Modelling the long-run economic impacts of a stylised US tariff increase: technical paper

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Riaghaltas na h-Alba

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Executive Summary

This paper uses the Scottish Government Computable General Equilibrium (CGE) model to assess the long-run economic impacts of a stylised 10% tariff increase by the United States on UK goods exports. The modelling captures the direct effects on Scotland's economy and interregional spillovers from the rest of the UK (rUK), as well as the domestic impacts of symmetric UK retaliation.

While the simulation is stylised and does not model industry-specific tariffs, exemptions or third-country dynamics, the modelling isolates how a US-UK tariff increase ripples through Scotland's economy in the long-run and which industries are most exposed.

Key findings:

- A 10% US tariff reduces Scotland's long-run GDP by 0.4%, with the largest impacts in industries with higher exposure to the US such as chemicals and pharmaceuticals and electronics. Scotland has more exposure in food and drink, in particular whiskey, while rUK has more exposure in machinery, in particular road vehicles.
- Around a third of the impact on Scotland's GDP is driven by spillover effects from the shock to the rUK economy, underscoring the importance of interregional linkages.
- If the UK retaliates with a 10% tariff increase on US imports, Scotland's GDP is lower by 1.0%, driven by higher input costs and weaker demand.
- The results are sensitive to trade elasticity assumptions, with higher elasticities amplifying the economic impact.

Introduction

The US tariff landscape for the UK has evolved over the last few months. On top of sector-specific tariffs on steel, aluminium and cars, on April 2 President Trump announced that the UK, along with many other countries, was to be subject to a 10% 'baseline' additional tariff on most products from April 5.[1] The UK then signed the Economic Prosperity Deal on May 8 which included concessions on steel, aluminium and cars.[2]

In our July economic bulletin we explored the impact of the US's tariff policy, as of June 2025, on trade patterns using our global gravity model.[3] It found that US tariff policy reduced Scotland's output by around 0.1% in the long-run. Importantly, gravity modelling focuses on trade flows and omits supply chain linkages and broader economic effects. As a result, it may provide a more conservative estimate of the overall economic impact.

[1] Pharmaceuticals, semiconductors, lumber and certain critical minerals were exempt from this announcement.
[2] UKTPO (2025) How does the UK stack up against other exporters in the US market?
[3] Scottish Government (2025) Scottish economic bulletin: July 2025

Our CGE model captures indirect effects on supply chains and induced effects on the wider economy. While the scenario modelled here is stylised, not accounting for sector-specific tariffs and exemptions, nor does it capture third country effects, the simplicity allows us to draw out the sensitivity of the Scottish economy to a 10% US tariff increase on UK goods.

The economic impact is driven by the exposure of Scottish industries to the US market. In our April Economic Insights Report we looked at regional trade statistics (RTS) data for Scotland and the UK and found that Scotland is more exposed in beverages and tobacco, in particular whisky, while the UK is more exposed in machinery and transport equipment, in particular road vehicles.[4]

Methodology

Model structure

To capture spillover effects between Scotland and the rest of the UK (rUK), we adopt a two-region CGE model. The model is parametrised to an inter-regional Social Accounting Matrix (SAM) for Scotland and the rest of the UK for 2013. There are three transactor groups in each region – firms, household and government – and twenty productive sectors. The model runs for fifty periods, which is to be interpreted as fifty years. We define the long run as approximately ten to twenty years after the shock occurs, once capital stocks, labour markets, and trade flows have stabilised.

Production structure

The model is built on a sectoral input-output production structure where sectors use each other’s output in their own production. In each sector, local intermediate inputs are combined with imports from the other region and the rest of the world. Value is added in each region by a combination of capital and labour. Intermediate input is combined with value added to determine the sector’s gross output.

Resource allocation

Labour and capital are allocated across sectors. There is imperfect competition in the labour market, so real wages are inversely related to unemployment. Labour is homogenous, with a single unemployment rate and wage for each region and there is no migration so potential labour supply in each region is stable. While capital reallocates to sectors with higher returns to capital, labour reallocates to sectors where labour is demanded based on firm profit maximisation.

Trade

International exports are exogenous, split into EU and non-EU aggregates. Export demand of the other UK region is fully endogenous, depending not only on relative prices, but also on all elements of intermediate and final demand in the other region.

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[4] Scottish Government (2025) Scottish economic insights: April 2025

Import demand is endogenous and sourced from a Rest of the World (RoW) aggregate. Imports enter the economy through household consumption, investment, and intermediate inputs, and are allocated based on relative prices using Armington trade functions which assume imperfect substitution between domestic and imported goods.

