frontier economics

MODELLING THE EFFECTS OF CLOSER UK-EU COOPERATION AND OF US TARIFFS

February 2025

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Executive Summary

Approach

Best for Britain has commissioned Frontier Economics to model the effects, of, respectively:

- Closer alignment in the area of regulation in goods and services between the UK and the EU;
- The effects of the United States (US) levying tariffs on the UK and other trade partners.

The modelling uses a gravity model for trade, embedded in a broader economic model, belonging to a class of models sometimes described as New Quantitative Trade Models (NQTM).

Regulatory alignment

We define regulatory alignment as a comprehensive approach to mutual recognition by the UK and the EU of each other's regulations, and a commitment to minimise regulatory divergence. We consider two scenarios: (1) deep regulatory alignment in goods, while services follow a more incremental and piecemeal approach based on provisions of the current Trade and Cooperation Agreement; (2) deep regulatory alignment in goods and services.

To model regulatory alignment, we need to examine how this is reflected in practice in trade agreements, and estimate how provisions relating to regulatory alignment affect trade costs. We use the World Bank Deep Trade Agreements database to construct a composite indicator of regulatory alignment based on the extent of mutual recognition provisions relating to sanitary and phyto-sanitary measures (SPS); technical barriers to trade (TBT); and services. We use a gravity model of trade to estimate the effects of this indicator on trade, and use the NQTM to simulate the effects on trade and real GDP of moving from a Free Trade Agreement (FTA) with weak alignment to one with strong alignment.

Tariffs

We model a scenario in which the US imposes 20% tariffs on all goods from all its trade partners, including the UK, but with the exception of China, whose exports to the US are subject to 60% tariffs. The effects on trade and real GDP are estimated via the same modelling framework as the regulatory alignment scenarios.

Results

Trade results

We present results for five scenarios:

a. US tariffs;
b. Deep alignment in goods, weak in services;
c. Deep alignment in goods, weak in services with US tariffs;
d. Deep alignment in goods and services;
e. Deep alignment in goods and services with US tariffs.

Table 1 and Table 2 report the results. We report results for the UK, the EU-27 as a whole, and specific results for Italy, France and Germany, and the remainder of the EU-27 outside these countries. The results should be interpreted as differences relative to the current (status quo) baseline, in one year.

Table 1: Changes to exports by scenario, in billions of dollars

	UK	France	Germany	Italy	Other EU	All EU
(i) Scenario: US tariffs						
Agrifood	-2.3	-3.5	-3.9	-2.3	-11.3	-21
Industrial	-27.4	-19.9	-56.9	-19.6	-91.6	-188
Services	19.3	5.7	17.8	2.1	17.2	42.8
Net	**-10.3**	**-17.6**	**-43**	**-19.8**	**-85.7**	**-166.2**
(ii) Scenario: Deep alignment in goods alignment, weak in services						
Agrifood	4.3	0.6	0.6	0.4	4.9	6.5
Industrial	19.8	1.5	2.6	0.8	9.2	14.1
Services	-2.3	0.0	-0.1	0	-1.5	-1.6
Net	**21.8**	**2**	**3.1**	**1.2**	**12.6**	**18.9**
(iii) Scenario: Deep alignment in goods, weak in services, with US tariffs						
Agrifood	1.9	-2.9	-3.3	-1.9	-6.4	-14.5
Industrial	-8.2	-18.4	-54.3	-18.8	-82.5	-174
Services	17.1	5.7	17.6	2.1	15.6	41
Net	**10.9**	**-15.6**	**-40**	**-18.6**	**-73.3**	**-147.5**

	UK	France	Germany	Italy	Other EU	All EU
(iv) Scenario: Deep alignment in goods and services						
Agrifood	4.3	0.6	0.7	0.4	4.9	6.6
Industrial	19.7	1.5	2.8	1.0	9.1	14.3
Services	8.9	1.3	1.3	0.4	5.9	8.8
Net	**32.9**	**3.4**	**4.8**	**1.7**	**19.9**	**29.7**
(v) Scenario: Deep alignment in goods and services with US tariffs						
Agrifood	1.9	-2.9	-3.2	-1.9	-6.4	-14.5
Industrial	-8.2	-18.4	-54.2	-18.7	-82.6	-173.9
Services	28.2	7.0	19.1	2.5	23	51.5
Net	**21.9**	**-14.3**	**-38.3**	**-18.1**	**-66.1**	**-136.8**

Table 2: Changes to exports by scenario, in percentage terms

(Note: numbers may not add up precisely due to rounding)

	UK	France	Germany	Italy	Other EU	All EU
(i) Scenario: US tariffs						
Agrifood	-0.2%	-0.4%	-0.2%	-0.3%	-0.3%	-0.3%
Industrial	-2.8%	-2.1%	-2.8%	-2.4%	-2.3%	-2.4%
Services	2.0%	0.6%	0.9%	0.3%	0.4%	0.6%
Net	**-1.0%**	**-1.9%**	**-2.1%**	**-2.4%**	**-2.2%**	**-2.2%**
(ii) Scenario: Deep alignment in goods alignment, weak in services						
Agrifood	0.4%	0.1%	0.0%	0.0%	0.1%	0.1%
Industrial	2.0%	0.2%	0.1%	0.1%	0.2%	0.2%
Services	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Net	**2.2%**	**0.2%**	**0.2%**	**0.1%**	**0.3%**	**0.2%**
(iii) Scenario: Deep alignment in goods alignment, weak in services, with US tariffs						
Agrifood	0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%
Industrial	-0.8%	-2.0%	-2.7%	-2.3%	-2.1%	-2.3%
Services	1.7%	0.6%	0.9%	0.3%	0.4%	0.5%
Net	**1.1%**	**-1.7%**	**-2.0%**	**-2.2%**	**-1.9%**	**-1.9%**
(iv) Scenario: Deep alignment in goods and services						
Agrifood	0.4%	0.1%	0.0%	0.0%	0.1%	0.1%
Industrial	2.0%	0.2%	0.1%	0.1%	0.2%	0.2%
Services	0.9%	0.1%	0.1%	0.0%	0.1%	0.1%
Net	**3.3%**	**0.4%**	**0.2%**	**0.2%**	**0.5%**	**0.4%**

	UK	France	Germany	Italy	Other EU	All EU
(v) Scenario: Deep alignment in goods and services with US tariffs						
Agrifood	0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%
Industrial	-0.8%	-2.0%	-2.7%	-2.3%	-2.1%	-2.3%
Services	2.8%	0.8%	0.9%	0.3%	0.6%	0.7%
Net	**2.2%**	**-1.5%**	**-1.9%**	**-2.2%**	**-1.7%**	**-1.8%**

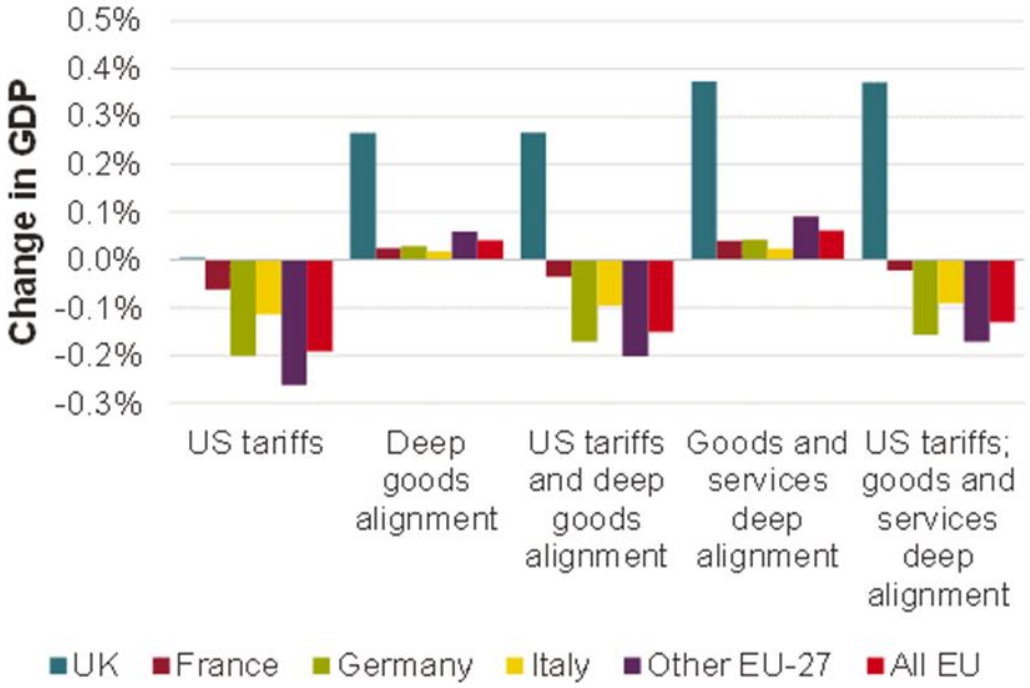
US tariffs reduce UK trade overall, though the results are asymmetric between goods and services. Tariffs reduce UK goods exports, but services exports increase, because tariffs increase trade costs affecting goods relative to those affecting services, inducing a substitution from goods to services. The effect is observed in the EU as well, but is stronger for the UK given the greater importance of services in overall UK trade.

