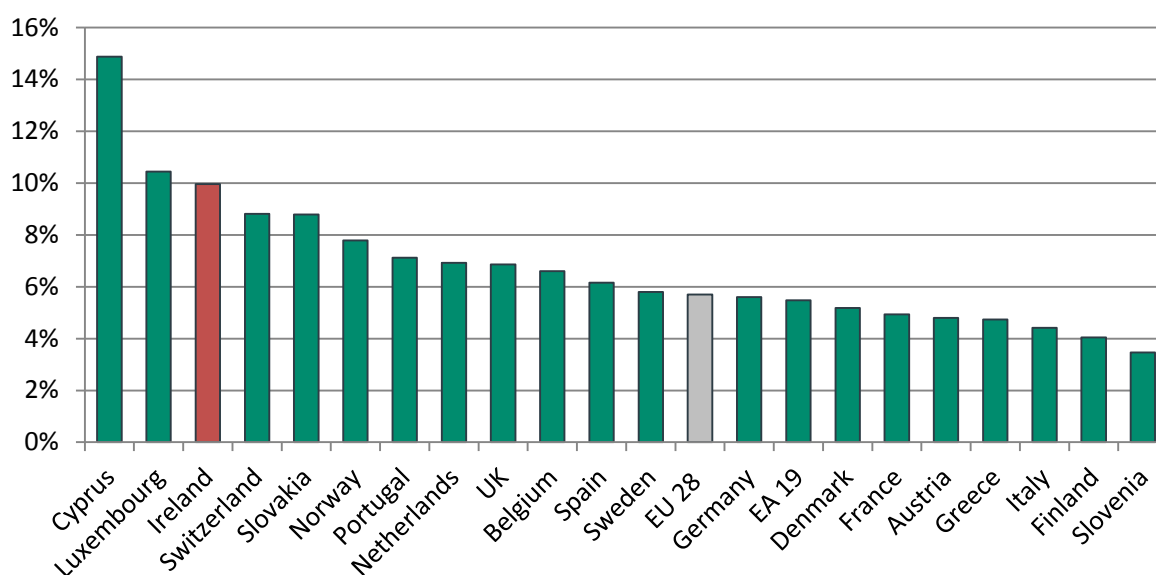
Source: Eurostat (average 2015-2016)

Table 2: Corporate tax concentration by company

	2008-12 average	2014	2015	2016	2017
Total CT receipts (€m)	4,091	4,617	6,873	7,352	8,201
Top 10 Companies CT paid (€m)	975	1,728	2,798	2,755	3,230
Top 10 companies CT %	23.8%	37.4%	40.7%	37.5%	39.4%

Source: Irish Revenue Commissioners

5. US capital purchasing Irish assets in recent years

Since the 1960s Ireland has been a destination for FDI from the US. However in recent years as well as American capital flowing into Irish subsidiaries/companies, US investors have increased their purchases of Irish assets. Some early examples would be Franklin Templeton investing in

government bonds and other North American investors taking stakes in Irish banks. In time American investors purchased Irish property assets.

Following the introduction of legislation to allow the creation of Real Estate Investment Trusts (REITs) in Ireland in April 2013, four REITs have listed on the ISE raising c. €1.4bn in IPOs. They have become significant players within the Irish property market. All of the REITs and two listed property homebuilders have documented US investments (Table 3). Individual US firms have also entered the Irish market such as Hines, Cerberus and Kennedy Wilson.

Two main factors play into this new development. Firstly, the loose monetary policy from the Federal Reserve - in particular its QE programs - in the last decade created a high level of liquidity. With returns low in traditional financial markets, investors have turned to more alternative investments in search for yield. At the same time, the introduction of the REIT legislation allowed easier access to an asset class for foreign investors. This all led to capital flowing in and a reflation of asset prices in Ireland. Reflation had positive balance sheet benefits for both the banking and household sectors. In effect, Ireland's recovery was impacted firstly by the Federal Reserve's monetary policy followed a few years later by the ECB's monetary policy.