Households

Households allocate their income between consumption and saving, with consumption decisions made to optimise utility. They choose between goods from different sectors based on relative prices, and further differentiate between domestic and imported varieties using Armington assumptions (Armington, 1969). Total consumption is influenced by disposable income, which accounts for wages, capital income, transfers, and taxes. In the forward-looking closure, households also consider intertemporal trade-offs, smoothing consumption over time based on expected future income.

Government

Government behaviour is defined by closure rules that determine whether expenditure, the budget balance, or tax rates are fixed or endogenous. In our setup, tax rates are exogenous and government spending adjusts to keep the budget balanced.

Investment

Investment demand is determined endogenously and allocated across industries between domestic and imported capital goods. The level of investment in each sector is influenced by the expected return on capital, adjustment costs, and the user cost of capital. In the forward-looking closure, investment decisions are based on intertemporal optimisation, where firms invest to maximise the present value of future returns, subject to capital accumulation dynamics and adjustment costs.

Table: Summary of model closures in our CGE simulations

Model Component	**Closure setting**	**Effect on Results**
Labour Market	Regional wage bargaining	Wages respond to regional unemployment
Agents	Forward-looking	Consumption and investment are smoothed over time. Firms maximise profit while households maximise utility
Government	Fixed balance	Government spending adjusts to keep the fiscal balance stable

Tariff policy is applied at the UK level, and any shock affects both Scotland and the rest of the UK. The two-region model includes both Scotland and rUK as endogenous regions feeding in to each other, allowing for interregional feedback effects. To examine the spillover on Scotland from the shock to the rUK economy, we run the simulation twice: first shocking just Scotland, and second shocking

Scotland and the rest of the UK. Comparing the results allows us to identify the effect of the rUK shock on Scotland economy.

Shock definition

Exports are split in to EU and non-EU in the database using OECD Trade in Value Added (TiVA) data for 2020 to split service exports for rUK and Export Statistics Scotland data for 2021 to split service exports for Scotland. RTS data for 2024 is used to split goods exports for both rUK and Scotland.

OECD TiVA statistics are directly mappable to the CGE industrial classifications while we used judgement to map RTS goods to CGE industries (see annex C).

For the export shocks a 10% price increase is applied to non-EU exports from Scotland and rUK , scaled by the share of non-EU exports from each region to the US. We model the impact of symmetric retaliation by applying a 10% price shock to Scotland and rUK international imports, scaled by the US's import share for each region. See Annex D for the shares fed in to the model.

Full passthrough of the cost of the tariff is assumed and an import demand elasticity of 2 is applied which captures the longer term substitution away from more expensive imports to domestic produce (Gibson, 1990). See Annex F for sensitivity analysis.

Limitations and considerations

There are several limitations and considerations to this analysis. First, the model is calibrated to a 2013 Social Accounting Matrix (SAM), and economic linkages may have evolved since then.

Secondly, while we have carefully mapped RTS product categories to CGE industries, it is possible that there is not full alignment.

Furthermore, there is inherent uncertainty around the trade elasticity parameter. This elasticity determines how responsive import volumes are to changes in relative import versus domestic prices. In practice, elasticities vary significantly across products, sectors, and time horizons. Higher elasticities imply greater responsiveness and are typically used in long-run simulations, where economic agents have more time to adjust to new trading conditions.

Recent studies illustrate this variation. The Office for Budget Responsibility (OBR) used a relatively low elasticity of -0.4, based on Bank of England estimates for UK import demand.[5] Meanwhile, empirical academic studies often find larger values for long-term trade elasticities. For example, Fontagne et al. (2022)[6] report considerable heterogeneity in trade elasticity across products, with an average elasticity of around -5. Boehm et al. (2022)[7] estimate short-run elasticities of around −0.76 and long-run values of around −2. Reflecting this, we adopt a central elasticity

[5] OBR (2025) Economic and Fiscal Outlook – March 2025
[6] Fontagne et al. (2022) Tariff-based product-level trade elasticities
[7] Boehm et al. (2022) The Long and Short (Run) of Trade Elasticities

of -2, consistent with a long-term perspective in which firms and households can substitute away from more expensive imports. This implies that a 10% increase in import prices leads to a 20% reduction in import demand. However, applying a uniform elasticity across all sectors is a simplification, as real-world responsiveness varies by industry. See Annex F for sensitivity analysis.

