

# **Modelling impacts of Free Trade Agreements on the Scottish economy**

**Office of the Chief Economic Adviser**

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# Executive Summary

## Background

This report explores the modelled impact of several free trade agreements (FTAs) on the Scottish economy. It considers the impact on the economy as a whole, as well as at a sectoral level.

The trade agreements covered in this analysis include Australia, India, Switzerland, Türkiye, and the UK–EU Trade and Cooperation (TCA) agreement. These were chosen to represent the diversity of UK trade agreements post the UK’s decision to leave the EU and to inform the Scottish Government’s engagement on the UK FTA programme.

This report utilises two modelling methodologies in parallel: gravity modelling and Computable General Equilibrium (CGE). Using both frameworks provides greater confidence in the estimated results. This analysis does not attempt to model the exact impact of the trade agreements as signed between the UK and other partners. However, it uses a well-established approach in trade literature to develop assumptions to approximate changes in trade barriers and explore the magnitude of potential economic effects.

## Macroeconomic Impact

The UK’s departure from the EU represents a large negative economic shock for the Scottish and UK economies. The impact of the trade agreements with non-EU partners considered in this assessment is significantly outweighed by the impact of increased trade barriers under the UK–EU TCA. Under the UK–EU TCA and non-EU FTAs Scotland’s GDP is estimated to be at least 2% lower (or at least £4 billion lower when measured in today’s GDP) in the long run compared to the baseline of continued EU membership. In contrast, the four non-EU trade agreements alone are estimated to increase Scotland’s GDP by 0.2% (or by £0.4 billion) in the long run. Other studies have shown that liberalisation between the UK and non-EU partners is likely to be significantly outweighed by the negative impact from the UK–EU TCA relative to full EU membership.

Note that these estimates only reflect changes in trade barriers<sup>1</sup> and do not account for any other channels of impact such as changes in productivity or investment. For example, recent modelling by the National Institute of Economic and Social Research showed that compared to EU membership, UK GDP could be 5.7% lower by 2035 when accounting for wider economic effects. This is larger than the 2% impact of this modelling which focusses only on changes in trade barriers and, in particular, changes in trade costs across the two scenarios.

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<sup>1</sup> Using specific assumptions around potential changes in trade costs informed by gravity modelling. Other studies may produce different results using different assumptions.

As a result of UK trade policy changes considered in this assessment, the UK–EU TCA and several non-EU FTAs, international exports could be 7.2% lower (or £3 billion using values in 2023) and international imports 8.8% lower (or £4 billion), compared to the baseline of continued EU membership. In contrast, the four non-EU trade agreements together could increase both international exports and imports by roughly 1% (or £0.5 billion) each. This report also shows that exports to Australia and India could increase by around 40% each, and exports to Switzerland and Türkiye could increase by around 6% each. However, in comparison to the EU, these represent smaller markets, which are geographically more distant and with higher trade costs. This means that large increases in trade with individual non-EU partners could have a very limited impact on overall trade.

### **Sectoral and Differential Impacts**

The TCA represents a large negative economic shock for all sectors of the Scottish economy, which significantly outweighs the positive impact of non-EU FTAs modelled. The largest reductions in output are estimated for Chemicals and pharmaceuticals (-9.1% or £424 million), Computer, electronic and electrical equipment (-7.7% or £296 million), Textiles, wood and paper (-5.9% or £289 million), Metals (-5.9% or £240 million), and Agrifood (-4.9% or £827 million).

While being significantly outweighed by the negative employment effect of the UK–EU TCA, this analysis estimates that the four non-EU FTAs could increase employment across all sectors of the economy. The largest increase in employment and output is estimated to be in the Metals sector.

However, because the Scotland-specific analysis is at a fairly high level of aggregation, it can hide a more complicated picture within sectors. UK-level granular analysis of impacts of the UK–India and UK–Australia FTAs on the agri-food sector finds the output of some industries increasing and others decreasing. The largest increase is found to be prepared animal feeds (+0.3% or £34 million) and the largest decrease is processing & preserving of meat (-0.1% or £26 million). A reduction in output of the meat industry is consistent with findings from other studies looking at the impact of non-EU FTAs on the agrifood sector. Similarly, UK-level granular analysis of impacts of the UK–India and UK–Australia FTAs on the textiles sector finds a pattern of winners and losers, driven primarily by the impact of the trade deal with India which is still being negotiated. It should be noted that these estimates are informed by analysis of sectors at a more granular level using data for the UK as a whole. However, this can provide broad insights for Scotland, where at this sub-sectoral level, there is likely to be a similar pattern of winners and losers.

This report also explores differential impacts of trade changes, showing that sectors with a larger proportion of female workers may see lower gains in employment resulting from the non-EU FTAs than sectors with a large proportion of male workers. Conversely, industries with a large proportion of male workers may experience a

greater adverse effect of the UK–EU TCA. It also shows some limited regional variation in impacts: all regions experience an increase in employment under the non-EU FTAs and all regions experience a decrease in employment when the TCA is included, though impacts in the North East of Scotland are more significant.

Finally, this analysis provides an indication of the magnitude of the potential long-term impact on the economy under different scenarios; it does not provide a forecast of the future path for the economy. As such, it does not consider any other future changes in the domestic and global economy that may affect the interpretation of findings.

## Related documents

A policy summary has been written to accompany this report. Its purpose is to provide a non-technical narrative and put the key findings in the context of the Scottish Government's approach to trade, in line with our Vision for Trade<sup>2</sup>, and our engagement with the UK Government on its programme of Free Trade Agreements.

The policy summary can be found here: [Modelling impacts of Free Trade Agreements on the Scottish economy - Policy Summary](#)

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<sup>2</sup> [Trade: our vision - gov.scot \(www.gov.scot\)](http://www.gov.scot)

# Introduction

Following departure from the European Union, the UK regained powers to conduct an independent international trade policy, including the negotiation of free trade agreements (FTAs) with partners around the world. The UK is currently in the process of updating some of those agreements inherited from its time as an EU member state, negotiating completely new trade agreements with several countries and has already secured agreements with others.

This report explores the modelled impact of several free trade agreements (FTAs) on the Scottish economy. The trade agreements covered in this analysis include Australia, India, Switzerland, Türkiye, and the UK–EU Trade and Cooperation Agreement (TCA). These were chosen to represent the diversity of UK trade agreements post the UK’s decision to leave the EU and to provide insights to guide Scottish Government policy and engagement with UK trade negotiators:

- The UK–EU TCA – Trade and Cooperation Agreement established following the UK’s exit from the EU.
- UK–Australia FTA – A new FTA, signed in 2021 and entering into force in May 2023.
- UK–India FTA – A new FTA, which remains under negotiation at the time of this analysis.
- UK–Türkiye FTA – An enhancement of an existing FTA, which remains under negotiation at the time of this analysis.
- UK–Switzerland FTA – An enhancement of an existing FTA, which remains under negotiation at the time of this analysis.

Following the General Election in July 2024, new UK Ministers inherited those ongoing FTA negotiations which were begun under the previous Government. In late July 2024 Secretary of State for Business and Trade Jonathan Reynolds confirmed the continuation of negotiations across a number of agreements, including those analysed here.<sup>3</sup>

The UK Government have already provided impact/scoping assessments<sup>4567</sup> for the non-EU FTAs noted above, considering impacts on the UK as a whole with limited regional breakdowns. While an estimate is provided of the impact on the Scottish economy as a whole in those assessments, impacts on specific sectors, regions, and

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<sup>3</sup> [New Government drives forward trade talks to turbocharge economic growth - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/news/new-government-drives-forward-trade-talks-to-turbocharge-economic-growth)

<sup>4</sup> [Impact assessment of the Free Trade Agreement between the United Kingdom of Great Britain and Northern Ireland and Australia \(publishing.service.gov.uk\)](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/123456/uk-australia-fta-impact-assessment)

<sup>5</sup> [UK-India Free Trade Agreement - The UK’s Strategic Approach \(publishing.service.gov.uk\)](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/123457/uk-india-fta-approach)

<sup>6</sup> [UK - Türkiye Free Trade Agreement \(publishing.service.gov.uk\)](https://publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/123458/uk-turkey-fta)

<sup>7</sup> [UK’s approach to negotiating an enhanced free trade agreement with Switzerland - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/news/uk-approach-to-negotiating-an-enhanced-free-trade-agreement-with-switzerland)

groups within Scotland are not considered. This work aims to close this gap in the evidence base for Scotland.

This report provides an economic assessment of the impact of the above trade policy scenarios on the Scottish economy, considering impacts on aggregate variables such as GDP, employment, and trade, as well as at a sectoral level.

It is generally accepted that international trade can lead to greater economic prosperity for countries, through improved specialisation, higher productivity, and higher levels of economic activity. In turn, it can also generate benefits to consumers and workers through lower prices, better quality and greater variety of goods and services available, and through higher incomes.

At the same time, trade policy changes cause a restructuring in the economy, through which some areas gain and others lose with associated implications for workers and businesses. There is evidence that the opportunities of international trade are often not evenly distributed, and that any negative impacts tend to be concentrated among particular industries, regions or societal groups. For that reason, the report also explores differential impacts of trade changes by gender and geography. This focus aligns with commitments in the Scottish Government's trade policy strategy, the Vision for Trade<sup>8</sup>, to better understand the role and impact of trade in Scotland's economy.

Finally, this analysis is based on enhanced investment in Scottish Government's trade modelling capacity building – within the Chief Economist Directorate – which required new in-house models and datasets.<sup>9</sup> This means that the Scottish Government can now undertake a more rigorous assessment of how trade policy changes can affect the economy.

## Approach to assessing economic impact

The impacts of FTAs on the Scottish economy are estimated in this analysis using the Scottish Government's Computable General Equilibrium (CGE) and gravity model. Both CGE and gravity models are standard tools in trade policy analysis.

Table 1 provides an overview of the models used.<sup>10</sup> A gravity model of trade is used to source assumptions around potential changes in trade barriers as a result of trade agreements. Gravity models are used to estimate the effect of trade policies (such as free trade agreements) and other variables (such as distance) on trade between two countries. The gravity model is also used to simulate the general equilibrium impact

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<sup>8</sup> [Trade: our vision - gov.scot \(www.gov.scot\)](https://www.gov.scot)

<sup>9</sup> In part, addressing the recommendations made by the trade modelling feasibility study commissioned by the Scottish Government in 2019. See [Feasibility Study on Developing Trade Modelling for Scotland | FAI \(fraserofallander.org\)](https://www.fraserofallander.org)

<sup>10</sup> See Annex B and D for a more detailed overview of both models.

of FTA scenarios on economic variables such as output, exports, and imports for each sector.

A CGE model is then used to provide a more comprehensive assessment of the cumulative impact of scenarios, including the impact on macroeconomic variables such as GDP or employment as well as sectoral impacts. A CGE model, unlike the gravity model used, incorporates input–output linkages between industries and more detailed treatment of the economy.<sup>11</sup> This means that sectoral results from the CGE model presented in this report account for wider supply chain effects of changes in trade barriers as well as wider economic effects.

Any economic model is only an approximation of a real economy, making simplifications where necessary in order to capture the most important real-world impacts while abstracting out others. This means there is always a degree of uncertainty when using models to understand complex systems such as the Scottish or global economy. Gravity models and CGE models make different simplifications and different assumptions, meaning they are unlikely to produce identical results. This means that using the two frameworks in parallel can provide a greater degree of assurance than using one in isolation: if the two models produce broadly similar results despite their fundamentally different approaches, we can be more confident that the results successfully capture the likely behavioural impact. Both modelling frameworks complement and depend on each other, with the assumptions for CGE modelling sourced from the gravity model whilst the CGE provides impacts on a wider set of economic variables.

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<sup>11</sup> For example, a CGE model incorporates input–output linkages between firms operating in different industries, as firms will be sourcing intermediate inputs from other industries.



**Table 1 – Models used**

<b>Gravity Model</b>	<b>CGE model</b>
<p><b>Overview</b>            In its simplified formulation, predicts international trade flows based on economic sizes and distance between two countries (in analogy to Newtonian gravity). Modern gravity models can take account of many other variables that can predict trade, including sharing a common language and having a free trade agreement. Using econometric estimation based on large bilateral trade datasets, one can find the impact that one or more of these variables has on trade, and then use this to simulate scenarios based on changing these variables. For example, estimate FTA effect and then simulate the impact of a new FTA between two countries.</p> <p><b>Outputs</b>            Change in:</p> <ul style="list-style-type: none"> <li>• Exports</li> <li>• Imports</li> <li>• Output</li> </ul> <p>Broken down by:</p> <ul style="list-style-type: none"> <li>• Industry sector</li> <li>• Country</li> </ul> <p><b>Data</b>            International bilateral trade data, for a large set of years, many countries, and broken down by industry sector</p>	<p><b>Overview</b>            Based on macroeconomic equations which describe how key economic variables depend on one another, and input–output data which describe supply chain links between different sectors in the economy. A user can apply an external shock to the system, such as a reduction in trade costs (for example as a result of signing a free trade agreement). This shock affects prices, which in turn affect both the supply side and the demand side of the economy. The model computes how various quantities would have to adjust to balance supply and demand, and the user can interrogate the details of the new equilibrium.</p> <p><b>Outputs</b>            For the country on which the CGE model is based:</p> <ul style="list-style-type: none"> <li>• GDP</li> <li>• Employment</li> <li>• Exports</li> <li>• Imports</li> </ul> <p>Aggregate and broken down by industry sector</p> <p><b>Data</b>            Inbuilt Social Accounting Matrix, which includes input–output data for all sectors of the economy</p>

Table 2 provides a summary of scenarios considered in this report. These include the impact of FTAs with all non-EU partners and the combined impact of FTAs with non-EU partners and the UK–EU TCA.

**Table 2 – Scenarios**

Scenario	Assumptions
Scenario 1 – Non-EU FTAs	<p>Combined impact of trade agreements with Australia, India, Switzerland, and Türkiye</p> <p>For Australia and India, our scenario considers a reduction in trade costs in all sectors of the economy according to the results of our sector-specific partial gravity estimation reflecting the impact of an average trade deal.</p> <p>For Switzerland and Türkiye, the existing trade agreements significantly liberalised trade in goods, so the greatest gains from enhanced agreements will materialise through reduced barriers in services trade.</p> <ul style="list-style-type: none"> <li>• For Switzerland, we shock trade costs in finance and insurance; professional, scientific, and technical activities; and administrative and support service activities.</li> <li>• For Türkiye, we shock transportation and storage; professional, scientific, and technical activities; and administrative and support service activities.</li> </ul>
Scenario 2 – Non-EU FTAs and UK–EU TCA	<p>Combined impact of trade agreements with Australia, India, Switzerland and Türkiye, and the UK–EU TCA</p> <p>Non-EU FTAs: same assumptions as above            UK–EU TCA: introduce trade costs across all sectors</p>

## Results

The following section presents estimates of the long-term impact of the modelled trade scenarios on the Scottish economy, including the impact on trade, GDP, employment, and sectoral impacts. Results are presented for the gravity modelling and Computable General Equilibrium (CGE) modelling separately followed by discussion of findings and policy implications.

All results in this section are presented as long-run impacts (over 10–15 years) relative to the baseline of continued EU membership. The modelling tools used incorporate baseline data that pre-dates the UK's exit from the EU. This is also necessary for Scenario 2 which simulates the impact of the new UK–EU TCA itself in addition to non-EU FTAs.

### Gravity

The first set of results is informed by gravity modelling and is estimated using OCEA's gravity model of international trade.<sup>12</sup> This modelling is undertaken for each industry separately and estimates the direct impact of changing trade barriers on exports, imports, and output. Gravity simulations account for changes in trade with the affected partner countries as well as changes in trade with other partners.

CGE modelling results are presented later in this section and provide a more complete assessment of impacts from the CGE model, reflecting wider changes in the economy (such as reallocation of factors of production) and supply chain effects.

### Scenario 1 – Non-EU FTAs

Table 3 shows how Scotland's trade with FTA partner countries changes in response to trade liberalisation.

**Table 3 – Long run effect of signing four non-EU FTAs on Scotland's international trade**

% change relative to the baseline

Partner(s)	Export change	Import change
Australia	+40% (£225 million)	+43%
India	+42% (£125 million)	+42%
Switzerland	+8% (£55 million)	+15%
Türkiye	+8% (£15 million)	+0.5%
All four non-EU FTA partners	+27%	+23%
All international partners	+1.4%	+1.3%

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<sup>12</sup> Office of the Chief Economic Adviser at the Scottish Government is grateful to Angelos Theodorakopoulos (Aston Business School), who as part of the UKRI Policy Fellow programme, reviewed the Scottish Government's gravity model and provided helpful comments and suggestions.

Source: SG OCEA gravity modelling and SG Export Performance Monitor.<sup>13</sup> Note that the monetary impact for each partner is only calculated for exports, as equivalent data is not available for imports.

The above results show substantial increases in trade with Australia and India (with both exports and imports with each country increasing by over 40% in the long run relative to the baseline of no change), with smaller increases for Switzerland and Türkiye (due to the more limited scope of those agreements). Overall international exports and imports increase a small amount (over 1%) as a result of the four non-EU FTAs, but as will be shown later, much less than the magnitude of the decrease in international trade as a result of the TCA.

The UK Government's impact/scoping assessments of the Australia and India agreements are based on a different modelling methodology and look at UK-wide impacts, so they are not directly comparable to the results presented in this report. Nevertheless, the estimated impacts are broadly similar (see Annex A for detail).

Figure 1 shows the results of our sectoral gravity simulation of Scenario 1. The impact due to each FTA is distinguishable by pattern in the stacked bar chart. All results are in real terms, meaning that they take account of any price changes resulting from the trade agreements.

The impact on Scotland's total output, exports, and imports by sector is presented, where exports and imports include trade with all trading partners.

Some industries gain more from the FTAs than others. In terms of output, metals (+0.4%), electrical equipment (+0.3%), and food and drink (+0.2%) see the biggest increases, while transport equipment and mining, quarrying, and utilities, see very small (around 0.01%) decreases in output.

These results are informative but are at quite a high level of aggregation due to the data available for Scotland. In particular, the positive impact on Scotland's Agrifood sector shown by these results hides a more complicated picture. More granular results are presented later in this chapter.

Metals sees a big increase in both exports and imports. For exports, this is mainly because a large share of Scotland's exports in metals in the underlying dataset is with the non-EU FTA partners. For imports, it's partly due to a large share of Scotland's imports in metals being with the non-EU FTA partners, and partly due to Australia's comparative advantage.

Accommodation and food services sees a big increase in both exports and imports in the gravity model. For exports, this might be explained by Scotland's comparative advantage. Although not very significant in isolation, it is significantly larger than

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<sup>13</sup> Cash impacts based on applying the percentage impact to [Exports Performance Monitor](#) figures for total Scottish exports to partner countries, 2021 data. This provides an illustration of potential monetary impact, but it is not a projection or forecast of future trade changes.

