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Luke Daly and Martina Lawless

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# Examination of the Sectoral Overlap of Covid-19 and Brexit Shocks

Luke Daly and Martina Lawless

## **Abstract**

Ireland is currently dealing with a severe public health crisis from Covid-19, which has substantially reduced social and economic activity. Prior to the onset of the pandemic, the most imminent risk to the strong performance of the Irish economy seemed likely to come from a hard Brexit. This paper looks at sectoral exposure to both the Covid-19 and Brexit shocks to assess if there is a risk that the impact of a hard Brexit on an economy weakened by dealing with Covid-19 could make the previously estimated effects of Brexit worse. Using a range of data sources, we assign an exposure rank to 57 sectors of the economy for each shock, from most severely affected sectors to those that are effectively unaffected. Overall, we find that there is limited overlap in the sectors exposed to the different shocks. We further examine the flow of goods and services between sectors affected by the two shocks to establish the extent of potential supply chain transmission of the shocks. Our main finding is that the sectors exposed to each shock are not particularly closely connected to those affected by the other shock. These results suggest that adding the Brexit shock to that of Covid-19 brings a wider range of sectors exposed to risk but that the impacts are not magnified by interaction effects.

This research is part of the joint research programme of the ESRI, Department of Finance and Revenue Commissioners on the Macro-economy, Taxation and Banking. We would like to thank members of the research programme steering for comments. The views expressed in this paper are those of the authors and they should not be regarded as an official position of the Department of Finance or the Revenue Commissioners. Contact: Martina Lawless ([martina.lawless@esri.ie](mailto:martina.lawless@esri.ie)) or Luke Daly ([luke.daly@finance.gov.ie](mailto:luke.daly@finance.gov.ie)).

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## Section 1: Introduction

It has been nearly six months since Ireland introduced restrictions to help prevent the spread of Covid-19. For Ireland, Covid-19 poses the single largest challenge to the economy since the financial crisis with potentially an even larger impact. The highly contagious nature of the disease has meant that the stringency of the containment measures imposed have been unprecedented in nature and scale. Economy activity in some sectors in Ireland completely ceased for a significant period of time, while the labour market was transformed from one of full employment in late-2019 to one in which an unemployment rate of 29 per cent was recorded in April. Though economic activity has returned as restrictions have been gradually eased, it is likely that this will remain below its pre-pandemic level for some time to come.

Alongside dealing with the largest economic downturn in recent history, Ireland also faces the prospect of the UK leaving the current transition period with the EU on the 1<sup>st</sup> January 2021 without a free trade agreement being reached. The UK has turned down an extension to the transition period and will leave the EU at the end of 2020. Irrespective of the final form of Brexit, it will have a negative impact on the Irish economy. Many studies have estimated the potential long run negative impact on the Irish economy (Bergin et al., 2019; Arriola et al., 2018; Central Bank of Ireland, 2019). However, these studies attempted to examine the question of the long-run impact of Brexit on the Irish economy based on a pre-pandemic world and were based on a backdrop of strong economic performance.

As both Covid-19 and Brexit represent significant economic shocks to the Irish economy, an inevitable question arises regarding the interrelationship of the two shocks. For example, do the two shocks exacerbate each other or could the impact of Brexit be less if activity has already been reduced? It is this question that this paper attempts to address. De Lyon and Dhingra (2020a, 2020b) recently attempted to address this question for the UK by comparing the sectors that have been most affected by Covid-19 with those affected by Brexit. Across a range of indicators, they find that the sectors that have been impacted by Covid-19 are generally different to the sectors are likely to be affected by Brexit.

In this paper, we follow a similar approach to De Lyon & Dhingra (2020a, 2020b) and compare the sectors that have been most affected by Covid-19 with those most likely to be affected by Brexit. To examine the sectoral impact of Covid-19, we make use of data on the number of recipients of pandemic income support from the State in the form of the Pandemic Unemployment Payment (PUP) and the Temporary Wage Subsidy Scheme (TWSS). In terms of the Brexit sectoral impact, we update the analysis in Lawless and Morgenroth (2019) for goods trade and the services trade analysis of Lawless (2018). For the impact of Brexit on goods trade, the update uses the most recent product-level data from UN Comtrade and matches this to the UK's announced tariff schedule from January 2021. This tariff schedule was published in May 2020.<sup>1</sup> We then formally compare the sectoral impacts of the two shocks and examine potential domestic supply chain connections between sectors that are likely to be impacted by Covid-19 and Brexit.

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<sup>1</sup> <https://www.gov.uk/guidance/uk-tariffs-from-1-january-2021>

Overall, we find that there is limited overlap in the sectors exposed to the different shocks. The most severely impacted sectors from Covid-19, such as hospitality and construction are expected to have almost no impact from Brexit. The most exposed sector to the Brexit shock, financial services and insurance, has not been unaffected by Covid-19, but is in the mid-range of the Covid-19 impacts. More formally estimating a correlation coefficient between the two shocks finds no statistically significant evidence of overlap. This finding also holds when we examine the flow of goods and services between sectors affected by the two shocks. We find that sectors that are severely affected by Covid-19 typically sell a greater share of their output for use as inputs in the production process to sectors that are likely to be relatively unaffected by Brexit and vice versa. This implies relatively limited exposure of producers to their customers experiencing one of the shocks while they experience the other shock. There is evidence of more connections between sectors in the form of buyers in relatively unexposed sectors purchasing from suppliers in sectors that are severely impacted by either the Brexit or Covid-19 shock. This could result in transmission of the shocks to the less directly exposed sectors either through prices or supply restrictions. Overall, these findings suggest that adding the Brexit shock to that of Covid-19 brings a wider range of sectors exposed to risk but that the impacts do not appear to be subject to interaction effects.

Business perceptions suggest a somewhat greater degree of overlap: a CSO survey on the Business Impact of Covid-19 in July 2020 found that just over twenty per cent of firms expected both that they would be negatively affected by Brexit and that the Covid-19 pandemic would make this impact worse than previously anticipated. A further fifteen per cent of firms that expected to be impacted by Brexit did not anticipate any change to the Brexit effect from having to deal with Covid-19 while a smaller group of just under eight per cent of firms expected that Brexit would now have less of an impact. This makes up the 43 per cent of firms reporting exposure to Brexit while the remainder did not feel Brexit was a risk to their business.<sup>2</sup>

The rest of the paper is structured as follows. Section 2 examines the sectoral level impact of Covid-19. Section 3 estimates sectoral level impacts of Brexit. Section 4 compares the sectoral impacts of the two shocks. In section 5 we make use of Input-Output tables to examine the potential supply chain linkages between Covid-19 and Brexit. Section 6 concludes.

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<sup>2</sup> Business Impact of Covid-19 Survey Wave 5 29<sup>th</sup> June to 26<sup>th</sup> July 2020 available here: <https://www.cso.ie/en/releasesandpublications/er/bic19/businessimpactofcovid-19survey29juntto26jul2020/>

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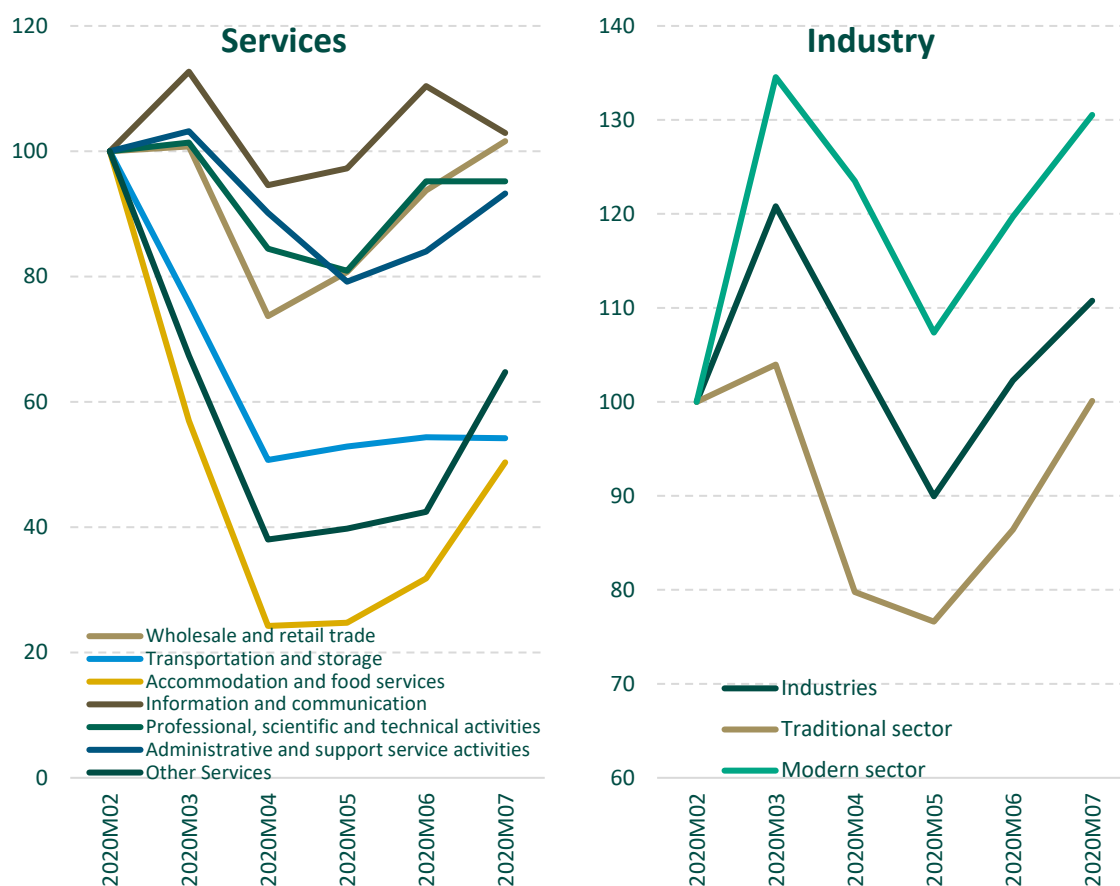
## Section 2: The Sectoral Effects of Covid-19

The policy response to the spread of the Covid-19 virus both domestically and internationally, while necessary from a public health perspective, has resulted in a sharp contraction in global and domestic economic activity, with the size and speed of impact unprecedented in modern times. The initial containment measures put in place to restrict the spread of the virus has meant that economic activity in many sectors of the economy was significantly reduced. The OECD (2020) estimated that 21 per cent of Irish economic activity (in GDP terms) takes place in sectors most likely to be directly affected by the containment measures introduced. However, this figure is affected by globalisation-related issues, which inflate Ireland's GDP and have limited impact on Irish living standards. The share increases to 32 per cent when expressed as a percentage of modified GNI and to almost 37 per cent when expressed as a percentage of 'domestic' gross value added (Department of Finance, 2020).

