Long-term Economic Implications of Brexit

A report for the Scottish Parliament

October 2016

Executive summary

Over the long term (i.e. 10+ years), most economists predict that the decision to leave the EU will have a negative impact on trade, labour mobility and investment.

To date studies have concentrated on the UK as a whole. At the same time, they have tended to focus on the aggregate economic impact, with little assessment of the different impacts by sector.

This report closes this gap by providing an inter-regional and multi-sectoral analysis of Brexit on Scotland and the rest of the UK.

To undertake this analysis we examine the geographical pattern of Scottish international exports and identify the sectors most exposed to any changing trading relationship with the EU. We then make use of an inter-regional macroeconomic model of Scotland and the rest of the UK to examine the long-term impact on the Scottish economy.

Our conclusion is that under all modelled scenarios, Brexit is predicted to have a negative impact on Scotland's economy. Based on the modelling and assumptions set out in the report, over the long-term a reduced level of trade is expected to result in Scottish GDP being between 2% and 5% lower than would otherwise be the case. The range of impacts is driven by the nature of any post-Brexit relationship between the UK and the EU – the stronger the economic integration with the EU, the smaller the negative impact.

We also find that the impact on Scotland, whilst significant, is estimated to be smaller than for the UK as a whole.

Our modelling suggests that ultimately, the size of the relative impact by sector depends on a complex interplay between the EU-export intensity of sectoral sales and how responsive particular sectors are to changes in competitiveness.

We recommend that focus is now given to sectors that have close trading links with the EU – e.g. food & drink and some manufacturing sectors – to fully understand the particular issues facing them on a product-by-product basis. However, we also find that other sectors which at first glance may not be thought as immediately at risk from a change in the UK's relationship with the EU – e.g. professional services – should also be considered. This analysis makes clear that Brexit is not going to be straightforward.

1. Introduction

The Fraser of Allander Institute (FAI) was commissioned by the Scottish Parliament's European and External Relations Committee to model the possible economic implications of Brexit for Scotland.

Over the long term (i.e. 10+ years), most economists predict that the decision to leave the EU will – all else remaining equal – have a negative impact on trade, labour mobility and investment. There remains debate however, over the scale of the impact – see for example, Ebell & Warren (2016), HM Treasury (2016a, b), Centre for Economic Policy (2016), PWC (2016) and Oxford Economics (2016). Capital Economics (2016) provides a more positive outlook. There is also debate over possible policy responses that may mitigate some of these effects.

To date however, studies have concentrated on the UK as a whole. At the same time, they have tended to focus on the aggregate economic impact, with little assessment of the possible different impacts by sector.

The analysis in this paper aims therefore to begin to shed light on some crucial questions.

Firstly, is there likely to be a common 'UK-wide' impact of Brexit? And crucially for our interests, what is the possible impact on Scotland? If the effects of Brexit differ across the UK, then this would suggest that there may be challenges in securing a consensus over the terms of any Brexit deal across English regions and devolved nations.

Secondly, we ask the same question but this time on a sectoral basis. Can we expect to see some sectors more or less impacted than others? If certain parts of the economy are relatively more exposed, then this suggests that understanding the implications for businesses here, and possible mitigating policy responses, should be an important priority.

To undertake this analysis we examine the geographical pattern of Scottish international exports and identify the sectors most exposed to any changing trading relationship with the EU. Next we make use of an inter-regional macroeconomic model of Scotland and the rest of the UK (rUK) to examine the long-term impact on the Scottish economy. This inter-regional framework is especially useful in that it captures not only direct effects via Scottish-EU export linkages, but also crucially, any indirect effects via changes in the rUK economy feeding through to Scottish exports to rUK alongside wider competiveness changes. This is

especially important for capturing the links Scottish firms may have to a much larger EU value-chain through sales to rUK firms.

Our conclusion is that under all modelled scenarios, Brexit is predicted to have a negative impact on the Scottish economy. Based on the modelling and assumptions set out in this report, after around 10 years from the shock, we find Scottish GDP to be between 2% and 5% lower than would have been the case had the UK (and Scotland) remained in the EU.

We find that any impact on Scotland, whilst significant, is estimated to be smaller than for the UK as a whole. Moreover we find that, in addition to the direct impact of becoming less integrated with the EU, there are also important spill-over effects from a slower rUK economy feeding through to Scottish sectors and firms.

The range of impacts is driven by the nature of any post-Brexit relationship between the UK and the EU. The scale also depends upon the extent to which possible 'dynamic' effects, such as any implications for productivity, are present.

While the sectoral distribution of effects varies by particular scenario, we find a couple of interesting results. The size of the relative long-term impact on a sector depends on a complex interplay between the EU-export intensity and sensitivity to changes in competitiveness. The first factor intensifies the impact on the sector, while the second may help to mitigate the negative effects. Sensitivity to changes in competitiveness is stronger in sectors that have a high share of domestic inputs and high exposure to rest of the world exports. This effect operates via both a real exchange rate depreciation and a relative fall in real wages.

When analysing the overall macro impact of each sectoral effect one also has to take into account the proportion of value added in the total output and the size of the sectoral contribution to the Scottish economy. Sectors with high value added, high EU-trade intensity and low sensitivity to competitiveness effects will have the strongest negative effect on the overall economy. Some of the sectors with high exposure to the EU are relatively small in terms of their overall contribution to the Scottish economy[1]. Finally, some other sectors which

[1] This is not to downplay the possible challenges within these industries, but simply to note their relative scale.

might not be immediately exposed to EU trade, could still face relatively large *absolute* impacts if Brexit leads to a more general slowdown in the Scottish economy[2].

In summary therefore, we find that this macroeconomic assessment makes clear that an analysis by sector is going to be crucial to understanding the likely impacts on the economy from Brexit and the relevant policy responses both to mitigate any negative shock and to take advantage of new opportunities. As a macroeconomic study, this report necessarily requires a degree of aggregation.

Having demonstrated the importance of a multi-sectoral approach, we would now recommend that the next step should be to examine individual industries and products – particularly within those sectors identified here – to determine the non-tariff and tariff barriers unique to them. The same factors identified by us at the sector level should be taken into account when analysing industries and products.