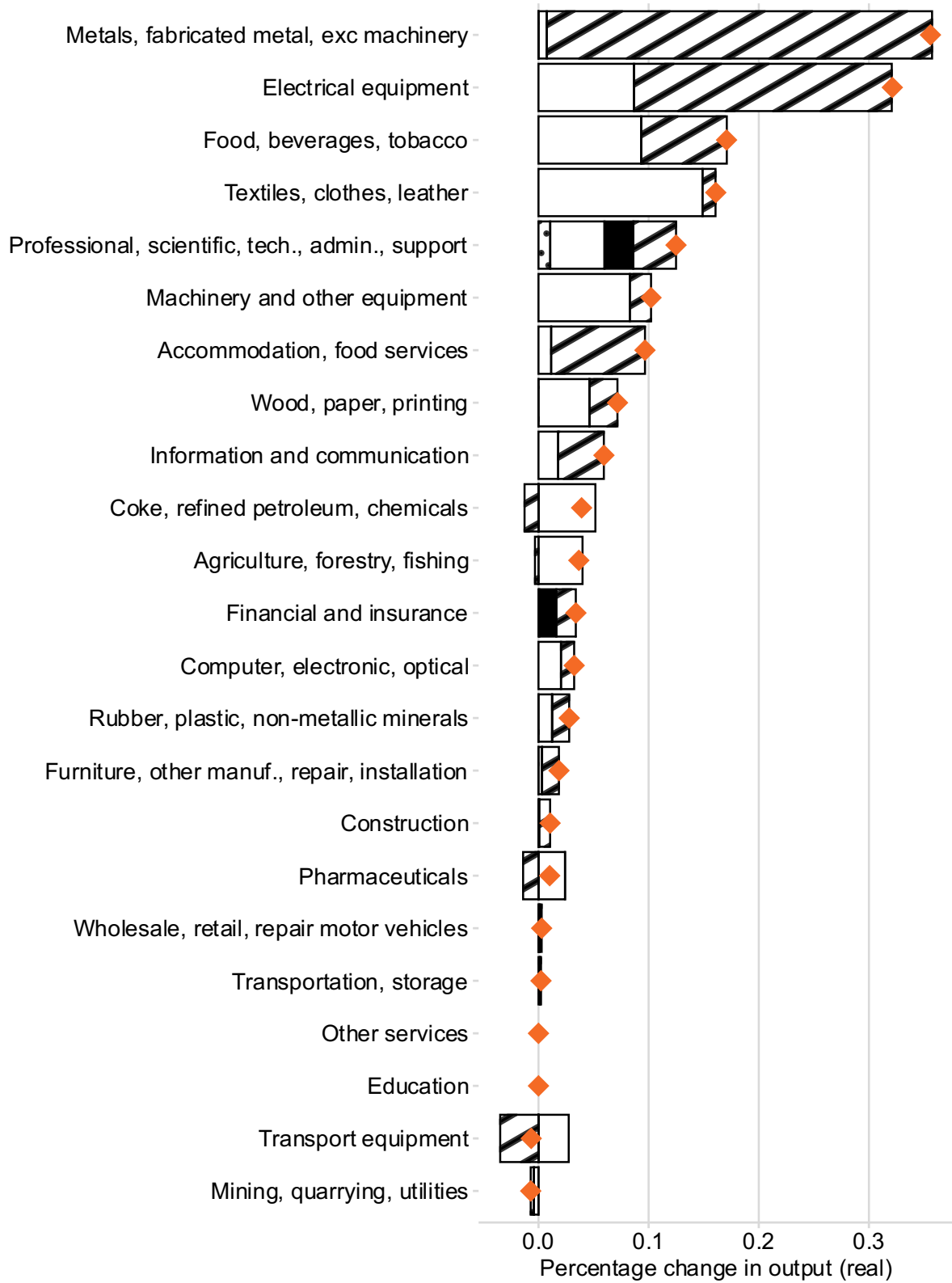
Australia and India's comparative advantage. The trade shares in both directions are fairly high and the estimated change in trade barriers in the gravity model is relatively large which may be part of the explanation.

Professional, scientific, technical, administrative, and support services activities see a big increase in both exports and imports. This is largely explained by Scotland's trade shares with the non-EU FTA partners being large for both imports and exports. Scotland has a big comparative advantage in this sector, which could explain why the increase in exports is larger than the increase in imports.

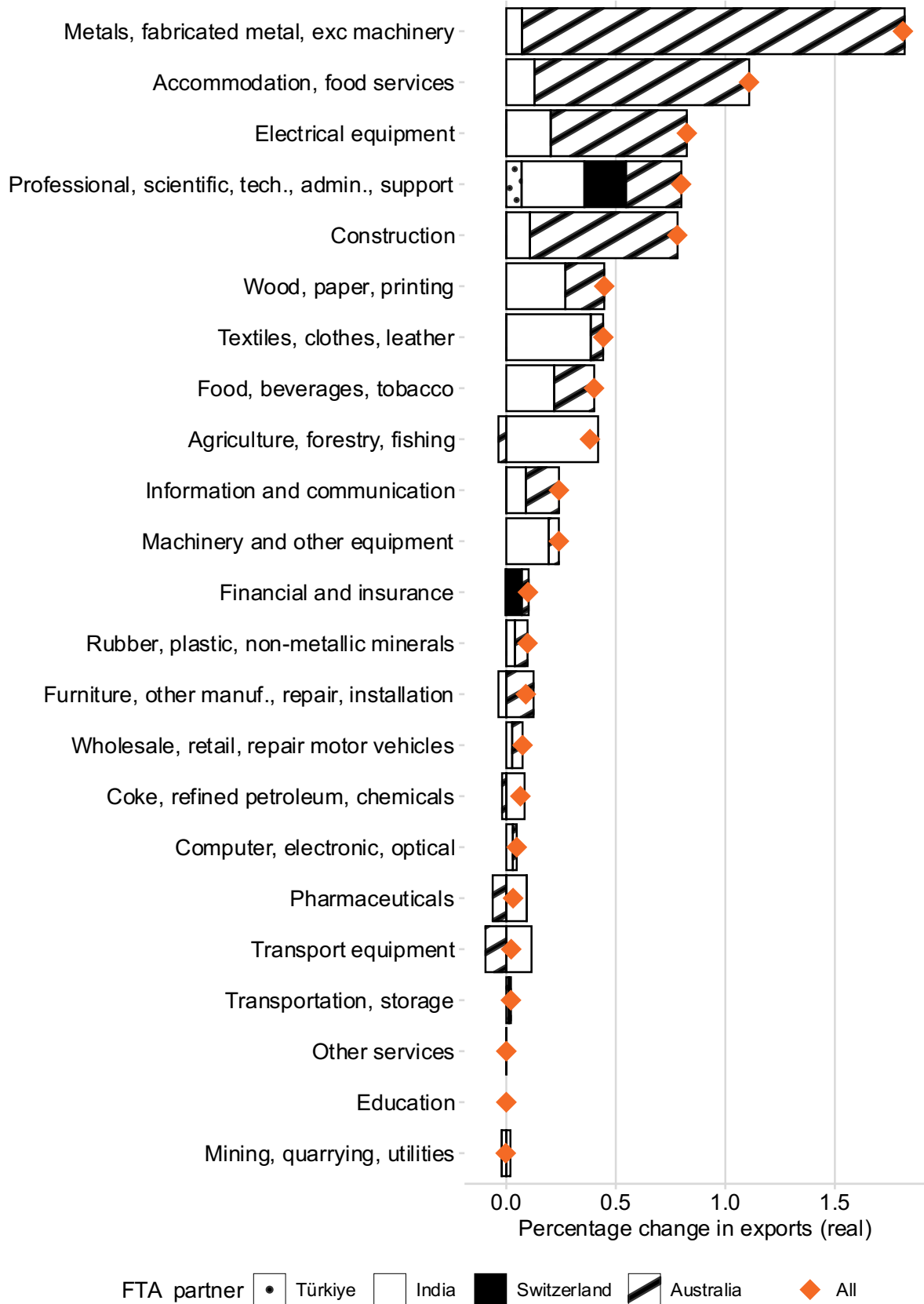
Electrical equipment sees a large increase in exports. The reason for this could be that, while Scotland's comparative advantage is small, it is larger than that of Australia. Most of the gains in Electrical equipment exports are due to the UK–Australia FTA.

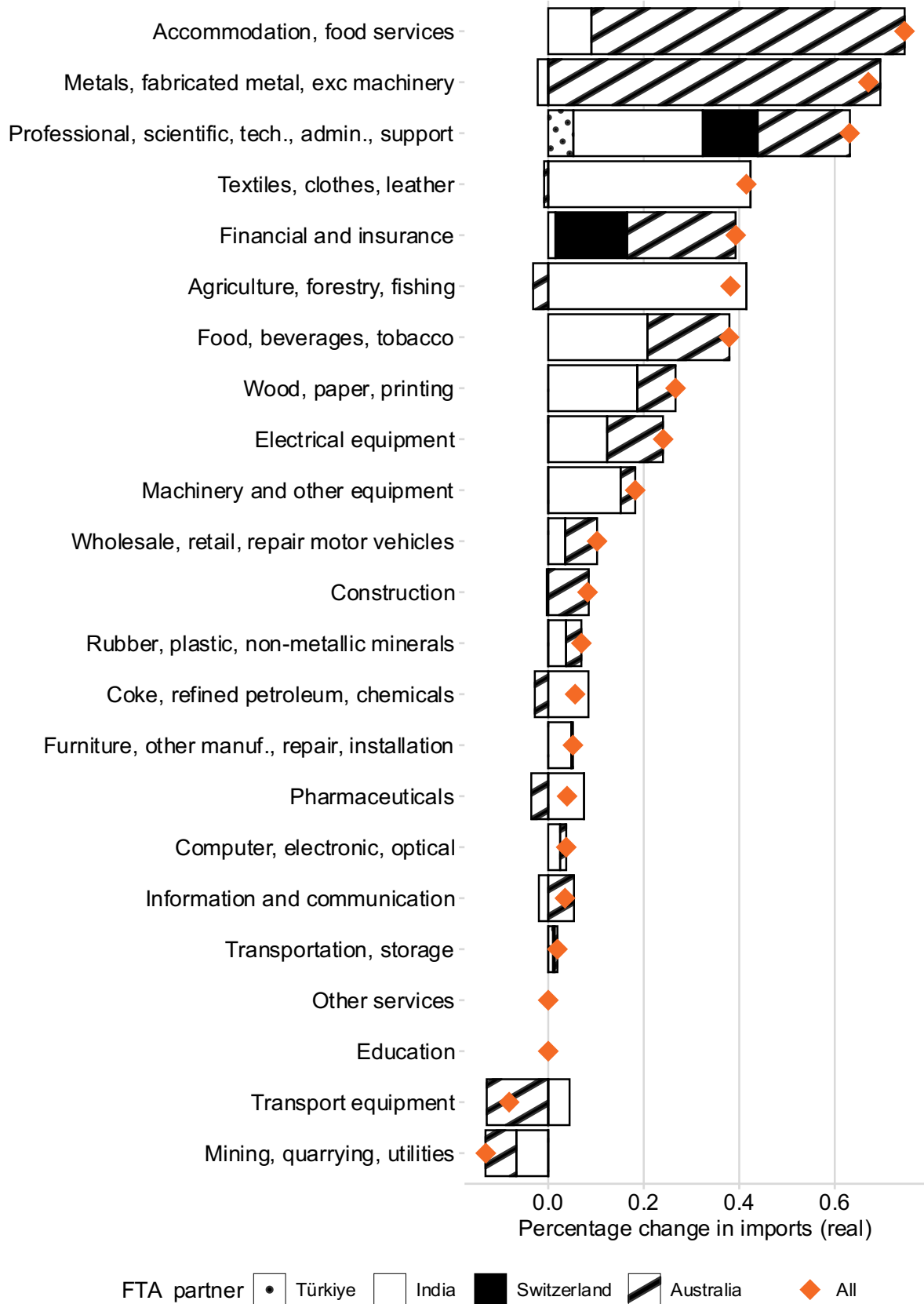
**Figure 1 – Non-EU FTAs and changes in Scotland’s sectoral output, imports, and exports**

% change relative to the baseline



FTA partner • Türkiye □ India ■ Switzerland ▨ Australia ◆ All





Source: SG OCEA gravity modelling



## Scenario 2 – Non-EU FTAs and EU TCA

Table 4 shows how Scotland's trade with partner countries and overall trade changes in response to trade liberalisation with non-EU partners and under the UK–EU TCA.

**Table 4 – Long run effect of signing all four non-EU FTAs and the UK–EU TCA on Scotland's international trade**

% change relative to the baseline

Partner(s)	Export change	Import change
Australia	+36% (£200 million)	+51%
India	+40% (£120 million)	+49%
Switzerland	+7% (£60 million)	+23%
Türkiye	+6% (£10 million)	+7%
All four non-EU FTA partners	+24%	+30%
EU	-29%	-23%
All international partners	-15%	-11%

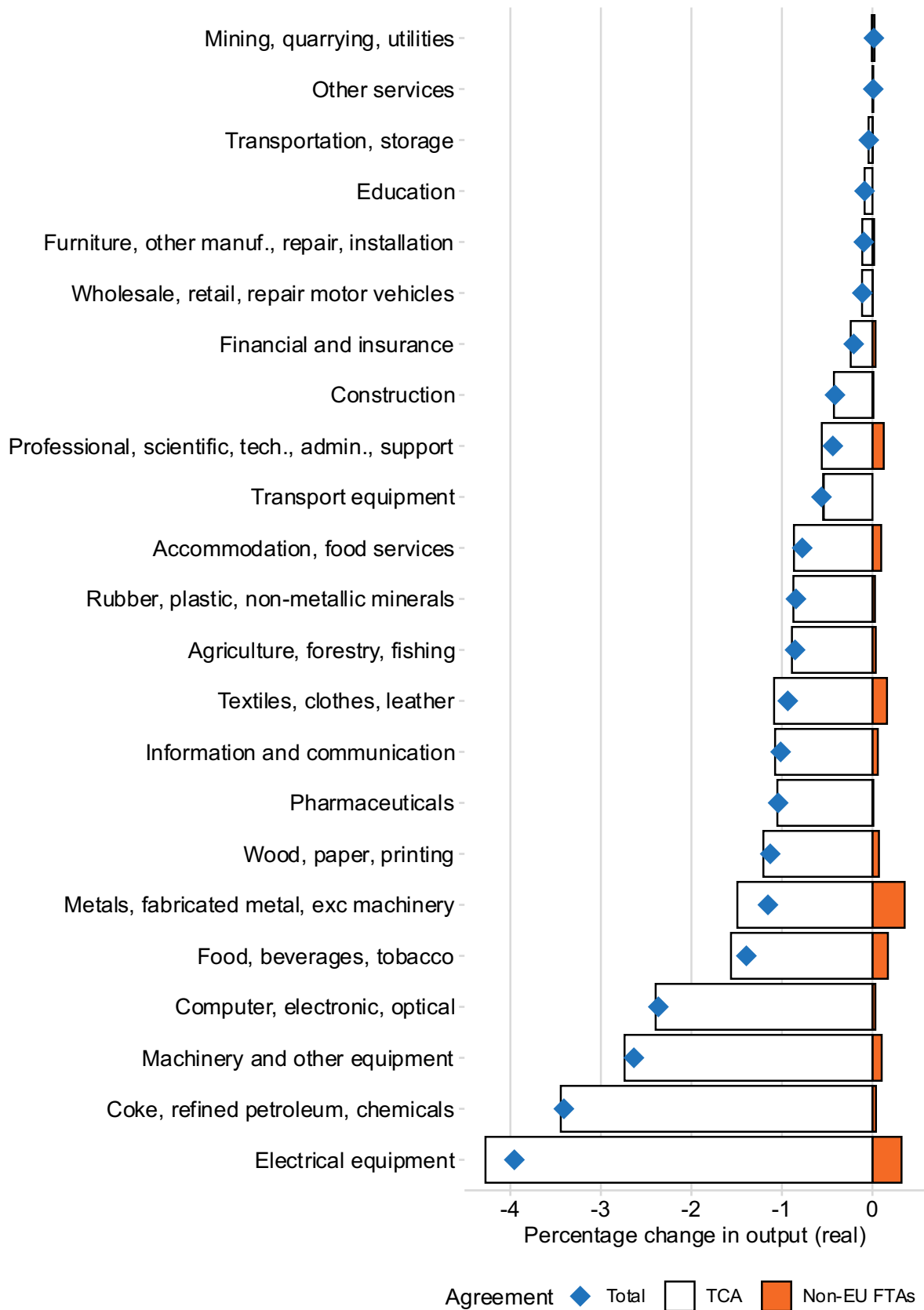
Source: SG OCEA gravity modelling and SG Export Performance Monitor.<sup>14</sup> Note that the monetary impact for each partner is only calculated for exports, as equivalent data is not available for imports.

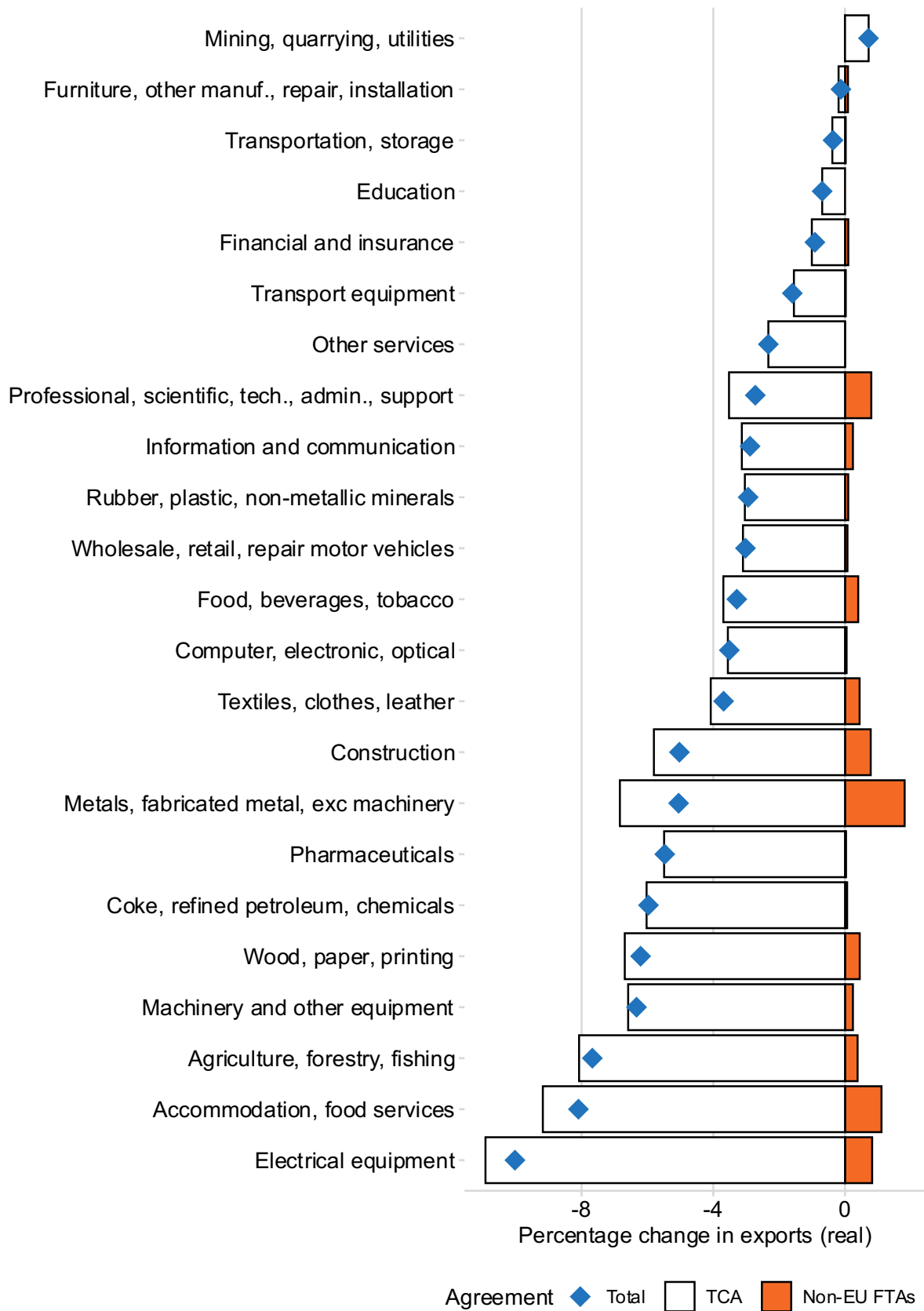
The above gravity modelling results show that the increase in trade resulting from the four non-EU FTAs is significantly outweighed by the reduction in trade with the larger EU market, leading to lower international exports and imports. The impact on trade with four non-EU partners is slightly different from the impact presented for Scenario 1 in Table 3. For example, Scenario 2 produces a larger increase in imports with four non-EU partners due to non-EU imports becoming relatively more attractive than imports from the EU which are affected by increased trade barriers.