Table 3: US investment in listed property

Entity	Portfolio Valuation (Estimation)	% from 10 Largest US Investors
Green	€1.5bn	34%
Hibernia	€1.3bn	45%
IRES	€750m	31%
Yew Grove	€29m	10%
Cairn Homes	€911m	36%
Glenveagh	-	43%

Source: ISEQ and various press releases

Table 4: US investment in major Irish banks

Entity	% of Bank Publicly Floated	% Owned by 10 Largest US Investors
AIB	28.88%	4.99%
BOI	86.06%	25.41%
PTSB	25.08%	7.82%

6. Data distortions caused by multinationals of which US companies play a role

From 2015 onwards, Ireland's national accounts are distorted by the reclassification of multinational companies or their assets as being resident in Ireland. The reclassification of multinational companies' activity as Irish, expanded the capital stock in 2015 by c. €300bn or c. 40%. In some cases, whole companies re-domiciled in Ireland while in others multinationals moved assets (mostly intangibles) to their Irish-based subsidiary. The goods produced by the additional capital were

mainly exported. Complicating matters, the goods were produced through "contract manufacturing". The result of contract manufacturing is a goods export is recorded in the Irish Balance of Payments even though it was never produced in Ireland. Little or no employment is generated in Ireland from this contract manufacturing.

Contract manufacturing (CM) has occurred in Ireland in the past but did not have a significant net impact on GDP since the company engaged in CM would send royalties back to its parent as a royalty import. However now that the parent/intangible asset is here, there is no royalty import and Ireland's exports and GDP are artificially inflated. Contract manufacturing inflates Ireland's exports by some c. €70bn, an amount unprecedented in previous years.

Further to these distortions, the import of intellectual property by firms in Ireland gives a misleading picture on many series of Irish growth. When a firm moves IP into Ireland it is recorded as an import and also as investment. Thus exports, imports and investment figures are distorted.

While it is not known which exact companies caused the distortions, it is clear US multinationals have played a role. One reason for the reclassification of multinational companies as being resident in Ireland is the use by some US firms of tax inversions. This is where a smaller Irish-resident company (which need not be Irish owned) purchases a larger US company and registers the new entity as Irish. This was done to reduce tax liabilities in the US. At the same time US companies could have moved assets to Ireland outside of a tax inversion process and caused distortions.

Cyclical Model

With these strong linkages comes risk. The question becomes how best to estimate and understand those risks. One way, is to view the risks to Ireland from the US as either cyclical or structural. In this section we discuss how we can estimate the cyclical risks to Ireland using a Bayesian Vector Autoregression model (BVAR).

A standard Vector Autoregression (VAR) model with a large numbers of variables will likely suffer from degrees of freedom problems unless the sample size is quite long. With too many parameters to estimate, the model would likely succumb to problems of high estimation uncertainty, over-fitting and poor out-of-sample forecasts. One econometric answer to this issue is to use a Bayesian VAR (BVAR). The Bayesian VAR approach introduces priors to the estimation process. A prior is a value for a parameter in the model, specified by the researcher before seeing the data. The ultimate aim of Bayesian analysis is to find the posterior distribution. The posterior can be thought of as our belief of

the distribution of the "true" parameters having seen the data. For more on the methodology underpinning the analysis, please see the annex.

Data

Given the presence of large distortions in Ireland national accounts, GDP and GVA have less information content in regards to Ireland's economic activity. Hence elasticities previously calculated using GDP/GVA for the impact of a US shock on Ireland's economy need to be supplemented by elasticities which use other growth metrics.

This paper produces a suite of models to estimate the impact of the US on Ireland. Each BVAR model specification includes five key macroeconomic variables along with either one or two Irish growth variables. One specification uses Gross Domestic Product (GDP) as the Irish growth variable while other uses Gross Value Added (GVA). A third specification splits GVA into a domestic GVA measure, and a GVA proxy for the MNC sector based in Ireland.

To isolate the "domestic" economy of Ireland we disaggregate the GVA of individual sectors of the Irish economy into multinational dominated and domestic sectors. Aggregating three sectors – the manufacturing part of Industry, Information and Communication technology, and Financial and Insurance Activities – we assign this grouping the "MNC GVA" designation. These three sectors are largely dominated by US companies as was described in the sections above. The rest of the GVA is assigned as "domestic GVA". The other five variables used in the BVAR models are real US GDP (US), oil prices in euros per barrel (OIL), total Irish exports (EXPS), Irish wages as measured by compensation of employee (COE) and Ireland's unemployment rate (UNE). The US GDP data come from the Federal Reserve Bank databank, the remaining data comes from the CSO database or DataStream. The reason for the selection of these five variables is for our results to be comparable to past literature.