Deep regulatory alignment in goods increases total UK exports, though the weaker treatment of services under this scenario leads to a fall in services exports (because trade costs affecting goods have decreased significantly relative to those affecting services). Increases to UK trade are larger than those to EU trade, reflecting the relative size of the UK and EU markets respectively. Deep alignment in goods helps to mitigate some of the negative impact of US tariffs on UK goods exports.

Deep regulatory alignment in goods and services delivers the strongest results for UK trade. Deep alignment has a bigger effect on goods than it does on services, likely reflecting the extent of other remaining barriers to services trade. Again the effects are bigger for the UK than the EU. Deep alignment in goods and services further mitigates the impact of US tariffs. The mitigating impact is larger for the UK than it is for the EU.

GDP effects

Figure 1: Changes to real GDP by country and by scenario, in percentage terms



US tariffs have a negligible impact on UK real GDP. This is because the size of UK services exports shelters the UK from US tariffs, and because the switch in goods consumption in the US from imports to local production as a result of the tariffs reduces global prices in the goods subject to tariffs, which boosts real GDP in the UK. **The alignment scenarios boost GDP across the UK and EU** – though in line with trade results, the effects are stronger for the UK than they are for the EU. For the EU, the alignment scenarios provide some measure of shielding against US tariffs, though again the effect is stronger for the UK.

The GDP effects of alignment are effects for one year, and are relatively significant. **The deep goods and services scenario estimates are more than double the government's 2019 upper estimate for a UK-US FTA. In monetary terms, they would cover close to two years' worth of desired increases to the NHS capital budget.**

The GDP effects are "comparative static effects", i.e. they reflect the difference between the scenarios and the status quo in one year. Longer term impacts on GDP can be derived by taking into account the effects of trade openness on GDP. On the basis of the reported trade results, and using estimates of 0.5% to 0.7% for the elasticity of GDP to trade openness, a broad estimate of long-run GDP effects for the UK would be those reported in the table below.

Table 3: Long run growth effects on the UK

Scenario	Real GDP change in percent
US tariffs	-0.5% to -0.7%
Deep regulatory alignment in goods, weak in services	1% to 1.5%
Deep regulatory alignment in goods, weak in services, with US tariffs	0.6% to 0.8%
Deep regulatory alignment in goods and services	1.7% to 2.2%
Deep regulatory alignment in goods and services, with US tariffs	1.1% to 1.5%

The Office for Budget Responsibility estimated that transitioning from EU membership to TCA arrangements would lead to a long-run fall of 4% in real GDP. The results suggest that the alignment scenarios could help recover between a quarter to a half of this loss. They also suggest that the regulatory scenarios provide security to the UK against long-run effects of US tariffs on growth.

Regional effects

We model regional effects by apportioning the GDP effects reported in Figure 6 across UK regions, based on regional economic data. The analysis reveals significant differences across regions. Under the tariff scenario, all regions see a fall in regional Gross Value Added (GVA), except for London, where GVA increases because of its specialisation in services. Under the regulatory alignment scenarios, all regions benefit, with particular gains in the Midlands and Yorkshire, principally because of the effects of regulatory alignment in goods on regions that are intensive in manufacturing. For all regions, the alignment scenarios either offset or dominate the effects of US tariffs. In addition to the Midlands and Yorkshire, this shielding result is also particularly notable in the North East, Scotland, Wales and Northern Ireland - regions that experience more pronounced negative effects under US tariffs than other UK regions.

1. Introduction

1.1 Context and objectives

Best for Britain has commissioned Frontier Economics to model the economic effects of strengthening the UK/ EU relationship through greater cooperation on regulation, where such cooperation would reflect substantial improvements relative to the current TCA baseline, but would also not involve the reintegration of the UK into the Single Market and its disciplines. This is consistent with the UK Government's stated negotiation "red lines" of "no return to the Single Market or Customs Union".

Following the United Kingdom's decision to exit the European Union (EU) under Article 50 of the Treaty on the Functioning of the EU, both parties negotiated a Trade and Cooperation Agreement (TCA) that came into force on 1 January 2021. The overall implementation of the TCA is supervised by a joint Partnership Council of both parties, which has a mandate to review the functioning of the agreement every five years. The Council also has the scope to make modifications to the TCA that both parties have agreed to be mutually beneficial.

It is generally recognised that the TCA represents a significantly lower level of economic integration between the UK and the EU than was the case with Single Market arrangements.[1] This is particularly true in relation to regulatory matters relating to trade in goods and in services. Regulatory divergence is known to generate trade costs, which in turn affect trade flows, and through that wider economic costs.[2] UK exporters have also reported extensively on the increased costs and challenges they have faced in demonstrating compliance with the regulations that need to be met before products and services are sold in the EU.[3]

There is therefore an economic case for considering how the UK and the EU may cooperate more closely on reducing trade costs, and specifically via cooperation on regulatory matters. Article 776 of the TCA makes provisions for the UK and EU to review the implementation, and matters related to, the TCA every five years. Combined with the UK Government's stated ambition for a relationship reset with the EU, 2026 will provide a significant opportunity for the UK and EU to reevaluate the TCA and the UK-EU trading relationship more generally.

[1] See for example, Borchert, I. and Morita-Jaeger, M. "Taking stock of the UK-EU Trade and Cooperation Agreement: Trade in services and digital", UK Trade Policy Observatory, Briefing Paper 53, January 2021: and Acquah, R., di Ubaldo M., and Gasiorek, M. "Regulatory intensity and the EU single market: Implications for the UK", UK Trade Policy Observatory, Briefing Paper 80, May 2024.

[2] OECD (2017), International Regulatory Cooperation and Trade – Understanding the Trade Costs of Regulatory Divergence and the Remedies.

[3] See for example Clarke, S, Gasiorek Hernandez, M., and Sandoval, A., "The challenges facing UK firms: Trade and Supply Chains", UKTPO Briefing Paper 73, March 2023.

It is possible to conceive of various scenarios regarding regulatory cooperation in both goods and services that lie between the TCA baseline and single market arrangements. For the purposes of this exercise, we consider the following scenarios:

1. Strong regulatory alignment in goods, weak in services

Regulatory alignment in goods in this scenario is based on the principle of mutual recognition by the UK and the EU of each other's regulations. We envision an expansive approach to mutual recognition, in which the UK and the EU take active steps to minimise regulatory divergence and commit to recognising the equivalence of each other's regulations. Regulatory alignment in services remains weaker: we assume that it builds on TCA provisions that provide for regulators to propose mutual recognition on a sector-by-sector basis.

2. Strong regulatory alignment in both goods and services

In addition to the regulatory alignment described in scenario 1 above, in scenario 2 we model a commitment to recognising the equivalence of each other's regulations across the services sector and a commitment to minimise regulatory divergence in services.

In undertaking this modelling, we also take into account broader trade policy developments, in particular the possibility that the new United States (US) administration under President Donald Trump may levy tariffs on partners. Specifically, we model the effects of a scenario in which the US imposes a 60% ad valorem rate on all goods imports from China, and a 20% ad valorem rate on all goods from all other sources, including the UK and the EU.

While there is a likelihood that new US tariffs may contain various product and country exemptions or mitigations, we model this scenario featuring comprehensive country and product coverage to provide an estimate of the relative impacts of tariffs imposed by the US, on one hand, versus the effects of greater UK-EU regulatory cooperation on the other.

1.2 Structure of this report

This report is structured as follows:

Section 2 presents the modelling results on trade and on real GDP.

Section 3 provides a conclusion and policy discussions.

Annex A provides more detail on the econometric measurement of trade costs, and explains also the derivation of regional effects.

Annex B provides more detail on the model used to estimate trade flow and GDP effects.

2. Modelling approach and results

2.1 Methodology

2.1.1 Description of overall framework

Trade flows between any two countries or regions are influenced by trade costs. Trade costs are factors that make it more expensive for a firm to supply a foreign market relative to the home market. Trade costs arise from various sources, including country characteristics, transient events, and distance. They also reflect policy decisions, including those referenced in section 1.1: respectively, approaches to regulation and decisions on import duties.