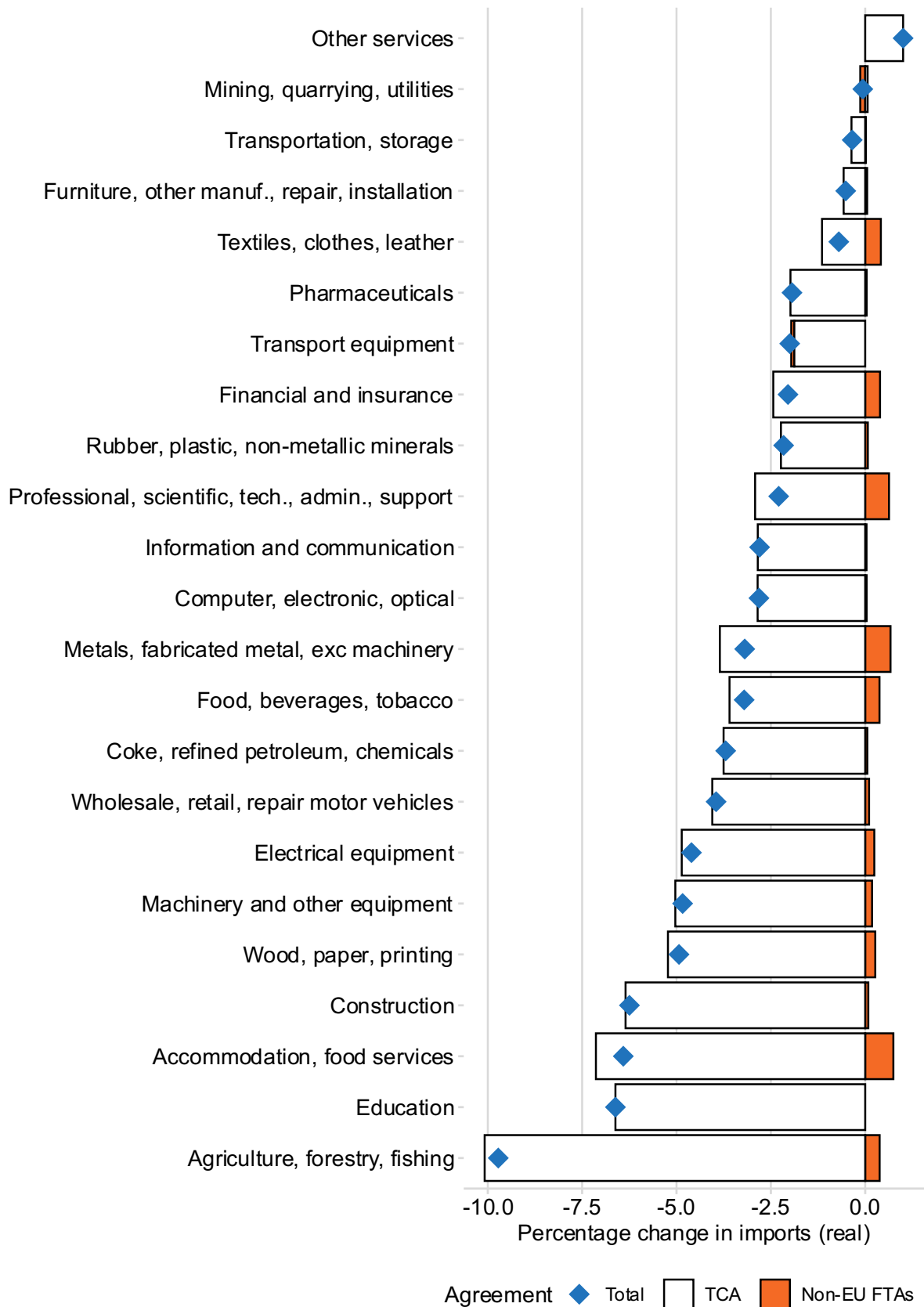
Figure 2 shows the impact on output, exports, and imports in the scenario where the UK signs all four non-EU FTAs and also the EU TCA. For readability, the effects due to the four non-EU FTAs were aggregated into one category. Just as with aggregate trade flows, the results show that reducing trade barriers with non-EU countries is insufficient to outweigh the reduction in output, exports, and imports resulting from the UK–EU TCA across most sectors.

<sup>14</sup> Cash impacts based on applying the percentage impact to [Exports Performance Monitor](#) figures for total Scottish exports to partner countries, 2021 data. This provides an illustration of potential monetary impact, but it is not a projection or forecast of future trade changes.

**Figure 2 – The combined impact of non-EU FTAs and the impact of the UK–EU TCA on Scotland’s sectoral output, imports and exports**  
 % change relative to the baseline







Source: SG OCEA gravity modelling

## The impact on the Agrifood sector

The Agrifood sector represents an important part of the Scottish economy. It can also be particularly sensitive to the impacts of international trade. For example, impact assessments produced by the UK Department for Business and Trade on the UK–Australia and UK–New Zealand FTAs estimated a negative impact on the Gross Value Added (GVA) of agricultural and processed food sectors. Australia has a strong comparative advantage in many areas of agriculture and it can be expected that some domestic industries could be losing out because of import competition.

Similarly, analysis produced on behalf of the Scottish Government by the Andersons Centre examining the Impact of Future UK FTA Scenarios on Scotland’s Agricultural Food and Drink Sector<sup>15</sup> also found some negative impacts for some sub-sectors, which are discussed below.

The Scotland-specific modelling presented above is insightful but limited by the level of industry aggregation in the data available for Scotland. The impact on the Agrifood sector as a whole can be positive as shown earlier but the impact can vary greatly across different subsectors or businesses. The positive aggregate result is in part driven by the inclusion of Drink in the total in the data available. The Scotch whisky sector is generally expected to gain from non-EU FTAs, with the current Indian tariff on whisky set at 150%.

Given the greater significance of the Agrifood sector in the Scottish economy than in the UK as a whole, and particularly in remote and island communities, it is important to understand these impacts in greater detail.

To provide a more comprehensive assessment for the sector, the next results draw from UK level data and modelling. UK data in the International Trade and Production Database for Estimation (ITPD-E)<sup>16</sup> provides a much more granular breakdown of these sectors but has the limitation of only allowing to model trade at the UK level. This may not be a problematic limitation – it is expected that findings at this sub-sectoral level could be very similar for Scotland.

Figure 3 shows the results of our gravity simulation for agriculture and food sectors using granular ITPD-E data. The more granular breakdown shows that the impact of the FTAs are more complicated than simply expanding or harming the agri-food sector, with some industries experiencing an increase in real output and others seeing a decrease.

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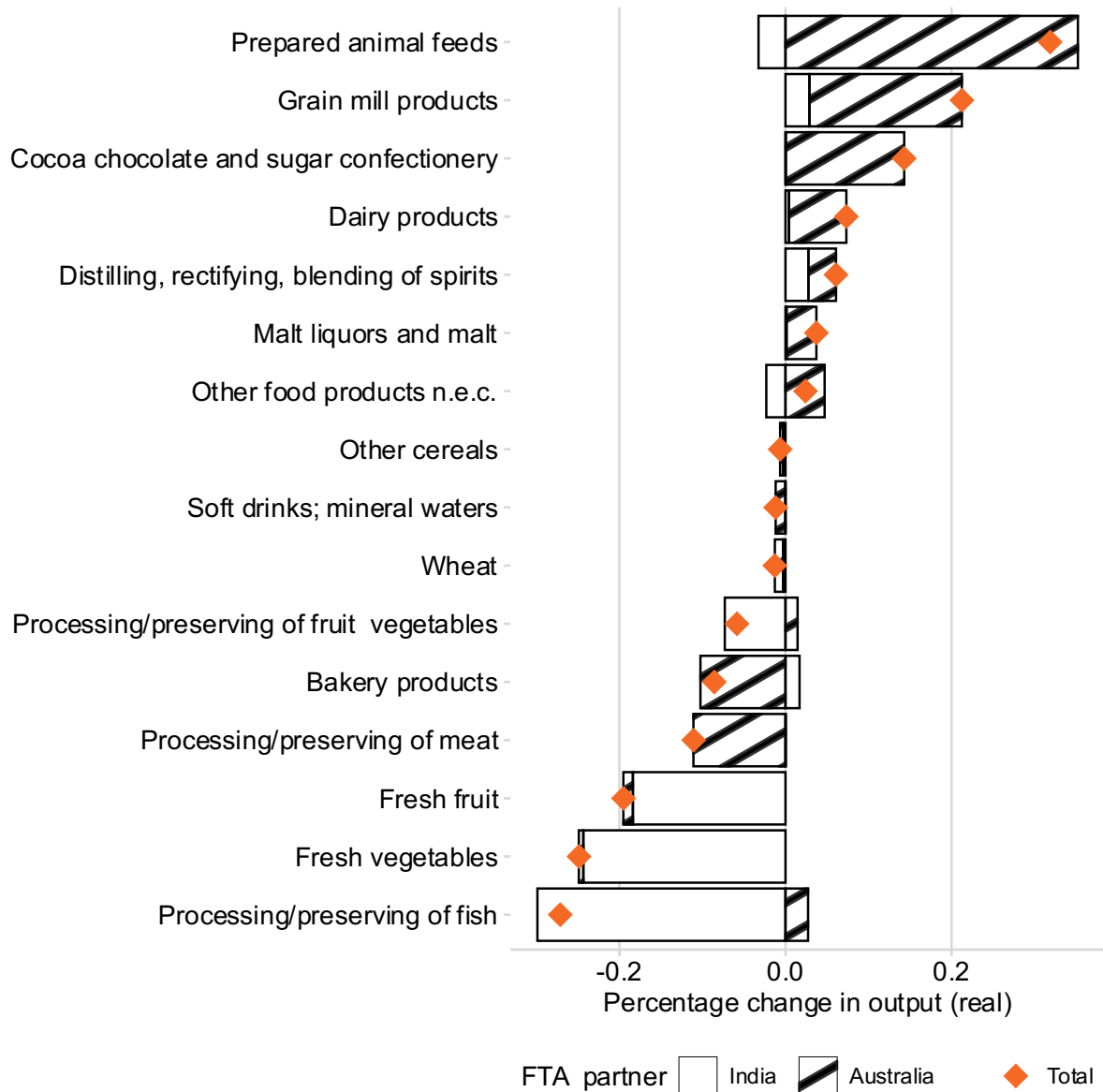
<sup>15</sup> [Summary Report: Analysis on the Impact of Future UK FTA Scenarios on Scotland’s Agricultural Food and Drink Sector](#)

<sup>16</sup> Borchert, I., Larch, M., Shikher, S., and Yotov, Y. (2022), “The International Trade and Production Database for Estimation - Release 2 (ITPD-E-R02),” *USITC Working Paper 2022–07–A*. Also: Borchert, I., Larch, M., Shikher, S., and Yotov, Y. (2021), “The International Trade and Production Database for Estimation (ITPD-E),” *International Economics*, 166, 140–166.

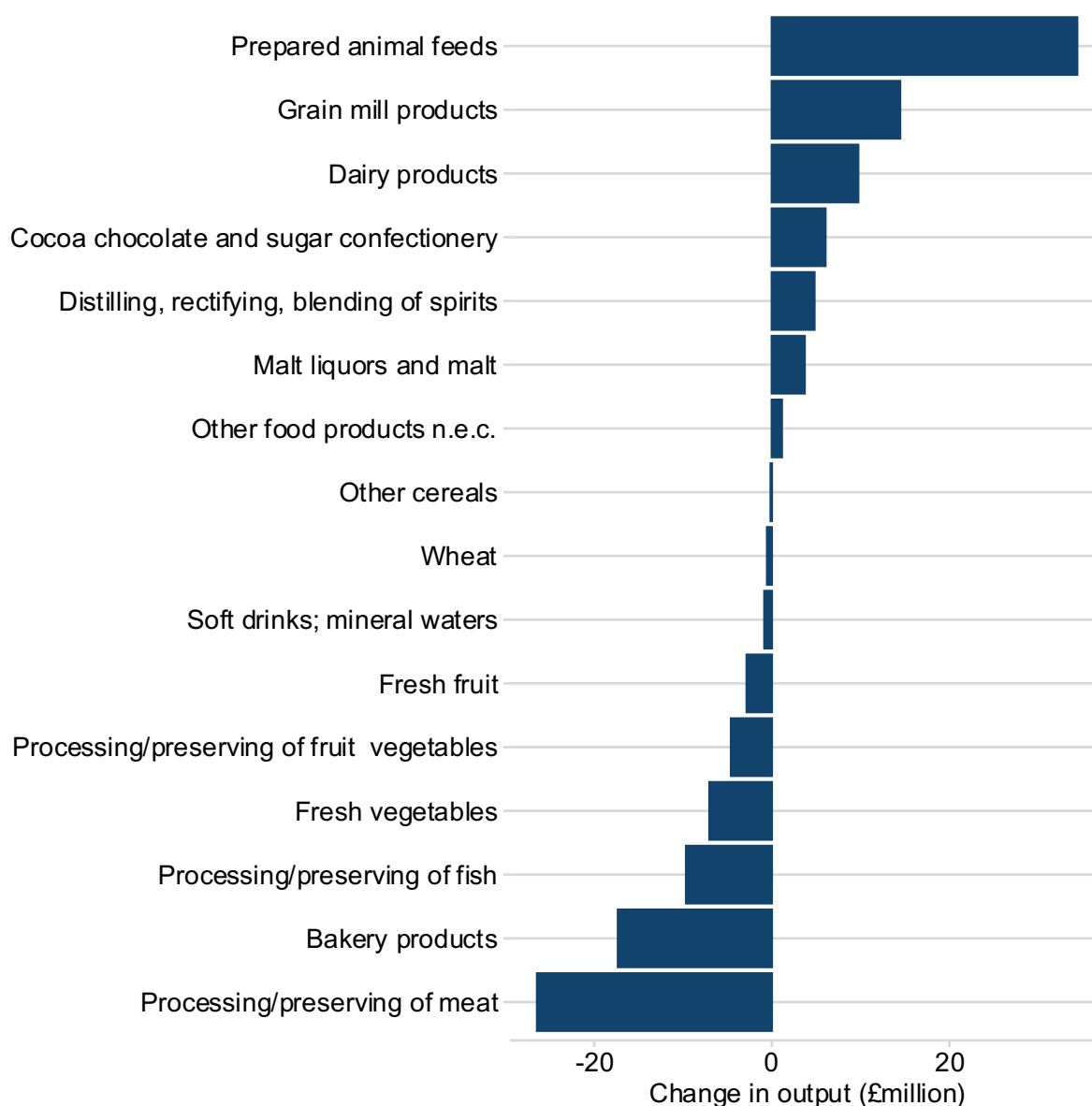
We present only a subset of all agri-food sub-sectors in the ITPD-E dataset. The ones we omit are those with very small UK production, as these are less important to the wider picture.

**Figure 3 – The impact of Australia and India FTAs on sectoral output in the UK Agri-food sector**

% change relative to the baseline



## Cash terms impacts in millions GBP<sup>17</sup>



Source: SG OCEA gravity modelling

The industries experiencing the largest increase in real output are Prepared animal feeds (+0.3%, +£34m), Grain mill products (+0.2%, +£14m), and Dairy products (+0.07%, +£10m). The industries experiencing the largest decrease in real output are Processing/preserving of meat (-0.1%, -£26m), Bakery products (-0.09%, -£17m), and Processing/preserving of fish (-0.3%, -£10m). In addition, it should be noted that above charts are likely to underestimate the impact on the Scottish whisky sector as the modelling approach does not directly account for

<sup>17</sup> We calculate cash-terms impacts by using United Nations data for UK production ([FAOSTAT](#) for agricultural production and [INDSTAT](#) for food and drink production). We use 2022 data as this is the most recent available. For bakery products, there was no data available on INDSTAT, so we have used ITPD-E 2018 data instead.

reductions in tariffs on whisky (currently at 150% in India) due to the lack of disaggregated data.

It is possible to compare the agrifood results presented above with previous work. A 2023 study by The Andersons Centre on behalf of the Scottish Government<sup>18</sup> analysed a high liberalisation and a low liberalisation scenario, and found that an FTA with Australia could result in UK GVA decreasing by 2.8% and 2.4% for Beef and Sheepmeat respectively in the low liberalisation scenario, and 6.7% and 3.6% in the high liberalisation scenario. Direct comparison may be misleading because above results are for total output, and the results of the Andersons study are GVA and informed by a different model, but the Andersons study does appear to show larger impacts than this analysis.

A 2022 impact assessment by the Department for International Trade in the UK Government<sup>19</sup> also analysed the impact of the FTA with Australia. It estimated reduction in gross output of around 3% and 5% for Beef and Sheepmeat respectively. Although these different analyses used different approaches, and the fundamentally uncertain nature of modelling means different models could produce different results, there may be an indication that this analysis underestimates the impact on meat production.

## The impact on the Textiles sector

Another area of interest, due to India's strong comparative advantage, is Textiles, Clothes, and Leather. Textiles and Apparel were estimated to see a reduction in GVA in the UK Government analysis of UK-India FTA, with the reduction estimated to be larger with a deeper agreement. In the gravity model for Scotland these industries are aggregated to a single sector due to data limitations, but in the UK gravity model they are represented by 11 industries.

Figure 4 below shows the results of our gravity simulation at the UK level for the industries covered by Textiles, Clothes, and Leather. As with Agri-food, it can be seen that some industries' output increases, while that of others decreases.

The industries experiencing the largest increase in real output are Tanning and dressing of leather (+0.4%), Textile preparation and weaving (+0.3%), and Footwear (+0.2%). The industries experiencing the largest decrease in real output are Made up textile articles except apparel (-0.6%), Carpets and rugs (-0.3%), and Cordage, rope, twine, and netting (-0.2%).