The model is estimated using quarterly data from 1995Q1 to 2017Q4. To take account of seasonality, the model is expressed in terms of the logged year-on-year change in the variables. The system used one lag to keep the model parsimonious although robustness checks were carried out on different lag lengths. The data used in this paper is available on request.

Results

To obtain our elasticity estimates a positive one standard deviation shock to US GDP growth is fed through the model and we use impulse response functions to examine the responses of the Irish

macroeconomic aggregates. The shock represents a once-off, unanticipated change in external demand whose effect is felt for 20 periods (five years). We measure the cumulated responses over the 20 periods by measuring the area under the impulse response curve. The elasticity is then calculated as the ratio of the cumulated response of the Irish variable over the cumulated US GDP response. This elasticity is then rescaled so that it is expressed in terms of a 1 per cent shock to US GDP growth. The results for our suite of models are shown in Table 5.

The split GVA model shows interesting but expected results. When we isolate the more domestically oriented sectors the elasticity is smaller and well below 1. For the MNC sector grouping the elasticity is greater than for GDP at 1.32. This makes intuitive sense – the domestic economy is less connected to the US economy and is therefore less sensitive. The MNC sector which is more US-focused has a larger elasticity.

Table 5: Elasticity Estimates of US GDP shock on Irish variables

	Split GVA Model	GVA model	GDP Model
Total Economy	N/A	1.01	1.16
Domestic GVA Growth	0.80	N/A	N/A
MNC GVA Growth	1.32	N/A	N/A
Exports	1.30	1.32	1.32
Unemployment Rate	-5.25	-5.33	-5.34
Compensation of Employee	1.53	1.56	1.56

The GVA elasticity 1.01 was estimated separately but can be viewed as a weighted average of the Domestic GVA (0.82) and MNC GVA (1.32) elasticities. The weighting is 0.59 on the Domestic GVA and 0.41 for MNC GVA. This suggests our elasticities estimates are in line proportionally to the underlying structure of the Irish economy since the CSO indicates 40 per cent of GVA is from MNCs and 60 per cent domestic.

Our GDP model is similar in its results to those of past literature albeit slightly smaller. Ireland's GDP elasticity is greater than one (1.16) reflecting the sensitivity to the US economy. Previous estimates were closer to 1.3 (Bermingham and Conefrey (2011)) with the smaller elasticity likely to be a result of estimating over the 2015-2017 period where Irish GDP does not correlate well with US GDP. The GVA estimate is smaller at 1.01. This smaller scale is to be expected given the major difference between GDP and GVA is repatriated profits of which US flows are a high proportion.

Turning to other macro-economic variables, the elasticity estimates are consistent with each other and are reasonably close to previous estimates. Bermingham and Conefrey (2011) estimated the export elasticity to be closer to 1.6 rather than 1.3 but both estimates show the outsized impact US GDP has on Irish exports. The exports data used is distorted by the increase in contract manufacturing in 2015 and onwards. It was decided to use the distorted exports data as the MNC GVA series is also distorted by the implications of contract manufacturing. However running the BVAR model using exports without contract manufacturing only lowers the exports elasticity to 1.16 and leaves the other elasticities relatively unchanged.

On the unemployment rate, the elasticity (-5.25) we produce is very similar to Bermingham and Conefrey (2011). To be clear the unemployment rate elasticity implies that the unemployment rate will be lower by 5.25pp of its previous value after a positive US shock. Thus if unemployment rate was 5.1 per cent before the shock, it would be 4.8 per cent after the shock.

We can easily substitute the GDP growth of the UK into versions of the same model for comparative purposes. Table 2 details the same elasticity analysis for the US and UK. Interestingly, the domestic growth elasticities are effectively the same but the MNC elasticity is far larger for the US. This is reasonable given the degree of FDI into Ireland is much larger for the US than the UK. The unemployment rate impact of a US shock is larger than that of the UK as is the exports elasticity. The results imply that while shocks to the UK economy can impact Ireland – and will assuredly do so in the case of Brexit – thanks to the stronger the economic links shocks from the US can probably have a larger impact on Ireland.