The shock also ignores global tariff policy announcements. This includes exemptions for the UK in the US-UK deal, and also US tariff policy on all other global partners. Furthermore, splitting exports in to EU and non-EU, the model captures some trade diversion from non-EU to EU, but it doesn’t account capture trade diversion within the non-EU region.

There is also consideration to be given to the presentation of results. Given the homogeneous labour force in the model, a shock to the goods sector affects labour costs across the whole economy. Under flexible wages, this can lead to misleading increases in real output in some industries due to falling input costs across the economy, even though in reality labour cost adjustments tend to vary by sector. To more accurately reflect the economy-wide impact of the demand shock, we report changes in nominal output, which capture both price and quantity effects.

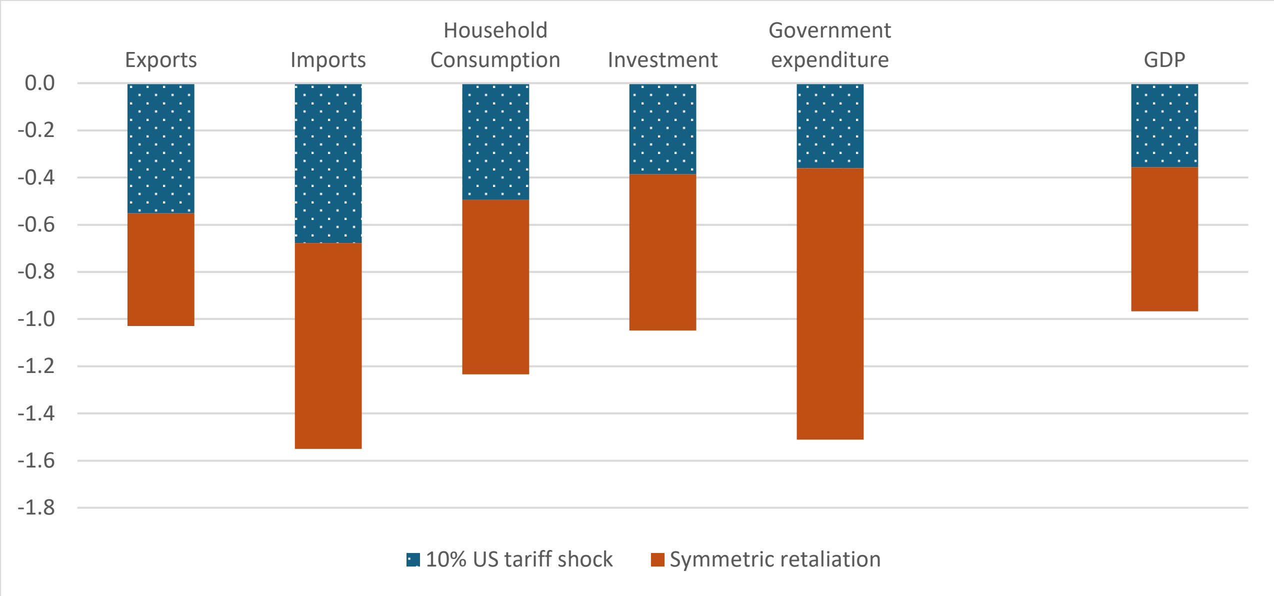
Results

The 10% US-UK tariff increase simulation results in a long-run reduction in Scotland’s GDP of approximately 0.4%. The shock to the rUK economy accounts for around a third of the impact on Scotland’s GDP, highlighting the importance of interregional linkages.

A tariff shock on non-EU exports reduces Scotland’s competitiveness, leading to a fall in export demand and total output. This contraction lowers firms’ demand for labour, resulting in higher unemployment and reduced household incomes. As consumption declines, firm revenues fall, discouraging investment. The government also experiences a drop in tax revenues, which under a balanced budget assumption reduces government spending, amplifying the overall economic downturn.

If the UK retaliates by imposing a 10% tariff increase on imports from the US, the economic impact deepens. This retaliation introduces demand and supply side shocks alongside the initial demand-side contraction. On the demand side, higher import prices reduce household and business incomes, reducing household consumption and business investment. On the supply side, increased input costs, especially in sectors reliant on imported goods, raise production costs and suppress output.

Figure: Macroeconomic impacts (% difference to long-run baseline)



Source: OCEA modelling

These retaliation findings are consistent with those of Figus et al. (2017)[8], who demonstrate that comparable import price shocks lead to more severe GDP and employment losses than export price shocks in a UK CGE model under WTO-style tariff assumptions. Their results identify the harmful effects of tariff retaliation, particularly when imported inputs are essential to domestic production.