The rest of the paper is structured as follows. Section 2 summarises the key channels through which Brexit may have an impact on the Scottish and UK economies. Section 3 provides a short outline of the modelling framework. Section 4 sets out a range of scenarios concerning the trading relationships that could hold in a post-Brexit world, whilst Section 5 presents the key results. Section 6 concludes.

2. Assessing the impact of Brexit on the Scottish economy

In assessing the possible impact of Brexit on the Scottish economy it is important to separate out two key phases – 1) the short-term and 2) the long-term.

Short-term impacts

At the UK level, the decision to leave the EU was clear. However, the exact terms of exit are unknown and are likely to remain so for the foreseeable future. Consequently, the referendum result has ushered in a period of heightened economic uncertainty and reduced

[2] For example, the results relating to Public Administration are driven – in part – by the subsequent impact on overall public expenditure rather than a direct trade effect. It should also be noted that this sector includes education (i.e. income from overseas students). This is explained below.

confidence. In response, businesses and households may postpone spending and investment.

But we should be wary of expecting to see any immediate change in the headline economic data for a few months. Most businesses will not – and cannot – change their plans overnight and many will await greater clarity over the likely outcome of any negotiated settlement before responding. For the time being, Scotland and the UK remain within the EU so in terms of trade, regulation and free movement nothing has changed thus far.

Policymakers can intervene to help mitigate both the uncertainty itself – for example, by providing reassurance around long-term trading relationships – and providing temporary support to the economy to help offset any negative short-term impacts.

After an initial period of political instability, the new UK Government has – at least for the time being – brought a degree of relative calm back to the political environment. At the same time, the Bank of England has responded with a further cut in interest rates, increased Quantitative Easing and launched a new Term Funding Scheme to ensure that interest rate cuts are passed on to businesses.

In our July Economic Commentary, we discussed the possible channels through which the referendum outcome could have an impact over the short-term[3]. Whilst we await official data post-June[4], most of the emerging evidence points toward businesses and the wider economy being in 'wait and see' mode with the actions of the UK Government and the Bank of England averting any immediate large negative shock[5]. However, concern about the possible implications over the months ahead clearly remains.

Long-term impacts

According to first principles, the likely long-term impacts of leaving the EU are known with a relative degree of confidence, albeit the exact quantitative effects are uncertain.

[3] See http://www.strath.ac.uk/business/economics/fraserofallanderinstitute/economic_commentary/

[4] Data on Scottish GDP for the post-EU referendum period will not be available until January 2017.

[5] See for example Q3 2016 Royal Bank of Scotland Scottish Business Monitor produced by the Fraser of Allander Institute - https://www.sbs.strath.ac.uk/feeds/news.aspx?id=1047

Trade opens up businesses to new opportunities for exporting and investment. Labour mobility boosts labour supply helping to increase productivity and address demographic challenges in countries – such as Scotland – with an ageing population. Competition helps efficiency, product specialisation and growth. And financial integration deepens and broaden capital markets. All of these – on balance – are expected to be impacted in one way or another by becoming less integrated with the EU.

Whether or not the decision to leave the EU leads to a permanent reduction in the *rate* of growth or the *level* of output is unclear. On the one hand, once the economy adjusts to life outside the EU, output could simply be a broadly constant step below the level it otherwise would have been in each and every year. There is the potential however, for Brexit to have a more damaging impact if it were to confine both Scotland and the UK to a lower long-term growth rate (perhaps via a permanent hit to productivity growth).

To assess the likely implications of Brexit on the Scottish economy in the long term, a helpful place to start is to look at the degree of trade integration between Scotland and the EU. The Scottish Government publishes Export Statistics Scotland each year – a National Statistics publication providing estimates of Scotland's international exports and exports to the rUK[6].

Table 1 shows the value of Scottish exports to the EU within Services and Manufacturing (with the largest sectors within these categories also included).

These statistics are helpful in identifying the sectors and industries that are most likely to be directly exposed to any changing trade relationship with the EU. By rank, many of the largest sectors are in manufacturing – including Food & Drink – but Scotland also has key exports in services, particularly those tied to professions such as legal services, R&D activities, education, IT and finance.

Many of these sectors are likely to be the ones where any immediate interest in potential policy responses and/or ensuring that their interests are represented in any trade negotiations should be targeted. Clearly the particular issues for individual sectors will vary and not just be determined by 'size' but also by sensitivity to changes in competitiveness, due to any real exchange rate depreciation and a relative fall in real wages, and the extent to

[6] EU export data contained here - http://www.gov.scot/Topics/Statistics/Browse/Economy/Exports/ESSPublication/ESSAddTables

which non-tariff barriers, customs controls – and in certain scenarios – tariffs will play a particular role in their sector.

Table 1: EU Exports by Industry Sector, 2014

	(£ million)	*Share of international exports*
Total EU Exports	**11,560**	**43%**
Manufacturing	**6,695**	**47%**
Food & Drink	*1,775*	*37%*
Coke, refined petroleum and chemical products	*1,775*	*83%*
Machinery and Equipment NEC	*650*	*37%*
Rubber & Plastic Products	*575*	*71%*
Computer, electronic and optical products	*555*	*50%*
Services	**3,885**	**40%**
Wholesale & Retail	*1,095*	*61%*
Professional Services	*760*	*32%*
Administrative and Support Services	*380*	*30%*
Transportation and Storage	*355*	*63%*
Other	**980**	**57%**

Source: Scottish Export Statistics (2016)[7]

Examining statistics such as Table 1 is therefore a useful exercise but it will only get you so far. What is also needed is an assessment about how wider economic channels will in turn feed through to the overall Scottish economy.

To assess these long-term implications, it is necessary to use a macroeconomic model of the Scottish economy where we can isolate these various channels. At the same time, it is vital that we capture not just changes in Scottish trade relationships with the EU, but also Scotland's trade relationships with the UK, given we know that Scotland is deeply integrated into the UK supply chain which in turn exports significant amounts to the EU.

It is important to note that this modelling exercise takes other policy dynamics as fixed. Whilst it is entirely possible that policy may respond in the aftermath of Brexit – e.g. possible new trade deals with 3rd countries – we hold such things constant. Our aim is simply to compare the modelled outcomes pre and post-Brexit.