Table 2: Elasticity Estimates of US GDP shock versus UK shock

	US	UK
Ireland Growth	0.80	0.79
MNC Growth	1.32	0.81
Exports	1.30	0.73
Unemployment Rate	-5.25	-4.55
COE	1.53	1.50

We noted previously that 51 of the top 100 corporate tax paying companies were US controlled firms. This would mean that there is a direct link between a shock to the US economy and Ireland's CT receipts. We can feed the elasticity analysis produced above into the CT model previously developed in an NTMA paper (Purdue 2015). In that paper, to fully understand the dynamics of corporate tax, we estimated a dynamic regression model. The methodology used to build the

models is based on Pankratz (1991). We created a suite of models for various explanatory variables of CT receipts. Here we will use the model including GVA to forecast the impact of an US shock on Irish corporate tax.

We find that a 1 per cent decrease in US GDP leads to 1.01 per cent decrease in Irish GVA which when applied to the tax model leads to a €300m decrease in CT receipts over a five year period versus a no-change scenario. This loss does not take into account the impact that a slowdown in the US would have on other tax heads.

Qualitative Analysis of US risks

As the first part of the paper indicates, it would be wrong to assume that Ireland's relationship with the US can easily be reduced to one model. Ireland is linked into global supply chains which are complex and do not rely solely on Irish-US interactions. The quantitative analysis carried out above is useful to understand how - without any large or structural changes - variables are related over time. However if large structural breaks do occur, modelling is less helpful such that more qualitative analysis is needed.

One example of a potential structural break in the Irish-US relationship would be a significant breakdown in the trade regime between the two countries. Ireland has benefitted from globalisation. At the heart of this is Ireland's connection to the US and its position in the EU single market. If large scale protectionism became the new norm between the US and the EU – that is if there is a significant structural change in the trade relationship between the two – the impact on trade flows between Ireland and the US could be larger than that suggested by model elasticities.

The likelihood of such an occurrence has increased in recent years. Across much of the developed world, a movement away from globalisation towards isolationism has become evident in political discourse. This shift is nowhere more prominent than in the rhetoric of the Trump administration. While the trade disagreement currently playing out between the US and the EU is mostly posturing and small actions, there is a risk that the small scale actions taken on both sides lead to further retaliatory imposition of tariffs and other barriers to trade and investment.

If such a trade war was to escalate Ireland would suffer greatly as both exports to the US and FDI into Ireland would likely be hit. At the same time, disruption of global supply chains by protectionist policies could slow exports flows out of Ireland by multinationals. A third indirect impact is that a trade war between the EU and US would slow growth in two important markets for Ireland's indigenous exporters. A final indirect impact would be if the US expands its trade war on all fronts - a

trade war between China and US would further dampen global growth. Taken together it is clear that Ireland stands to lose heavily in terms of exports and jobs from a return to protectionism.

To mitigate against such risk is difficult, particularly given the context of Brexit. If Ireland's three main trading partners continue to drift apart in politically and trade-wise the basis for Ireland's business model will have changed. The economy would have to adapt. It is not obvious to see how.

Another related example of a structural change to Ireland's business model is a large reduction in FDI flows into Ireland or even withdrawal of US FDI from Ireland. This could happen for a couple of reasons. As stated above, a move towards protectionism and hence lower international sales would mean less need for US multinationals to invest in their overseas subsidiaries.

A second reason for why US multinationals would reduce FDI in Ireland could be tax policy in the US. Last year the US government overhauled its corporate tax legislation. It lowered its headline rate to 21% while changing its rules on the treatment of overseas income and income generated from intellectual property. This reform has the effect of reducing the competitive advantage Ireland has enjoyed over the US. While the long-term impact of the tax reform is still uncertain, the base case of tax advisors is that significant withdrawal of FDI from Ireland is unlikely. However, it is thought that the reforms could reduce in some form the flow into Ireland of FDI. Ireland did very well to attract a large proportion of the last wave of US capital i.e. the technology sector FAANG/social media wave. Whatever the next wave of US FDI, it may in totality be smaller as US firms decide to stay in the US rather than set up abroad. If the impact is larger than expected, it could have significant ramifications for exports, jobs and tax revenues in Ireland.