The 10% US tariff shock has a compounding effect on Scotland's economy over time. Initially modest, the impact increases as falling demand reduces firm profitability, leading to lower wages, household income and consumption. This weakens overall demand further, putting more downward pressure on employment, investment, and wages until a new equilibrium is reached.

While the shock to rUK exports is bigger than Scotland's, the net impact on GDP is very similar.

[8] Figus et al. (2017) The Long-term Economic Implications of Brexit for Scotland: An Interregional Analysis

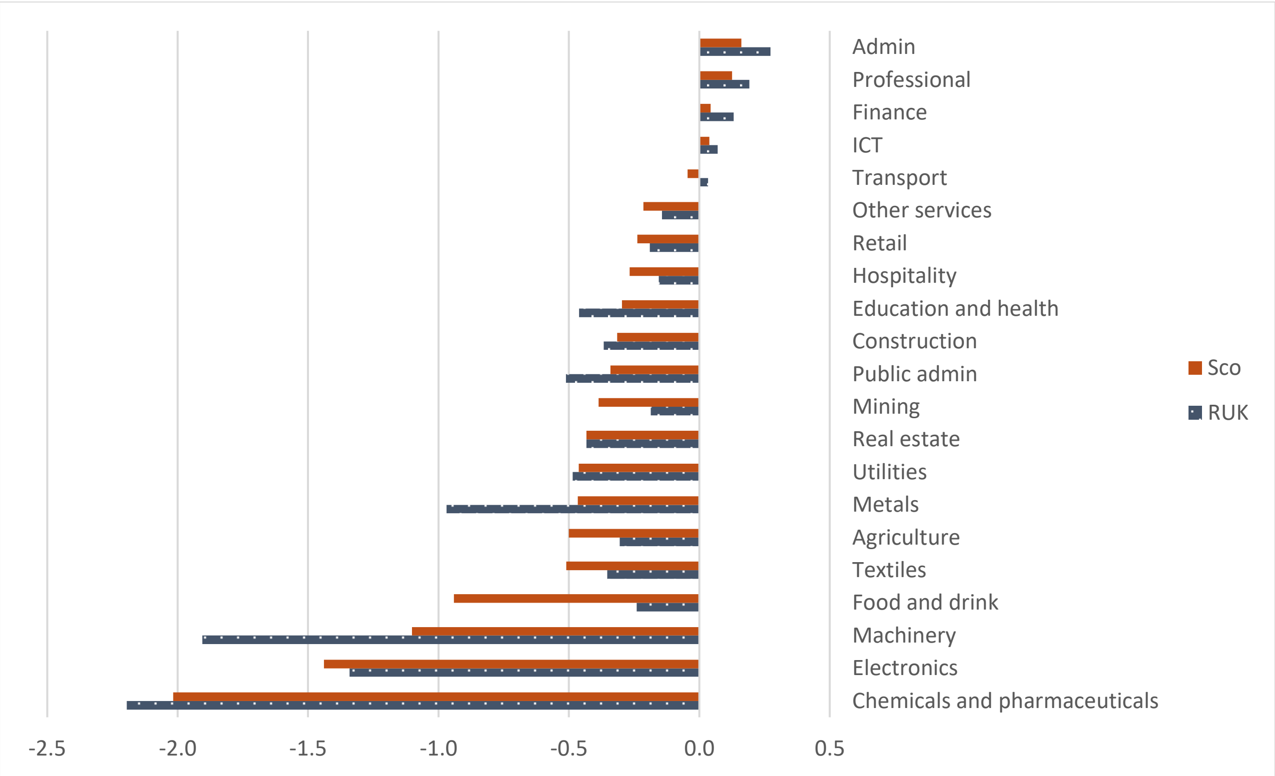
Figure: Macroeconomic impacts over time (% difference to baseline)

Variable	Short-run	5 years	10 years	Long-run	rUK long run
GDP	-0.06	-0.23	-0.33	-0.36	-0.34
Exports	-0.40	-0.45	-0.53	-0.55	-0.70
Imports	-0.52	-0.64	-0.67	-0.68	-1.06
Employment	-0.02	-0.17	-0.24	-0.26	-0.25
Real wage	-0.03	-0.29	-0.41	-0.44	-0.44
Household consumption	-0.33	-0.41	-0.48	-0.50	-0.48
Investment	-0.25	-0.56	-0.44	-0.39	-0.37
Government expenditure	0.36	-0.09	-0.30	-0.36	-0.57

Source: OCEA modelling

Sectors for which US exports account for a greater share of economic activity experience the greatest shortfalls in output (see Annex E). The overall impact is similar for Scotland and the rest of the UK. However, Scotland's food and drink sector is more impacted, driven by whiskey exports, and rUK's machinery industry is more impacted, driven by road vehicle exports. Lower demand overall has wider impacts across the economy while some sectors benefit slightly from labour and capital reallocation.