To estimate the effects of policy decisions on trade we use an econometric model that estimates the effects of changes to trade costs on trade, once country fixed characteristics and year-specific factors (including transient shocks such as Covid-19) are accounted for. This is usually known as a gravity model of trade, which is widely used in the modelling of international trade.[4]

The trade model is embedded in a model of the broader economy. Under this model, businesses make decisions as to whether to supply the local or the domestic market, based on trade costs. Consumers make decisions as to whether to buy goods and services from domestic or foreign suppliers. Changes to trade costs change patterns of trade, and affect the overall terms of trade and volume of trade. That leads to change in real income. The model uses actual data on trade between and (importantly) within countries, taking into account sectoral linkages. The model, often referred to as a New Quantitative Trade Model, is described more fully in Annex [A]. Its structure draws on recent theoretical and empirical work on measuring the effects of trade policy.[5]

2.1.2 Approach to measuring trade costs

As already observed, trade costs refer to those additional costs that apply to the supply of products or services in the market of a trade partner, relative to the domestic market. These therefore need to be expressed as a percentage. For tariffs, this is simple: it requires knowing what ad valorem duty rate applies to products entering a particular market.

[4] We follow the approach described notably in Yotov et al. (2016), An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model. Other important contributions informing our approach include Andeson, J. E. and van Wincoop, E. (2003) "Gravity With gravitas: A solution to the border Puzzle", American Economic Review 93[1], 170-192. and Santos Silva, J.M.C and Tenreyro, S. "The Log of gravity". The Review of Economics and Statistics 88[4], 641-658.

[5] See notably Caliendo, L., and F. Parro. 2015. "Estimates of the Trade and Welfare Effects of NAFTA." Review of Economic Studies, 82(1): 144; Ottaviano, G. 2015. "European Integration and the Gains from Trade." In Routledge Handbook of the Economics of European Integration, London: Routledge; Aichele, R., and I. Heiland. 2018. "Where is the Value Added? Trade Liberalization and Production Networks." Journal of International Economics, 115(C): 130-144: and Shepherd, B. 2022. "Modelling global value chains: From trade costs to policy impacts", World Economy, 45(8): 2478-2509.

For non-tariff measures, which capture the costs associated with regulation and regulatory divergence, the task is less straightforward. It requires estimating ad valorem equivalents. In this case we are interested in how trade costs reflect decisions made by the EU and the UK, on common approaches to regulation and ways of managing regulatory effects on trade.

In order to capture the effects of regulatory alignment on trade costs, we use the World Bank's Deep Trade Agreements (DTA) database: the database captures all provisions in Free Trade Agreements (FTAs) notified to the World Trade Organisation (WTO). Our specific focus is understanding how far provisions relating to regulation, and mutual recognition specifically, matter in explaining trade between pairs of countries.

A significant challenge is that FTA provisions on regulation, notably in relation to sanitary and phyto-sanitary standards, technical barriers to trade, and trade in services are strongly correlated with other aspects of trade agreements that reflect the depth (i.e. strength) of the agreement, such as commitments on non-discrimination and market access. This is particularly true in the case of the EU, where regulatory alignment is closely related to the broader set of single market rules (notably the "four freedoms" – of goods, services, capital and labour) that affect trade costs.

We have therefore taken a conservative approach to capturing regulatory alignment. We focus on the existence of provisions relating to mutual recognition in sanitary and phyto-sanitary (SPS) measures, technical barriers to trade (TBT), and services chapters in the FTAs reported in the DTA. We construct a composite index that reflects whether these provisions are in force. We also control specifically for the broader effects of the FTA itself.

The gravity model estimates the effect of regulatory alignment on trade flows, controlling for exporter-year, importer-year and pair fixed effects. Controlling for these features, the coefficient on regulatory alignment measures the average change in trade between partners before and after being in alignment. That in turn allows us to run simulations to represent the effect on trade of the UK and the EU moving from current arrangements to closer alignment based on enhanced mutual recognition principles. A more detailed explanation is provided in Annex [A].

2.2 Trade effects

2.2.1 Effects of US tariffs

In this scenario, the US applies 60% tariff duties on all goods imports from China, and 20% tariff duties on all goods imports from other sources.

The results are reported in Figure 2. We report percentage changes in exports and dollar value changes relative to the status quo. The results are for total exports of the countries concerned to all partner destinations (not just the US). Results are broken down by three aggregate sectors: agrifood, goods, and services. Table 4 presents the same results in numerical form.

Figure 2: Effects of US tariffs: changes to exports in per cent and in billions of US dollars

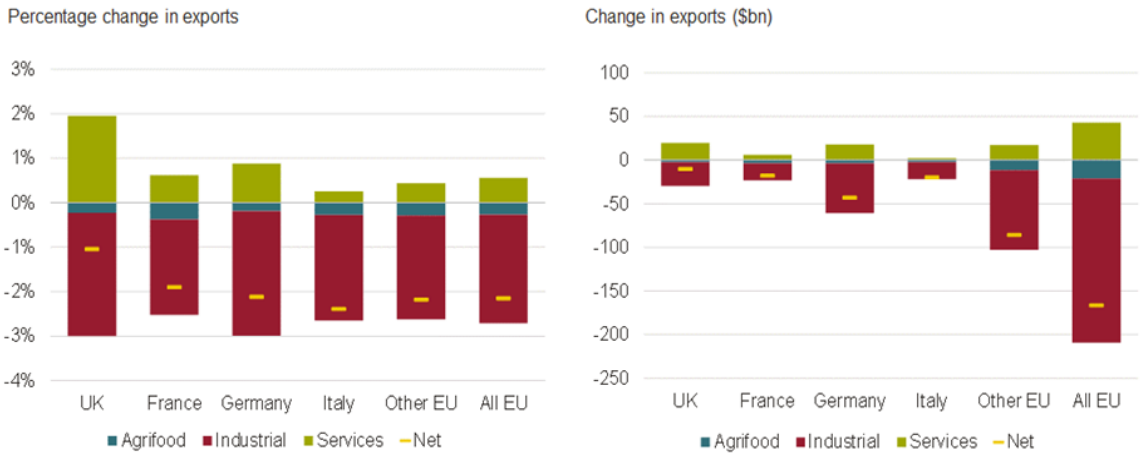


Table 4: Effects of US tariffs: changes to exports in billions of US dollars and in per cent

	UK	France	Germany	Italy	Other EU	All EU
Changes in billions of US dollars						
Agrifood	-2.3	-3.5	-3.9	-2.3	-11.3	-21
Industrial	-27.4	-19.9	-56.9	-19.6	-91.6	-188
Services	19.3	5.7	17.8	2.1	17.2	42.8
Net	**-10.3**	**-17.6**	**-43**	**-19.8**	**-85.7**	**-166.2**
Changes in per cent						
Agrifood	-0.2%	-0.4%	-0.2%	-0.3%	-0.3%	-0.3%
Industrial	-2.8%	-2.1%	-2.8%	-2.4%	-2.3%	-2.4%
Services	2.0%	0.6%	0.9%	0.3%	0.4%	0.6%
Net	**-1.0%**	**-1.9%**	**-2.1%**	**-2.4%**	**-2.2%**	**-2.2%**

For all five countries or regions reported, the imposition of US tariffs reduces exports as a whole. But for all of these, exports of services rise. This is due to a combination of reasons:

- The US imports less goods, but imports more services. This is because tariffs lead to a switch in economic activity towards goods in the US, and specifically goods for domestic consumption as tariffs increase the relative price of goods in the US and makes selling to domestic consumers more attractive. At the same time, US demand for services needs to be met, and this is supplied by foreign sources.
- For exporters to the US, trade costs for goods have increased, encouraging a switch to services.

We note that in relative (i.e. percentage) terms, the "pro-services" effects of US tariffs are stronger for the UK than they are for EU partners. For this reason, the negative effects on overall trade of the tariffs on exports are more muted for the UK. In a situation in which the US levies tariffs on everyone, the UK is less exposed to tariffs because services are the biggest component of its exports and it is a net services exporter.[6] UK exports of services to the US increase under this scenario. EU member states, and Germany in particular, for whom goods are a more important component of exports than they are for the UK, are more exposed to the US tariffs imposed in this scenario.

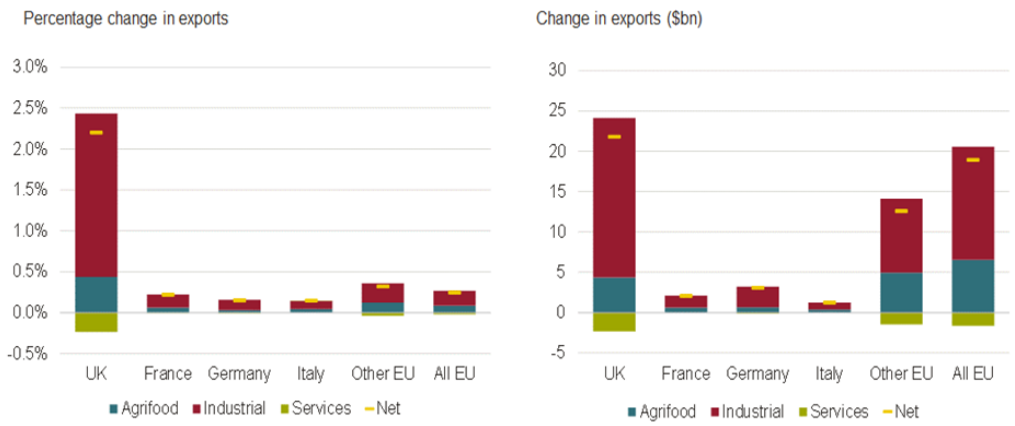
2.2.2 Effects of strengthened alignment in goods, weak alignment in services

In this scenario, the UK and the EU agree to comprehensive mutual recognition in goods, and to actively limit the extent of regulatory divergence. Services follow a more piece-meal approach, building on TCA provisions.