Finally, aside from cyclical risks and structural risks, there are many idiosyncratic company-specific risks to those multinationals in Ireland. Due to the concentration of exports, value added, and tax in multinational dominated sectors a shock to one major multinational company could have outsized effects. Examples of such risk are a consumer backlash due to privacy concerns (an issue for Facebook, Google), untested business models in recessions (social media advertising model, emerging market demand for technology) and anti-trust cases. This type of shock is not something Ireland can easily mitigate. Multinationals by definition are globally-focussed and as such Irish domestic policy will have little effect. Some risk must, in the end, simply be borne.

Conclusion

Ireland has positioned itself as being open to trade, capital and immigration, in particular from the US. This policy has been a major driver in employment and living standards in Ireland since the

1990s. However it also opens Ireland up to volatility. It is key for policymakers to understand how shocks to the US economy impact this economy. This paper describes the degree to which US companies are involved in the Irish economy, how Ireland has inserted itself in many global supply chains and the level of jobs and tax revenues that are created in Ireland from US activity. From these linkages it's clear that the US plays an outsized role in the Irish economy.

With those linkages comes risk. The cyclical risks from the US can be estimated using a Bayesian Vector Autoregression model (BVAR). Given the distortions present in Ireland's national accounts we estimate elasticities for the domestic sector versus multinational dominated sectors. We find that the more domestically oriented sector is less sensitive to US GDP shocks.

It would be wrong to assume that Ireland's relationship with the US can easily be reduced to one model however. For more structural or complex risks we discuss qualitatively the threats Ireland faces from the US. The withdrawal of US investment or a sharp slowdown in trade from protectionism could have profound impacts on the long term growth of Ireland and could necessitate a shift in Ireland's business model.

References

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- The Irish Macroeconomic Response to an External Shock with an Application to Stress Testing: Colin Bermingham and Thomas Conefrey, 2011, Research Paper, Central Bank of Ireland
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Annex

Methodology

A standard Vector Autoregression (VAR) model with a large numbers of variables will likely suffer from degrees of freedom problems unless the sample size is quite long. With too many parameters to estimate, the model would likely succumb to problems of high estimation uncertainty, over-fitting and poor out-of-sample forecasts. One econometric answer to this issue is to use a Bayesian VAR (BVAR). The Bayesian VAR approach introduces priors to the estimation process. A prior is a value for a parameter in the model, specified by the researcher before seeing the data. The ultimate aim of Bayesian analysis is to find the posterior distribution. The posterior can be thought of as our belief of the distribution of the "true" parameters having seen the data.

The formula for the posterior distribution of the parameters is given by

$$\hat{B} = (x'x + \Omega^{-1})^{-1}(x'y + \Omega^{-1}\bar{b})$$

where Ω measures the variance of the prior and $\bar{b}$ is known as the peak of the prior.

Note that if we set these two terms which relate to the prior equal to zero, we just have the standard OLS formula for estimating coefficients. Thus, the Bayesian approach gives us a posterior which is a weighted average of the unbiased OLS estimate and our prior beliefs. While this method may lead to worries that our subjective beliefs – that is the chosen prior - will unduly affect the resulting posterior, several robustness checks can be performed to alleviate these concerns.

<u>Prior Selection</u>

There are a number of priors that are commonly used when estimating VAR models. The prior used in this paper is frequently referred to as the Litterman/Minnesota prior. This prior seeks to shrink the following

$$x_t = c + B_1 x_{t-1} + \cdots + B_p x_{t-p} + \epsilon_t$$
$$\epsilon_t \sim N(0, \Sigma)$$

Into a naïve model such as

$$x_t = c + x_{t-1} + \epsilon_t$$

The naive model is a random walk model in each of the variables in the VAR. This prior is only a reasonable assumption to make about the variables used if those variables display a degree of persistence. To test for persistence the variables included in the Bayesian VAR (discussed in the next

section) were tested using individual AR (1) models. All variables had high persistence with AR coefficients above 0.71. This evidence suggests that all variables exhibit persistence over time.