Figure: Impact of US tariff shock on long-run value added (% difference to long-run baseline)



Source: OCEA Modelling

Discussion

Comparisons to other organisations

The Office for Budget Responsibility (OBR) estimated that a scenario including 20% US tariff on UK goods could reduce UK GDP by 0.3% without retaliation and by 0.75% with retaliation by 5 years.[9] Our results for a scenario of a 10% tariff are comparably larger in magnitude, primarily because our analysis is long run so we use an elasticity of trade of -2, compared to their value of -0.4. A lower elasticity assumption would reduce our estimates (see Annex F for sensitivity analysis).

Using a one-region model for Northern Ireland, the Northern Ireland Government found a 10% US tariff shock reduced Northern Ireland's long-run GDP by 0.2%.[10] This impact is similar to our figure for the Scotland-only shock, excluding the spillover effects from the shock to the rUK economy.

Conclusion

We find a 10% US tariff increase on UK goods exports leads to a reduction in Scotland's long-run economic output. The impact is concentrated in sectors with high exposure to US trade, but broader effects emerge through reduced consumption, investment, and government spending. Retaliatory tariffs significantly deepen the economic cost as higher import prices raise production costs and suppress household demand. The modelling also highlights the role of interregional spillovers, with around a third of Scotland's GDP loss driven by spillover effects from the shock to the rUK economy.

The results are sensitive to trade elasticity assumptions, but are broadly similar to modelling by the Northern Irish Government for Northern Ireland and OBR for the UK. While stylised, the analysis offers a useful lens for assessing Scotland's sensitivity to a US tariff increase.

[9] OBR (2025) Economic and Fiscal Outlook – March 2025
[10] Northern Ireland Government (2025) The Direct Economic Impact of the New USA Tariff Regime on the Local Economy

Annex A - Bibliography

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Annex B – CGE Industry Definitions

CGE industry	CGE industry description
Agriculture	Agriculture, forestry and fishing
Mining	Mining and quarrying
Food and drink	Manufacture of food products, beverages and products
Textiles	Manufacture of textiles, wearing apparel and leather, wood and paper products, and printing
Chemicals	Manufacture of chemicals, coke and refined petroleum products, basic pharmaceuticals and their products
Metals	Manufacture of basic metals and fabricated metal products, except machinery, rubber, plastic and other non-metallic mineral products
Electronics	Manufacture of computer, electronic and optical products, and electrical equipment
Machinery	Manufacture of machinery and equipment n.e.c, transport equipment, furniture, other manufacturing; repair and installation of machinery and equipment
Utilities	Electricity, gas, steam and air conditioning supply, Water supply; sewerage, waste management and remediation activities
Construction	Construction
Retail	Wholesale and retail trade; repair of motor vehicles and motorcycles
Transport	Transportation and storage
Hospitality	Accommodation and food service activities
ICT	Information and communication
Finance	Financial and insurance activities
Real estate	Real estate activities
Professional	Professional, scientific and technical activities
Admin	Administrative and support service activities
Public admin	Public administration and defence; compulsory social security
Education and health	Education, Human health and social work activities
Other services	Other service activities

Annex C – CGE industry to RTS goods mapping

Table: CGE sector – RTS good mapping:

CGE sector	RTS SITC product
Agriculture	00 - Live animals other than animals of division 03 03 - Fish,crustaceans,molluscs & aq.inverts & preps thereof 22 - Oil seeds & oleaginous fruits 26 - Textile fibres not manufactured & their waste etc 29 - Crude animal & vegetable materials n.e.s.
Mining	27 - Crude fertilizers & crude minerals (exc fuels etc)
Food and drink	01 - Meat & meat preparations 02 - Dairy products & birds' eggs 04 - Cereals & cereal preparations 05 - Vegetables & fruit 06 - Sugar, sugar preparations & honey 07 - Coffee, tea, cocoa, spices & manufactures thereof 08 - Feeding stuff for animals (not inc.unmilled cereals) 09 - Miscellaneous edible products & preparations 11 - Beverages 12 - Tobacco & tobacco manufactures 21 - Hides, skins & furskins, raw 41 - Animal oils & fats 42 - Fixed vegetable fats & oils, crude,refined,fractionated 43 - Animal or vegetable fats & oils, processed, & waxes
Textiles	24 - Cork & wood 25 - Pulp & waste paper 61 - Leather, leather manufactures n.e.s & dressed furskins 63 - Cork & wood manufactures (excluding furniture) 64 - Paper, paperboard & manufactures thereof 65 - Textile yarn, fabrics, made up articles etc 83 - Travel goods, handbags & similar containers 84 - Articles of apparel & clothing accessories 85 - Footwear
Chemicals and pharmaceuticals	23 - Crude rubber (including synthetic & reclaimed) 32 - Coal, coke & briquettes 51 - Organic chemicals 52 - Inorganic chemicals 53 - Dyeing, tanning & colouring materials 54 - Medicinal & pharmaceutical products 55 - Essential oils & perfume materials; toilet preps etc 56 - Fertilizers (other than those of group 272) 57 - Plastics in primary forms 59 - Chemical materials & products n.e.s.
Metals	58 - Plastics in non-primary forms 62 - Rubber manufactures n.e.s. 66 - Non-metallic mineral manufactures n.e.s. 67 - Iron & steel

	68 - Non-ferrous metals 69 - Manufactures of metal n.e.s.
Electronics	76 - Telecomms & sound recording & reproducing app. & eqp. 77 - Ele machinery, app & appliances & ele pt thereof n.e.s. 87 - Professional, scientific & controlling ins & app n.e.s. 88 - Photographic & optical goods, n.e.s.; watches & clocks
Machinery	71 - Power generating machinery & equipment 72 - Machinery specialized for particular industries 73 - Metalworking machinery 74 - General industrial machinery & eqp. & machine pt.n.e.s. 75 - Office machines & adp machines 78 - Road vehicles (including air cushion vehicles) 79 - Other transport equipment 82 - Furniture & parts thereof; bedding, mattresses etc 89 - Miscellaneous manufactured articles n.e.s. 93 - Special transactions and commodities not classified according to kind 96 - Coin (other than gold coin), not being of legal tender
Utilities	28 - Metalliferous ores & metal scrap 35 - Electric current
Transport	91 - Postal packages not classified according to kind
Excluded[11]	33 - Petroleum, petroleum products & related materials 34 - Gas, natural & manufactured

[11] The Social Accounting Matrix and CGE model are built for the onshore economy. Oil and gas exports are excluded from the analysis because they are not included in the accounting of the onshore economy.

Annex D – US shares of trade

Figure: US shares of trade for scaling price shocks in CGE model, per cent

US share of trade in exports and imports	Scotland	UK	Scotland	UK
CGE sector	US share of exports within division	US share of exports within division	US share of imports within division	US share of imports within division
Chemicals	28.4	20.1	26.8	12.5
Electronics	17.8	17.3	17.1	9.0
Mining	16.6	3.5	23.7	6.3
Machinery	15.6	18.1	15.0	8.5
Food and drink	13.3	10.4	3.8	1.9
Textiles	12.7	9.7	13.4	5.1
Metals	9.1	13.7	9.0	5.8
Agriculture	9.0	11.1	4.5	3.0
Utilities	8.5	4.7	0.9	9.0
Transportation	-	15.4	-	5.5

Annex E – Exposure of domestic output to US trade

Figure: US exports as a share of domestic output by industry, per cent

CGE sector	Scotland	UK
Chemicals and pharmaceuticals	10.6	11.6
Electronics	8.1	7.6
Machinery	5.7	10.3
Food and drink	5.4	1.6
Textiles	2.9	2.6
Metals	2.2	4.3
Mining	1.8	2.2
Agriculture	1.1	1.1
Utilities	0.3	0.2
Transportation	0.0	1.9

Annex F – Sensitivity Analysis

Table: Sensitivity to change in elasticity of trade parameter, percentage point difference to long-run baseline

Variable	Lower (e = -0.4)	Central (e = -2)	Upper (e = -4)
GDP	-0.15	-0.36	-0.44
Exports	-0.20	-0.55	-0.78
Imports	-0.26	-0.68	-0.93
Employment	-0.10	-0.26	-0.33
Real wage	-0.19	-0.44	-0.56
Household consumption	-0.21	-0.50	-0.62
Investment	-0.16	-0.39	-0.47
Government expenditure	-0.14	-0.36	-0.47

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