[7] There remain ongoing questions around the quality and completeness of export data for Scotland. However, the Scottish Export Statistics remain the best source for information on Scottish exports. The need for greater coverage of Scottish trade should be an urgent priority for both the Scottish and UK Governments.

3. Modelling Framework

To undertake this analysis we make use of a Computable General Equilibrium (CGE) framework – a technical economic modelling approach widely used by governments and organisations across the world including the Scottish Government, HMRC and the World Trade Organisation[8].

CGE models provide detailed representation of the economy which capture the interlinkages between the private sector, government and households.

They combine economic data with a complex system of equations to give an accurate picture of the structure and operation of the economy. Economic relationships in the model are based on theory and empirical evidence.

In this exercise, we use an 18 sector inter-regional model of Scotland and the rUK developed by researchers at the Fraser of Allander Institute. In this framework, Scotland and rUK are modelled simultaneously. This model is useful if the particular research question is targeted at analysing possible spill-over effects from Scotland into rUK (and vice versa). Given that Brexit is a shock to both Scotland and rUK this is vital.

It is a multi-sectoral, imperfectly competitive Computable General Equilibrium model. It captures – in the most realistic way possible – the structure of the Scottish and UK economies. It generates estimates of the impacts of any shock, such as Brexit, on aggregate and sectoral levels of gross output, GDP, employment, unemployment, the capital stock, population levels, and real wages.

The technical details of the model are set out in Lecca et al (2013, 2014).

[8] See for example - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263652/CGE_model_doc_131204_new.pdf

4. Scenarios

Given the uncertainties surrounding the form that Brexit may take, we need to consider alternative futures, reflecting a range of different possible trading relationships.

We were asked to consider three scenarios:

i. 'Norway' model:

This scenario implies that the UK will be characterised by:

- membership of the European Economic Area (EEA);
- full access to the Single Market but outside customs union and therefore subject to 'economic border' including 'rules of origin'[9];
- not being party to the EU's trade deals with the rest of the world;
- being obliged to make a financial contribution to the EU and accept majority of EU laws; and,
- free movement.

ii. 'Switzerland' model

This scenario implies that the UK will be characterised by:

- membership of the European Free Trade Association but not the EEA;
- access to EU market governed by series of bilateral agreements, covering some but not all areas of trade (in particular, services are excluded). Outside customs union and therefore subject to 'economic border' including 'rules of origin';
- not being party to the EU's trade deals with the rest of the world;
- making a financial contribution to EU but smaller than Norway's;
- no general duty to apply EU laws but has to implement some EU regulations to enable trade; and,
- free movement applies.

[9] Norway – and Switzerland – are both outside the Common Agricultural and Common Fisheries policies and therefore face tariffs on products that fall under its remit. As this is a macroeconomic analysis, we do not model separately the potential impact of different tariff and non-tariff barriers by particular sector but instead capture the aggregate impact. In this case of agriculture and fisheries, given their different structures, this could possibly lead to this aggregate modelling approach underestimating the overall sectoral impact.

iii. 'WTO' model

This is the "default" Brexit scenario, which would apply if other deals cannot be secured[10]. This scenario implies that the UK will be characterised by:

- WTO rules for international trade that apply to all members;
- no obligation to apply EU laws although traded goods would still have to meet EU standards;
- some tariffs would be in place on trade with the EU;
- trade in services would be restricted;
- no financial contribution to EU; and,
- no free movement.

Clearly these scenarios are simplifications of any post-Brexit deal the UK will actually secure. Indeed, there is no single arrangement that can be taken off-the-shelf and applied immediately. The aim of these scenarios is, however, to provide an illustration of the direction and scale of possible impacts.

Each of these scenarios implies a different degree of integration with the EU. In the stylised 'Norwegian scenario' for example, the trading relationship is more open with good access to the Single Market. Other non-tariff barriers will still remain including the need for 'customs controls' for goods being exported to the EU[11].

'Rules of Origin' also apply in the Norwegian case. These require exporters to obtain certificates to prove the domestic content of their exports. The cost of these can be significant, particularly for smaller firms and businesses who rely on complex cross-border supply chains. Firms trading with the EU have to submit customs declarations and there can be complications with VAT arrangements when products cross borders. This may have implications for costs, efficiency and time competitiveness[12].

---

[10] In fact, even in this case we do assume a degree of successful negotiation over tariffs, with a long-term tariff of only 2% being applied.

[11]The relevant form has more than 50 boxes requesting information, and the guidance is 78 pages long. It typically requires evidence proving products are either made inside the EEA, or comply with a number of product specific rules. For information see - http://eur-lex.europa.eu/legal-ontent/EN/TXT/HTML/?uri=OJ:L:2005:321:FULL&from=en

[12] HMT estimate that over half of UK goods exports to the EU would need to be certified as complying with rules of origin requirements in order to continue to receive tariff-free access into the Single Market.

In the stylized 'Switzerland scenario', trade in goods remains highly integrated but less so in services. The issues set out above for Norway would continue to hold.

Finally, the 'WTO scenario' assumes no special trading relationship between the UK and the EU so barriers to trade – both non-tariff and tariff barriers – could in principle be higher.

Initial shock

We use estimates of the impact on UK exports under these three stylized scenarios identified by the National Institute for Economic and Social Research (NIESR) in Ebell and Warren (2016). These estimates were based on academic research into the links between alternative trading relationships and volumes of economic activity (Baier et al., 2008; Ceglowski, 2006).

Table 2 provides an estimate of the aggregate impact on trade for 'goods' and 'services' under each scenario. The anticipated effects relate to the estimated reduction in total trade, are substantial[13]. However, others estimates of these effects, including HM Treasury's, are similar in scale.[14] 'Optimistic' and 'pessimistic' variants refer to upper and lower estimates of the effects.

In our model each sector has different trade shocks depending on their exposure to the EU trade. For example, Figure 1 shows the sector specific international trade shocks for 'Norway optimistic' scenario. The absolute size of the shock is the largest in big sectors that have the highest exposure to the EU trade: Other Primary[15]; Wholesale & Retail, Transportation & Storage; and Food & Drink.