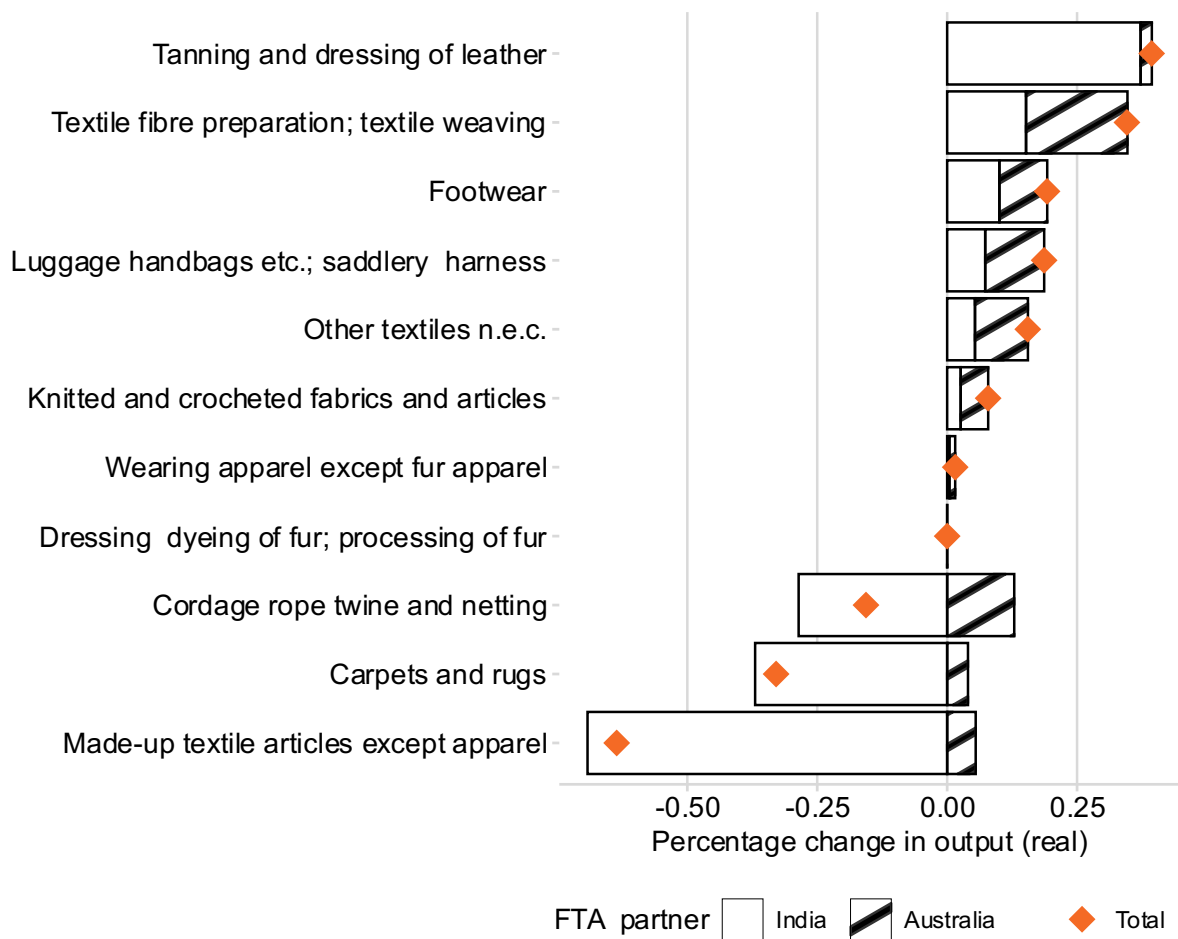
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<sup>18</sup> [Summary Report: Analysis on the Impact of Future UK FTA Scenarios on Scotland's Agricultural Food and Drink Sector](#)

<sup>19</sup> [Impact assessment of the Free Trade Agreement between the United Kingdom and Australia](#)



**Figure 4 – The impact of Australia and India FTAs on sectoral output in the UK  
Textiles, Clothes, Leather sector**  
% change relative to the baseline



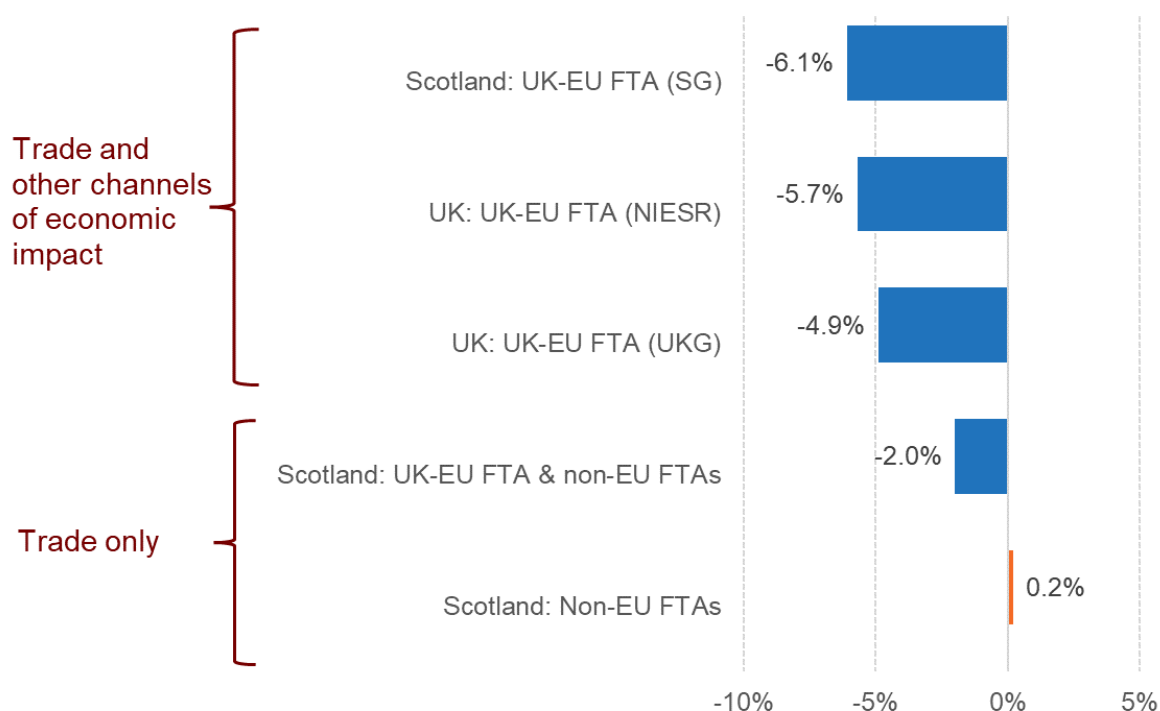
Source: SG OCEA gravity modelling

## Computable General Equilibrium

This section presents the results from CGE modelling and provides a more complete assessment of the combined impact of FTAs with four countries and the UK–EU TCA on the Scottish economy, accounting for wider feedback effects such as reallocation of factors of production and supply chain effects.

As before, all results in this section are presented as long-run impacts (over 10–15 years) relative to the baseline of continued EU membership. Figure 5 shows the estimated impact of two scenarios on Scotland’s GDP and trade in the long run in this analysis alongside other estimates of the TCA impact. The four non-EU FTAs alone (Scenario 1) are estimated to increase Scotland’s GDP by 0.2% in the long run whereas under the UK–EU TCA and with four non-EU FTAs implemented (Scenario 2) GDP is estimated to be at least 2% lower compared to the baseline of continued EU membership. A sensitivity analysis (presented in Annex E) shows that for Scenario 2 the impact on GDP ranges from -1.4% to -2.7%, when changing some of the parameters underpinning central estimates presented in this report.

**Figure 5 – Impact on the long run level of Scotland’s and the UK’s GDP**  
% change relative to the baseline



Sources: Trade only impacts – this report / SG OCEA CGE modelling (2025); Trade and other channels of economic impact – UK Government (2018);<sup>20</sup> NIESR (2023)<sup>21</sup>; SG OCEA SGGEM modelling (2018)<sup>22</sup>

<sup>20</sup> [Exiting the European Union: Publications - GOV.UK \(www.gov.uk\)](https://www.gov.uk)

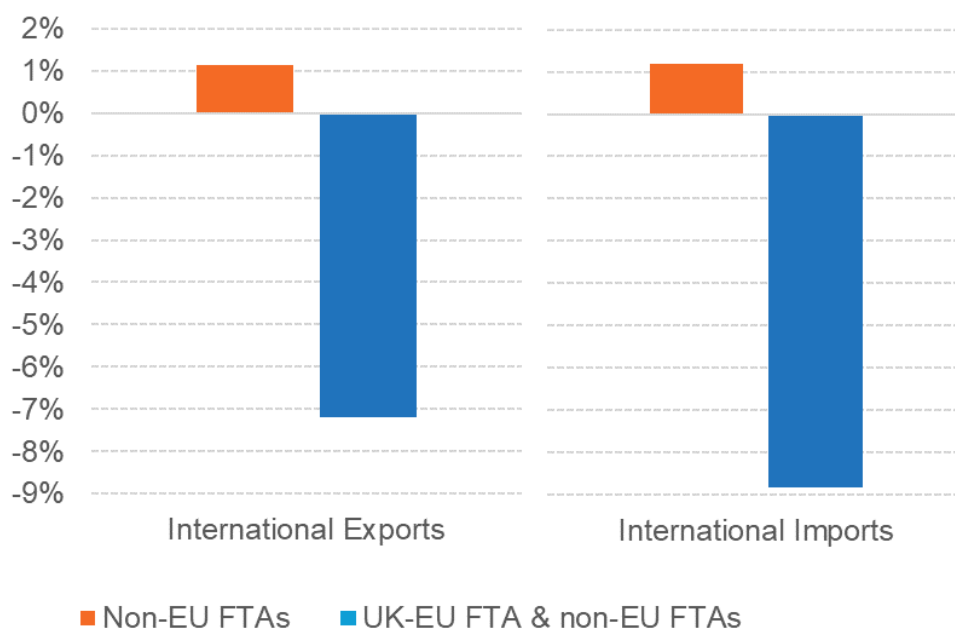
<sup>21</sup> [Revisiting the Effect of Brexit - NIESR](#)

<sup>22</sup> [Scotland's place in Europe: people, jobs and investment - gov.scot \(www.gov.scot\)](https://www.gov.scot)

Scenario 1 and Scenario 2 in this report only reflect changes in trade due to increased barriers whereas other estimates of TCA impacts by the UK Government (2018), the National Institute of Social and Economic Research (NIESR, 2023), and earlier Scottish Government’s macroeconomic modelling (2018) accounted for other channels of impacts such as any changes in productivity or investment as a result of the UK’s exit from the EU. These other channels of impact can have significant economic effects as shown in Figure 5. For example, recent modelling by NIESR estimates that the UK’s GDP could be 5.7% lower in the long run than if the UK had remained in the EU.

Figure 6 shows that under Scenario 1, international exports and imports could increase by 1.1% and 1.2% whereas under Scenario 2, international exports are estimated to be 7.2% lower and international imports 8.8% lower. The following sections explore sectoral impacts of both scenarios.

**Figure 6 – Impact on Scotland’s international exports and imports**  
% change relative to the baseline

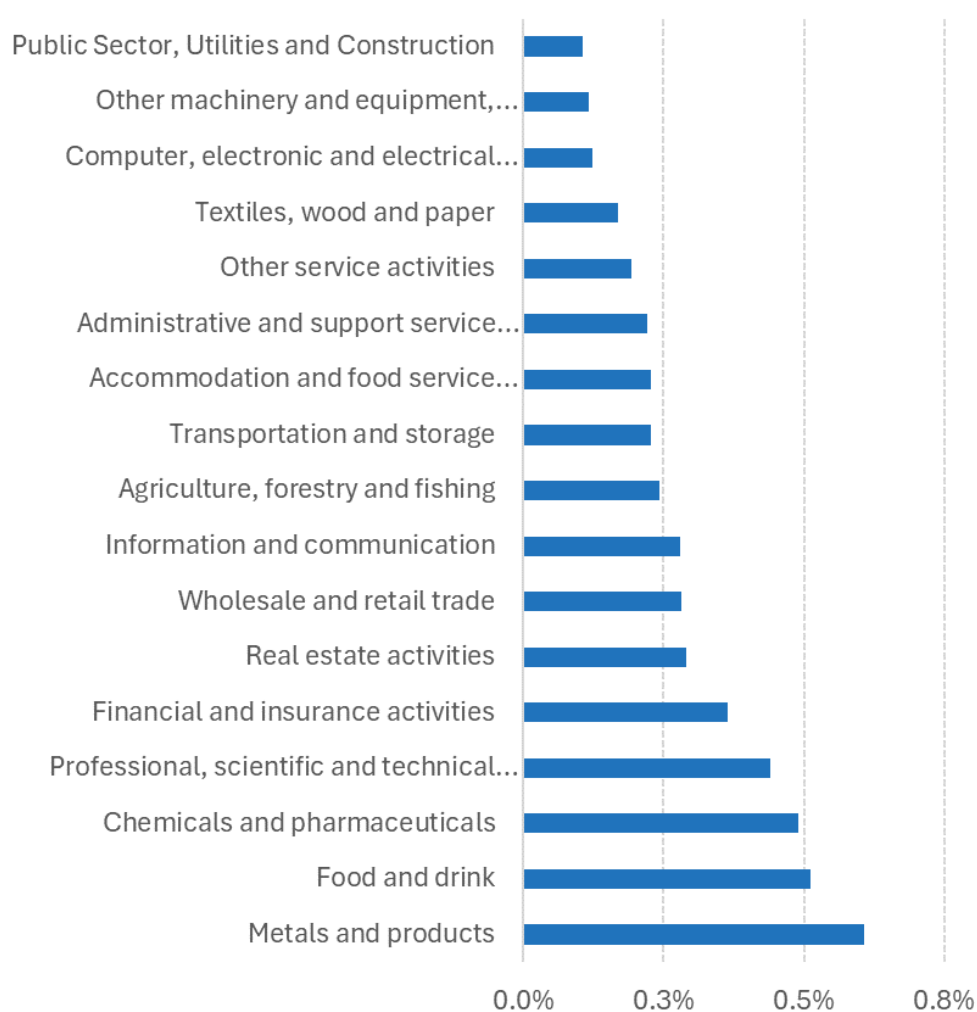


Source: SG OCEA CGE modelling

## Scenario 1 – Non-EU FTAs

Figure 7 shows the impact of the four non-EU FTAs on sectoral employment in the Scottish economy. As a result of trade liberalisation, the level of employment increases across all industries, with the largest increase observed in Metals and products, where employment increases by 0.6% relative to the baseline, followed by Food and Drink sector with 0.5% increase.

**Figure 7 – Non-EU FTAs and employment by industry, Scotland**  
% change relative to the baseline

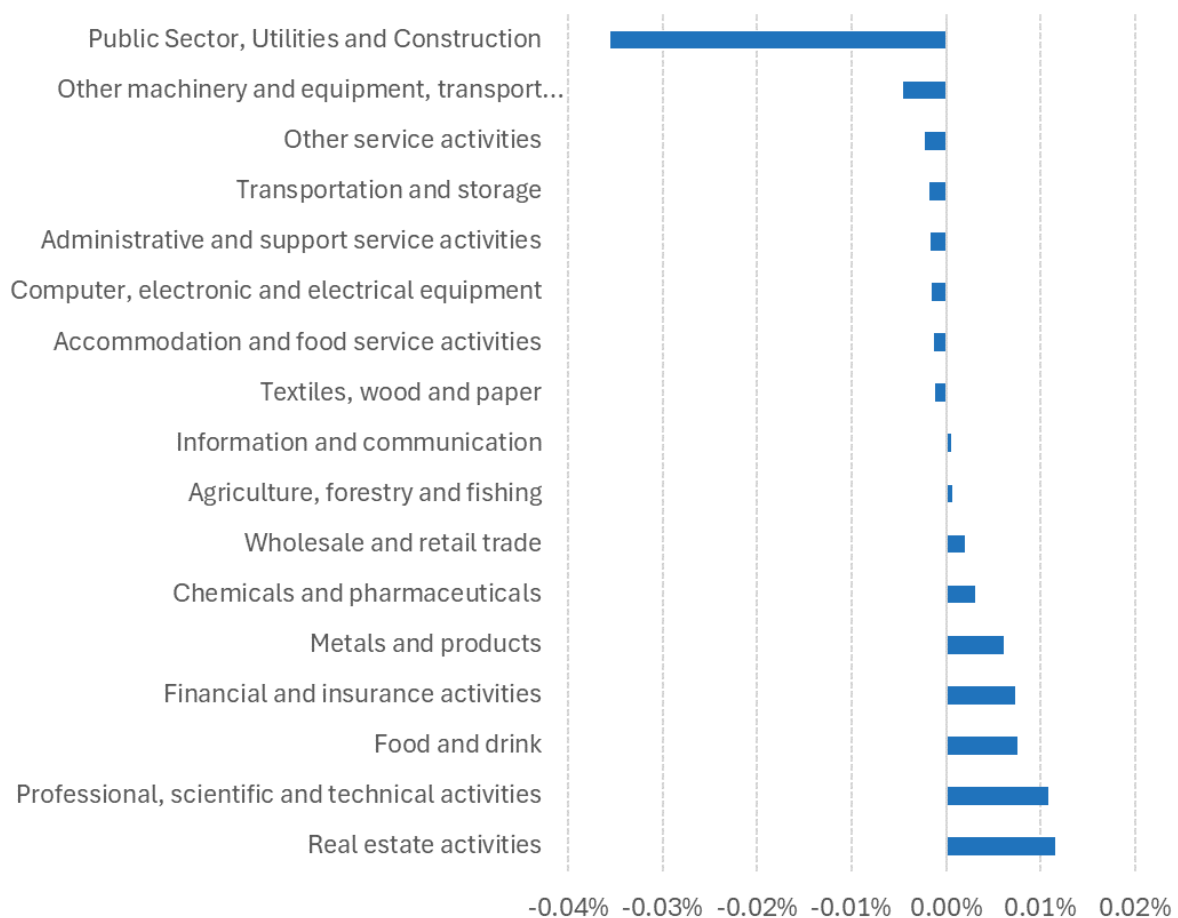


Source: SG OCEA CGE modelling

Whilst the level of employment is slightly higher across all sectors of the economy, Figure 8 shows a small decrease in the contribution of non-tradeable sectors as a share of total GVA. The share of total GVA for Public Sector, Utilities and Construction falls by 0.036 percentage points.

In contrast, some tradeable sectors – such as Professional Services, Food and Drink, Financial Services, and Metals – experience a very small increase (just over 0.01 percentage points) in their share of total GVA. This is not surprising: tradeable sectors become relatively more important in the economy due to the removal of trade barriers, which drives reallocation of resources towards those sectors and changes slightly the structure of the economy. For illustration, this means that whilst in the baseline Public Sector, Utilities and Construction accounted for around 35.13% of total GVA in the modelled economy, under this scenario the share drops to 35.10%. These changes are relatively small.