Data Charts
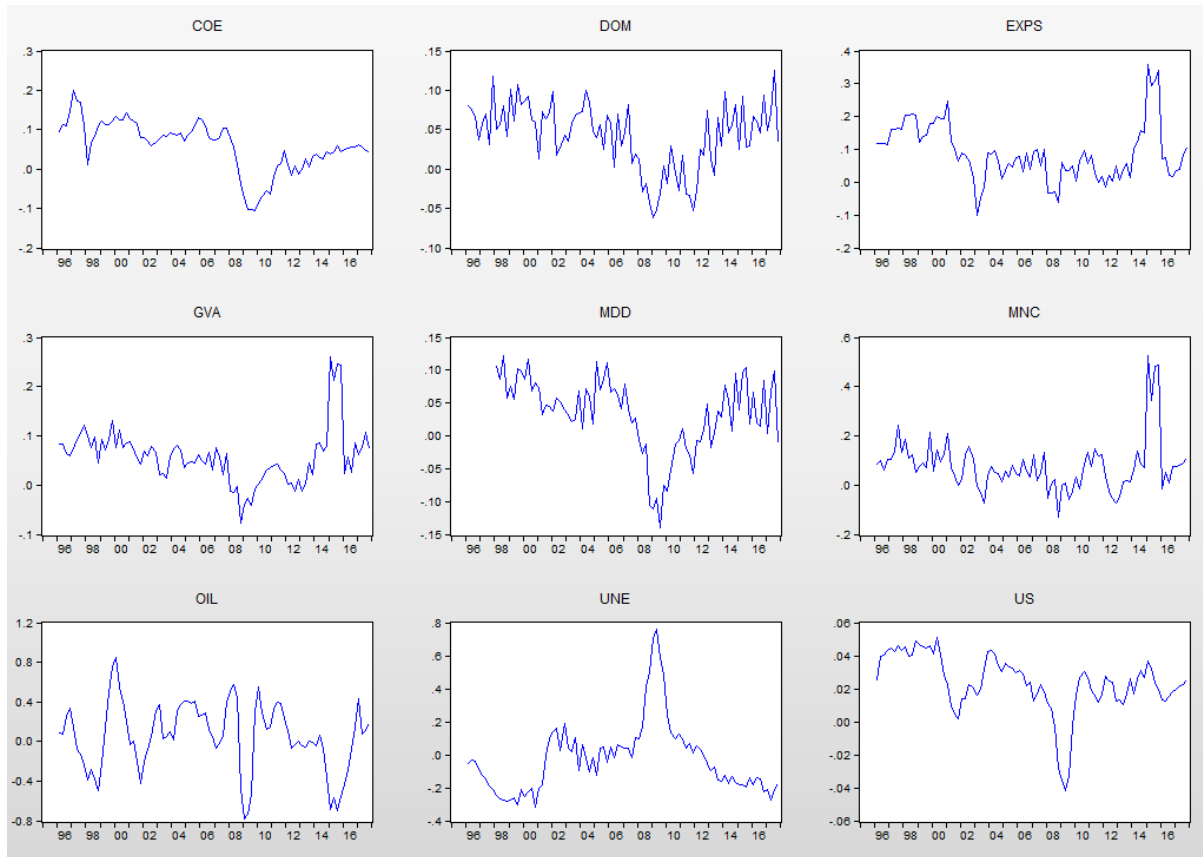
Robustness Checks

Number of Lags in the VAR

We examined the impulse response functions of the key macroeconomic variables in the VAR model using a different lag length of 2 (versus model specification of 1). The choice of lag length does not have a major impact on the results. The impulse response functions generally have broadly the same shape and peak effects.