[13] The quantitative impact we derive ultimately depends upon the scale and composition of the initial shock. Different studies use different estimates of the possible effect of Brexit on trade, although the scale tends to be similar. Of course, any quantitative results are sensitive to the precise size of the applied shock, and timescale of adjustment, and it is therefore entirely possible to model different shocks (larger or smaller). We have tested for a wide range of scenarios and whilst the quantitative impacts change, the qualitative impacts and relative scale of the effects between regions, sectors and transmission channels found here still hold.

[14] The size of the initial shock to each sector reflects its dependence on exports to the EU. The ultimate impact will depend on the entire general equilibrium of the system.

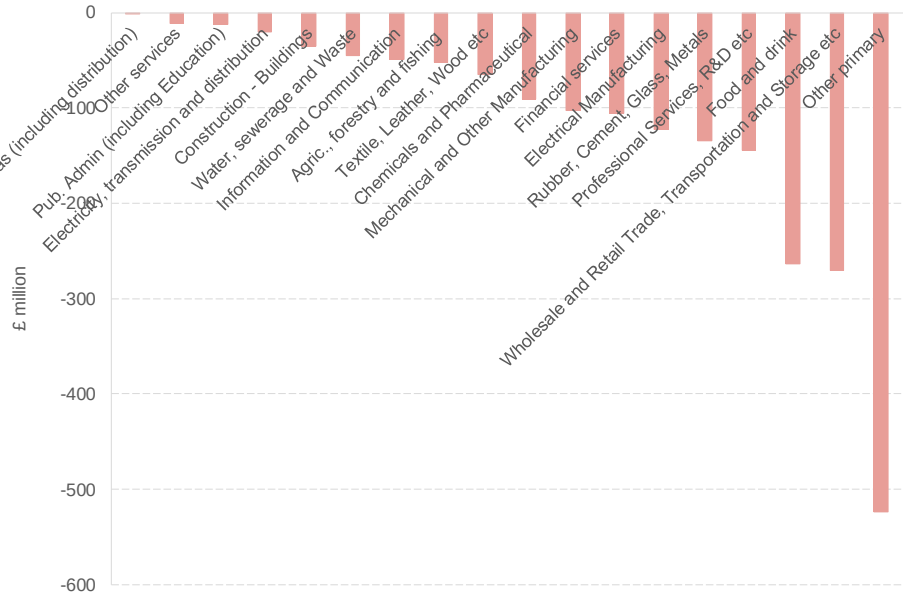
[15] Other Primary includes refined petroleum, petrochemicals and elements of the oil and gas supply chain.

Table 2: Impact of various post-Brexit scenarios on Scotland's exports

	Estimated reduction in total exports	
	Goods	Services
Norway Scenario		
Optimistic	-12%	-8%
Pessimistic	-18%	-11%
Switzerland Scenario		
Optimistic	-12%	-18%
Pessimistic	-18%	-22%
WTO Scenario	-26%	-25%

Source: Ebell & Warren (2016)

Figure 1: Absolute reduction in exports from Scotland to ROW in £m (Norway optimistic)



This chart therefore provides a helpful first indication of the sectors worthy of attention[16].

[16] Within a macroeconomic analysis such as ours, whilst it offers a much richer analysis of sectoral detail than previous studies, it is still necessary to have a degree of aggregation. Whilst not impacting on the overall qualitative results, some caution should always be used in interpreting exact % point estimates, particularly sectors with the greatest complexities in trading and ownership models. For example, both financial services and other primary sectors are particularly complex and (in the case of financial services especially) are subject to data limitations. Our reported results reflect: the sector's dependence directly (and indirectly through rUK links) on EU exports; the scale of the sectors, and the estimated impact of tariff and non-tariff barriers on goods and services.

The sectoral differentiation of the results are driven by a complex combination of factors, including direct EU-export intensity of the sector, size, sensitivity to competitiveness effects and inter-regional linkages. It is therefore a macroeconomic assessment.

The exact impact by type of *product* will in practice be further driven by a number of additional complex microeconomic factors such as the specific individual non-tariff and tariff barriers relevant not just for sectors but individual products.

Once again, it should be noted that all scenarios assume no change in policy. Our modelling therefore implies that Scotland maintains its initial fiscal balance. Given that public sector revenues will fall in response to the economic shock, this leads to falling government expenditure. Over the longer term, there may be a policy response by both the UK and/or Scottish Governments – although given what this could be remains unclear, our modelling highlights the outcomes in specified scenarios with no policy response.

While we do not include it in our core scenarios, we also explore the likely impact of a 5% reduction in labour productivity as assumed by HM Treasury (HM Treasury 2016a). While we have concerns that such dynamic effects are much more uncertain than the trade effects, for completeness we illustrate the potential importance of this factor by simulating a one-off, permanent reduction in Scottish (and rUK) labour productivity.[17]

5. Results

Throughout all scenarios the estimated negative impact of Brexit on the rUK is greater than it is on Scotland, in terms of GDP, employment and other measures. This reflects, in part, the fact that rUK has greater exposure to EU trade than Scotland and complex inter-linkages between Scotland and the rUK which acerbate/dampen certain effects.

We discuss the key results below[18].

[17] This relates to the difference between impacts on the growth rate or the growth level as set out above.

[18] CGE models are most suited to medium-to long-term effects. They do not take into account the business cycle or other short-term fluctuations. All simulations presented here are timed from the moment when the agreement on Brexit is implemented.

The 'Norway' model

Table 3 summaries the long-term (reached after around 10 years) change from the basline position that would be implied under the 'Norway' model set out above under an 'optimistic' and 'pessimistic' scenario.

In summary, after around 10 years:

- Scottish GDP is expected to be between 2% and 3% lower than would otherwise be the case – equivalent to GDP being £3bn-£5bn lower in 2015-16 terms[19];
- Real wages are expected to be between 3% and 4% lower than would otherwise be the case; for someone on average full-time earnings in Scotland, this would be equivalent to a reduction of £800-£1,200 per year[20];
- A 1-2% reduction in the employment level is expected; this is equivalent to the loss of around 30,000 jobs in the optimistic scenario[21].