**Figure 8 – Non-EU FTAs and sectoral GVA share, Scotland**  
percentage point change relative to the baseline share

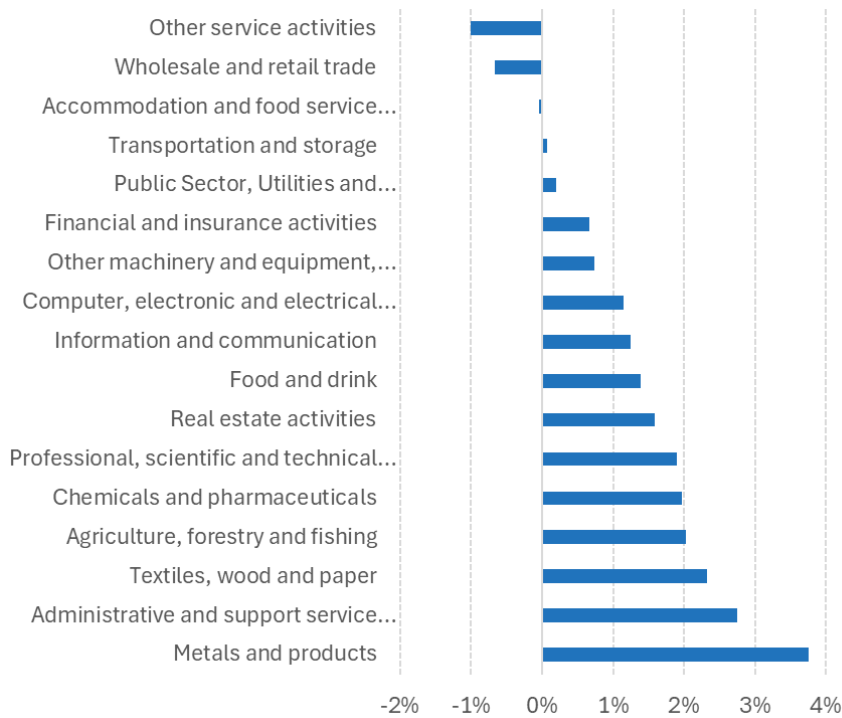


Source: SG OCEA CGE modelling

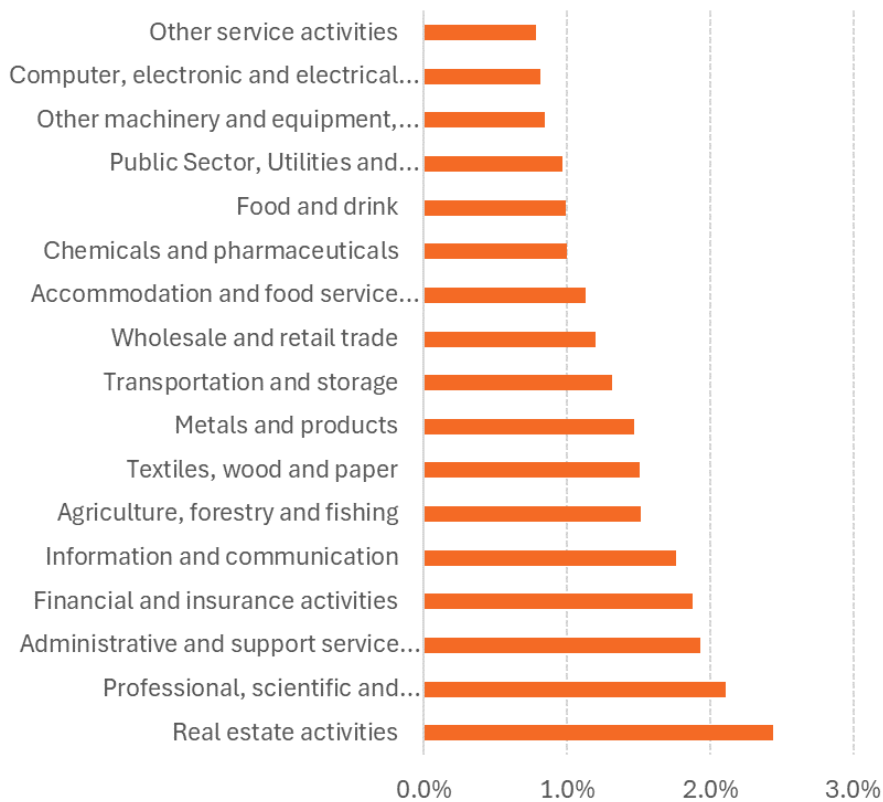
Figure 9 below shows estimated changes in international exports from the four non-EU FTAs. The largest increase in exports is estimated for Metals (+3.8%), followed by Administrative and Support Services (2.8%), and Textiles (+2.3%).

Figure 10 shows the estimated effect on international imports from the four non-EU FTAs. The largest increases are estimated across a number of services sectors, such as Real estate (+2.4%), followed by Professional, scientific and technical (+2.1%), and Administrative and support services (+1.9%).

**Figure 9 – Non-EU FTAs and international exports, Scotland  
% change relative to the baseline**



**Figure 10 – Non-EU FTAs and international imports, Scotland  
% change relative to the baseline**

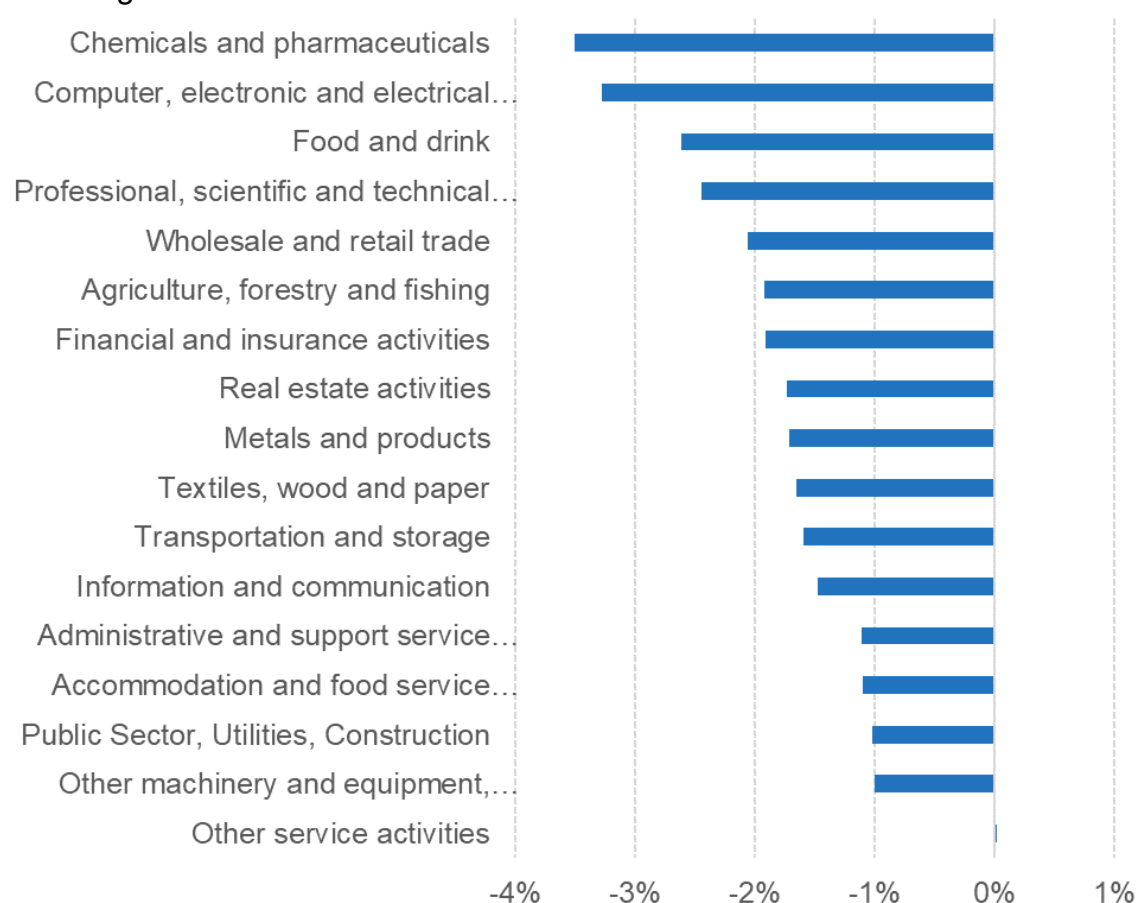


Source: SG OCEA CGE modelling

## Scenario 2 – Non-EU FTAs and TCA

Figure 11 shows the combined impact of UK–EU TCA and four non-EU FTAs on sectoral employment in the Scottish economy. The level of employment decreases across all industries, with the largest decrease observed in Chemicals and Pharmaceuticals where employment is 3.5% lower than in the baseline, followed by Computer & electronics (-3.3%) Food and Drink (-2.6%), and Professional Services (-2.4%). The estimated impact on employment is only very marginally positive, if not negligible, in Other service activities.

**Figure 11 – Non-EU FTAs plus TCA and employment by industry, Scotland**  
% change relative to the baseline

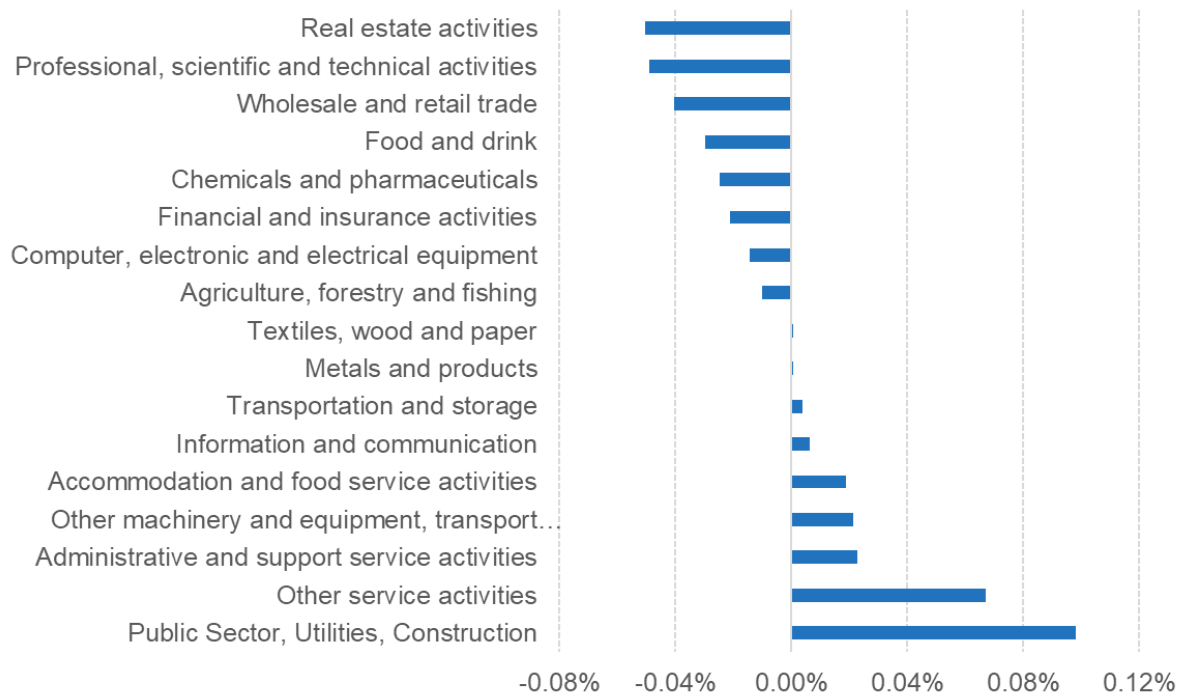


Source: SG OCEA CGE modelling

Figure 12 shows the extent of the restructuring in the Scottish economy – measured by a share of GVA – in response to a much bigger change such as the UK–EU TCA and liberalisation with non-EU countries. As the economy is less open to trade, there is a small increase in the GVA of non-tradeable sectors as a share of total GVA. The GVA share of Public Sector, Utilities and Construction increases by 0.10 percentage points relative to the baseline. In contrast, some tradeable sectors – such as Professional Services, Wholesale and Retail, Food and Drink, Chemicals, and Financial Services – experience a very small decrease in their share of total GVA.

Overall, Figure 12 suggests some compositional changes in the economy as tradeable sectors become relatively less important in the economy with the increased trade frictions under TCA outweighing any reduced barriers with non-EU partners.

**Figure 12 – TCA and non-EU FTAs and sectoral GVA share (percentage point change relative to the baseline share), Scotland**



Source: SG OCEA CGE modelling

Table 5 shows estimated changes in output of each sector, with the largest percentage reductions estimated for Chemicals and pharmaceuticals (-9.1% or £424 million), Computer, electronic and electrical equipment (-7.7% or £296 million), Textiles, wood and paper (-5.9% or £289 million), Metals (-5.9% or £240 million), and Agrifood (-4.9% or £827 million). The sectors impacted are somewhat similar to the results from the gravity simulations covered earlier in this report but unlike the earlier results, these estimates account for any supply chain impacts and wider economic effects, often amplifying the impact of the initial trade shock.



**Table 5 – non-EU FTAs plus TCA and changes in output, Scotland**

(relative to the baseline)

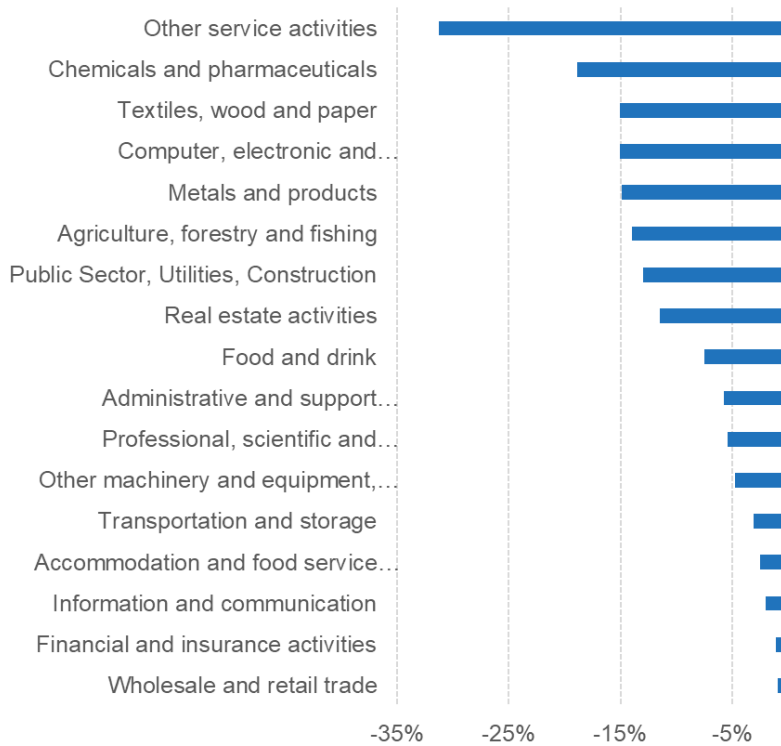
Sector	% change	Change in £m, based on 2019 output data
Chemicals and pharmaceuticals	-9.1	-£424m
Computer, electronic and electrical equipment	-7.7	-£296m
Textiles, wood and paper	-5.9	-£289m
Metals and products	-5.9	-£240m
Food and drink	-4.9	-£540m
Agriculture, forestry and fishing	-4.8	-£287m
Other machinery and equipment, transport equipment	-2.8	-£246m
Professional, scientific and technical activities	-2.1	-£325m
Other service activities	-1.9	-£589m
Real estate activities	-1.9	-£397m
Administrative and support service activities	-1.6	-£176m
Information and communication	-1.4	-£339m
Financial and insurance activities	-1.4	-£122m
Transportation and storage	-1.3	-£156m
Public Sector, Utilities, Construction	-0.7	-£490m
Wholesale and retail trade	-0.6	-£140m
Accommodation and food service activities	-0.5	-£42m

Source: SG OCEA CGE modelling; Scottish Government Supply and Use Tables 2019

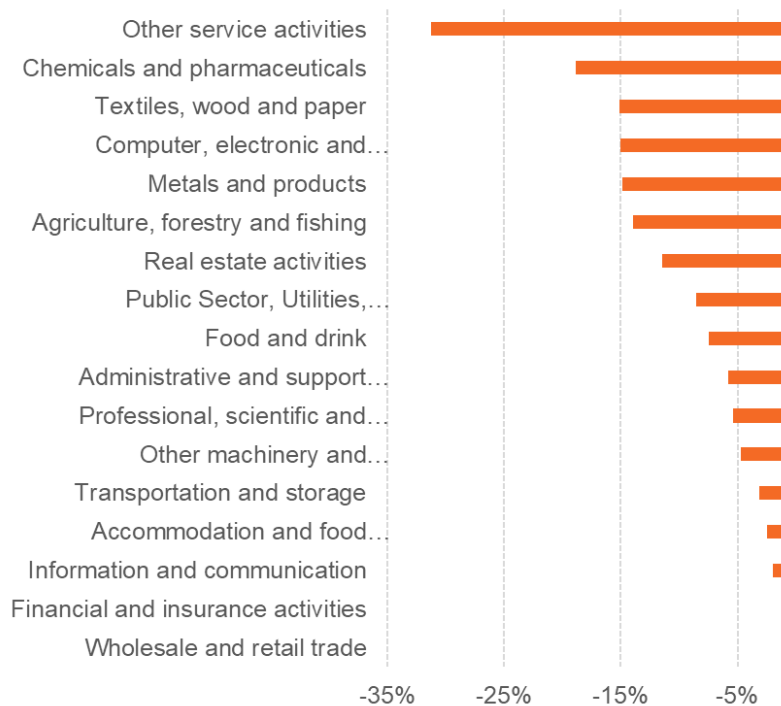
Figure 13 shows the combined impact of UK–EU TCA and four non-EU FTAs on international exports, with all sectors experiencing a decrease relative to the baseline. The largest decrease is estimated for Other services activities (-31.2%), followed by Chemicals and Pharmaceuticals (-18.8%), and Textiles (-15.1%). Similarly, international imports across all sectors are also estimated to decrease in the long run, with the largest decreases observed in the same sectors as for exports.

**Figure 13 – TCA and non-EU FTAs and Scotland’s international exports and imports (% change relative to the baseline)**

**Exports**



**Imports**



Source: SG OCEA CGE modelling

## Limitations

This analysis aims to estimate the long-term impact of trade policy changes using a range of established modelling frameworks. Any economic modelling is inherently uncertain and driven by assumptions. Assumptions underpinning the gravity model and CGE model are covered in Annex B and D.

There are underlying data limitations which affect the modelling. The main international trade dataset that is widely used for gravity modelling, ITPD-E, has some problems with missing data. Our Scottish version, based on ITPD-E, mitigates this to some extent by using more aggregated sectoral data (due to lack of availability of granular trade data for Scotland).

However, this lack of granularity in Scottish data, both for the gravity model and the CGE model, limits the detail available in the modelling outputs. It also makes it difficult to undertake any detailed analysis of any changes in tariffs and non-tariffs barriers for the scenarios which is typically done with product-level data.

The other key data limitation is that the baseline year for the data used in the models is 2018 for the gravity model and 2013 for the two-region CGE model, reflecting the latest available Social Accounting Matrix that incorporates both Scotland and the rest of the UK. Whilst it is typical for economic models to use lagged data for the baseline year there have been changes in the economy over the period that may have a bearing on the results of simulations. That said, the structure of the economy – in terms of sectoral composition and importance of tradeable sectors – has not necessarily changed substantially which provides a level of confidence in the simulation results. The lagged nature of the model inputs is also the reason why all monetary figures are informed by the latest statistics on international exports, imports, and employment.