At this stage it is clear that there is a significant degree of heterogeneity across sectors with regard to the impact of Covid-19. Activity in the services sector has been significantly reduced in recent months and may continue to be reduced in the months to come to accommodate social distancing and additional hygiene requirements. For example, activity in the distribution, transport, hotels and restaurants sector has experienced a significant decline. Hotels and restaurants were effectively closed since mid-March and only reopened upon the beginning of Phase 3 of the Government's Roadmap for Reopening Society and Business on 29<sup>th</sup> June. Many forms of travel including by air have been reduced significantly. Many non-food retailers were closed for several months and only reopened with the onset of Phase 2 on 8<sup>th</sup> June. Activity in the arts and entertainment sector effectively stopped for four months and only resumed with the onset of Phase 3 on the 29<sup>th</sup> June which allowed for the reopening of museums, galleries, theatres and cinemas etc. It is likely that other services sectors such as administration and support activities, which includes rental/leasing activities and travel agency, and real estate activities will also be significantly reduced. That being said, finance and insurance activities and information and communication technology are likely to be the least affected service sectors primarily on the basis that they rely less on direct contact between consumers and service providers while the activity in those sectors should be able to be completed from home. Likewise, activity in the government sector should be minimally affected.

This differing impact amongst services sectors is further outlined in Figure 1 below which presents the value of monthly services index rebased so that February 2020 is equal to 100. This chart shows that amongst the service sectors, accommodation and food services, other service activities and transportation and storage are the most impacted sectors. In contrast, some services sectors including information and communication appear to be relatively less affected by the Covid-19 shock.

**Figure 1: Sectoral Impacts of Covid-19, February 2020=100**



Source: CSO Monthly Services Index, CSO Industrial Production and Turnover

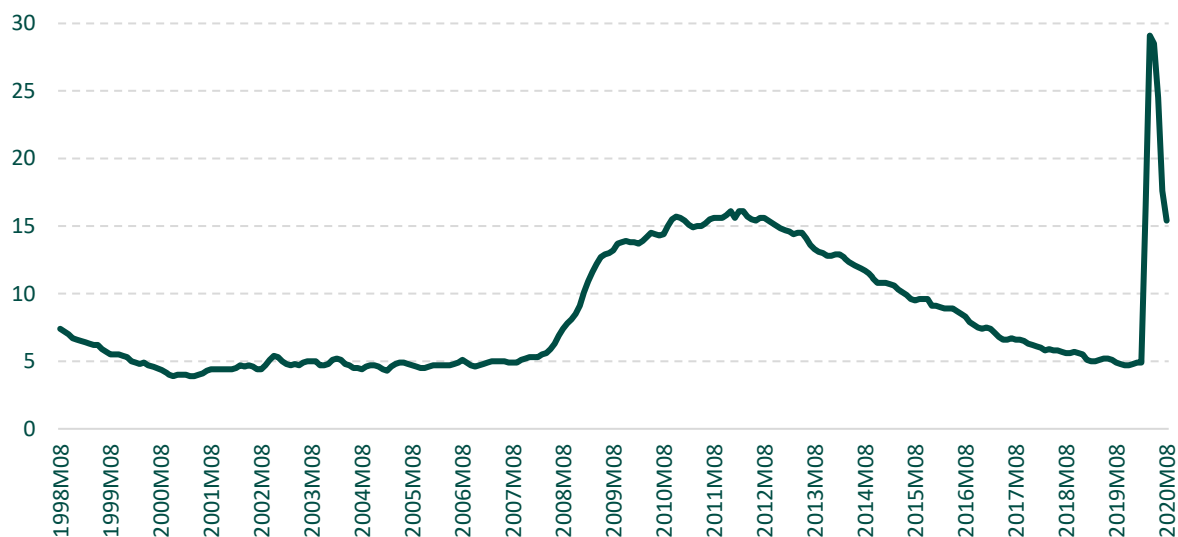
The direct impact of Covid-19 on manufacturing sectors is likely to be smaller than that of services sectors. This is primarily on the basis that many manufacturing industries were regarded as ‘essential’ when restrictions were first put in place. Output in manufacturing is expected to grow this year primarily due to the performance of the pharmaceutical and chemical products sectors which dominate the manufacturing sector in Ireland, accounting for the majority of industrial production in 2019 (CSO, 2020). Production in this ‘modern’ sector, which comprises a number of high-tech pharmaceutical sectors, has been relatively unaffected by Covid-19 (Figure 1). However, production in the mainly indigenous sector has been adversely affected with manufacturing production volumes in the traditional sector only returning to its pre-Covid level by the end of July (Figure 1). The traditional sector has a higher domestic value-added and is more labour intensive than the modern sector of the economy. It is also less affected by contract manufacturing, thus providing a more accurate assessment of domestic economy activity in industry.

The economic impact of Covid-19 is perhaps best seen through the prism of the labour market.<sup>3</sup> The outbreak of Covid-19 and the measures introduced to reduce the spread of the virus resulted in an unprecedented unemployment rate of 29 per cent being recorded in April if all claimants of the

<sup>3</sup> Labour market data correct as of 7<sup>th</sup> September 2020.

Pandemic Unemployment Payment were classified as unemployed, as shown in Figure 2. Though the unemployment rate has fallen since April, many workers have not yet returned to employment as the Covid-19 restrictions have been lifted with a Covid-19 adjusted unemployment rate of 15.4 per cent recorded in August.

**Figure 2: Monthly Unemployment Rate, % labour force**



Source: CSO

Note: This series includes the seasonally adjusted monthly unemployment rate from July 1998 to February 2020. From March 2020 onwards we use the CSO's Covid-19 adjusted monthly unemployment rate which includes recipients of the Pandemic Unemployment Payment (PUP).

As of 7th September 2020, approximately 220,000 people are currently unable to work as a result of the pandemic and are in receipt of the Pandemic Unemployment Payment (PUP).<sup>4</sup> These individuals are eligible to receive this payment if they have lost their job on or after 13<sup>th</sup> March due to the pandemic.<sup>5</sup> Though this number is 63 per cent below the peak as of 5<sup>th</sup> May (602,000), the pace of reduction in the numbers claiming the PUP has begun to slow in recent weeks.<sup>6</sup> A further 360,000 employees, remain linked to their employer and are currently being supported by the Temporary Wage Subsidy Scheme (TWSS) payment administered by the Revenue Commissioners<sup>7</sup>, having received a subsidy in their most recent pay period as of 3rd September.<sup>8</sup> At present, therefore, there are approximately 580,000 people receiving some form of pandemic related income support from the state.

<sup>4</sup> See Byrne et al. (2020) for an overview of the initial labour market impact of Covid-19.

<sup>5</sup> The PUP was initially set at €203 per week before being increased to €350 per week after the first week. From the 29<sup>th</sup> June, the rate of payment changed again. The rate of payment is currently based on earnings from previous employment; if you earned less than €200 a week, your payment is €203 per week and if you earned €200 or more a week the payment remains at €350. Furthermore, the PUP has been extended to 21<sup>st</sup> April 2021 with further rate changes due on 17<sup>th</sup> September 2020, 1<sup>st</sup> February 2021 and 1<sup>st</sup> April 2021.

<sup>6</sup> See figure A1 and A2 in the annex.

<sup>7</sup> The Employment Wage Subsidy Scheme (EWSS) replaced the Temporary Wage Subsidy Scheme from 1<sup>st</sup> September, and it will run to 31<sup>st</sup> March 2021. Under the EWSS scheme, employers and new firms in sectors impacted by Covid-19 whose turnover has fallen by at least 30 per cent will receive a flat rate subsidy per week based on the number of qualifying employees on the payroll, including seasonal staff and new employees.

<sup>8</sup> The TWSS statistics presented in this paper are the CSO's estimate of those who are 'currently' being supported by the scheme even if they do not have a pay date in that week. For more information see <https://www.cso.ie/en/statistics/labourmarket/liveregister/detailedCovid-19incomesupportandliveregistertables/>

To examine the sectoral impact of Covid-19, Figure 3 presents the most exposed sectors in terms of the share of the total number of people receiving either the PUP or the TWSS at the peak, namely the week ending the first week in May.<sup>9</sup> In particular, each area in the chart represents the sectoral share of the total number receiving either the PUP or TWSS where bigger sectoral shares correspond to bigger areas in the chart. At the peak in the start of May, just over 1 million people were in receipt of either the PUP or the TWSS. The sectors most exposed to the Covid-19 shock, in terms of the number of people receiving either the PUP or TWSS, were Wholesale and Retail Trade (196k) representing almost one-fifth of all income support recipients, Accommodation and Food Services (161k) representing 16 per cent of all income support recipients, Construction (119k) representing 12 per cent of all income support recipients and Industry (98k) representing 10 per cent of all income support recipients.

**Figure 3: Recipients of Pandemic Income Support by Sector, % of total at peak**



Source: Department of Employment Affairs and Social Protection (DEASP), CSO

As of the end of the first week in May, more than forty per cent of all those employed in Q4 2019 were receiving income support through either the PUP or TWSS (Table 1). The worst affected sectors in terms of the share of sectoral employment receiving income support, were Accommodation and Food Services (90 per cent), Construction (81 per cent), Administrative and Support Services (65 per cent), Wholesale and Retail Trade (63 per cent), Arts, Entertainment and Other Services (61 per cent),

<sup>9</sup> Due to timing issues regarding the publication of pandemic income support data, the first week in May is a combination of those receiving the PUP to the week ending 5<sup>th</sup> May and those who were 'currently' being supported by the TWSS to the week ending 3<sup>rd</sup> May.