Table 3: Norway model: long-term % changes relative to baseline

	Optimistic % change	Pessimistic % change
GDP	-2.0	-3.1
Exports	-4.4	-6.7
Real wages	-2.9	-4.3
Employment	-1.2	-1.8
Population	+0.8	+1.2

Source: Fraser of Allander Institute

Figure 2 illustrates the long-term impact on value-added by sector in 2010 terms. The results are driven by a complex combination of factors, including the direct EU-export intensity of the sector, size, sensitivity to competitiveness effects and inter-regional linkages.

As pointed out above, the exact impact by type of product will in practice be driven by a number of additional complex microeconomic factors. Our analysis should be seen as an

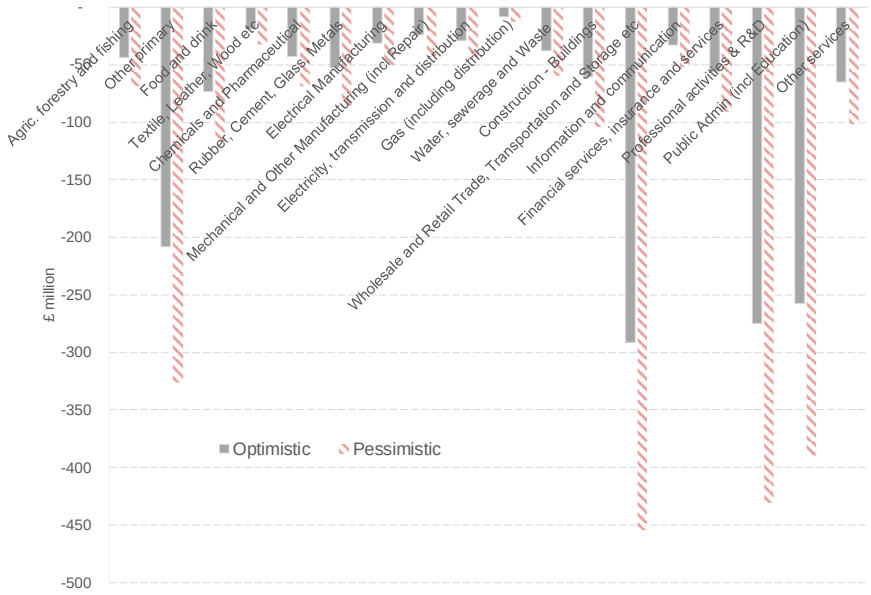
[19] It should be noted that we refer to onshore Scottish GDP only.

[20] Based on 2015 Annual Survey of Hours and Earnings (median, gross full-time earnings of £27,710 in Scotland)

[21] Note the modest rise in population may – at first glance – seem somewhat counterintuitive. However, as we will see later, the negative shock is greater in the rUK which makes Scotland a 'relatively' more attractive location to move to.

aggregate assessment and therefore a helpful guide to what individual sectors are worthy of particularly detailed examination.

Figure 2: Long-term level change in value added in the 'Norway' scenario



Source: Fraser of Allander Institute

In summary –

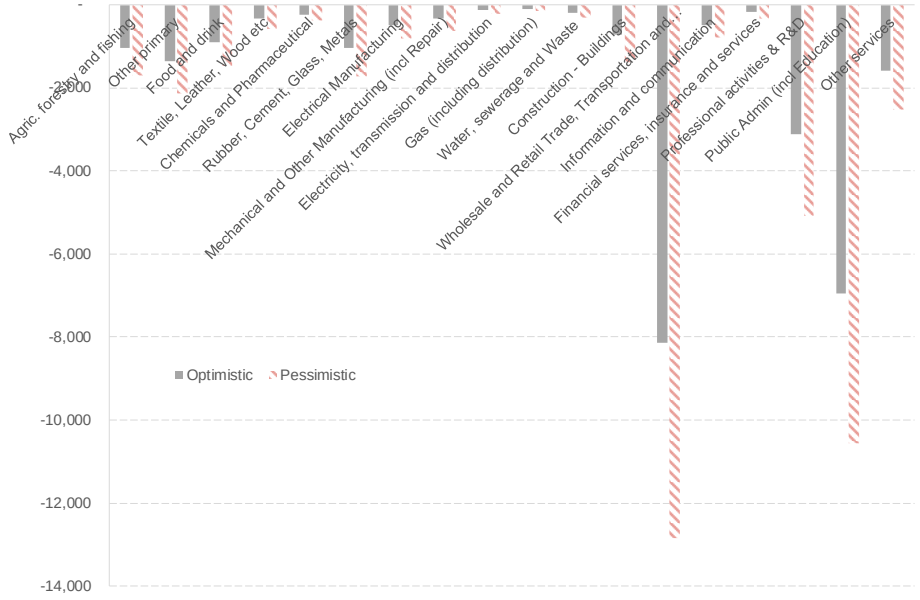
- In each case, the greatest contraction in value added is experienced by Wholesale & Retail, Transportation & Storage; and Professional Services & R&D sectors;
- Public Administration; and Other Primary are the 3rd and 4th hardest hit sectors in terms of value added contraction;
- Three of these four sectors also register the biggest employment contractions (see Figure 3);
- The different rankings of employment vis-à-vis value-added reflects, in part, the different labour intensities of the sectors.

Another way to look at the results, is to examine what sectors are likely to experience the largest *percentage* declines in employment and output in the long term:

- Other Primary – employment 4-7% lower than would otherwise be the case; output 5-8% lower;
- Chemicals & Pharmaceutical – employment and output both 3-5% lower;

- Electrical Manufacturing – employment and output both 3-5% lower;
- Rubber, Cement, Glass & Metals manufacturing – employment 2-4% lower; output 3-5% lower.

Figure 3: Long-term level change in full-time equivalent employment in the 'Norway scenario'



Source: Fraser of Allander Institute

All sectors are, however, expected to experience some decline in employment and output although clearly there are substantial differences both in relative and absolute scale.

The 'Switzerland' model

Table 4 summaries the long-term changes (reached after around 10 years) that would be implied under our stylised trading relationship which is similar to that of Switzerland. In this scenario:

- The anticipated reduction in GDP is larger: in the long-term GDP is expected to be 3-4% lower than would otherwise be the case (equivalent to £4bn-£6bn in 2015-16 terms.);
- Real wages are expected to be around 5-6% (£1,200-£1,600 per year) lower than would otherwise be the case and exports 6-8% lower;
- Employment is projected to fall by 1-2%.