One of the key assumptions driving the results of this analysis are assumed changes in trade costs due to changes in trading relationships. This analysis assumes that changes in trade costs with each partner country would reflect an impact of an average trade deal as estimated in a sectoral gravity model. The estimated impact of an average trade deal reflects the impact of both reductions in tariffs and other trade costs, and non-tariff barriers. This means that trade costs estimates are highly uncertain and may not reflect the actual changes in trade costs. On the other hand, the approach taken has a benefit of being simple and transparent and is also widely used in the literature.<sup>23</sup>

In addition, the estimated impact of an average trade deal relies on a sample of data and changes in trading relationships between countries covering 2003–2018 in line with the approach taken by a study that estimates sectoral gravity model using

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<sup>23</sup> See for example [Estimating the trade and welfare effects of Brexit: A panel data structural gravity model - Oberhofer - 2021 - Canadian Journal of Economics/Revue canadienne d'économie - Wiley Online Library](#)

similar data.<sup>24</sup> This estimate may not be reflective of changes in trade that may take place under future trading agreements. It is also possible that the main specification omits important factors such as any changes in relative trends between international and domestic trade, the pace of globalisation and other factors. The literature in this space is still evolving and there is no established best practice approach to estimating the impact of trade agreements.

Moreover, it is also assumed that the impact of the UK–EU TCA relative to the continued EU membership can be also captured by changes in trade costs for an average trade deal. It is likely that the negative impact of replacing the full EU membership with the UK–EU TCA could be larger in magnitude than the impact of an average trade deal due to the depth of the economic relationship between the UK and the EU compared to the average trade agreement and wider channels of economic impact.

It is possible to account for larger changes in trade barriers in a gravity model specification and that could mean that the UK–EU TCA could represent an even larger negative shock for the economy. At the same time, it would not alter substantially one of the key findings of this analysis – the cumulative impact of trade liberalisation with a number of non-EU partners represents a much smaller economic shock than changes in the economic relationship with the EU.

Taken together, the uncertainty around changes in trade costs is explored through further sensitivity analysis and robustness checks. As part of these checks, additional simulations are undertaken using lower and upper estimates of changes in trade costs or varying value of key parameters such as trade elasticity to develop ranges for the estimated impacts in addition to the reported central estimates. These are covered in more detail in Annex E.

In this report we present estimated impacts from both the gravity model and the CGE model. The methodological differences between the two approaches, and their individual limitations, can lead to differences in results. Using both approaches in conjunction allows us to mitigate their individual limitations. The fact that the models often yield broadly similar findings despite their methodological differences gives confidence in the robustness of the results.

A limitation of the sectoral gravity modelling is that the relationship between different sectors is not taken into account. In the real economy, a change in prices in one sector can affect prices in another sector, due to changes in the cost of inputs or substitution effects. The gravity model treats each sector separately, ignoring any such effects. This is one reason for combining the gravity analysis with the CGE model, which has input–output linkages between sectors built in.

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<sup>24</sup> [Borchert et al 2020. Disaggregated Gravity: Benchmark estimates and stylized facts from a new database](#)

The CGE model used in this report, while it does include trade, is not primarily designed as a trade model, and it treats the rest of the world as completely exogenous. This means that third country effects are not included. This is not likely to be a significant issue, due to the small scale of the Scottish economy and the scenarios considered. This is also an aspect that the gravity model is designed to include.

It should be noted that the differential impacts analysis presented in this report uses aggregated data and relies on sectoral averages to show how different types of workers or different geographies in Scotland could be impacted by the scenarios. Data limitations mean that any impacts are highly illustrative and may not reflect the true experiences of workers and communities across Scotland.

Furthermore, this analysis only provides an indication of magnitude and direction of the potential impact on the economy under scenarios analysed. It does not provide a forecast of the future path of the economy but shows what the impact may be relative to the baseline under a specific set of scenario assumptions. It also does not account for any other changes and economic policy changes that may take place and transform the economy, nor does it consider any potential future changes in the global economy, including any potential changes in demand, trade, and technological progress.

## Differential impacts

Trade liberalisation can benefit the economy through greater specialisation, higher productivity, and higher levels of economic activity.

As trade barriers are removed, businesses benefit from greater access to international markets, firms are encouraged to enter new markets, and trade increases. This tends to raise productivity across the economy, resulting in higher earnings for workers.

However, trade also exposes domestic firms to import competition which may reduce demand for domestic goods and services. In response, domestic industries are required to adjust: either becoming more productive and competitive, or risking loss of market share and profitability, with associated impacts on workers and the communities where these firms are based.

In other words, trade liberalisation causes a restructuring in the economy – some sectors gain and others lose. This has implications for workers as well as businesses.

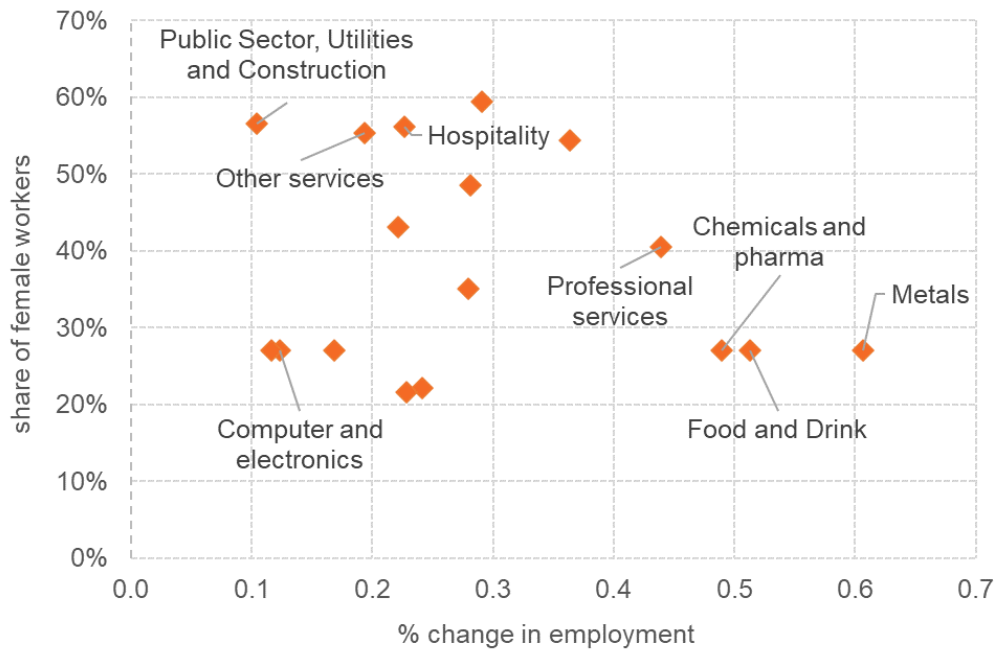
To understand the distributional impact of trade scenarios on workers, the estimated impact on sectoral employment from the CGE model is linked to the additional data on sectoral employment by characteristics. The impact can be different across characteristics such as gender, ethnicity, disability, age, and others.

As an initial exercise, this section considers the impact on female and male workers. We also look at regional impact of the scenarios. We do not consider the impact on consumers through changes in prices and availability of products as a result of trade policy changes, although this is also an important channel of impact on households. Further work in this space could explore feasibility of producing labour market impact breakdowns for other characteristics, smaller geographies, and consumer impacts with the data available for Scotland.

First we look at the labour market impact of Scenario 1 – trade liberalisation with non-EU partners. Figure 14 shows that employment increases the most in relative terms in manufacturing of metals, which tends to have a low proportion of female workers. Sectors with a higher proportion of female workers (such as Public Administration, Education, and Health combined with Utilities and Construction, Other services, Hospitality) generally tend to see smaller increases in employment relative to the baseline. This finding is not surprising as tradeable sectors tend to have a lower share of female workers.

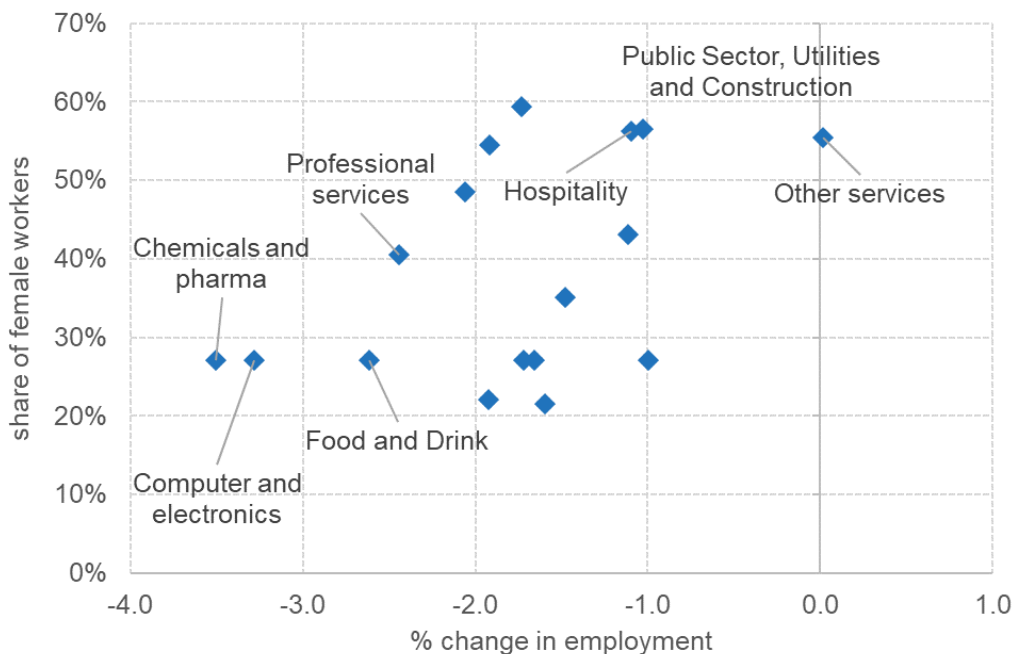
Figure 15 shows the combined impact of the four non-EU FTAs and the UK–EU TCA on sectoral employment alongside the share of female workers. It shows that sectors that see the largest decreases in employment tend to have lower shares of female workers. This may suggest that industries with a large proportion of male workers may be impacted more negatively by the UK–EU TCA.

**Figure 14 – Employment impact of non-EU FTAs and share of female workers by industry in Scotland**



Source: CGE modelling and ONS employment data

**Figure 15 – Employment impact of non-EU FTAs + TCA and share of female workers by industry in Scotland**



Source: CGE modelling and ONS employment data

Another way in which our scenarios could affect different groups of people differently is through varying impacts across regions of Scotland. To investigate this, we have used the sectoral percentage change in employment as above, and combined this

with data on employment in each region by sector, from the ONS Business Register and Employment Survey. This allows us to estimate the impact on employment by region in our scenarios.

Figure 16 shows the employment change by region in Scenario 1: the four non-EU FTAs. All regions experience an increase in employment, with employment in the North East of Scotland and parts of the Central Belt increasing the most, and Dundee, East Ayrshire, and Clackmannanshire increasing the least. However, the differences between regions are relatively small, with all increases in employment being between 0.19% and 0.23%.

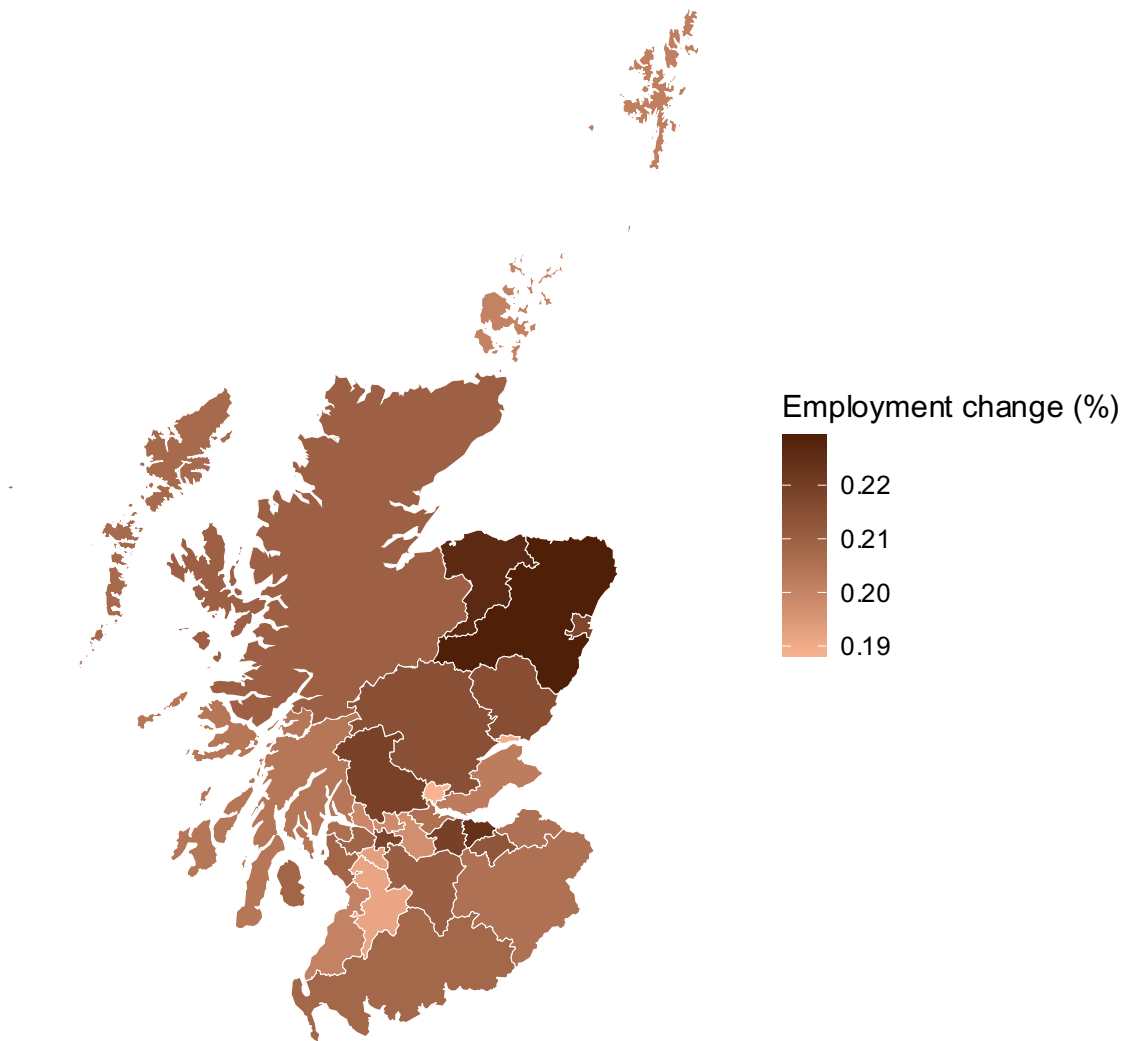
Figure 17 shows the employment change by region in Scenario 2: the non-EU FTAs and the UK–EU TCA. All regions experience a decrease in employment. The pattern is similar to that seen for Scenario 1: the North East experiences the largest decrease in employment, while Dundee, Clackmannanshire, and areas around Glasgow experience the smallest decrease. The decreases are all between 1.3% and 1.5%.

The sectors most affected by Scenario 1 are Metals, Food & Drink, and Chemicals & Pharmaceuticals. The regions whose overall employment is most affected by Scenario 1 tend to be above average in terms of employment share in these sectors.

The sectors most affected by Scenario 2 are Chemicals & Pharmaceuticals, Electrical Equipment, and Food & Drink. Employment share in these sectors is concentrated in the North-East, which is the region most affected by Scenario 2.



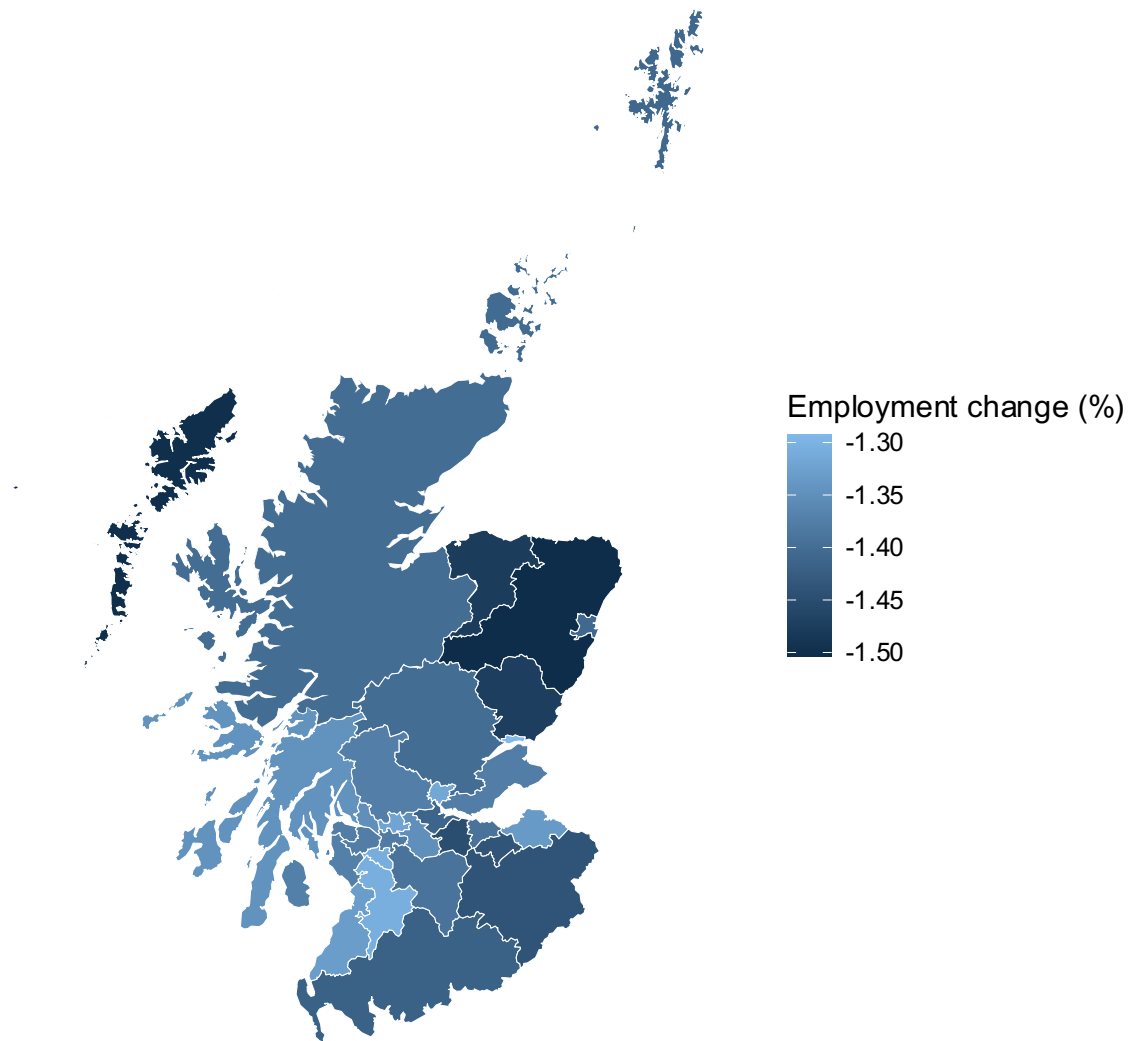
**Figure 16 – Employment change by local authority region due to all non-EU FTAs**



Source: SG OCEA CGE modelling and ONS employment data

The map shows greater employment increase in the North East and parts of the Central Belt, and smaller employment increases in local authorities such as Dundee, East Ayrshire, and Clackmannanshire.