Transportation and Storage (45 per cent), Professional, Scientific and Technical Activities (44 per cent) and Industry (34 per cent).<sup>10</sup>

**Table 1: Recipients of Pandemic Income Support by Sector as of 1<sup>st</sup> Week May 2020, '000s**

Sector	PUP Recipients (1)	TWSS Recipients (2)	Total Number of Recipients (1+2)	(1+2) as % of All Recipients	(1+2) as % of Employment in this Sector
Wholesale and Retail Trade	91	105	196	19	63
Accommodation and Food Services	129	32	161	16	90
Construction	80	40	119	12	81
Industry	40	58	98	10	34
Administrative and Support Service Activities	46	27	73	7	65
Arts, Entertainment and Other Services	54	18	71	7	60
Professional, Scientific and Technical Activities	25	37	62	6	44
Transportation and Storage	18	30	48	5	45
Human Health and Social Work Activities	23	25	48	5	16
Financial Insurance and Real Estate Activities	21	16	36	4	32
Education	22	10	33	3	17
Information and Communication	12	14	26	3	21
Public Administration and Defence, Compulsory Social Security	15	0.4	15	1	13
Agriculture	9	3	12	1	11
<b>Total</b>	<b>602</b>	<b>425</b>	<b>1,027</b>	<b>100</b>	<b>44</b>

Source: DEASP, CSO

Note: Figures may not sum due to rounding. The sectoral employment data is taken from the CSO's Labour Force Survey (LFS) data for 2019Q4. The PUP is measured as 18-66 while the LFS employment data is 15+ so shares presented are not exact but rather are approximate. We use the PUP sectoral breakdown from DEASP. For the TWSS in the week up to 3<sup>rd</sup> May approximately 9,000 people were not assigned to a sector while for the PUP 19,000 were not assigned to a sector.

In terms of the sectoral analysis, we rank Wholesale and Retail Trade, Construction, Transportation and Storage, Accommodation and Food Services, Real Estate, Travel Agency and tourism service activities as 'severely affected' by Covid-19. As it is currently not possible to get disaggregated

<sup>10</sup> As a robustness check we also examine the sectoral labour market impacts if we use the PUP data published by CSO presented in Table A1 in the annex. In general, the ranking of most vulnerable sectors (PUP + TWSS recipients as % of 2019Q4 sectoral employment) is the same across data sources although the absolute magnitude of the number of recipients by sector differs.

pandemic income support data on subsectors within Industry, we make the assumption that sectors included in the traditional or indigenous industry are likely to be ‘moderately affected’ by Covid-19 while those in the high-tech pharmaceutical and chemicals sector are likely to be relatively unaffected by Covid-19. Land Transport, Warehousing and certain aspects of Administration and Support Services are also likely to be moderately affected. In terms of those sectors which are viewed as relatively unaffected we include Agriculture, the Manufacture of Food and Beverages, the Provision of Water Supply, Sewerage, Waste Management and Remediation Activities, Information and Communication Activities, Financial and Insurance Activities, Public Administration Health and Education, and the majority of Professional, Scientific and Technical Activities.

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### **Section 3: The Sectoral Effects of Brexit**

To estimate the effect of Brexit across sectors, we update and re-estimate the results from two previous pieces of research, Lawless and Morgenroth (2019) for goods trade and Lawless (2018) for services. It is necessary to estimate the impacts for goods and services separately due to differences in data collection and in the methodology applied to estimate how changes in the trading landscape would affect the two types of trade flow in the event of no trade deal being concluded between the EU and UK by the end of the transition period.

The methodology for goods trade is to match published tariff rates to current product level trade data and estimate the effect this would have on demand if the entire tariff was passed into prices. The results in Lawless and Morgenroth (2019) emphasised the variation in external tariffs applied by the EU and how this resulted in quite different trade impacts of Brexit across EU member states and across different sectors within each country. Due to a combination of closer trade links with the UK and a relatively high share of agri-food exports where tariffs tend to be highest, Ireland was found to be the most exposed to trade effects of Brexit of all of the remaining EU members.

When the previous analysis was carried out, there was no information available on the tariff rates that the UK might apply to countries that it had no free trade agreement with and the results were therefore based on an assumption that the UK would mirror the tariff schedule that the EU had registered with the WTO. In May 2020, the UK government announced a new tariff schedule that would apply to imports from countries that the UK had no trade agreement with, including the EU if no agreement is reached by the end of the year.<sup>11</sup> This paper therefore updates the previous research by applying this new information on UK tariffs to more recent detailed trade flow data from 2018.

The UK Global Tariff is broadly similar in structure to the EU’s WTO tariffs with typically higher tariffs applying to agri-food products and lower tariffs on manufactured goods. Compared to the EU tariffs, around half of product lines have lower tariffs that are to be applied and these products account for around 31 per cent of Irish exports to the UK. The products with tariff reductions fall almost evenly into two groups. The first group of products with lower tariffs are described in the official documentation as “simplifications” whereby tariffs have been rounded down to the nearest whole number. The second set

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<sup>11</sup> <https://www.gov.uk/guidance/uk-tariffs-from-1-january-2021>

are products where tariffs have been entirely abolished. The number of products with zero tariffs under the UK schedule is around 25 per cent higher than that of the EU tariff schedule. In terms of impact on trade, however, this liberalisation is less dramatic than might be expected as the majority of tariffs in this second group were already very low with few exceeding 2 per cent. We repeat the same methodology used by Lawless and Morgenroth (2019) using the new UK Global Tariff rates applied to current levels of Irish-UK trade. An assumption is made that the full tariff amount would be incorporated into the price, and we use sector level elasticity estimates calculated by Imbs and Mejean (2016) to estimate what this tariff-induced price increase would do to trade values across products.

The top panel of Table 2 present the results aggregated to broad groups of sectors along with the pattern of trade across these groups. The UK overall accounts for approximately ten per cent of Irish goods exports although it is more important as an export destination for domestically-owned firms (Lawless, Siedschlag and Studnicka, 2017). Around 30 per cent of exports to the UK are in the food and beverages sector where tariffs are systematically higher than on other goods and, as a result, the estimated reduction in exports for this group is higher at 75 per cent than the overall reduction of 34 per cent.

The second panel of Table 2 recalculates the estimated effects on services trade as in Lawless (2018) in order to align the subsectors in the services data (which is reported using Balance of Payments (BOP) categories) with the sectors in the employment data. This is necessary in order to be able to make a comparison of the Brexit and Covid-19 shocks on a comparable basis. However, this does come with a caveat that the aggregation and matching are based on an assumption that all of a particular services category is exported by the most closely related employment sector which is slightly simplistic. As there is no comparable fall-back position for services trade that external tariffs provide for goods, the methodology applied here is different. A gravity model approach is used, which is a standard method of estimating the determinants of trade flows between countries based on fundamental factors such as the size of their markets and the cost of moving goods between them (Head and Mayer, 2014). These costs can be direct transport costs (often proxied by distance between the countries) and a wide range of other characteristics of the country or product that can facilitate or inhibit trade. Here our main interest is in how EU membership has affected trade costs in services. A number of other factors are also controlled for including common language, sharing a land border and a colonial relationship in addition to the size of the market (GDP) and its income level (GDP per capita).

The key focus on the degree to which the European Union has facilitated trade in services amongst its members compared to trade between other partner countries. To estimate the effect of Brexit, we assume that any statistically significant impact of EU membership on services trade flows is removed and these are reported below. Trade in financial services is found to have benefited most from the EU's single market and, as such, is the most at risk of reductions in trade following Brexit. This is followed by information and communication services. The overall impact of Brexit on services exports from Ireland to the UK in the absence of a trade deal is estimated to be somewhat larger than the effect on goods with a reduction of 43 per cent estimated. This is equivalent to a fall of 6 per cent in total Irish services exports. Compared to the previous results in Lawless (2018), the effects on exports to the UK are very similar but the estimated reduction in overall services exports is much lower. This overall impact had

been estimated as being 9 per cent and is now 6 per cent, which is due to a fall in the share of overall services exports destined for the UK since the 2014 data that was used in the previous work.

**Table 2: Structure of Irish Exports to UK and Estimated Effects of Brexit**

	Exports to UK (€m)	Export Change
<b>Goods</b>		
Agriculture, Forestry and Fishing	341	20%
Food Products, Beverages and Tobacco	4,706	75%
Traditional	3,347	21%
Modern	6,180	10%
Miscellaneous	1,196	41%
Total Goods Exports to UK	15,771	34%
Irish Total Goods Exports	152,521	4%
UK Share of Goods Exports	10%	
<b>Services</b>		
Administrative and support services	728	39%
Financial, insurance and real estate	8,212	62%
Information and communication	8,831	43%
Professional, scientific and technical activities	412	31%
Transportation and storage	3,552	13%
Accommodation and food services	1,008	0%
Other services	5,540	0%
Total Services Exports to UK	28,282	43%
Irish Total Services Exports	180,077	6%
UK share of Services Exports	16%	

Source: Goods export data from United Nations ComTrade, tariffs from UK Government and elasticities from Imbs and Mejean (2016). Services export data from CSO.

Note: Goods data aggregated from HS6 product-level and services data aggregated from BOP categories for comparison with employment data across NACE sectors. Services aggregation assumes all services in a BOP category is exported by one sector.