As a preliminary step, we considered the effects on the agrifood sector of an agreement on aligning approaches to SPS regulation only. However, the coefficient on SPS measures in isolation from others turns out to be statistically insignificant, meaning that such an approach is unlikely to have material impacts on agrifood trade as a whole. As observed below and then in section 2.2.4, agrifood exports are more responsive to a comprehensive approach to regulatory alignment that takes into account TBT and services provisions as well. This could reflect the effects of regulatory alignment in these areas on the costs of agrifood value chains, e.g. cost of inputs, transport and distribution.

Results for enhanced alignment in goods and weaker alignment in services are reported in Figure 3, while Table 5 presents the same results in numerical form. The results are for exports to all countries.

Figure 3: Effects of deep regulatory alignment in goods, weak in services: changes to exports in per cent and in billions of US dollars



[6] It needs to be emphasised that the outcomes would be different if the UK alone were to be singled out for tariffs, or if the UK were to face tariffs but the EU did not.

Table 5: Effects of deep regulatory alignment in goods, weak in services: changes to exports in billions of US dollars and in per cent

	UK	France	Germany	Italy	Other EU	All EU
Changes in billions of US dollars						
Agrifood	4.3	0.6	0.6	0.4	4.9	6.5
Industrial	19.8	1.5	2.6	0.8	9.2	14.1
Services	-2.3	0.0	-0.1	0	-1.5	-1.6
Net	**21.8**	**2**	**3.1**	**1.2**	**12.6**	**18.9**
Changes in per cent						
Agrifood	0.4%	0.1%	0.0%	0.0%	0.1%	0.1%
Industrial	2.0%	0.2%	0.1%	0.1%	0.2%	0.2%
Services	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Net	**2.2%**	**0.2%**	**0.2%**	**0.1%**	**0.3%**	**0.2%**

Effects on the UK are on the whole significantly stronger than those for the EU and its individual member states, particularly in relative terms. This is intuitive, reflecting:

(i) the relative size of both UK and EU markets: while the UK is also a significant market for EU member states, the EU internal market is significantly larger than the UK; and

(ii) the role of the EU as the largest destination for UK exports in goods.

Under this scenario, total UK services exports drop slightly. This is because deep alignment in goods generates a decrease in trade costs applicable to goods, relative to those affecting services. That encourages a switching away from services and towards goods (in contrast to the effect observed in the US tariff scenario in section 2.2.1 which encouraged switching to services by increasing trade costs in goods). The effect is also observable for other EU-27 countries (outside France, Germany and Italy) and the EU as a whole, but is more pronounced in the UK. This reflects the structure of UK trade and its comparative advantage in services sectors. Some of the negative effects of the change in relative trade costs on services exports will be offset by increased demand for services that are used as inputs into goods exports.

2.2.3 Effects of strengthened alignment in goods, weaker in services and with the imposition of US tariffs

We now bring together the two previous scenarios described in sections 2.2.1 and 2.2.2 respectively. Results are reported in Figure 4 below, while Table 6 presents the same results in numerical form.

Figure 4: Effects of deep regulatory alignment in goods, weak in services, with US tariffs: changes to exports in per cent and in billions of US dollars

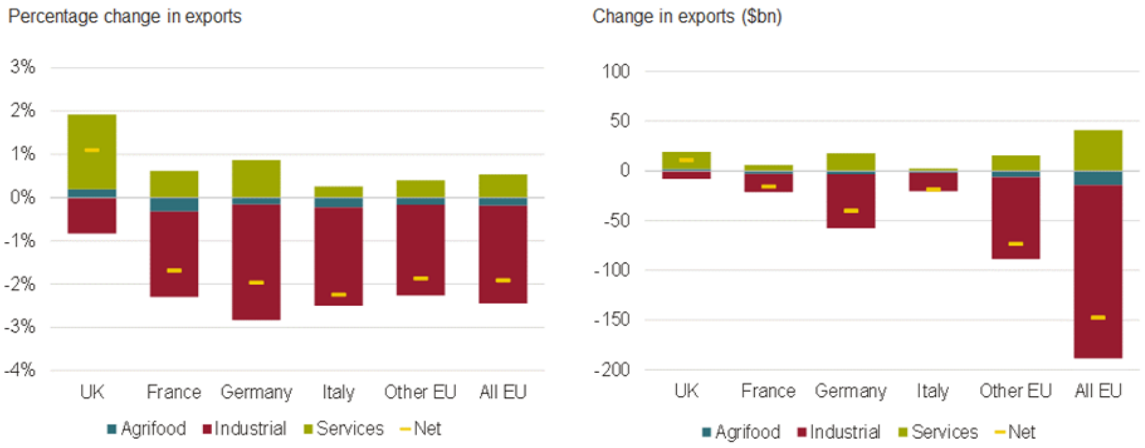


Table 6: Effects of deep regulatory alignment in goods, weak in services, with US tariffs: changes to exports in billions of US dollars and in per cent

	UK	France	Germany	Italy	Other EU	All EU
Changes in billions of US dollars						
Agrifood	1.9	-2.9	-3.3	-1.9	-6.4	-14.5
Industrial	-8.2	-18.4	-54.3	-18.8	-82.5	-174
Services	17.1	5.7	17.6	2.1	15.6	41
Net	**10.9**	**-15.6**	**-40**	**-18.6**	**-73.3**	**-147.5**
Changes in per cent						
Agrifood	0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%
Industrial	-0.8%	-2.0%	-2.7%	-2.3%	-2.1%	-2.3%
Services	1.7%	0.6%	0.9%	0.3%	0.4%	0.5%
Net	**1.1%**	**-1.7%**	**-2.0%**	**-2.2%**	**-1.9%**	**-1.9%**

The pattern of effects is similar to the case with US tariffs and no change to the UK-EU relationship. For the EU, the deep alignment in goods provides a small measure of mitigation against the effects of US tariffs: losses are a little lower than under the “pure US tariffs” scenario.

For the UK, the deep alignment in goods helps to mitigate the negative effects of US tariffs on industrial goods. This is intuitive: alignment reduces trade costs affecting goods exports to the EU. We also see that for agrifood specifically, deep alignment more than offsets the effects of US tariffs.

Losses for the EU under the US tariff scenario are a little lower with deep alignment in goods than they were with US tariffs and no changes to the EU-UK relationship.

UK services exports increase under this scenario, whereas they fell when deep alignment in goods and weak alignment in services were considered without the effects of US tariffs. In economic terms, leaving services out of deep alignment runs against the services-dominated structure of UK exports. But US tariffs tax UK goods exports, and while this is bad for those sectors, they also "correct" the distorting effect of leaving services out of deep alignment. The results also underscore that in the face of US tariffs, it is services that provide the primary "shield" for the UK.

2.2.4 Effects of strengthened regulatory alignment in goods and services

In this scenario, the UK and the EU agree to a comprehensive approach to mutual recognition in goods and services and a commitment to limiting the scope of regulatory divergence.

Results are reported in Figure 5, while Table 7 presents the same results in numerical form.

Figure 5: Effects of deep regulatory alignment in goods and services: changes to exports in per cent and in billions of dollars

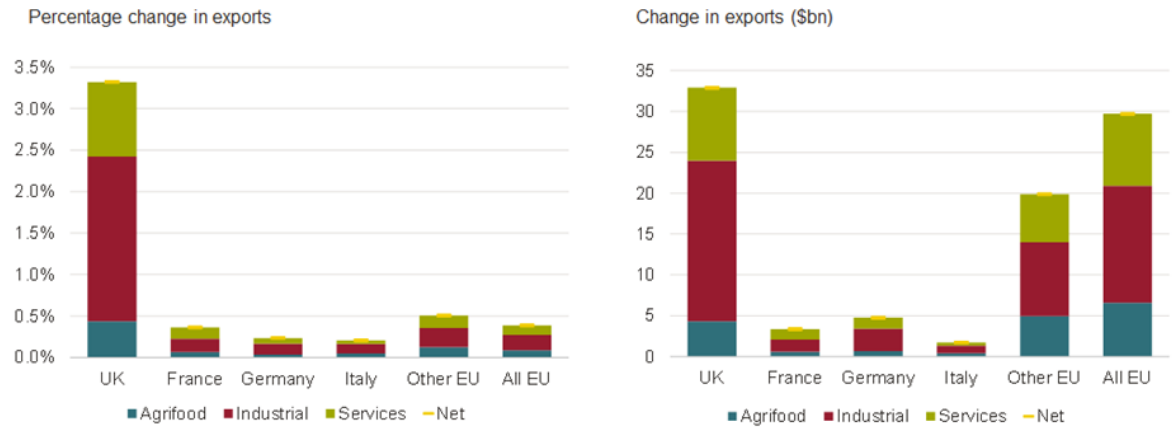


Table 7: Effects of deep regulatory alignment in goods and services: changes to exports in billions of US dollars and in per cent