Ordering of the Domestic Variables in the VAR

In estimating the VAR and the subsequent impulse response functions, the standard Choleski decomposition was used. This imposes a certain ordering on the variables. The ordering of the variables in the VAR system was changed to test the sensitivity of the responses. In the main, there was little difference in results when the ordering of the variables was changed.
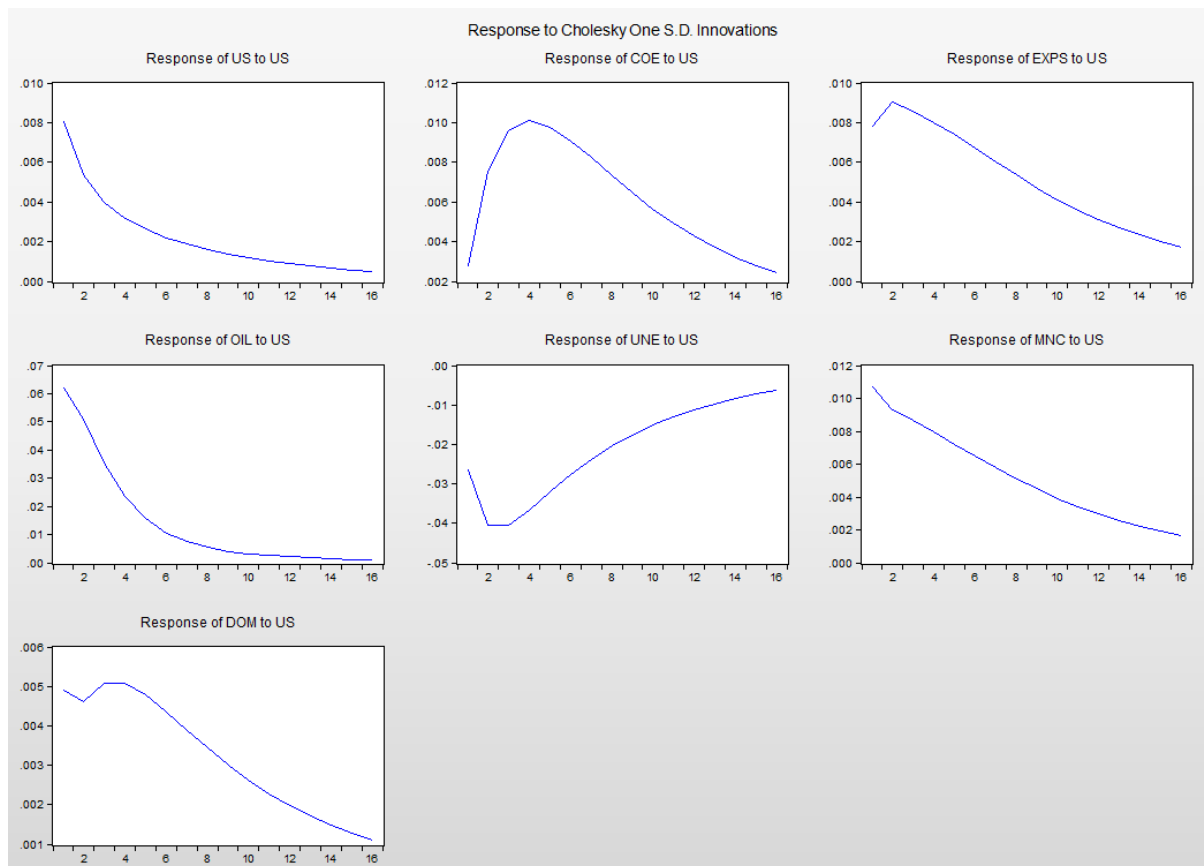
Impulse Response Functions