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## Section 4: Comparison of Sector Impacts

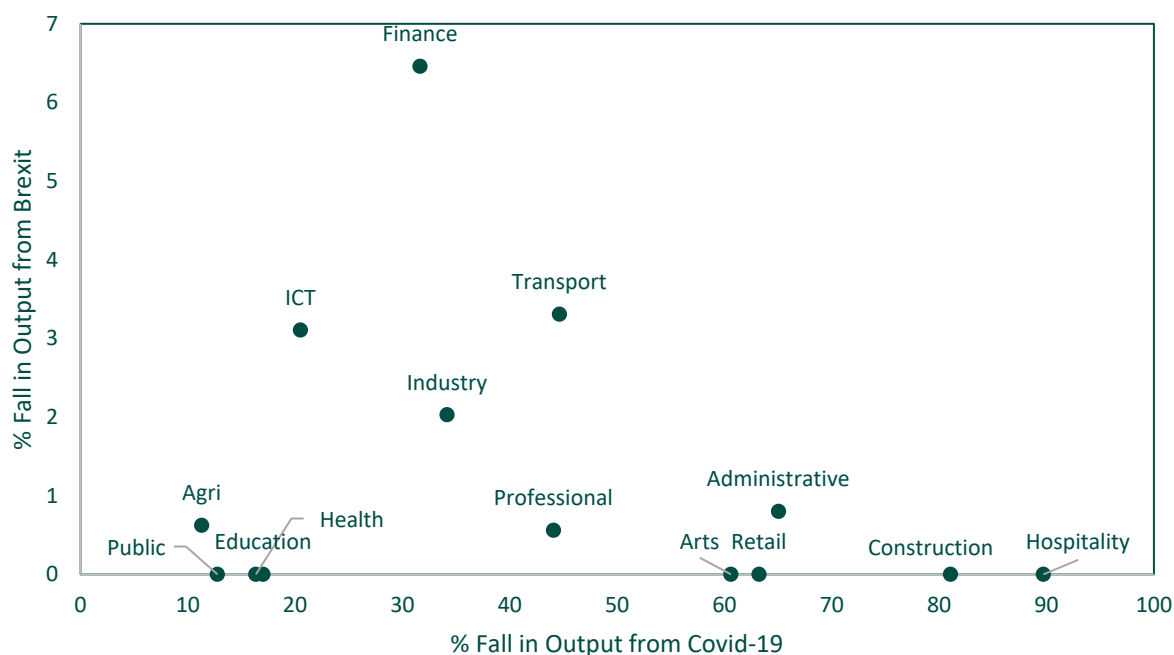
The previous sections examined the available information on the sectoral impacts of Covid-19 and Brexit separately. The key question of this paper is the extent to which these impacts are correlated across sectors. We compare the impacts across sectors in a number of ways: We first use output reductions from the sectoral breakdowns described previously to calculate how closely these are correlated. We then use a finer level of sectoral detail to broaden the analysis building on the evidence from the previous sections and assign a rank to each sector across both shocks according to their expected vulnerability. Three categories are used: severely affected sectors (“Red”), moderately affected sectors (“Amber”) and unaffected sectors (“Green”). It should be noted that this characterisation is at a broad sector level and does not preclude exposure to the shocks that differs at an individual firm level. In this section, we do a simple comparison of the level of overlap in rankings across the sectors. Section 5 then uses these rankings to further investigate the interactions between the sectors through supply chain channels.

Figure 4 compares the impacts of the Covid-19 and Brexit shocks from the two previous sections. Both shocks are converted to an output fall for comparability, assuming that with a constant output per worker that the reduction in employment used to measure the Covid-19 shock is equivalent to the same percentage reduction in output for each sector. This may slightly underestimate the impact if productivity itself is impacted by the shock – in the case of Covid-19, for example, output per worker could be lower as new requirements for social distancing and greater hygiene may slow down some business processes. However, no evidence is yet available for the size of this effect or how sustained it may be so we cannot directly incorporate it into this assessment. For the Brexit shock, output is assumed to reduce by the amount of lost exports. This simple comparison suggests fairly limited overlap in the sectors exposed to the different shocks. The most severely impacted sectors from Covid-19, such as hospitality and construction are expected to have almost no impact from Brexit. The most exposed sector to the Brexit shock, financial services and insurance, has not been unaffected by Covid-19, but is in the mid-range of the Covid-19 impacts. More formally estimating a correlation coefficient between the two shocks finds no statistically significant evidence of overlap.<sup>12</sup>

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<sup>12</sup> The correlation between both output falls is -0.226 with a significance level of 0.44.

**Figure 4: Comparison of Sectoral Impacts of Covid-19 and Brexit**



Source: Authors calculations of impacts using data from CSO, UN ComTrade and UK Government tariffs. See text for details.

In order to use the more detailed sectoral interactions in the next section, we next assign rankings to each sector at a slightly finer level of detail. In the main, this is done by giving the same level of exposure to each subsector within a broader grouping. There are some exceptions, however, as we use the evidence on Brexit export impacts to assign different levels of exposure to different manufacturing sectors. Table 5 lists the most severely affected sectors (red ranking) for both of the shocks, Table 6 lists those more moderately affected and Table 7 lists the unaffected sectors.

Table 3 compares the numbers of sectors in each of the categories and the extent to which they overlap. Broadly similar numbers of sectors are assigned to each rank group for the two different shocks with 21 of the 57 sectors ranked Green (i.e. unaffected) for Brexit and 11 ranked Red (i.e. likely to be severely impacted). For the Covid-19 shock, 23 sectors are ranked Green, 18 Amber (i.e. moderately affected) and 16 are Red. In terms of overlap, no sector is ranked as Red for both shocks and just 7 are ranked as Green for both. If a numerical ranking is applied (where Green is 1, Amber is 2 and Red 3) to generate a correlation coefficient, we find a statistically significant negative correlation between the ranking of exposure to the two shocks.<sup>13</sup> In contrast to the correlation estimated above, this uses only the broad exposure and not the severity of the impact. Both correlations are consistent in showing that the shocks are not impacting on the same sectors to any substantial degree.

Although the broad pattern of this comparison is that sectors tend to be exposed to either one shock or the other, there are a number of sectors at higher risk of being impacted by both which is a cause for concern. Four sectors that are severely exposed to Covid-19 are also likely to be affected (albeit more

<sup>13</sup> The correlation between the ordinal ranking of sectors is -0.39 with a significance level of 0.003.

moderately) by Brexit: Water transport, Air transport, Publishing, film and broadcasting services and Travel agency and tourism service activities. A further five sectors that are severely exposed to Brexit have an Amber ranking for exposure to Covid-19: these are mainly in the traditional manufacturing group (Textiles, Wearing apparel, Leather, Wood Products and Paper Products).

**Table 3: Comparison of Sector Rankings**

		Brexit			Sum Covid-19 Sectors
		Green	Amber	Red	
Covid-19	Green	7	10	6	23
	Amber	2	11	5	18
	Red	12	4	0	16
	Sum Brexit Sectors	21	25	11	57

While Table 3 suggests limited sectoral overlap between the shocks, it is possible that the most exposed sectors for each shock are co-located in certain regions which could be important from a policy response perspective. To examine if this might be the case, Table 4 compares employment in each of the categories by region and the extent to which they differ between shocks. This is done by calculating the numbers employed in the red, amber and green sectors in each region as a share of total employment in that region in 2019Q4.

It is striking that there appears to be little divergence across regions with regard to the impacts of the shocks. The share of employment in sectors ranked Red for Brexit ranges from 9 per cent in Dublin to 14 per cent in Border, South-East and Midland. In contrast, the shares of employment in sectors ranked Red for Covid-19 appear to be relatively consistent across regions with a range of 35 per cent in Dublin to 41 per cent in Mid-East.<sup>14</sup> However, the share of employment taking place in 'Red' sectors is consistently higher for Covid-19 across all regions reflecting the overall greater severity of this shock.

<sup>14</sup> Table A2 in the annex shows recipients of pandemic income support by region. In this case, as a share of total regional employment, the number of people receiving pandemic income support is relatively consistent across regions, ranging from 41 per cent in West to 45 per cent in Mid-East. At present, it is not possible to examine recipients of pandemic income supports by sector and region jointly.

**Table 4: Employment Share by Region, % of total regional employment<sup>15</sup>**

<b>Region</b>	<b>Red</b>	<b>Amber</b>	<b>Green</b>	<b>All Sectors</b>
<b><u>Brexit</u></b>				
<b>Border</b>	<b>14</b>	<b>24</b>	<b>62</b>	<b>100</b>
<b>West</b>	<b>12</b>	<b>28</b>	<b>60</b>	<b>100</b>
<b>Mid-West</b>	<b>12</b>	<b>27</b>	<b>61</b>	<b>100</b>
<b>South-East</b>	<b>14</b>	<b>27</b>	<b>59</b>	<b>100</b>
<b>South-West</b>	<b>11</b>	<b>32</b>	<b>56</b>	<b>100</b>
<b>Dublin</b>	<b>9</b>	<b>36</b>	<b>55</b>	<b>100</b>
<b>Mid-East</b>	<b>11</b>	<b>28</b>	<b>61</b>	<b>100</b>
<b>Midland</b>	<b>14</b>	<b>28</b>	<b>57</b>	<b>100</b>
<b><u>Covid-19</u></b>				
<b>Border</b>	<b>39</b>	<b>10</b>	<b>51</b>	<b>100</b>
<b>West</b>	<b>36</b>	<b>11</b>	<b>54</b>	<b>100</b>
<b>Mid-West</b>	<b>36</b>	<b>12</b>	<b>52</b>	<b>100</b>
<b>South-East</b>	<b>38</b>	<b>12</b>	<b>49</b>	<b>100</b>
<b>South-West</b>	<b>37</b>	<b>13</b>	<b>49</b>	<b>100</b>
<b>Dublin</b>	<b>35</b>	<b>9</b>	<b>56</b>	<b>100</b>
<b>Mid-East</b>	<b>41</b>	<b>10</b>	<b>49</b>	<b>100</b>
<b>Midland</b>	<b>38</b>	<b>11</b>	<b>51</b>	<b>100</b>

Source: CSO

<sup>15</sup> The counties included in each region are: Border – Cavan, Donegal, Leitrim, Monaghan and Sligo; Midland – Laois, Longford, Offaly and Westmeath; West – Galway, Mayo and Roscommon; Mid-East- Kildare, Louth, Meath and Wicklow; Mid-West – Clare, Limerick and Tipperary; South-East – Carlow, Limerick, Waterford and Wexford; South-West – Cork and Kerry.