	UK	France	Germany	Italy	Other EU	All EU
Changes in billions of US dollars						
Agrifood	4.3	0.6	0.7	0.4	4.9	6.6
Industrial	19.7	1.5	2.8	1.0	9.1	14.3
Services	8.9	1.3	1.3	0.4	5.9	8.8
Net	**32.9**	**3.4**	**4.8**	**1.7**	**19.9**	**29.7**
Changes in per cent						
Agrifood	0.4%	0.1%	0.0%	0.0%	0.1%	0.1%
Industrial	2.0%	0.2%	0.1%	0.1%	0.2%	0.2%
Services	0.9%	0.1%	0.1%	0.0%	0.1%	0.1%
Net	**3.3%**	**0.4%**	**0.2%**	**0.2%**	**0.5%**	**0.4%**

Unsurprisingly, the effects on total exports are strongest under this scenario, since deep alignment in goods and services boosts exports in both. The effect of deep regulatory alignment on services exports is not as strong as deep alignment is on goods exports. The likely explanation for this is that trade costs affecting services exports are influenced by a range of policy settings that lie outside the scope of regulatory alignment. These include broader limitations on market access and non-discrimination, such as measures requiring national presence of measures restricting the movement of labour. In relation to goods trade, the TCA already offers tariff-free trade, and non-preferential tariffs applied by the EU and UK on industrial goods are low. Along with other non-tariff measures, such as rules of origin, regulatory barriers to trade are the main remaining sources of trade costs; hence addressing these in a comprehensive manner boosts industrial goods exports significantly.

The effects, relative to the overall value of exports, are bigger for the UK than they are for EU member states. In monetary terms, they are roughly equivalent. The larger effect for the UK is, as discussed before, in line with the relative size of both markets. In particular, the EU's much larger internal market means that a given reduction in trade costs will have a smaller effect on its external trade than the same reduction will have for the UK's external trade.

The overall export effects are consistent with the findings of studies that have estimated the effects on UK trade arising from the replacement of EU membership with TCA arrangements. Depending on the methodology used, a range of effects have been found. Some suggest

losses of between 8-11% for the UK.[7] A more recent (2024) study based on firm level data suggests a reduction of worldwide goods exports of around 6.4%.[8]

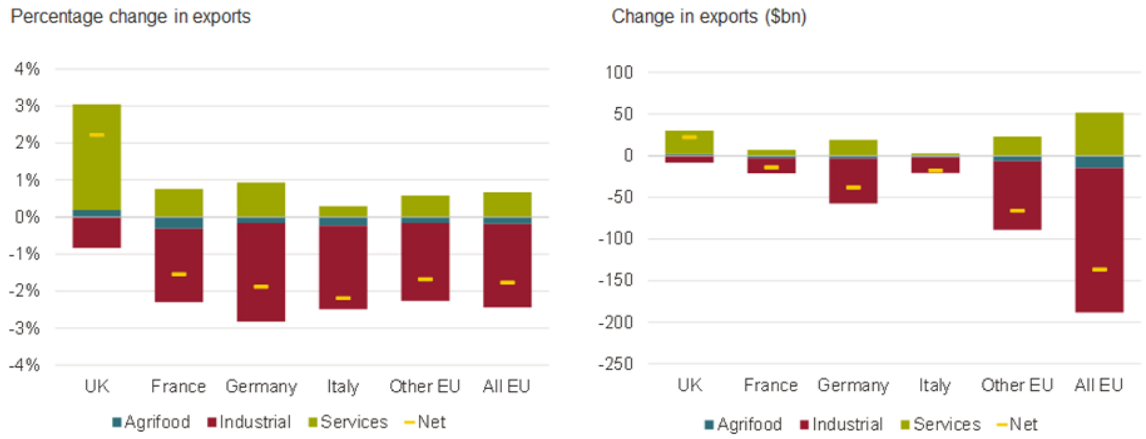
The results suggest that the deep alignment scenario claws back a significant proportion – though not all – of those losses. One of the findings of the 2024 study suggested that smaller firms were hardest hit by the loss of EU membership and the switch to current TCA agreements. This is consistent with the finding that regulatory barriers are more liable to affect smaller businesses. To the extent that the deep alignment scenarios help to reduce these barriers, we would expect a substantial proportion of the gains in goods trade to be driven by positive effects on smaller businesses.

An analysis of regional patterns shows that France, Germany, Italy and other EU-27 as a whole increase exports to the UK. Increased UK exports go primarily to the "other EU" and to a lesser extent to France. Trade to non-EU partners does not change (i.e. there is no sign of deeper UK-EU integration affecting trade with the rest of the world).

2.2.5 Strengthened regulatory alignment in goods and services, with US tariffs

We repeat the deep alignment scenario, this time with the imposition of US tariffs. Results are reported in Figure 6 and in numerical form in Table 8.

Figure 6: Effects of deep regulatory alignment in goods and services, with US tariffs: changes to exports in per cent and in billions of dollars



[7] de Lucio, Juan, Raúl Mínguez, Asier Minondo, and Francisco Requena. „The negative impact of disintegration on trade: The case of Brexit." European Economic Review 163 (2024): 104698; Du, Jun, Emine Beyza Satoglu, and Oleksandr Shepotylo. „How did Brexit affect UK trade?." Contemporary Social Science 18, no. 2 (2023): 266-283 ; Kren, Janez, and Martina Lawless. „How has Brexit changed EU–UK trade flows?." European Economic Review 161 (2024): 104634.

[8] Freeman, R. et al (2024), "Deep integration and trade: EU firms in the wake of Brexit", Centre for Economic Performance, Discussion Paper No.2066.

Table 8: Effects of deep regulatory alignment in goods and services, with US tariffs: changes to exports in billions of US dollars and in per cent

	UK	France	Germany	Italy	Other EU	All EU
Changes in billions of US dollars						
Agrifood	1.9	-2.9	-3.2	-1.9	-6.4	-14.5
Industrial	-8.2	-18.4	-54.2	-18.7	-82.6	-173.9
Services	28.2	7.0	19.1	2.5	23	51.5
Net	**21.9**	**-14.3**	**-38.3**	**-18.1**	**-66.1**	**-136.8**
Changes in per cent						
Agrifood	0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%
Industrial	-0.8%	-2.0%	-2.7%	-2.3%	-2.1%	-2.3%
Services	2.8%	0.8%	0.9%	0.3%	0.6%	0.7%
Net	**2.2%**	**-1.5%**	**-1.9%**	**-2.2%**	**-1.7%**	**-1.8%**

The effects of US tariffs are asymmetric between the UK and EU. For the EU, deep alignment moderates, but does not offset, impacts of US tariffs. For the UK, US tariffs reduce, but do not offset, the benefits of deep alignment.

2.3 Economic effects

We use real GDP as a measure of economic welfare. Changes to GDP, in this model, are driven by changes to the terms of trade, and changes to the volume of trade, both of which are in turn influenced by the changes to trade costs that arise from the scenarios modelled. Results are reported in Figure 7 and Figure 8 showing, respectively, changes in percentage terms and in dollar terms.