**Figure 17 – Employment change by local authority region due to all non-EU FTAs and the EU TCA**



Source: SG OCEA CGE modelling and ONS employment data

The map shows greater employment decrease in the North East, and smaller employment decrease in Dundee, Clackmannanshire, and areas around Glasgow.

## Discussion

This section summarises key findings from the analysis presented in earlier chapters.

### **TCA is a big economic shock compared to the non-EU FTAs considered in this analysis**

As shown in this analysis and other publications<sup>25</sup> the departure of the UK from the EU represents a large negative economic shock for the Scottish and UK economies. The impact of trade agreements with the four non-EU partners considered is significantly outweighed by the impact of increased trade barriers under the UK–EU TCA. It is expected that the cumulative impact of the four deals analysed in this report combined with trade agreements with other non-EU partners, such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), New Zealand, and others, would still likely be outweighed by the negative impact from the UK–EU TCA.<sup>26</sup>

### **Impact on GDP**

This analysis shows that under the UK–EU TCA and with four non-EU trade agreements implemented, Scotland's GDP is estimated to be at least 2% lower (or at least £4 billion lower using the 2023 value of GDP) in the long run compared to the baseline of continued EU membership. In contrast, the four non-EU trade agreements alone are estimated to increase Scotland's GDP by only 0.2% (or by £0.4 billion) in the long run. Note that these estimates only reflect changes in trade barriers<sup>27</sup> and do not account for any other channels of impact. For example, any impacts on productivity or investment under the UK's departure from the EU are not reflected in this modelling and can be significant. For example, recent modelling by the National Institute of Economic and Social Research showed that compared to EU membership UK GDP could be 5.7% lower by 2035 when accounting for wider economic channels. For simplicity and comparability, this analysis only focuses on changes in trade costs across the two scenarios.

### **Impact on trade**

As a result of UK trade policy changes considered in this assessment – the UK–EU TCA and non-EU trade agreements – international exports could be 7.2% lower (or £3 billion using values in 2023) and international imports could be 8.8% lower (or £4 billion), compared to the baseline of continued EU membership. In contrast, the four non-EU trade agreements considered in this analysis could together increase both international exports and imports by roughly 1% (or £0.5 billion using 2023 values).

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<sup>25</sup> See for example [Scottish Sectoral Economic Impact Analysis \(www.gov.scot\)](http://www.gov.scot) or [Modelling the long-term impact of Brexit on the Scottish economy | FAI \(fraserofallander.org\)](http://fraserofallander.org)

<sup>26</sup> See [EU Exit: Long-term economic analysis](#)

<sup>27</sup> Using specific assumptions around potential changes in trade costs informed by gravity modelling. Other studies may produce different results using different assumptions.

This reflects the nature and scale of trade that happens currently with these non-EU partners, who, in comparison to the EU, represent a much smaller market for the UK and are geographically more distant and more costly to trade with.

This report shows that exports to Australia and India could increase by around 40% each, and exports to Switzerland and Türkiye could increase by around 6% each. This corresponds to £200 million in increased exports to Australia, £120 million to India, £55 million to Switzerland, and £10 million to Türkiye (based on the latest available values for exports to these countries which is for 2021).<sup>28</sup> Imports could increase by 51%, 49%, 23%, and 7% respectively. The four non-EU FTAs alone could lead to an increase in total exports to the four countries of 29%<sup>29</sup>, and an increase in imports of 23%. Because of data availability, it is not possible to calculate cash terms increases in imports.

### **Non-EU FTAs (Scenario 1) – Sectoral Impact**

This analysis estimates that the four non-EU FTAs could increase employment across all sectors of the economy, with the largest increase estimated for the Metals and products sector which is also a sector that is estimated to see the largest increase in output. In general, tradeable sectors become relatively more important in the economy due to the removal of trade barriers with non-EU partners, which drives reallocation of resources towards those sectors and changes slightly the structure of the economy.

However, because the Scotland-specific analysis is at a fairly high level of aggregation, it can hide a more complicated picture. UK-level granular analysis of the agri-food sector finds the output of Prepared animal feeds increasing by 0.3% or £34 million, and that of processing and preserving of meat decreasing by 0.1% or £26 million. Similarly, UK-level granular analysis of textiles finds the output of industries such as “tanning & dressing of leather” and “textile fibre preparation & weaving” increasing by over 0.3%, and “made up textiles except apparel” decreasing by 0.6%, driven primarily by the impact of the trade deal with India which is still being negotiated at the time of this analysis. It should be noted that these estimates are informed by analysis of sectors at a more granular level using data for the UK as a whole but broad implications for Scotland, at this sub-sectoral level, are likely to be similar revealing a pattern of winners and losers.

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<sup>28</sup> Note that this refers to the changes in trade when accounting for the impact of the TCA as reported in Table 4 (non-EU partner results are qualitatively similar to Table 3).

<sup>29</sup> Or by 27% when removing the impact of TCA – see Table 3.

## **TCA plus non-EU FTAs (Scenario 2) – Sectoral Impact**

This analysis shows that the UK–EU TCA represents a large negative economic shock for all sectors of the Scottish economy which significantly outweighs the positive impact of the four non-EU FTAs modelled. The largest decreases in employment are estimated for Chemicals and Pharmaceuticals, Computer and electronics, Food and Drink, and Professional Services. More broadly, tradeable sectors become relatively less important in the economy with the increased trade frictions under TCA significantly outweighing reduced barriers with non-EU partners. The largest reductions in output are estimated for Chemicals and pharmaceuticals (-9.1% or £424 million), Computer, electronic and electrical equipment (-7.7% or £296 million), Textiles, wood and paper (-5.9% or £289 million), Metals (-5.9% or £240 million), and Agrifood (-4.9% or £827 million). International exports and imports are also estimated to be lower across all sectors, with the largest decreases in Other services sectors, Chemicals and Pharmaceuticals, and Textiles across both exports and imports.

### **Limitations**

One of the key assumptions driving the results of this analysis is that changes in trade costs with each partner country or the EU as a whole would reflect an impact of an average trade deal, as estimated in a sectoral gravity model using historical data. It is not possible to accurately measure changes in trade barriers that will take several decades to fully affect the economy.

Moreover, three out of the four non-EU FTAs are still under negotiation, which means these estimates are highly illustrative. In general, using an average trade deal to approximate trade costs is a well-established approach in the literature but also means the estimated impacts are highly uncertain. Sensitivity analysis is used to explore some of this uncertainty in trade costs – see Annex E.

Furthermore, the economic impact of the foregone EU membership may be larger than the impact estimated in this report. For simplicity, this analysis only considers changes in trade barriers associated with an average trade deal and does not account for other channels of economic impact which will be important for this scenario.

Finally, this analysis provides an indication of magnitude of the potential long-term impact on the economy under different scenarios; it does not provide a forecast of the future path for the economy. As such, it does not consider any other future changes in the domestic and global economy that may affect the interpretation of findings.

## Conclusion

This report carries out modelling of four non-EU FTAs and the UK–EU TCA, employing two modelling methodologies (Computable General Equilibrium and Gravity) in parallel, to estimate the long-run impacts on the Scottish economy.

Introducing new trade agreements with Australia, India, Switzerland, and Türkiye represents a reduction in trade costs and is estimated to increase in trade with these partners. The UK–EU TCA represents an increase in trade costs and is estimated to decrease the level of trade and economic activity in the Scottish economy.

When the impacts of the non-EU FTAs and the UK–EU TCA are considered together, the generally negative effect of the TCA is estimated to significantly outweigh the small positive impact of the new FTAs.

This analysis has shown that different sectors can be affected differently by trade agreements. This can mean that different groups of people might be affected differently. The exploratory analysis included in this report shows how the impacts could differ by gender and by region of Scotland.

This analysis indicates that sectors with a larger proportion of female workers may see lower gains in employment resulting from the non-EU FTAs than sectors with a large proportion of male workers. Conversely, industries with a large proportion of male workers may experience a greater adverse effect of the UK–EU TCA.

We find some regional variation, but not of sufficient magnitude to complicate the national picture: all regions experience an increase in employment under the non-EU FTAs and all regions experience a decrease in employment when the TCA is included. The main standout result is the North East of Scotland which experiences the biggest impact in both scenarios, with employment increasing by around 0.23% under the non-EU FTAs, and decreasing by around 1.5% when the TCA is included.

Overall, the findings of this report show that UK trade policy, such as signing new FTAs or implementing the TCA, can have important implications for the Scottish economy. These findings reinforce the generally accepted picture that reducing barriers to trade can lead to greater economic prosperity and increasing barriers can harm the economy, while also highlighting that all sectors and participants in the economy are unlikely to be affected equally. This report forms part of an evidence base to understand the impacts of trade policy changes in Scotland and supports objectives set out in the Scottish Government's Vision for Trade.

# Annex

## A. UK Government analysis for Australia and India FTAs

**Table A1 – UK-wide effects of UK–Australia FTA**

Trading partner	Export change	Import change
Australia	+44.2%	+66.1%
All international partners	+0.43%	+0.36%

Source: [Impact assessment of the Free Trade Agreement between the United Kingdom of Great Britain and Northern Ireland and Australia \(publishing.service.gov.uk\)](#) See page 66, Table 5.

**Table A2 – UK-wide effects of UK–India FTA**

Trading partner	Export change	Import change
India (Scenario 1)	+49.5%	+30.7%
All international partners (Scenario 1)	+0.5%	+0.38%
India (Scenario 2)	+94.6%	+63.7%
All international partners (Scenario 2)	+1.1%	+0.77%

Source: [UK–India Free Trade Agreement – The UK's Strategic Approach \(publishing.service.gov.uk\)](#) See page 55, Table 2. Scenarios 1 and 2 represent moderate and higher degrees of tariff liberalisation respectively, defined on page 54.

Compared to modelling results in Tables 3 and 4 of this report, the impact on exports to Australia is similar, but UK modelling finds larger impact on imports. The modelling results for India presented in this analysis are broadly similar to the UK results under a moderate degree of tariff liberalisation. It would not be reasonable to expect the results to be exactly the same, as a different modelling methodology was deployed in this report and there could be underlying differences between the Scottish and UK economies.

It is also important to note that the “all international” export and import changes are based on just considering one FTA at a time, while SG results presented in Tables 3 and 4 are based on all scenarios cumulatively.

## B. Gravity model

### Estimation and Simulation

The following equation to specify the gravity model is used.

$$\log X_{ij,t}^k = \pi_{i,t}^k + \chi_{j,t}^k + \mu_{ij}^k + \beta^k \text{FTA}_{ij,t} + \varepsilon_{ij,t}^k$$

Where:

- $X_{ij,t}^k$  is the trade flows from country  $i$  to country  $j$  in year  $t$  for industry sector  $k$
- $\pi_{i,t}^k$  is the exporter–year fixed effect
- $\chi_{j,t}^k$  is the importer–year fixed effect
- $\text{FTA}_{ij,t}$  is a dummy variable recording whether countries  $i$  and  $j$  have a free trade agreement in year  $t$
- $\beta^k$  is the coefficient that determines the magnitude of the effect of a free trade agreement on trade flows after controlling for the fixed effects
- $\varepsilon_{ij,t}^k$  is a stochastic error term

Trade data from the Scottish International Bilateral Trade Dataset (SIBTD) and International Trade and Production Database for Estimation (ITPD-E)<sup>30</sup> to obtain  $X_{ij,t}^k$ , data from the Dynamic Gravity Dataset to obtain  $\text{FTA}_{ij,t}$ , and use Poisson Pseudo-Maximum Likelihood (PPML) estimation with fixed effects to estimate  $\beta^k$ <sup>31</sup>. This model is applied to each industry separately in SIBTD and ITPD-E, using data from 2003 to 2018. In addition, partial estimates in instances where the model does not converge or produce economically meaningful results are also supplemented with values from Borchert et al. (2020) which runs a slightly different PPML specification for the 170 industries in the International Trade and Production Database for Estimation (ITPD-E).

For simulation, the `ge_gravity` function in the `GEGravity` R package<sup>32</sup> is used with the baseline year of 2018 and using a trade elasticity parameter of 4.

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<sup>30</sup> Borchert, I., Larch, M., Shikher, S., and Yotov, Y. (2022), "The International Trade and Production Database for Estimation - Release 2 (ITPD-E-R02)," *USITC Working Paper 2022–07–A*. Also: Borchert, I., Larch, M., Shikher, S., and Yotov, Y. (2021), "The International Trade and Production Database for Estimation (ITPD-E)," *International Economics*, 166, 140–166.

<sup>31</sup> Specifically, we use the function `feglm` from the R package `fixest`.

<sup>32</sup> Baier, Scott L., Yoto V. Yotov, and Thomas Zylkin. "On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration". *Journal of International Economics* 116 (2019): 206-226.



## Data

For Scotland-specific analysis a new dataset called the Scottish International Bilateral Trade Dataset (SIBTD) is used. This dataset is based in the International Trade and Production Database for Estimation (ITPD-E), which is a widely used dataset for gravity estimation. ITPD-E contains 170 industries, 265 countries, and covers the years 1986 to 2019 (services industries only from 2000 onwards, and 2019 having substantial gaps).

ITPD-E contains trade data for the UK as a whole. To carry out Scotland-specific gravity modelling various other sources of data (including Scottish Government and ONS supply–use tables (SUTs) and Export Statistics Scotland (ESS)) were used to split UK flows in ITPD-E into Scottish and the rest of the UK flows.

SIBTD contains 25 industries, 43 countries, and covers the years 2002 to 2019. The loss of industry granularity results from the need to aggregate to a common industry classification in order to combine ITPD-E data and SUT/ESS data. The dataset starts in 2002 because this is when ESS starts. The decision to use a smaller set of 43 countries is partly motivated by availability of ESS data, but it is worth noting that these 43 countries account for over 90% of world trade, and the results of gravity estimations are not usually particularly sensitive to the choice of whether to include the smaller countries.

## C. Revealed comparative advantage

Comparative advantage is an important concept in international trade. A country is said to have a comparative advantage in a given sector if it can produce products in that sector at a lower cost than other countries. In theory, one would then expect countries to produce more of products in which they have a comparative advantage and import products where they do not have an advantage.

Revealed comparative advantage (RCA) is a way of quantifying comparative advantage using real trade flows by inverting the above logic. A country's RCA for a sector  $k$  is defined by

$$RCA_{i,k} = \frac{E_{i,k} / \sum_{k'} E_{i,k'}}{\sum_{i'} E_{i',k} / \sum_{i',k'} E_{i',k'}}$$

Where  $i$  denotes the country in question and the dummy variables  $i'$  and  $k'$  are summed over all countries and industry sectors. In other words, a country's RCA in a sector is the fraction that sector contributes to the country's total exports divided by the corresponding ratio for all countries summed together.

We have calculated the normalised RCA according to

$$NRCA = \frac{RCA - 1}{RCA + 1}$$

In order to obtain values between -1 and 1. We have calculated these using the Scottish International Bilateral Trade Dataset in order to inform the discussion of what might be driving the results we have obtained in our main analysis. Results for Scotland, the UK, the EU, and the four FTA partners are shown below. A few particularly large comparative advantages have been highlighted in bold.

**Table C1 – Revealed comparative advantage by sector (Scotland, the UK, Australia, India, Switzerland, Türkiye, and EU27)**

Industry sector	Scotland	UK	AUS	IND	CHE	TUR	EU27
Agriculture, forestry, fishing	0.04	-0.56	<b>0.40</b>	0.16	-0.89	0.24	-0.37
Mining & quarrying	<b>0.66</b>	-0.17	<b>0.85</b>	-0.48	-0.95	-0.24	-0.77
Food and beverages	<b>0.56</b>	-0.10	<b>0.22</b>	0.04	-0.22	-0.07	0.07
Textiles, clothes, leather	-0.29	-0.47	-0.89	<b>0.58</b>	-0.66	<b>0.68</b>	-0.17
Wood, paper, printing	-0.39	-0.33	-0.41	-0.66	-0.50	-0.39	-0.02
Coke, refined petroleum, chemicals	-0.36	-0.12	-0.63	0.25	-0.22	-0.37	-0.05
Pharmaceuticals	-0.52	-0.01	-0.60	0.19	<b>0.65</b>	-0.69	<b>0.35</b>
Rubber, plastic, non-metallic minerals	-0.25	-0.29	-0.89	-0.12	-0.38	0.27	-0.09
Metals, fabricated metal, exc machinery	-0.52	-0.03	0.14	0.03	<b>0.38</b>	0.25	-0.14
Computer, electronic, optical	-0.48	-0.46	-0.81	-0.74	-0.07	-0.73	-0.28
Electrical equipment	-0.69	-0.45	-0.89	-0.30	-0.28	0.13	-0.10
Machinery and other equipment	-0.36	-0.20	-0.84	-0.22	-0.05	-0.19	0.13
Transport equipment	-0.56	-0.01	-0.92	-0.40	-0.77	<b>0.31</b>	0.07
Furniture, other manuf., Repair, installation	-0.69	-0.35	-0.51	<b>0.45</b>	0.15	-0.23	0.01
Utilities	-0.69	-0.54	-0.99	-1.00	0.07	-0.46	-0.06
Construction	<b>0.51</b>	0.18	-0.61	-0.17	-0.25	<b>0.52</b>	<b>0.20</b>
Wholesale and retail,	-0.44	<b>0.37</b>	-0.72	-0.13	0.22	-0.08	-0.01
Transportation, storage	-0.07	0.06	-0.53	-0.48	-0.06	0.11	0.19
Accommodation, food services	0.01	-0.04	-0.32	-0.34	-0.13	0.16	0.01
Information and communication	0.24	<b>0.30</b>	-0.42	<b>0.58</b>	0.18	-0.77	<b>0.23</b>
Financial and insurance	<b>0.56</b>	<b>0.67</b>	-0.45	-0.65	<b>0.33</b>	-0.77	0.09
Professional, scientific, tech., admin., support	0.30	<b>0.50</b>	-0.41	0.27	0.03	-0.62	0.19
Education	<b>0.68</b>	0.24	-0.31	-0.67	-0.65	-0.82	-0.35
Other services	<b>0.75</b>	<b>0.30</b>	-0.81	-0.22	0.08	<b>0.30</b>	0.03

Source: SG OCEA calculations using Scottish Government supply-use tables and International Trade and Production Database for Estimation

## D. Computable General Equilibrium model

A Computable General Equilibrium (CGE) model consists of a series of equations based on economic theory which describe the behaviour of agents in an economy (firms, households, and government). It is also a standard tool for trade policy analysis.

In this analysis, a two-region version of the Scottish Government's CGE model is used, incorporating both the Scottish and the rest of the UK economies. Some of the key assumptions underpinning the model are covered below but for further detail please refer to [Computable General Equilibrium modelling: introduction – gov.scot \(www.gov.scot\)](https://www.gov.scot/publications/computable-general-equilibrium-modelling-introduction/pages/2.aspx)

- Changes in trade costs are sourced from the gravity model estimations and are introduced in the model for both exports and imports broadly in line with the approach outlined in [The long-term economic implications of Brexit for Scotland: An interregional analysis – ScienceDirect](https://www.sciencedirect.com/science/article/pii/S0950080418300011)
- The model assumes regional bargaining in the labour market (a negative relationship between real wages and unemployment); fixed government spending so that any changes in government revenues are absorbed by changes in the fiscal balance; that investors and consumers are forward looking; and that Scotland is a small open economy, too small to affect significantly any global prices.