Table 4: Switzerland model: long-term % changes relative to baseline

	Optimistic % change	Pessimistic % change
GDP	-2.7	-3.9
Exports	-5.9	-8.4
Real wages	-4.5	-5.8
Employment	-1.4	-2.2
Population	+1.8	+2.3

Source: Fraser of Allander Institute

The sectoral impact on employment and output differs slightly from the Norway scenario. This reflects both the larger scale of shock and the greater impact on services. The sectoral impacts also reflect the larger reduction in real wages, which will have differential impacts depending on how reliant particular sectors are on labour relative to other inputs, and how sensitive they are to changes in competitiveness.

Figure 4 illustrates the long-term changes in value-added for each sector in the Switzerland case:

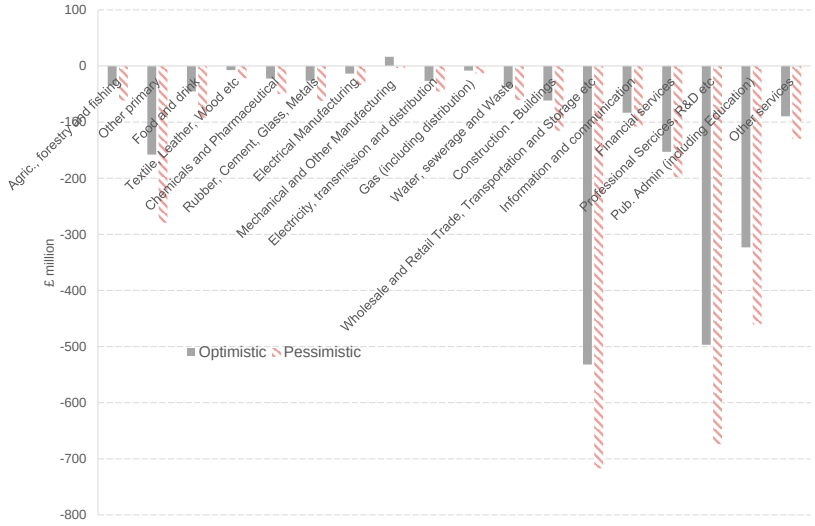
- The impact is greater on many sectors, mostly services, but the larger fall in the real wage improves competitiveness relative to the Norwegian case and that limits (and in one case offsets) the impact on the non-service sectors exposed to trade;
- The same four sectors contribute most to the overall contraction in GDP as in the Norway case, but here the impacts on services are increased;
- The biggest contraction in value added is experienced by the Wholesale & Retail Trade, Transportation & Storage sector;
- Professional Services & R&D; Public Administration; and Other Primary are the 2nd, 3rd and 4th hardest hit;
- The greater impact on Public Administration reflects the bigger contraction in GDP and therefore in tax revenues.

In terms of the *relative* impact of Brexit:

- Other Primary is still the hardest hit in percentage terms although the impact is lower than in the Norway scenario – employment 3-5% lower than would otherwise be the case; output 4-7% lower;

- The service sectors experience greater relative reductions than in the Norwegian case. Wholesale & Retail trade, Transportation & Storage are expected to see employment and output 3-4% lower. Information and communication services are expected to see employment and output 2-3% lower[22].

Figure 4: Long-term level change in value added in the 'Switzerland scenario'



Source: Fraser of Allander Institute

The 'WTO' model

The modelling of the WTO scenario shows the largest anticipated reductions in economic activity, as summarised in Table 5. In the long term (reached after around 10 years):

- GDP is expected to be over 5% (£8bn in 2015-16 terms) lower than would otherwise be the case and exports over 11% lower;
- Real wages are expected to be 7% lower, equivalent to a reduction of around £2,000 per year;
- The number of people employed is 3% lower (around 80,000 jobs).

[22] A modest positive impact is anticipated for 'mechanical and other manufacturing' – this reflects the fact that, relatively speaking, it experiences smaller negative trade shock than other sectors but benefits from the reduction in real wages and depreciation in the real exchange rate.

Table 5: WTO model: long-term % changes relative to baseline

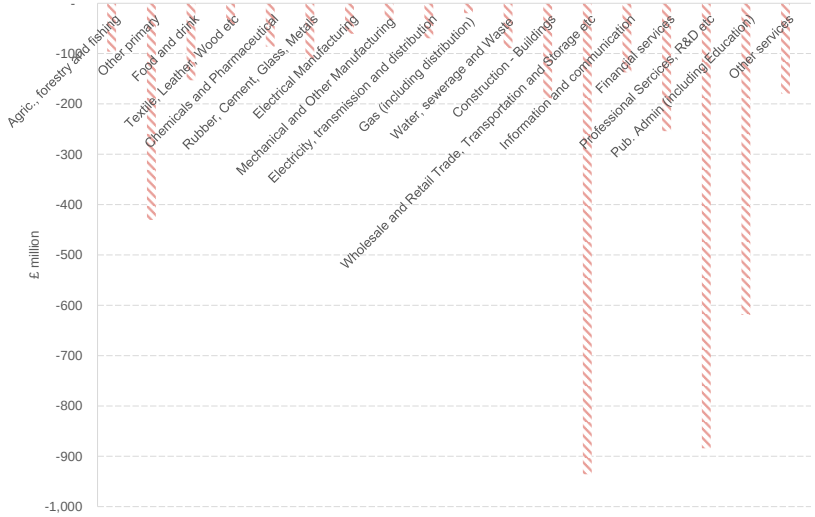
	% change
GDP	-5.3
Exports	-11.3
Real wages	-7.2
Employment	-3.2
Population	+3.0

Source: Fraser of Allander Institute

The contribution of each sector to the fall in GDP is apparent from Figure 5, with all sectors more adversely impacted than even under the pessimistic Swiss case:

- As before, the biggest contraction in value added is experienced by Wholesale & Retail Trade, Transportation & Storage sector;
- Again, Professional Services & R&D; Public Administration; and Other Primary are the 2nd, 3rd and 4th hardest hit in terms of value added.