Figure 7: Change to real GDP in one year across all scenarios, per cent

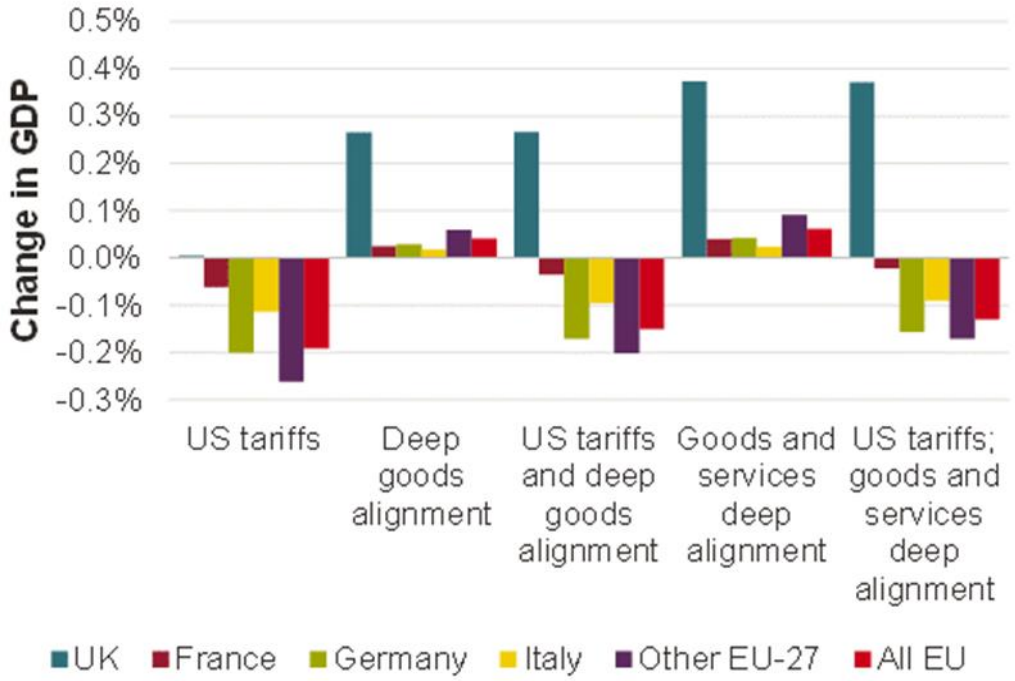
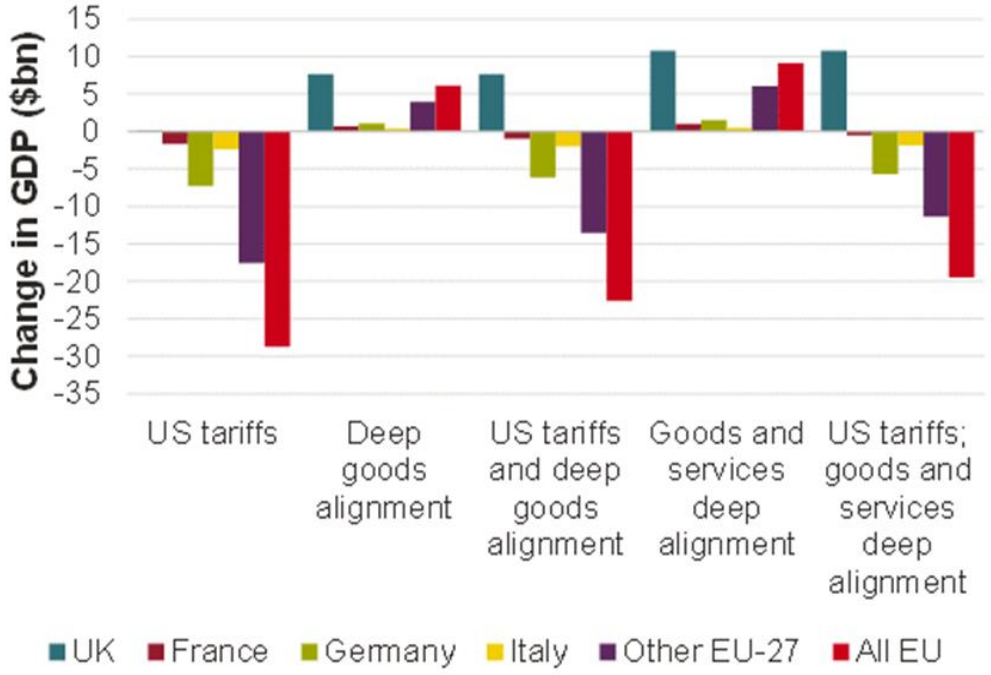


Figure 8: Changes to real GDP in one year across all scenarios, billions of dollars



In line with the "comparative static" nature of the modelling, the effects should be understood as a change to GDP in one particular year.

The effects of US tariffs in isolation have no discernible impact on the UK as whole; while they are more significant for the EU. The effect on the UK is likely driven by two factors. First, the role played by services exports in the overall structure of UK exports. As observed in section 2.2.1, UK services exports rise significantly as a result of US tariffs, and the effect is stronger for the UK than the EU. Secondly, US tariffs switch the US consumption of goods from imported to domestic sources. While that generates inflationary pressures in the US, the drop in US demand for imported goods reduces global prices for the goods subjected to tariffs, which benefits other countries, including the UK and EU member states. The downward pressure on the price level boosts real GDP in net goods importing countries such as the UK.

In overall economic terms, alignment scenarios have a bigger economic impact on the UK than the EU relative to the size of their economies. In monetary terms the impacts are about equal.

The UK impacts are relatively significant. The increase in GDP under the deep alignment in goods and services scenario is more than double the upper estimate that was modelled in 2019 by the UK government for a hypothetical UK-US FTA.[9] The effects would also dominate the reported £2 billion long-run gain in GDP from the UK's accession to the CPTPP.[10] In monetary terms, if the gains were used 1 for 1 to support fiscal spending, they could support a variety of budgetary aims. For example, it could cover close to two years' worth of desired increases to the NHS health and social care capital budget.[11] We summarise the results in numerical form in Table 9 and Table 10.

[9] HMG (2019), *UK-US Free Trade Agreement*, Department for International Trade, p. 33. The modelling reported effects over 15 years, which was then applied to current GDP to give a monetary equivalent..

[10] HMG (2023), Impact Assessment of the UK's Accession to the CPTPP, p. 8.

[11] See for example: https://www.nhsconfed.org/publications/autumn-budget-2024-what-you-need-know

Table 9: GDP impacts in billions of US dollars

	UK	France	Germany	Italy	Other EU	All EU
US tariffs	**0.1**	**-1.6**	**-7.2**	**-2.4**	**-17.5**	**-28.7**
Deep alignment in goods, weak in services	7.7	0.7	1.1	0.4	4.0	6.1
Deep alignment in goods, weak in services, plus US tariffs	7.7	-0.9	-6.1	-2.0	-13.5	-22.6
Deep alignment in goods and services	10.8	1.0	1.5	0.5	6.1	9.1
Deep alignment in goods and services plus US tariffs	10.7	-0.6	-5.7	-1.9	-11.4	-19.5

Table 10: GDP impacts in per cent

	UK	France	Germany	Italy	Other EU	All EU
US tariffs	**0.0**	**-0.06**	**-0.20**	**-0.1**	**-0.3**	**-0.2**
Deep alignment in goods, weak in services	0.3	0.02	0.03	0.02	0.06	0.04
Deep alignment in goods, weak in services, plus US tariffs	0.3	-0.03	-0.2	-0.1	-0.2	-0.2
Deep alignment in goods and services	0.4	0.04	0.04	0.02	0.1	0.06
Deep alignment in goods and services plus US tariffs	0.4	-0.02	-0.2	-0.1	-0.2	-0.1

The results are "comparative static" ones – they compare the state of the economy with and without the policy change in question at one point in time based on current data. An alternative way of estimating the dynamic effects of trade policy changes is to consider the long run relationship between trade openness (the share of trade to GDP) and GDP. The empirical relationship reflects the various contributions that trade brings to growth, particularly effects on productivity through gains from specialisation, scale and the diffusion of knowledge.

There are various empirical estimates of the responsiveness (or "elasticity") of GDP to trade openness.[12] On the basis of this range, we would expect long run effects on GDP of between 1% and 1.5% per year, under the deep alignment in goods only scenario; and between 1.7% and 2.2% under a deep alignment in goods and services scenario (see Table 11).

Table 11: Long run GDP effects for the UK under tariff and alignment scenarios

Scenario	Real GDP effect in percent
US tariffs	-0.5% to -0.7%
Deep regulatory alignment in goods, weak in services	1% to 1.5%
Deep regulatory alignment in goods, weak in services, with US tariffs	0.6% to 0.8%
Deep regulatory alignment in goods and services	1.7% to 2.2%
Deep regulatory alignment in goods and services, with US tariffs	1.1% to 1.5%

The Office for Budget Responsibility (OBR) estimated that the effects of moving from EU membership to the TCA would reduce productivity, and hence long run GDP, by around 4%.[13] Set against this, the findings from the modelling suggest that, depending on the scenario, and on assumptions on the effects of trade on GDP in the long run, closer alignment could recover between a quarter to around half of loss estimated by the OBR.

Were US tariffs to be maintained at the level assumed in section 2.2.1, we would expect that over time the negative impacts on productivity via lost trade would reduce UK GDP by between 0.5% and 0.7%. This also suggests, in conjunction with the results reported in the previous paragraph, that in the long run, regulatory alignment between the UK and the EU provides the UK with a relatively robust safeguard against the negative effects of US protectionism.

[12] Feyrer, J. (2009): "Trade and Income – Exploiting Time Series in Geography," NBER Working Papers 14910, National Bureau of Economic Research, suggests a range of 0.5 to 0.7 i.e. a percentage point increase in trade openness increases real GDP by 0.5 to 0.7%.

[13] Office for Budget Responsibility 2024, Economic and Fiscal Outlook, March, p38, accessed via https://obr.uk/box/how-are-our-brexit-trade-forecast-assumptions-performing

2.4 Regional effects

The previous section on economic effects reported results for the UK as a whole. We report regional results in this section because, as with any policy change of external impact, there can be significant differences between regions under the scenarios we have modelled.