**Table 5: Severely Affected (“Red”) Sectors**

<b>Brexit</b>	<b>Covid-19</b>
<b>Agriculture, forestry and fishing (1-3)</b>	<b>Mining, quarrying and extraction (5-9)</b>
<b>Manufacture of food products (10)</b>	<b>Construction and construction works (41-43)</b>
<b>Manufacture of beverages and tobacco products (11-12)</b>	<b>Wholesale and retail trade and repair of vehicles (45)</b>
<b>Manufacture of textiles (13)</b>	<b>Wholesale trade (46)</b>
<b>Manufacture of wearing apparel (14)</b>	<b>Retail trade (47)</b>
<b>Manufacture of leather and related products (15)</b>	<b>Water transport services (50)</b>
<b>Manufacture of wood and wood products (excluding furniture) (16)</b>	<b>Air transport services (51)</b>
<b>Manufacture of pulp, paper and paper products (17)</b>	<b>Accommodation services (55)</b>
<b>Financial service activities (64)</b>	<b>Food and beverage services (56)</b>
<b>Insurance, reinsurance and pension funding (65)</b>	<b>Publishing, film and broadcasting services (58-60)</b>
<b>Other financial activities (66)</b>	<b>Real estate activities (68)</b>
	<b>Travel agency and tourism service activities (79)</b>
	<b>Cultural, arts and gambling activities (90-92)</b>
	<b>Recreation and sports activities (93)</b>
	<b>Repair of consumer goods (95)</b>
	<b>Other personal service activities (96)</b>

**Table 6: Moderately Affected (“Amber”) Sectors**

<b>Brexit</b>	<b>Covid-19</b>
Printing and reproduction of recorded media (18)	Manufacture of textiles (13)
Manufacture of chemicals and chemical products (20)	Manufacture of wearing apparel (14)
Manufacture of rubber and plastic products (22)	Manufacture of leather and related products (15)
Manufacture of other non-metallic mineral products (23)	Manufacture of wood and wood products (excluding furniture) (16)
Manufacture of basic metals (24)	Manufacture of pulp, paper and paper products (17)
Manufacture of fabricated metal products (25)	Printing and reproduction of recorded media (18)
Manufacture of electrical equipment (27)	Manufacture of refined petroleum, basic pharmaceutical, computer, electronic & optical products, machinery and equipment n.e.c., furniture, other manufacturing (19, 21, 26, 28, 31, 32)
Manufacture of motor vehicles, trailers, other transport equipment (29-30)	Manufacture of basic metals (24)
Repair and installation of machinery and equipment (33)	Manufacture of fabricated metal products (25)
Land transport services (49)	Manufacture of motor vehicles, trailers, other transport equipment (29-30)
Water transport services (50)	Repair and installation of machinery and equipment (33)
Air transport services (51)	Land transport services (49)
Warehousing (52)	Warehousing (52)
Publishing, film and broadcasting services (58-60)	Architectural and engineering services (71)
Telecommunications services (61)	Rental and leasing activities (77)
Computer programming, consultancy and data processing (62-63)	Employment services (78)
Legal and accounting activities (69)	Security, office and business support activities (80-82)
Head office and management consultancy activities (70)	Membership organisation services (94)
Architectural and engineering services (71)	
Rental and leasing activities (77)	
Employment services (78)	
Travel agency and tourism service activities (79)	
Security, office and business support activities (80-82)	
Advertising, market research, other professional & scientific services (73-75)	

**Table 7: Unaffected (“Green”) Sectors**

<b>Brexit</b>	<b>Covid-19</b>
Mining, quarrying and extraction (5-9)	Agriculture, forestry and fishing (1-3)
Manufacture of refined petroleum, basic pharmaceutical, computer, electronic & optical products, machinery and equipment n.e.c., furniture, other manufacturing (19, 21, 26, 28, 31, 32)	Manufacture of food products (10)
Electricity and gas supply (35)	Manufacture of beverages and tobacco products (11-12)
Water collection, treatment and supply (36)	Manufacture of chemicals and chemical products (20)
Sewerage, waste collection and remediation services (37-39)	Manufacture of rubber and plastic products (22)
Construction and construction works (41-43)	Manufacture of other non-metallic mineral products (23)
Wholesale and retail trade and repair of vehicles (45)	Manufacture of electrical equipment (27)
Wholesale trade (46)	Electricity and gas supply (35)
Retail trade (47)	Water collection, treatment and supply (36)
Postal and courier services (53)	Sewerage, waste collection and remediation services (37-39)
Accommodation services (55)	Postal and courier services (53)
Food and beverage services (56)	Telecommunications services (61)
Public administration (84)	Computer programming, consultancy and data processing (62-63)
Real estate activities (68)	Financial service activities (64)
Education services (85)	Insurance, reinsurance and pension funding (65)
Human health and social work activities (86-88)	Other financial activities (66)
Cultural, arts and gambling activities (90-92)	Legal and accounting activities (69)
Recreation and sports activities (93)	Head office and management consultancy activities (70)
Membership organisation services (94)	Scientific research and development services (72)
Repair of consumer goods (95)	Advertising, market research, other professional & scientific services (73-75)
Other personal service activities (96)	Public administration (84)
	Education services (85)
	Human health and social work activities (86-88)

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## Section 5: Supply Chain Connections

The analysis to this point has shown that the sectors most likely to be adversely impacted by Covid-19 are quite different to those likely to be impacted by Brexit. However, we have implicitly assumed that the Brexit and Covid-19 shocks are independent of one another, i.e. that the impact of Covid-19 on certain sectors does not affect Brexit impacted sectors and vice versa. The next stage of our analysis is to examine the potential linkages between sectors. The analysis here is based on domestic flows of inputs and outputs, making use of the CSO's Input-Output tables from 2015. The analysis takes a similar structure to that outlined in McCann and Myers (2020) who examine the transmission of the Covid-19 shock through domestic supply chains.

In this section we examine the cross-sectoral flows using several approaches. The first examines the flows between sectors to examine the degree to which the vulnerable sectors engage with each other to outline any potential supply chain effects. The second examines the magnitude of the flows between sectors as a share of their total output. Finally, we examine potential difficulties sectors may have if they source a large degree of their inputs from Covid-19 impacted sectors. In order to examine the inter-sectoral flows, we once again rank each sector across both shocks according to their expected vulnerability outlined in the previous sections.

The data used to examine the supply connections between sectors comes from information contained in the CSO's 2015 Input-Output table of domestic product flows. Input-Output tables describe the sales and purchases relationships between producers and consumers within the economy. In particular, we are interested in the flow of goods and services between sectors. A firm or sector purchases inputs from other firms or sectors and then uses those inputs to produce outputs. The firm or sector then sells their output to other sectors/firms for use as inputs in the production process. Once the final outputs are produced sectors/firms then supply sectors such as households, business, government, and exports with final output. In terms of our analysis, we focus on the flow of goods between sectors only and analyse the linkages through the domestic supply chain to examine the potential inter sectoral impact of Covid-19 and Brexit in Ireland. We first do this separately and then by looking at the sectoral linkages across the shocks in order to understand the degree to which domestic supply chains could be affected by both shocks.

The linkages between sectors are presented in value terms (millions of euro) in Table 8a with the corresponding percentages of total inter-sector flows in Table 8b. In the top-left panel, we see the sectors ranked by their exposure to the Brexit shock and how they interact with one another. In this, we see that severely affected Brexit sectors supplied close to €16bn to other severely affected sectors (labelled Red-Red in our matrix) which accounts for 17 per cent of total sector-to-sector transactions. The more moderately affected (Amber) Brexit sectors supplied €21bn to other moderately affected sectors (23 per cent of the total). In total, sales from sectors severely impacted by Brexit account for 24 per cent of purchases, with sales from moderately impacted sectors accounting for 45 per cent and unaffected sectors the origin of the remaining 31 per cent. If we look at it from the purchaser side, the unaffected sectors buy 40 per cent of the total inputs.

These flows represent the inter-industry flows between sectors which only represent a share of total sectoral output, i.e. where total output is equal to the sum of inter-industry flows and total final uses with final uses being the sum of household and government consumption, investment and exports. Therefore, these sector-to-sector flows are relatively small compared to total outputs. For example, the total output of severely affected, moderately affected and unaffected Brexit sectors in 2015 were €76bn, €182bn and €263bn respectively.

**Table 8a: Economic Activity Between Sectors, € millions**

		Sectors, purchasing inputs									
		Brexit					Covid-19				
		Red	Amber	Green	Row total	Red	Amber	Green	Row total		
Sectors, selling inputs (output)	Brexit	Green	2,613	7,234	18,082	27929	8,891	5,083	13,955	27929	
		Amber	5,651	20,746	14,052	40449	11,418	6,424	22,607	40449	
		Red	15,677	2,080	3,796	21553	2,726	1,407	17,420	21553	
		Column total	23941	30060	35930	89931	23035	12914	53983	89931	
Sectors, selling inputs (output)	Covid-19	Green	20,558	18,259	17,262	56079	10,048	4,834	41,197	56079	
		Amber	1,725	5,859	7,620	15204	5,272	4,334	5,598	15204	
		Red	1,657	5,943	11,048	18648	7,714	3,745	7,188	18648	
		Column total	23941	30060	35930	89931	23035	12914	53983	89931	

Source: Authors calculations based on CSO 2015 Input-Output Tables

**Table 8b: Economic Activity Between Sectors, percentage of inter-sector flows (from Table 8a)**

		Sectors, purchasing inputs									
		Brexit					Covid-19				
		Red	Amber	Green	Row total	Red	Amber	Green	Row total		
Sectors, selling inputs (output)	Brexit	Green	3%	8%	20%	31%	10%	6%	16%	31%	
		Amber	6%	23%	16%	45%	13%	7%	25%	45%	
		Red	17%	2%	4%	24%	3%	2%	19%	24%	
		Column total	27%	33%	40%	100%	26%	14%	60%	100%	
Sectors, selling inputs (output)	Covid-19	Green	23%	20%	19%	62%	11%	5%	46%	62%	
		Amber	2%	7%	8%	17%	6%	5%	6%	17%	
		Red	2%	7%	12%	21%	9%	4%	8%	21%	
		Column total	27%	33%	40%	100%	26%	14%	60%	100%	

Source: Authors calculations based on CSO 2015 Input-Output Tables

The bottom-right quadrant of Tables 8a and 8b show the sector-to-sector sales of sectors ranked by their exposure to the Covid-19 shock. Here we find that €23bn (26 per cent) was purchased by severely affected sectors while a further €13bn (14 per cent) was purchased by moderately affected sectors.

Severely affected Covid-19 sectors supplied close to €8bn to other severely affected sectors while moderately affected Covid-19 sectors supplied €4bn to other moderately affected sectors. In contrast, there are €54bn of sales to unaffected sectors representing 60 per cent of the total. Once again, it should be noted that these total sector-to-sector sales represent only a small portion of total sector output. Total outputs of the severely affected, moderately affected and unaffected sectors in relation to Covid-19 were €122bn, €158bn and €242bn respectively in 2015.