## E. Sensitivity Analysis

To explore how sensitive the results are to the choice of key parameter values, gravity and CGE simulations are also run with higher or lower values of trade elasticity and trade cost changes. This aims to account for uncertainty around the central estimates presented in the main body of the report.

In addition, there are many choices one can make in specifying the gravity estimation, with some ongoing discussion in the literature as to best practice. To investigate whether the partial estimates from the gravity model are sensitive to the particular choices made, various alternative specifications were explored, covering different choice of years used in the estimation sample, using symmetric and asymmetric pair fixed effects, border–year fixed effect, and different clustering approaches. As expected, some of these alternative specifications produced different estimates but did not fundamentally alter the key findings of this analysis.

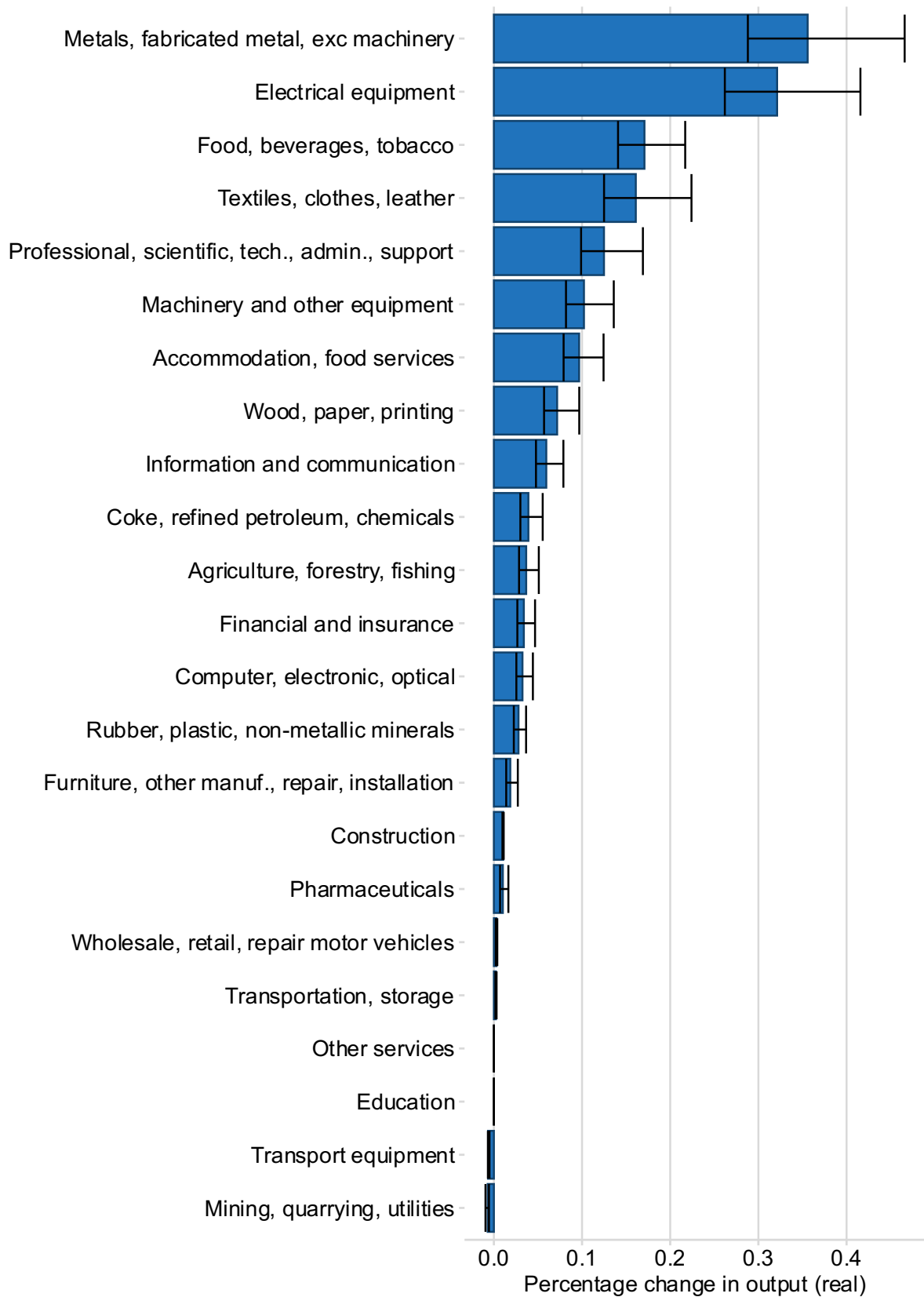
### Gravity

For the main analysis, a trade elasticity of 4 is used following the default specification in GE Gravity R package. In practice elasticities can vary significantly by sector. For example, a recent paper by Fontagne et al. (2022)<sup>33</sup> showed considerable heterogeneity in trade elasticity across products and with an average elasticity of around 5. To investigate how sensitive the results are to the choice of trade elasticity, simulations are also undertaken with trade elasticities of 3 and 5. The results are shown in Figure E1 and E2.

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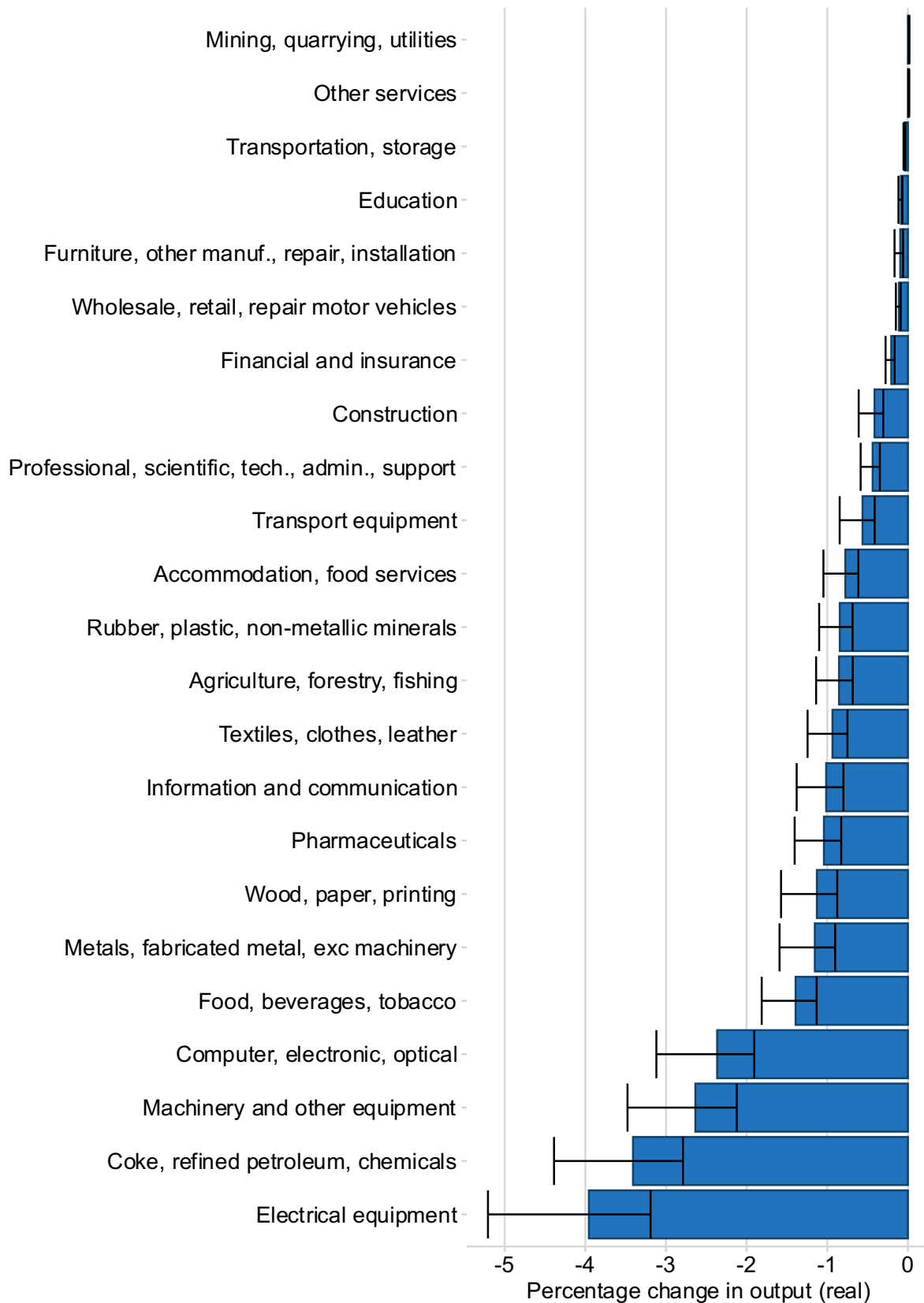
<sup>33</sup> [Tariff-based product-level trade elasticities - ScienceDirect](#)

**Figure E1 – Sensitivity Analysis, Trade Elasticity, all four non-EU FTAs**



Source: SG OCEA gravity modelling

**Figure E2 – Sensitivity Analysis, Trade Elasticity, all four non-EU FTAs and the UK–EU TCA**



Source: SG OCEA gravity modelling

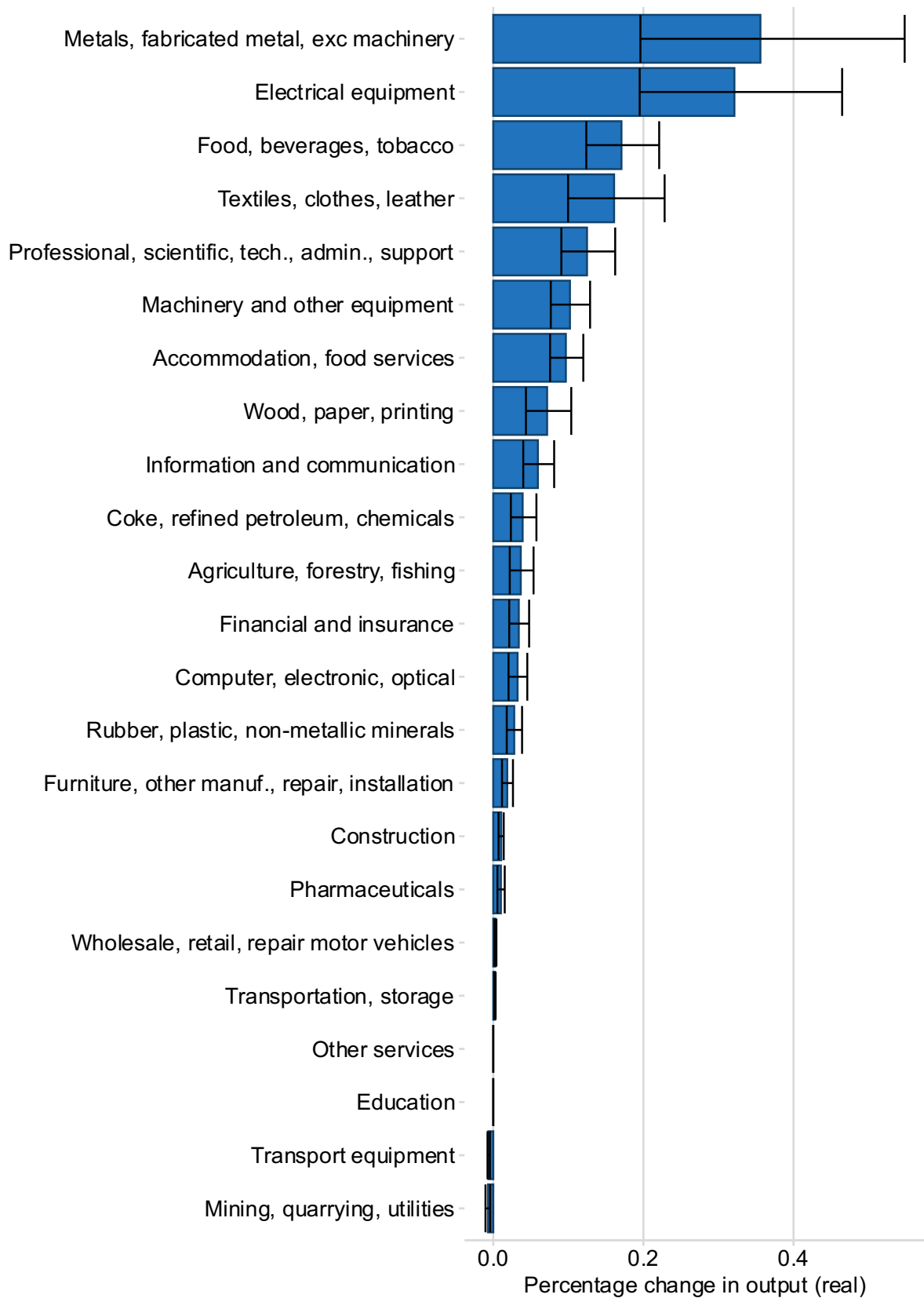
We have also analysed how sensitive the results are to the trade cost estimates. The first stage in our analysis is to estimate trade cost changes as a result of an FTA, before using these estimates as inputs to the General Equilibrium simulations. Because the estimates are found by an econometric procedure using real trade data, they carry some degree of uncertainty, which is quantified by the estimator in the form of a standard error. We use this standard error to define upper and lower values for the sensitivity analysis, one standard error above and below the central estimate.

However, some of our estimations fail to reach statistical significance with our input data. For these sectors, we have used estimates from Borchert et al. (2020). Because these are at a more granular industry classification and we have no robust way to aggregate standard errors, we have chosen to simply use an illustrative fractional error of plus or minus 35%, informed by the fractional errors we find in our own estimates.

The results are shown in Figure E3 and E4. Note that we use the standard trade elasticity of 4 for these simulations.

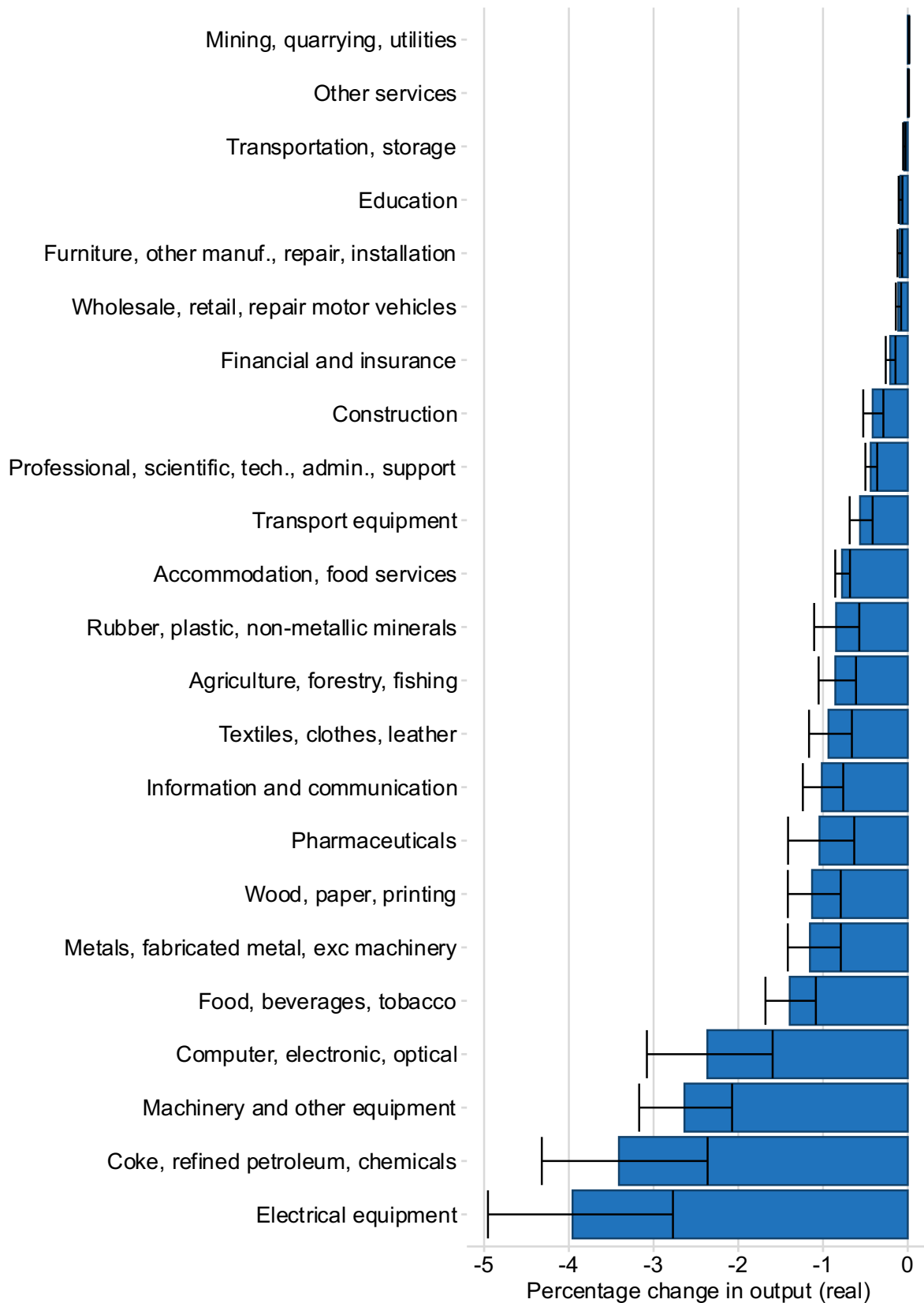


**Figure E3 – Sensitivity Analysis, Trade Costs, all four non-EU FTAs**



Source: SG OCEA gravity modelling

**Figure E4 – Sensitivity Analysis, Trade Costs, all four non-EU FTAs and the UK–EU TCA**



Source: SG OCEA gravity modelling

## Computable General Equilibrium analysis

A sensitivity analysis was also undertaken in the CGE model using upper (a higher increase in trade costs relative to the central scenario) and lower (a lower increase in trade costs relative to the central scenario) estimates of the trade cost shock and varying trade elasticities in the model. The trade cost shocks used in the CGE sensitivity run are similar to the inputs used for an equivalent exercise in the gravity model. The default values of trade-related elasticities (Armington, CET) in the CGE model were either increased (from 2 to 4) or decreased (from 2 to 1.5) for sensitivity analysis. Table E1 provides a summary of the sensitivity analysis for Scenario 2. Furthermore, the results of the model are also sensitive to the choice of model closure (e.g. labour market or fiscal closure).

**Table E1 – Sensitivity Analysis, Impact on Scotland’s GDP, all four non-EU FTAs and the UK–EU TCA**

<b>Scenario</b>	<b>% change relative to the baseline</b>
Central estimate	-2.0%
Lower increase in trade costs	-1.4%
Higher increase in trade costs	-2.7%
Lower elasticities	-2.1%
Higher elasticities	-1.7%

Source: CGE modelling



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