We estimate regional effects by using the "comparative static" effects computed for the UK as a whole under each scenario (reported in section 2.3) and apportioning these by region, by using data on the structure of economic activity in each region. The intuition is that under each of the scenarios, the exposure of a region to a specific change in trade costs resulting from tariffs and/ or regulatory alignment will reflect the mix of economic activities that take place in each of these regions. For example, if a region is particularly intensive in traded services, it will benefit under scenarios that reduce trade costs affecting the services sector relative to those affecting industrial goods, with the opposite being true for a region intensive in traded industrial goods.

This methodology is a high level approximation. In particular it does not take into account longer run adjustment effects such as the movement of labour or capital from one region to another. A fuller analysis would require a more detailed modelling exercise. A fuller description of the methodology and data sources is presented in Annex [A].

Results are reported in Table 12 below as changes in regional Gross Value Added. They should be interpreted as changes in a given year.

Table 12: Summary of regional effects, change in one year in percent of Gross Value Added

	US tariffs	Deep goods alignment	US tariffs and deep goods alignment	Goods and services deep alignment	US tariffs; goods and services deep alignment
North East	-0.14%	0.29%	0.15%	0.38%	0.24%
North West	-0.04%	0.26%	0.22%	0.37%	0.32%
Yorkshire	-0.17%	0.29%	0.11%	0.39%	0.21%
East Midlands	-0.21%	0.29%	0.07%	0.39%	0.18%
West Midlands	-0.27%	0.34%	0.06%	0.44%	0.16%
East	-0.01%	0.27%	0.25%	0.38%	0.36%
London	0.33%	0.23%	0.56%	0.36%	0.68%
South East	0.07%	0.27%	0.33%	0.38%	0.44%
South West	-0.09%	0.26%	0.17%	0.36%	0.26%
Wales	-0.18%	0.27%	0.08%	0.36%	0.18%
Scotland	-0.16%	0.26%	0.09%	0.35%	0.19%
Northern Ireland	-0.14%	0.24%	0.09%	0.34%	0.19%
United Kingdom	0.00%	0.27%	0.27%	0.37%	0.37%

We observe that the US tariffs have a negative effect on all regions, except London (especially) and the South East. The most pronounced negative effects are in the Midlands, followed by Wales, Scotland, Northern Ireland and Yorkshire. London does better out of the tariff scenarios than other regions because of the role services play in its economy. As explained in section 2.2.1, under tariffs, trade costs affecting services are lower relative to those affecting goods (which have increased), favouring UK exporters of services, who notably take advantage of greater imports of services into the US (where demand for services imports rise relative to demand for goods imports). By contrast, other regions tend to be more intensive in goods exports and therefore are worse off under tariffs. So while the overall growth effect on the UK is (virtually) nil, there are significant regional disparities in exposure to the tariff scenarios, and therefore in effects on economic activity, in the short run.

The results reported in Table 12 also show that the alignment scenarios generate positive results for all regions. The pattern of regional results is also markedly different to the tariff scenarios. The Midlands regions and Yorkshire record the strongest positive results. In particular, deep alignment in goods regulation reduces trade costs affecting goods, and therefore has a particular benefit to regions that are intensive in goods exports.

The regional pattern of results remains broadly consistent when comparing deep alignment in goods only with deep alignment in goods and services. Note that regulatory alignment in services, by reducing trade costs affecting services, can have a beneficial impact on goods trade, because services are inputs into goods and often play a role in reducing the transactions costs with goods trade.

Positive results are also observable for London, though they are more moderate than those reported for other regions. In the scenario in which there is deep alignment in goods only, this is because there is a small drop recorded in overall services exports. At the same time, London (and other services-intensive regions) benefit from the fact that some services are embedded in good exports, so an increase in goods exports benefits services indirectly. In the scenario featuring deep alignment in goods and services, London also benefits from an increase in services exports.

The results also suggest that for all regions, the alignment scenarios help to at least offset the effects of tariffs, and in many cases dominate them. For the regions worst impacted by tariffs, this is because regulatory alignment reduces trade costs in goods with the UK's largest export market for goods. In addition to the Midlands, we see particular strong shielding effects in the North East, Yorkshire, Scotland, Wales and Northern Ireland. Moreover, as explained above, reducing trade costs affecting services improves the conditions of supply for services that are inputs into goods, and more specifically services that facilitate the trade of goods.

3. Conclusions and policy discussion

We have modelled the effects of greater regulatory alignment between the UK and the EU, characterised as progress toward a comprehensive approach to mutual recognition of regulations and a commitment to mitigate regulatory divergence. The modelling also takes into account the possibility that the UK, the EU and other trade partners could face tariffs imposed by the US government on all their goods exports (at the rate of 20%; with 60% levied on China's exports). The modelled results should be treated as a counterfactual/ "what-if" analysis: they estimate what effects on trade and welfare could be in a state of the world in which the UK and the EU were to enter into deeper forms of cooperation that is currently embodied in the TCA.

The results suggest that both the UK and the EU stand to gain from deeper integration via regulatory alignment. The gains arise because of the reduction in trade costs generated by greater regulatory alignment. The gains are bigger for the UK than the EU, relative to the respective size of their trade flows and their economies. This is intuitive, given the relative size of both economies. For the UK, the gains represent a significant fraction of the losses to trade and welfare that have been estimated to have arisen as a result of the replacement of EU membership by TCA arrangements.

The results also highlight the role played by particular features of the UK's trade structure, notably its comparative advantage in services sectors and the dominance of these in UK exports. These features mean that the UK would benefit from a broad approach to regulatory alignment that includes both goods and services. Narrower approaches have more limited payoffs. A SPS-only arrangement produces few discernible benefits, reflecting the role that TBT and services trade barriers also play in relation to agrifood value chains.

A goods-only approach to regulatory alignment generates significant benefits for the goods sector. However, it does lead to a small reduction in services trade, since the reduction in trade costs favours goods over services exports. Deep alignment in services boost services exports as a whole, though the effect is less pronounced than the effect of regulatory alignment in goods. Further gains to services trade may require negotiations on other limitations to market access and non-discrimination that go beyond regulation. Under both alignment scenarios, the effects on the UK are larger than they are for the EU. This is principally because of the differences in size of both markets: a given reduction in trade costs will have a larger effect on the party with the smaller internal market (the UK).

The modelling also shows that the UK as a whole is less exposed to tariffs levied by the US compared to its partners in the EU (and indeed the rest of the world). The comparative static welfare effects on the UK of the US tariffs are virtually zero. This is partly because of the role that services play in the UK's trade structure: they shield the UK from the brunt of tariff impacts. It is also because the switch from import consumption to domestic goods consumption in the US reduces world import prices, which has a positive effect on real GDP.

Policy implications from these results are that:

- Measures that reduce services trade costs would further secure the UK economy against tariff threats, whether from the US or elsewhere.
- Measures that the UK may take against cheaper foreign imports (resulting from UK tariffs) are liable to have a negative impact on UK real GDP as a whole.

The longer run estimates of the scenarios on GDP (via effects on productivity) suggest a less sanguine outlook in relation to tariffs, as these progressively impact on trade openness and through that on productivity. The longer run estimates also show that regulatory alignment could help to recover between a quarter to around a half of the long term loss to GDP estimated by the Office for Budget Responsibility. If US tariffs were to be in place over the longer term, we would expect negative effects on the UK. Assuming tariffs remain in the range of 20%, regulatory alignment between the UK and the EU – even if just in goods – would shelter the UK from the adverse impacts of the tariffs.

The regional analysis shows a relatively pronounced degree of divergence across the scenarios – and in particular the tariff scenarios – on regional economies (as measured by regional Gross Value Added). These differences reflect differences in economic structure and in particular the relative role of services in trade. Under the tariff scenarios, in the short run at least, all regions lose out with the exception of London and the South East, which see positive effects. All regions, by contrast, gain from regulatory alignment scenarios, with the main gains located outside of London and the South East. The alignment scenarios also shelter all regions from the impacts of US tariffs.

The modelling results are likely on the conservative side. Our approach to model specification has been conservative. Similarly, our modelling does not take into account the effects of uncertainty on trade. In particular, we do not take into account the costs to exporters, and value chains more broadly, of facing uncertainty around the actual profile of tariffs applied by the US. And indeed, creating such uncertainty appears to be an integral part of the US' strategic approach to trade relations and global governance more broadly, in order to create negotiating leverage. By contrast, deeper alignment between the UK and the EU opens the possibility for both parties to put their trade relations on a predictable footing supported by treaty arrangements.

The asymmetry in impacts between the UK and the EU under the alignment scenarios suggests that from a UK perspective it may be necessary to offer the EU a broader set of incentives to negotiate. One possibility, mooted by EU officials, is to consider implementing a youth mobility scheme. Indeed, it is possible that such a scheme could generate its own economic benefits. A rough "back-of-the envelope" calculation suggests a small gain in GDP to the UK, of around 0.45% over a 10 year horizon.[14] These would be additional to the gains from reduced trade costs modelled in this report.

[14] Springford, J. (2024), "The gap between the "Brexit reset" rhetoric and reality", Centre for European Reform.