We now move on to examine the potential supply chain overlap between the sectors impacted by Covid-19 and those likely to be impacted by Brexit. To examine the potential linkages, we first examine the Covid-19 sectors that sell their output to Brexit sectors (bottom-left quadrant of Tables 8a and 8b). We estimate sector-to-sector sales of €15bn from sectors that are severely or moderately affected by Covid-19 to sectors that are severely or moderately affected by Brexit (total of the Red-Red, Red-Amber, Amber-Red and Amber-Amber flows). This represents 17 per cent of total inter-sector transactions. Of this only €1.7bn (2 per cent) of sector to sector sales occur in 'severely affected to severely affected sectors'. Where this is the case, the severely affected Covid-19 sectors with the largest sales to severely affected Brexit sectors are Wholesale Trade (€439m), Construction (€262m) and Publishing, Film and Broadcasting Activities (€238m).

There is also €5.9bn (7 per cent) of sales from severely affected Covid-19 sectors to moderately affected Brexit sectors. In this case the largest Covid-19 severely affected sectors include Real Estate Activities (€1.1bn), Wholesale Trade (€1.1bn) and Publishing, Film and Broadcasting Services (€943m). In terms of the moderately affected Covid-19 sectors selling to moderately affected Brexit sectors there are sales at a similar level of €5.9bn. The largest selling sectors in this case include Security, office and business support activities (€1.2bn), Warehousing (€1.1bn), Architectural and engineering services (€748m) and Land Transport Services (€577).

Perhaps the most striking finding is that of the sales from sectors likely to be unaffected from Covid-19 which total €56bn, the majority goes to sectors that are severely or moderately affected by Brexit. Of this, almost €21bn (23 per cent total sales) goes to sectors severely affected by Brexit. Perhaps unsurprisingly, the sectors unaffected by Covid-19 with the largest sales to severely affected Brexit sectors include Agriculture (€5bn), Other Financial Activities (€3.4bn), Financial Service Activities (€2.9bn), Insurance, Reinsurance and Pension Funding (€2.3bn), Computer Programming, Consultancy and Data Processing (€1.7bn) and Manufacture of Food (€1.4bn).

Looking at the final quadrant of sales from Brexit exposed sectors to Covid-19 sectors (top-right quadrant), we find that €2.7bn (3 per cent) of sector to sector sales occur between severely affected Brexit to severely affected Covid-19 sectors. In this case, the severely-affected Brexit sectors with the largest sales to severely-affected Covid-19 sectors is Financial Service Activities (€1.6bn). There is €6.4bn (7 per cent) of sales from moderately affected Brexit to moderately affected Covid-19 sectors. In this case the largest Brexit moderately affected sectors include Warehousing (€699m), Legal and accounting activities (€672), computer programming, consultancy and data processing (€565) and publishing, film and broadcasting services (€553). We again find that severely affected Brexit sectors have sales of €17bn to unaffected Covid-19 sectors suggesting that though there is some supply chain overlap between the two shocks, in the most part the sectors most impacted by the individual shocks are different. For both the Covid-19 and Brexit shocks the connections between sectors in the form of

buyers in relatively unexposed purchasing from suppliers in sectors that are severely impacted by either shock are quite significant. This could result in the transmission of the shocks to the less directly exposed sectors either through prices or supply restrictions.

Looking at the detailed sectoral level, we can see which sectors have the most exposure to vulnerable Brexit (Red or Amber) buying sectors. These results are presented in Table 9 for Brexit buying sectors. The Computer Programming sector has the largest overall exposure to vulnerable Brexit buying sectors of €9.4bn although this represents only 16 per cent of the sectors overall output. It is interesting to note that the nine of the top eleven sectors with the largest sales to vulnerable Brexit sectors are all sectors which are relatively unaffected by Covid-19.

**Table 9: Largest Sector by annual sales to firms in vulnerable Brexit buying sector**

<b>Producer Sector</b>	<b>Covid-19 Status</b>	<b>Annual Flows, €m</b>	<b>% Share of producer sector's total output</b>
<b>Computer programming, consultancy and data processing</b>	<b>Green</b>	<b>9,433</b>	<b>16</b>
<b>Agriculture, forestry and fishing</b>	<b>Green</b>	<b>5,470</b>	<b>65</b>
<b>Other Financial activities</b>	<b>Green</b>	<b>4,207</b>	<b>63</b>
<b>Financial service activities</b>	<b>Green</b>	<b>3,667</b>	<b>17</b>
<b>Insurance, reinsurance and pension funding</b>	<b>Green</b>	<b>2,552</b>	<b>18</b>
<b>Legal and accounting activities</b>	<b>Green</b>	<b>2,536</b>	<b>47%</b>
<b>Security, Office and Business Support Activities</b>	<b>Amber</b>	<b>1,672</b>	<b>50</b>
<b>Head Office and Management Consultancy Activities</b>	<b>Green</b>	<b>1,512</b>	<b>37</b>
<b>Wholesale Trade</b>	<b>Red</b>	<b>1,493</b>	<b>4</b>
<b>Advertising, market research and other professional &amp; scientific activities</b>	<b>Green</b>	<b>1,489</b>	<b>4</b>
<b>Manufacture of Food Products</b>	<b>Green</b>	<b>1,461</b>	<b>7</b>

Source: Authors estimates based on CSO data

Table 10 presents the sectors which have most exposure to vulnerable Covid-19 (Red or Amber) buying sectors. The Construction sector has the largest overall exposure to vulnerable Covid-19 buying sectors of €4.5bn although this represents only 26 per cent of the sectors overall output. However, the majority of this represents sales to other firms in the Construction sector. It is also worth noting that 10 per cent of the output from financial services activities, a sector likely to be severely impacted by Brexit, is sold to sectors that are regarded as vulnerable to Covid-19.

**Table 10: Largest Sector by annual sales to firms in vulnerable Covid-19 buying sector**

<b>Producer Sector</b>	<b>Brexit Status</b>	<b>Annual Flows, €m</b>	<b>% Share of producer sector's total output</b>
<b>Construction and construction works</b>	<b>Green</b>	<b>4,548</b>	<b>26</b>
<b>Real estate activities</b>	<b>Green</b>	<b>2,124</b>	<b>11</b>
<b>Financial service activities</b>	<b>Red</b>	<b>2,095</b>	<b>10</b>
<b>Legal and accounting activities</b>	<b>Amber</b>	<b>1,831</b>	<b>34</b>
<b>Computer programming, consultancy and data processing</b>	<b>Amber</b>	<b>1,784</b>	<b>3</b>
<b>Warehousing</b>	<b>Amber</b>	<b>1,641</b>	<b>71</b>
<b>Security, office and business support activities</b>	<b>Amber</b>	<b>1,578</b>	<b>47</b>
<b>Electricity and gas supply</b>	<b>Green</b>	<b>1,520</b>	<b>24</b>
<b>Advertising, market research, other professional &amp; scientific services</b>	<b>Amber</b>	<b>1,505</b>	<b>17</b>
<b>Head office and management consultancy activities</b>	<b>Amber</b>	<b>1,381</b>	<b>34</b>

Source: Authors estimates based on CSO data

The next two tables present the highest shares of sales in sectoral total output to the most affected Brexit (Table 11) and Covid-19 buying sectors (Table 12). The sectors most exposed to vulnerable Brexit sectors are Agriculture, Forestry and Fishing (65 per cent) and Warehousing (50 per cent). The sectors most exposed to vulnerable Covid-19 sectors are Warehousing (71 per cent) and Repair and Installation of Machinery and Equipment (62 per cent).



**Table 11: Sectors with largest % of total output going in sector-to-sector flows to vulnerable Brexit buying sector**

<b>Producer Sector</b>	<b>Covid-19 Status</b>	<b>% Share of producer sector's total output</b>
Agriculture, forestry and fishing	Green	65
Other Financial Activities	Green	63
Repair of Consumer Goods	Red	63
Warehousing	Amber	52
Security, office and business support activities	Amber	50
Employment Services	Amber	49
Repair and installation of machinery and equipment	Amber	49
Legal and Accounting Services	Green	47
Head Office and Management Consultancy Services	Green	37
Architectural and Engineering Services	Amber	36
Postal and courier services	Green	35

Source: Authors estimates based on CSO data

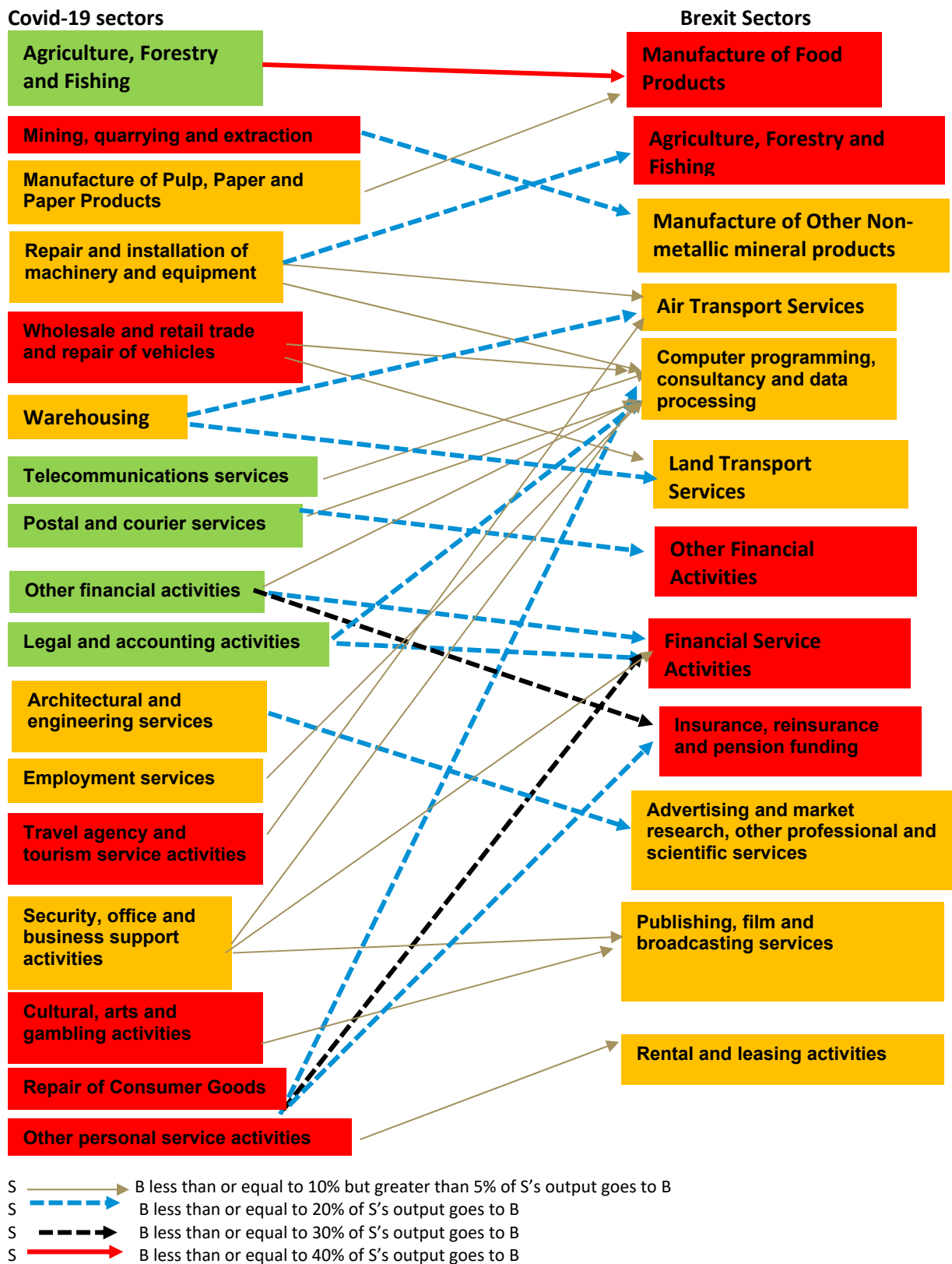
**Table 12: Sectors with largest % of total output going in sector-to-sector flows to vulnerable Covid-19 buying sector**