Figure 5: Long-term level change in value added in the 'WTO scenario'



Source: Fraser of Allander Institute

In terms of the *relative* impacts on employment and output across sectors:

- Other Primary is again the hardest hit, with employment around 9% lower and output around 10% lower in the long term than would otherwise be the case;
- In percentage terms, the Chemicals and Pharmaceutical, Electrical Manufacturing and Rubber, Cement, Glass & Metals sectors again suffer larger reductions in output and employment than other sectors;

- The impact on the Wholesale & Retail trade, Transportation & Storage sector is smaller in percentage terms, but this sector is a large employer, so it translates into relatively large fall in overall employment level.

WTO scenario - fiscal effects

A key area of debate in the referendum was the net fiscal contribution of the UK to the EU[23]. To account for this, we model the positive effects resulting from higher public expenditure in the UK as a result of reduced EU contribution (even after maintaining existing EU spending in both Scotland and rUK).

The extent of the positive fiscal effects will depend upon the negotiated settlement – both Norway and Switzerland make contributions to the EU budget. It is only under the WTO scenario that UK public sector expenditure would benefit from the full saving of the current net EU contribution.

The UK's net EU contribution was £8.6bn in 2014. This takes account the UK rebate and receipts such as CAP and EU structural funds (and assumes that the UK Government replaces all EU expenditures in the UK).

Suppose, for example, that the Scottish Government's budget was increased by £860m (10% of the UK figure). We assume that both the UK and Scottish Governments spend the additional resource (rather than using it, for example, to reduce the deficit). Table 6 below sets out the long-term effects of this.

Table 6: Fiscal effects: long-term % changes relative to baseline

	% change
GDP	+1.0
Exports	-0.4
Employment	+1.1
Scottish Government expenditure	+3.9

Source: Fraser of Allander Institute

Note that these are the effects of the fiscal stimulus in isolation i.e. not taking into account the trade impacts set out above. As expected the increase in government expenditure in isolation

[23] See Box 2.3 in Scotland's Budget 2016 - https://www.sbs.strath.ac.uk/economics/fraser/20160913/ScotlandsBudget-2016.pdf

stimulates GDP and employment, but leads to some crowding out in exports as the real wage increases in this case (in response to the stimulus to demand). The combined effect is considered below.

WTO scenario – tariff effects

In the WTO scenario, the UK would cease to be covered by the EU Single Market. In one scenario, if the UK was to leave the EU without a trade deal, then WTO tariffs could apply to EU trade. Ebell & Warren (2016) research suggests that, in the long term, there would be an average 2% increase in trade tariffs.

It is possible to assess the effect of a 2% increase in tariffs applied to EU trade. Their results suggest that, in isolation from other effects, this would result in GDP being 0.8% lower than would otherwise be the case after 10 years.

The sectors most affected are the Food & Drink sector; Electrical Manufacturing and services.

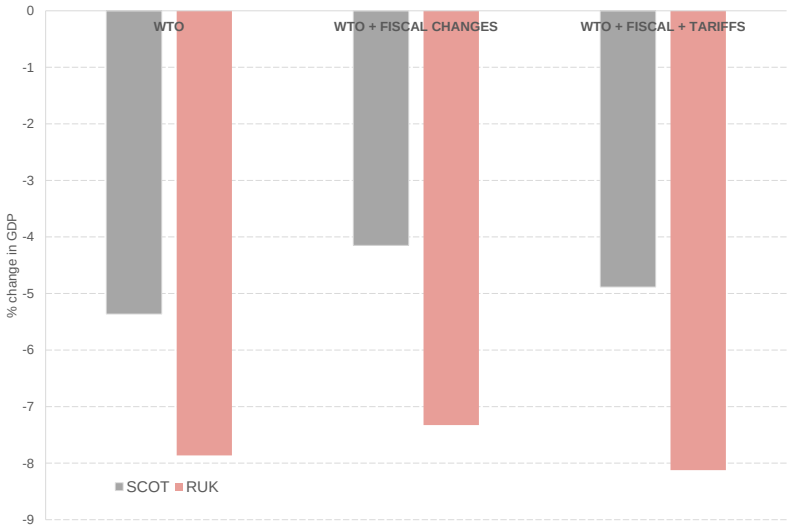
It should be noted that the actual outcome will vary by sector depending upon the exact tariff arrangement by product.

WTO model – combined effect

Figure 6 illustrates the long-term impact of Brexit on Scottish and rUK GDP under the WTO model.

The first two columns indicate the decline in Scottish and rUK GDP directly attributable to non-tariff barriers. The middle two columns indicate that if the net fiscal savings from Brexit are used to fund increased government expenditure, this mitigates the impact of the shock. Finally, the imposition of tariffs on EU trade exerts a further negative impact. In each case, the impact on the rUK economy exceeds that for Scotland.

Figure 6: Percentage change in long-term GDP in Scotland and rUK in 'WTO Scenario'



Source: Fraser of Allander Institute

WTO model – labour productivity effects

Finally, a further potential consideration is the potential impact on labour productivity. In their analysis, HM Treasury assumed that Brexit would have a negative impact on labour productivity, based on research suggesting that more open economies are also more productive.

The productivity assumption has not been universally adopted. Indeed it remains controversial, as although economists tend to agree in principle, the actual scale is much more uncertain.

For completeness however, it is possible to incorporate such an assumption into our modelling. For example, the long-term effect of incorporating a direct reduction of 5% in labour productivity is set out in Table 7. Again, these results show the impact of the reduction in labour productivity in isolation from other effects.

Table 7: Labour productivity effects: long-term % change relative to baseline

	% change
GDP	-4.8
Real wage	-2.3
Employment	-0.6

Source: Fraser of Allander Institute

6. Conclusions

In this report we explore the possible consequences of Brexit for the Scottish economy. However, since Brexit impacts simultaneously on both the Scottish and rUK economies, and since they are inextricably linked through interregional trade and migration flows, we model the likely impacts on both. While there have been a number of studies of the impact of Brexit on the UK macroeconomy, ours is the first attempt to model its regional impact. We employ an interregional computable general equilibrium (CGE) model of Scotland and rUK developed by the Fraser of Allander Institute.

We find that Brexit has a negative impact on the Scottish economy, even under more optimistic assumptions about future trading arrangements. However, we also find that impacts on the rUK economy are more severe than those on Scotland. To a degree this acts to cushion the impacts on the Scottish economy as the shock induces net migration into Scotland from rUK.