GVA Model

Response to Cholesky One S.D. Innovations

Split Model

Response to Cholesky One S.D. Innovations
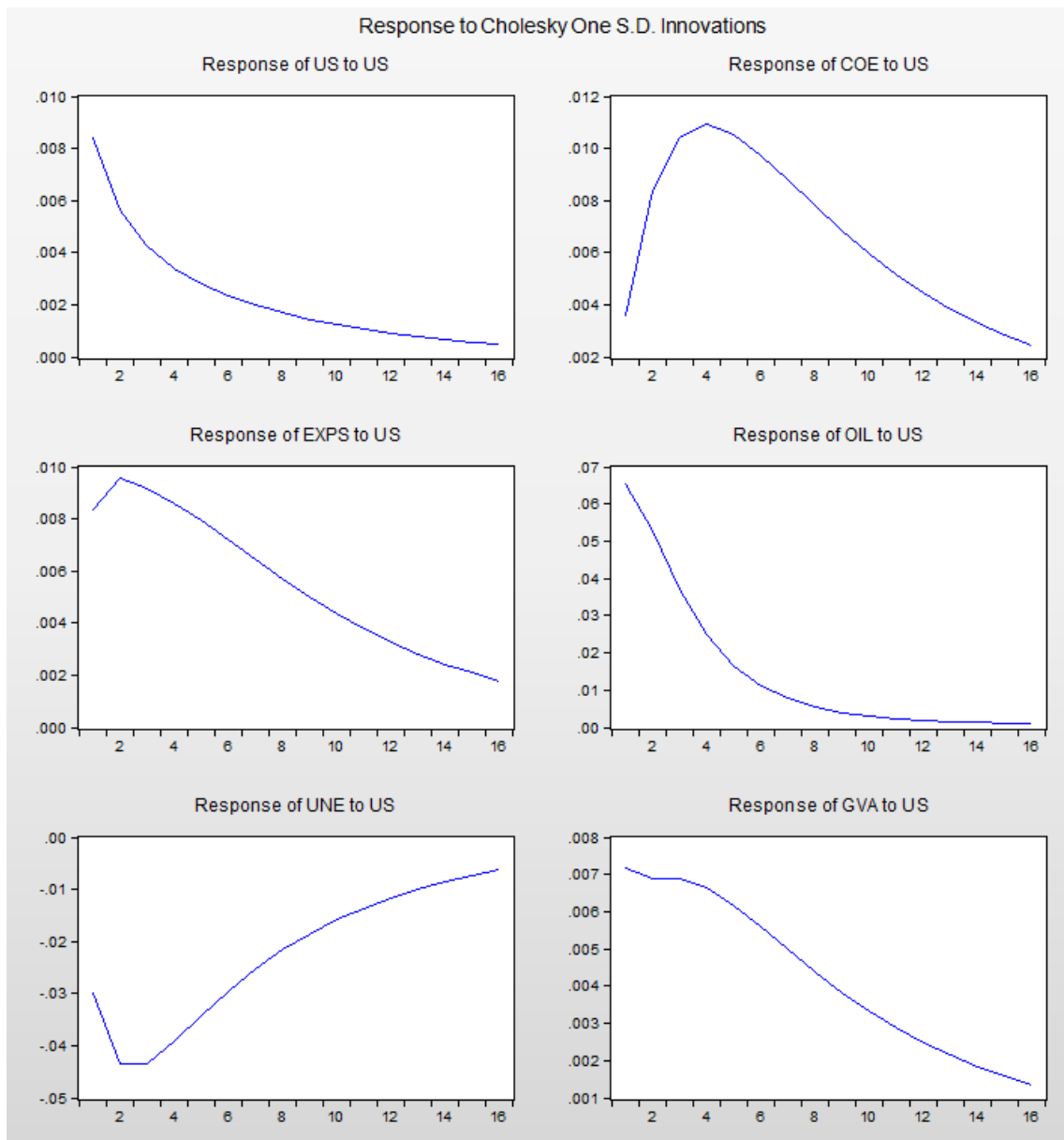
Specifications for GVA Corporation tax model

Dependent Variable: LOGCT
Sample (adjusted): 1996Q1 2017Q4
Included observations: 88 after adjustments
Convergence achieved after 10 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.586616	6.983589	-0.083999	0.9333
LGVA_S	1.351583	0.636121	2.124724	0.0365
DUM10Q1	-0.943983	0.278030	-3.395253	0.0010
AR(4)	0.876476	0.051709	16.95007	0.0000

R-squared	0.826095	Mean dependent var	13.64924
Adjusted R-squared	0.819884	S.D. dependent var	0.869697
S.E. of regression	0.369100	Akaike info criterion	0.888889
Sum squared resid	11.44371	Schwarz criterion	1.001495
Log likelihood	-35.11112	Hannan-Quinn criter.	0.934255
F-statistic	133.0076	Durbin-Watson stat	2.369882
Prob(F-statistic)	0.000000		

Inverted AR Roots	.97	.00-.97i	.00+.97i	-.97

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