<b>Producer Sector</b>	<b>Brexit Status</b>	<b>% Share of producer sector's total output</b>
Warehousing	Amber	71
Repair and installation of machinery and equipment	Amber	62
Employment services	Amber	52
Manufacture of other non-metallic mineral products	Amber	50
Security, office and business support activities	Amber	47
Manufacture of wood and wood products (excluding furniture)	Red	44
Architectural and engineering services	Amber	41
Head office and management consultancy activities	Amber	34
Legal and accounting activities	Amber	34
Water transport services	Amber	33

Source: Authors estimates based on CSO data

However, the vulnerability of certain sectors could also be related to strong links to certain individual sectors. Figure 5 presents the sectors (and their associated Covid-19 ranking) who sell more than 5 per cent of their output to a particular severely or moderately affected Brexit sector. In this case, there are sales from unaffected, severely and moderately affected Covid sectors which sell more than 5 per cent of their output to severely or moderately affected Brexit sectors. As presented below, the largest flow of output from one sector to another is from agriculture, forestry and fishing which sells nearly 40 per cent of its output to manufacture of food products sector. Also of note is that the Computer programming, consultancy and data processing sector and the financial services activities sectors buys a significant portion of the output from sectors which are likely to be both affected and unaffected by Covid-19.

**Figure 5: Covid-19 Sectors that sell more than 5% of total output to specific Vulnerable Brexit Sector**



Source: Authors estimates based on CSO data.

Another way to examine the potential supply chain linkages between Covid-19 and Brexit is to examine the reliance on sectors affected by Covid-19 for inputs in the production process. Figure A3 in the annex presents the buyers (and their associated Brexit ranking) who purchase more than 5 per cent of their inputs from individual sectors (and their associated Covid-19 ranking). In comparison to the output analysis presented in Figure 4, the input links appear to be much less pronounced implying that sectors are less reliant on other sectors for use as inputs in the production process when presented as a share of total sectoral inputs.

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## Section 6: Conclusion

Along with the rest of the world, Ireland has been experiencing the greatest public health crisis in living memory. The measures to limit the spread of Covid-19 have severely impacted social and economic activity. Prior to the onset of the pandemic, the Irish economy was performing strongly with the main source of exogenous risk being a concern that trade negotiations between the EU and UK would not reach agreement by the end of the year. While the potential economic impacts of Brexit without a trade deal have been substantially overshadowed by the Covid-19 crisis, it opens up the possibility that layering a hard Brexit on an economy weakened by dealing with Covid-19 could make the previously estimated effects of Brexit worse. The interrelationship of the two shocks is therefore an important consideration for the near-term economic prospects. The direction of the relationship is not obvious *ex ante* as to whether the two shocks might exacerbate each other or if the impact of Brexit be less if economic activity has already shifted to a lower base.

This paper attempts to give some insight into this question by examining the sectoral exposure to both shocks. This broadly follows work on the UK by De Lyon and Dhingra (2020a, 2020b) who found very little overlap between the sectors exposed to Covid-19 and those exposed to Brexit. We then expand on this by also examining interlinkages between the exposed sectors to each shock in terms of supply chains to those exposed to the other shock. This allows us to not just examine each shock separately but to also get a sense of possible “knock-on” effects from a reduction in activity in one sector to other areas of the economy.

Overall, we find that there is limited overlap in the sectors exposed to the different shocks. We assign a rank to each sector for each shock, using three categories: severely affected sectors (“Red”), moderately affected sectors (“Amber”) and unaffected sectors (“Green”). We rank the sectors most exposed to the Covid-19 shock using data on the number of people receiving either the PUP or TWSS. The sectors worst affected were Wholesale and Retail Trade, Accommodation and Food Services, Construction and Industry. Using estimates based on modelling trade barriers in goods and services, we find that these sectors are fairly limited in terms of their exposure to Brexit. No sector was found to be in a category of severely exposed to both the Brexit and Covid-19 shocks. That said, a number of sectors did fall into the category of being severely exposed to one shock and moderately exposed to the other, a combination that leaves them at particular risk if the two shocks are combined. The most exposed sector to the Brexit shock, financial services and insurance, is in the mid-range of the Covid-19 impacts. In terms of overlap, no sector is ranked as Red for both shocks. On the other hand, only 7

(out of 57) sectors are found to be unaffected by either shock. We should also note that the ranking of shock impact that we undertake is at a sector level and impacts on individual firms may of course deviate from this.

The initial comparison of sector exposure does not take into account linkages between sectors. We therefore examine the flow of goods and services between sectors affected by the two shocks to establish the extent of potential supply chain transmission of the shocks. Our main finding is that the sectors exposed to each shock are not particularly closely connected to those affected by the other shock. This comes from the observation that sectors that are severely affected by Covid-19 typically sell a greater share of their output for use as inputs in the production process to sectors that are likely to be relatively unaffected by Brexit. A similar pattern is found for sectors exposed to Brexit not being strongly linked to those affected by Covid-19. Overall, these findings suggest that adding the Brexit shock to that of Covid-19 brings a wider range of sectors exposed to risk but that the impacts are not magnified by interaction effects. There may however be other mechanisms at play, particularly in terms of heightened uncertainty regarding the aggregate economic outlook that impact across all sectors in addition to their direct exposure to the two particular shocks focused on in this analysis.

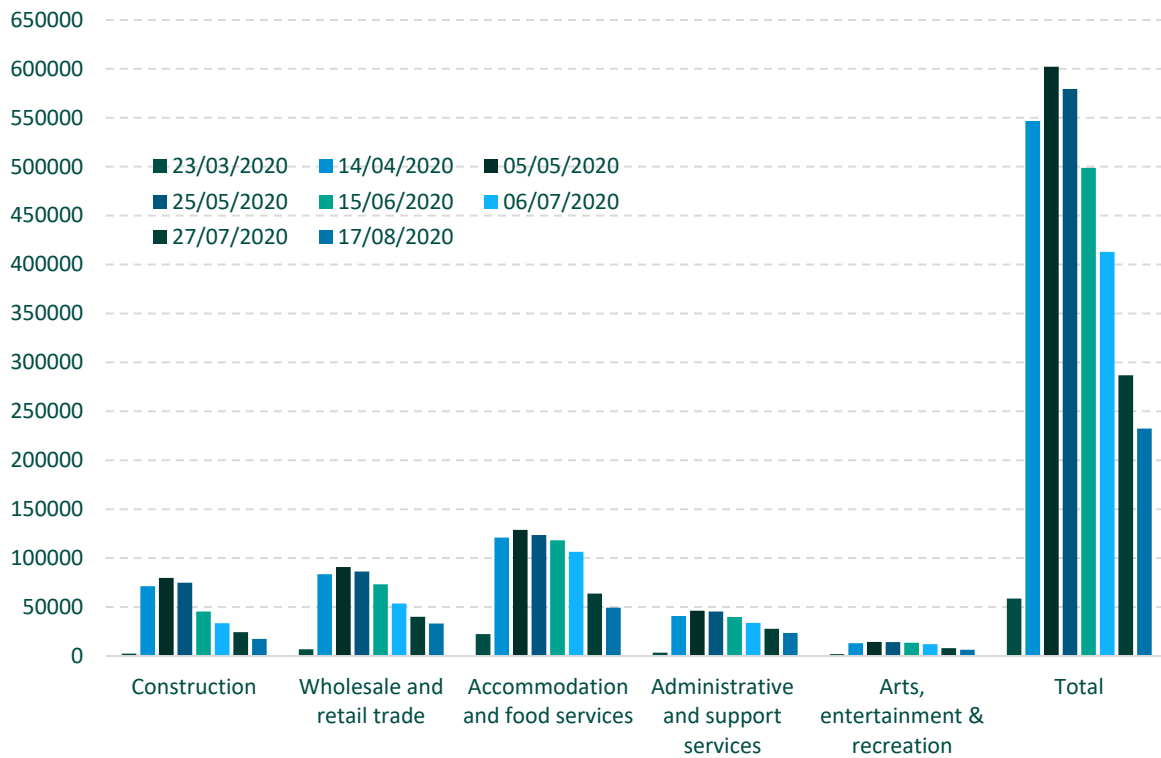
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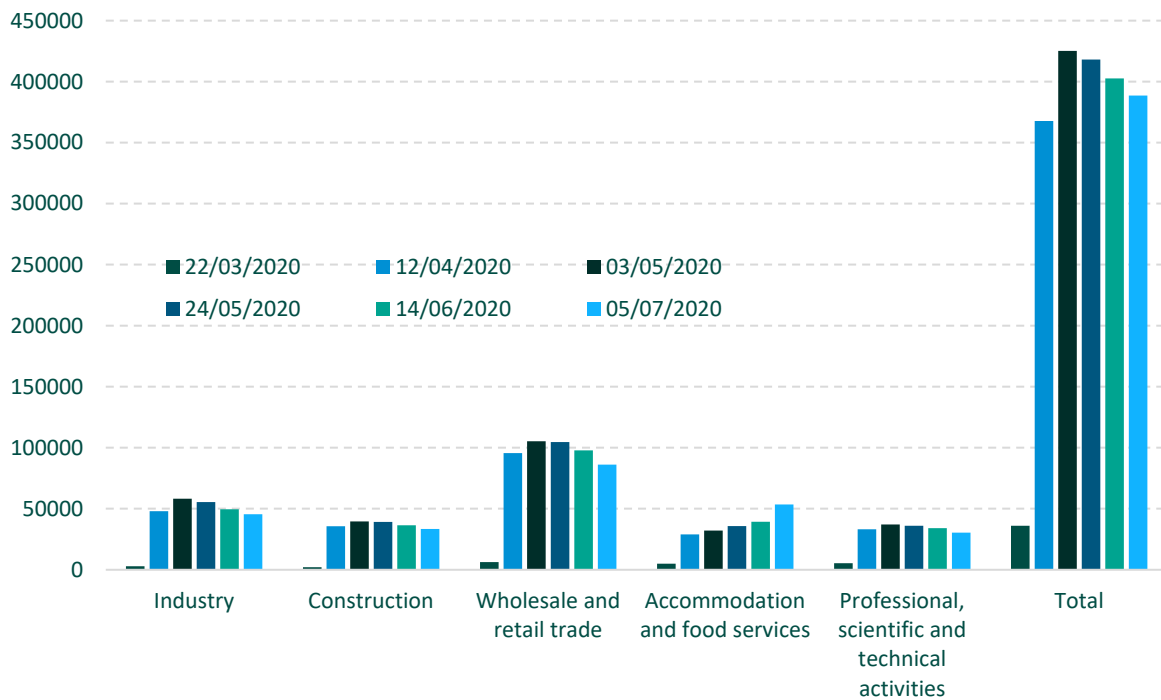
## Annex