The scale of the long-term impact depends on the precise trading arrangements negotiated post Brexit. The more optimistic, stylised 'Norway scenario', suggests a range of long-term effects from a decline of 2% to just over 3% of GDP, while the default WTO case, implies a decline of 5% given the overall impact of non-tariff and tariff barriers and fiscal effects in this case.

These are not the worst case scenarios, however. Some, including HM Treasury, have argued that there are potentially dynamic effects – for example, if labour productivity is positively linked to the openness of an economy. In the Scottish case inward investment tends to be associated with higher productivity, and any decline could have a relatively larger impact here. While we do not build such effects into our core scenarios, we do separately simulate the impact of lower labour productivity and find that it would indeed have a significant additional negative effect.

A further distinctive feature of our analysis is its ability to identify sectoral distribution impacts. The macroeconomic studies of the impact of Brexit on the UK as a whole are typically highly aggregated.

The most straightforward way – and arguably most important in the short-term – to examine the potential impact by sector is simply to examine those sectors which trade most predominantly with the EU. The Scottish Government publishes Export Statistics Scotland each year which provides an estimate of exports to the EU.

This helps identify those sectors which not only trade the most with the EU but also for which the EU comprises a particularly large share of the overall international export market. This analysis identifies Food & Drink, Other Primary, Wholesale and various professional services as being areas to focus upon.

Looking at export markets can only take you so far, as in practice any shock to the economy – such as Brexit – has much wider effects than just on exports. It will influence overall competitiveness, wages, levels of investment, tax revenues and wider economic activity in Scotland and the UK as a whole.

To illustrate this we make use of our multi-sectoral model of Scotland. Our model identifies the effects across eighteen sectors of the economy.

While the sectoral distribution of effects does vary with the precise form of Brexit, typically, those sectors that contribute most to the decline in GDP are: Wholesale & Retail Trade, Transportation and Storage; Professional Services & R&D; Public Administration and Other Primary. The first three of these also tend to register the greatest falls in employment.

While the sectoral impacts are, of course, of interest, they merit careful interpretation. In particular, as we are undertaking a macroeconomic assessment we effectively assume an aggregate shock across all sectors. The sectoral differentiation of the shocks are therefore driven by a complex combination of factors, including direct EU-export intensity of the sector, size, sensitivity to competitiveness effects and inter-regional linkages. It is therefore a macroeconomic assessment.

The exact impact by type of product will in practice be driven by a number of additional complex microeconomic factors such as the specific individual non-tariff and tariff barriers relevant not just for sectors but individual products. Our analysis should be seen as a helpful guide to what individual sectors are worthy of particular detailed examination.

Another extension of our analysis would be to consider the potential role of migration between the UK and the rest of the world (including the EU). While we have not explicitly

modelled the impact of Brexit on the (rest of the) EU, the scale of these effects are likely to be proportionately smaller than the impacts on Scotland and rUK given the relative size of the economies. It could be argued that Brexit may make both Scotland and rUK less attractive locations to live and work relative to the rest of the world, since both experience significant falls in real wages and fewer employment opportunities in our modelling. Any induced net out-migration would increase the scale of the decline in the economy.[24]

Future research could consider alternative scenarios as appropriate. As negotiations proceed it may be possible to narrow the range of projected outcomes, once greater clarity is forthcoming about possible future trade relations. The present study has not attempted to incorporate any estimate of trade deals with 3rd countries. Clearly, however, successful trade negotiations, and indeed EU and rest of the world growth, could mitigate some of the impacts identified here.

[24] Some part of this flow would likely be return migration. We have conducted one limiting simulation, assuming UK and EU labour markets were completely integrated. This added significantly to the contraction in both Scotland and rUK.

References

Baier, S., Bergstrand, J., Egger, P. and McLaughlin, P., 2008, "Do economic integration agreements actually work? Issues in understanding the causes and consequences of the growth in regionalism", The World Economy, vol.31, no.4, pp. 461–97.

Capital Economics, 2016, "The economic impact of 'Brexit'", report prepared for Woodford Investment Management, http://www.viewfromthebridge.co.uk/wp-content/uploads/2016/02/the-economic-impact-of-Brexit.pdf

Ceglowski, J., 2006, "Does gravity matter in a service economy?", Review of World Economics, vol. 142, no.2, pp. 307–29.

Centre for Economic Performance, 2016, Various Authors, "Brexit 2016", London School of Economics, http://cep.lse.ac.uk/pubs/download/brexit08_book.pdf.

Ebell, M., and Warren, J., 2016, "The Long-Term Impact of Leaving the EU", National Institute Economic Review, May 2016.

Fraser of Allander Economic Commentary, www.strath.ac.uk/business/economics/fraserofallanderinstitute/economic_commentary/latestcommentary/

Fraser of Allander Scotland's Budget: 2016, www.sbs.strath.ac.uk/economics/fraser/20160913/ScotlandsBudget-2016.pdf

HM Treasury, 2016a, "The long-term economic impact of EU membership and the alternatives", April 2016, https://www.gov.uk/government/publications/hm-treasury-analysis-the-long-term-economic-impact-of-eu-membership-and-the-alternatives

HM Treasury, 2016b, "The immediate economic impact of leaving the EU", May 2016, https://www.gov.uk/government/publications/hm-treasury-analysis-the-immediate-economic-impact-of-leaving-the-eu

Lecca, P., McGregor, P. G. and Swales, J. K., 2013, "Forward-looking versus Myopic Regional CGEs: How Significant is the Difference?", Economic Modelling, vol. 31 (C), pp 160-176.

Lecca, P, McGregor, P. G., Swales, J.K. and Y Yin, 2014, “Balanced budget multipliers for small open regions within a federal system: Evidence from the Scottish variable rate of income tax”, Journal of Regional Science, vol. 53, pp 402-421.

Oxford Economics, 2016, “Assessing the Economic Implications of Brexit”, http://www.oxfordeconomics.com/brexit/executive-summary

PWC, 2016, “Leaving the EU: Implications for the UK Economy”, Report prepared for the CBI, March 2016, http://www.cbi.org.uk/news/leaving-eu-would-cause-a-serious-shock-to-uk-economy-new-pwc-analysis/leaving-the-eu-implications-for-the-uk-economy/