**Figure A1: Numbers Claiming PUP over time by selected sector, to week ending**



Source: Department of Employment Affairs and Social Protection

**Figure A2: Numbers 'currently' being supported by the TWSS over time, to week ending**



Source: CSO

**Table A1: Recipients of Pandemic Income Support as of 1<sup>st</sup> Week May 2020, '000s**

<b>Sector</b>	<b>PUP Recipients (1)</b>	<b>TWSS Recipients (2)</b>	<b>Total Number of Recipients (1+2)</b>	<b>(1+2) as % of All Recipients</b>	<b>(1+2) as % of Employment in this Sector</b>
<b>Wholesale and Retail Trade</b>	75	105	181	18	58
<b>Accommodation and Food Services</b>	121	32	154	15	86
<b>Construction</b>	52	40	92	9	62
<b>Industry</b>	31	58	89	9	31
<b>Administrative and Support Service Activities</b>	34	27	61	6	54
<b>Professional, Scientific and Technical Activities</b>	17	37	54	5	39
<b>Arts, Entertainment and Other Services</b>	34	18	51	5	43
<b>Transportation and Storage</b>	13	30	44	4	40
<b>Human Health and Social Work Activities</b>	18	25	43	4	15
<b>Financial Insurance and Real Estate Activities</b>	13	16	29	3	25
<b>Education</b>	16	10	27	3	14
<b>Information and Communication</b>	7	14	21	2	17
<b>Public Administration and Defence, Compulsory Social Security</b>	7	0.4	7	1	6
<b>Agriculture</b>	4	3	7	1	7
<b>Total</b>	602	425	1,027	100	44

Source: CSO

**Table A2: Recipients of Pandemic Income Support by Region as of 1<sup>st</sup> Week May 2020, '000s**

Nuts 3 Region	PUP Recipients (1)	TWSS Recipients (2)	Total Number of Recipients (1+2)	(1+2) as % of All Recipients	(1+2) as % of Employment in this Region
<b>Border</b>	53	28	80	8	44
<b>West</b>	56	35	91	9	41
<b>Mid-West</b>	56	36	92	9	43
<b>South-East</b>	53	33	87	8	44
<b>South-West</b>	85	56	140	14	42
<b>Dublin</b>	175	136	311	30	43
<b>Mid-East</b>	88	68	156	15	45
<b>Midlands</b>	34	24	58	6	43
<b>Region not included</b>	2	9	11	1	
<b>Total</b>	602	425	1,027	100	44

Source: DEASP, CSO

Note: Figures may not sum due to rounding. The regional employment data is sourced from the CSO's Labour Force Survey (LFS) data for 2019Q4. The PUP is measured as 18-66 while the LFS employment data is 15+ so shares presented are not exact but are approximate. We use the PUP sectoral breakdown from DEASP. For the TWSS in the week up to 3<sup>rd</sup> May approximately 8,880 people were not assigned to a region while for the PUP 2,000 were not assigned to a region.

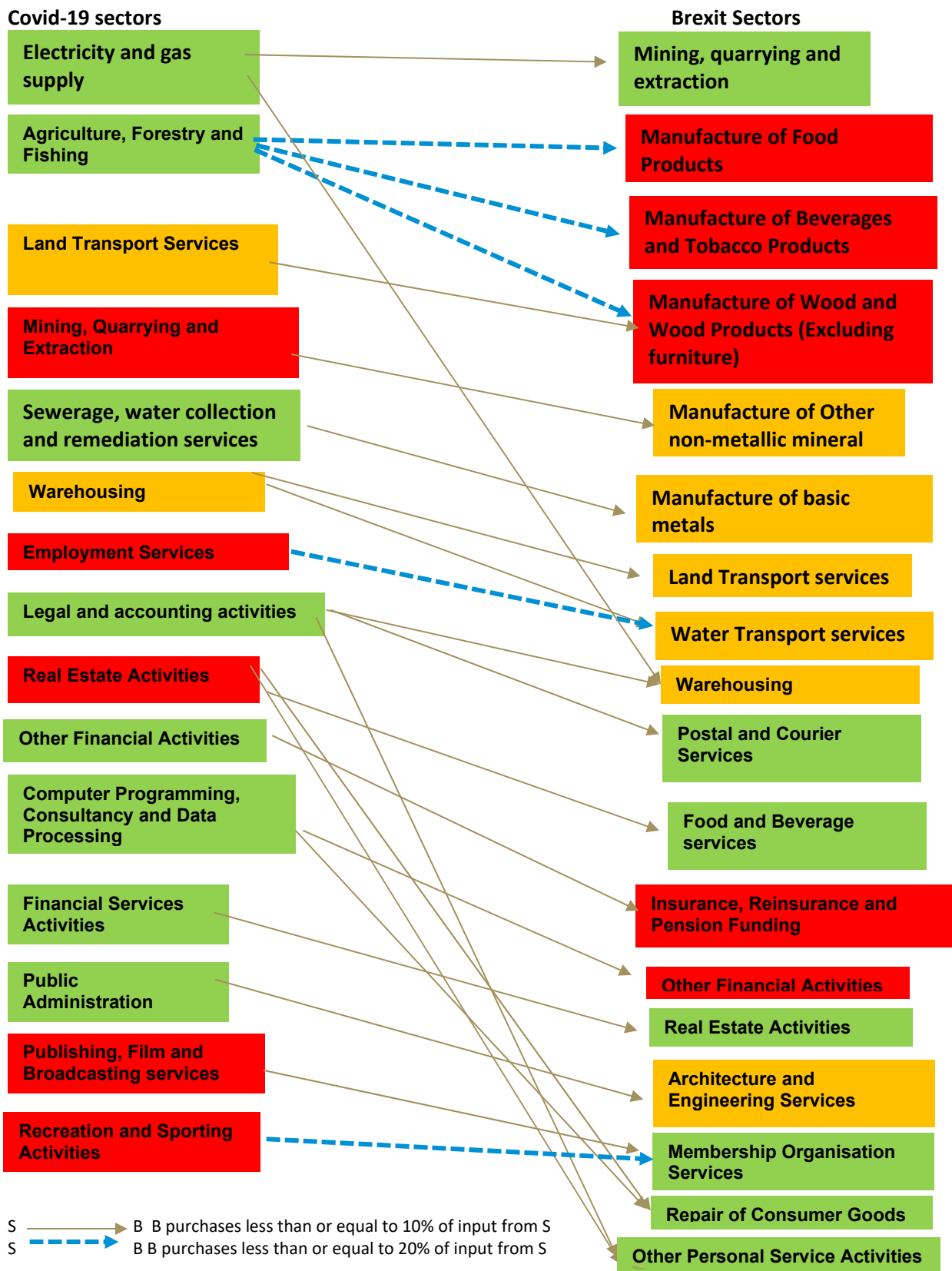


**Table A3: NACE Sectors**

<b>NACE Sector</b>	<b>2-digit NACE Codes</b>	<b>A10</b>
A. Agriculture, Forestry and Fishing	01-03	Agriculture, Forestry and Fishing
B. Mining and Quarrying	05-09	Industry
C. Manufacturing	10-33	
D. Electricity, Gas, Steam and Air Conditioning Supply	35	
E. Water Supply, Sewerage, Waste Management and Remediation Services	36-39	
F. Construction	41-43	
G. Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	45-47	Distribution, Transport, Hotels and Restaurants
H. Transportation and Storage	49-53	
I. Accommodation and Food Service Activities	55-56	
J. Information and Communication	58-63	Information and Communication
K. Financial and Insurance Activities	64-66	Financial and Insurance Activities
L. Real Estate Activities	68	Real Estate Activities
M. Professional, Scientific and Technical Activities	69-75	Professional, Admin and Support Services
N. Administrative and Support Service Activities	77-82	
O. Public Administration and Defence; Compulsory Social Security	84	Public Admin, Education and Health
P. Education	85	
Q. Human Health and Social Work Activities	86-88	
R. Arts, Entertainment and Recreation	90-93	Arts, Entertainment, recreation and other service activities
S. Other Service Activities	94-96	
T. Activities of Households as Employers; Undifferentiated Goods – and services – producing activities of households for own	97-98	
U. Activities of Extra Territorial Organisations and Bodies	99	

Source: CSO

**Figure A3: Brexit Sectors that purchase more than 5% of total input from another specific Covid-19 ranked sector**



Source: Authors calculations based on CSO data