ANNEX A

Approach to trade modelling

Annex A Approach to trade modelling

Methodology

We simulate the impacts of UK-EU alignment and US 'Trump tariffs' using a 'New Quantitative Trade Model' (NQTM – see Annex B). This is a counterfactual analysis that defines tariffs and alignment as changes to trade costs, which are applied to a baseline state of the world, giving impacts under different scenarios. The NQTM explores the impact of assumed tariff increases and changes to non-tariff barriers estimated in ad valorem terms using an econometric gravity model. The NQTM estimates changes in trade, output, welfare and prices. These can be combined with estimates of regional economic activity to give effects at a regional level.

NQTM

The NQTM is based on sectoral linkages and trade flows. In essence, it models how a policy change leads to a change in relative prices, which feeds directly through to consumer prices, and also indirectly through its effect on production costs. These price changes then influence each country's terms of trade—the price of its exports in terms of its imports—and the composition of its trade, meaning exports and imports in particular sectors and with individual country partners. Consumers and producers will switch away from goods/services for which trade costs are towards those for which trade costs are lower, resulting in substitution. This substitution means that increases in trade will be accompanied by reductions in domestic production-consumption, as more production is exported and more consumption is imported. The NQTM also has an exogenous trade balance, so that the trade deficit / surplus in the scenario stays at its baseline level, even though trade and production flows have all changed.

The NQTM here uses data from Asian Development Bank Multi-Region Input Output Tables, which cover 73 countries and 35 sectors, and runs up to 2022.

Tariffs are straightforward to model as they have a direct quantitative representation. The tariff scenarios assume that US tariffs on all goods imports rise to 20% from current levels, or 60% in the case of China.

For regulatory alignment, as they have no direct quantitative representation as trade costs, the implied trade costs are estimated using an econometric 'structural gravity model'. The observed differences in trade flows that arise as a result of different regulatory alignment arrangements is used to infer the corresponding trade costs that are associated with it.

Econometric approach

Gravity models are based on the premise that trade between pairs of markets is affected by each market's size and the distance between them. Hence the term gravity model, borrowed from planetary gravity: just as planets are attracted to each other in proportion to their sizes and proximity, so trade gravitates to geographically close and big economies. The analysis

follows current best practice in following a 'structural gravity' approach, which is based on representations of the supply- and demand-side economies and are general equilibrium in nature.[15] This approach is used because it aligns fully with a suite of underlying theoretical models of consumer demand and trade, giving robust theory-consistent results that can be then used in a simulation model, all within the same unified theoretical framework. A key feature of structural gravity models is the inclusion of importer and exporter fixed effects which fully capture each country's relative prices and thus propensity to trade. Structural gravity models also include 'domestic shipments', production that is consumed in the home country, giving a complete and exhaustive system of supply and demand.

The gravity model we focus on includes importer-year, exporter-year, and importer-exporter 'pair' fixed effects. These account for a substantial amount of variation in trade flows. For example, the fixed effects would control for UK's propensity export in 2022, France's propensity to import in 2022, and the average propensity for UK-France trade over time. On top of this the model measures the effects of 1) a regional trade agreement (RTA) with alignment, 2) a regional trade agreement (RTA) without alignment. The effects of these are given by the dummy variables β_1 and β_2 respectively. The coefficient β captures the effect of regulatory alignment while controlling for these various factors. Since the fixed effects already control for much time-variation, β_1 and β_2 are identified by changes over time in a country pair's RTA/alignment status.

The model can be written:

$$Trade_{ijt} = a + \beta_1 RTA\_alignment_{ijt} + \beta_2 RTA\_no\_alignment_{ijt} + Importer_{it} + Exporter_{jt} + Pair_{ij} + u_{ijt}$$

The model is estimated for each aggregate sector in turn, i.e. agrifoods, industrial products, services. In line with best practice the model is estimated in pseudo-poisson maximum likelihood (PPML), which means that coefficients have a proportional impact.[16]

Data

The gravity modelling uses the ADB MRIO dataset on trade flows, from 2000 to 2022. Regulatory alignment is modelled using the World Bank Deep Trade Agreement datasets (DTA). The database provides detailed information on the content of a sub-sample of eighteen policy areas most frequently covered in a set of 400 agreements currently notified to the WTO between 1958 and 2023.

[15] For a recent detailed explanation of the use of gravity models in trade policy analysis, see Yotov et al. (2016). Other important contributions informing our approach include Anderson and van Wincoop (2003) and Santos Silva and Tenreyro (2006).

[16] To derive first-order marginal effects the coefficient is raised by the exponential. For example, the percentage change in trade associated with moving from no RTA to an RTA with alignment is given by $\exp(\beta_1)$-1.

We focus on the following provisions within DTA:

Sanitary and Phytosanitary Measures (SPS)
-SPS 17 Is mutual recognition recognised?

Technical Barrier to Trade:
-TBT08 Is mutual recognition/equivalence in force?
-TBT09 Is the burden of justifying non-equivalence on the importing country?

Services:
-dr_mutrec: Does the agreement contain provisions on mutual recognition?

The RTA_alignment variable is set equal to one if any of these provisions are in place in an RTA. For RTAs that do not have alignment the variable RTA_non_alignment is set equal to one.

The RTA alignment variable measures the effect on a sector of being in an RTA with alignment, while separately controlling for the effect of other RTAs (without alignment). Using a single alignment variable is a pragmatic step to draw on different aspects of alignment and address potential issues in the coding of RTAs in the DTA dataset. For example, SPS mutual recognition is not coded in DTA as applying between EU member states; since partners will already have common standards there is no need for mutual recognition in SPS. The RTA_ alignment variable measures the effect on a sector of alignment occurring in some combination of SPS, TBT, and services, without being specific as to which of these may be driving the results.

Results

The results of the regression are shown in Table 13 below. Results for the different sectors and RTA variables are shown on different rows. The columns show the coefficients, t-statistics and p-values for statistical significance. As can be seen, the results are larger and more significant for RTAs with alignment than those without.

Table 13: Gravity model estimates of regulatory alignment

Sector	Variable	Coefficient	T-statistic	P-value
Agrifoods	RTA_alignment	0.308	6.40	0.000
	RTA_no_alignment	0.097	0.92	0.358
Industrial goods	RTA_alignment	0.217	7.81	0.000
	RTA_no_alignment	0.098	1.07	0.283
Services	RTA_alignment	0.366	5.33	0.000
	RTA_no_alignment	0.299	2.08	0.037

The effects of moving to an RTA with alignment from one without are given by the difference between β_1 and β_2 which is fed into the NQTM as the reduction in non-tariff barriers in the relevant scenarios.[17]

A general challenge with the econometric approach is the high correlation between the regulatory alignment and other aspects of RTA depth. Given that the regulatory alignment variable may be picking up some of these wider effects of depth, the shocks are scaled down by 25%.

Regional impacts

The results from the NQTM can be used to give high-level estimates of regional impacts on welfare. The welfare change in a region is defined as the weighted sum (over sectors) of the output change multiplied by the sector value added share, plus price changes. This can be written as follows:

$$\Delta Welfare_g/Welfare_g = \sum_s[(\Delta Output_s/Output_s)*(Output_{sg}/Output_g)*(VA_{sg}/Output_{sg})] + \Delta prices$$

For region g and sector s, the elements are described below:

$\Delta Welfare_g/Welfare_g$ is the percentage change in welfare in region g.

$(\Delta Output_s/Output_s)$ is the percentage change in output for sector s, calculated in the NQTM. It includes both changes to trade as well as domestic shipments. In other words, the regional analysis is agnostic as to whether regions are trading internationally or with other regions or supply chains.

$(Output_{sg}/Output_g)$ is the sector's share of regional output, e.g. 75% of the output in region X is services. The regional sector shares of output are derived from sectoral turnover totals from ONS Business Population Estimates (BPE) 2022.[18] Several further adjustments are needed: 1) financial turnover is not reported, so this is estimated using national output from the ADB MRIO apportioned to region in line with sector shares of financial employment; 2) food manufacturing is not split out within general manufacturing so assumed to be a constant share of it, in line with relevant totals from ADB MRIO.

$(VA_{sg}/Output_{sg})$ is the value-added share for the sector in the region. For example, for each unit of output in the sector, x% is value added and the remainder is inputs from other sectors. This is calculated by dividing regional GVA estimates from ONS[19] by the corresponding regional turnover totals from ONS BPE.

[17] $Exp(\beta_1 - \beta_2) - 1$

[18] https://assets.publishing.service.gov.uk/media/632c88808fa8f51d2669fa2e/2022_BPE_detailed_tables.xlsx

[19] https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry

∆**prices** are national changes in prices that are calculated as the difference between national output (in nominal terms) and real GDP. As a high-level analysis we assume the price effects are uniform across regions.

ANNEX B

Technical description of the NQTM model

Annex B: Technical description of the NQTM model

We model the economic impacts of measures enacted under the scenarios described in the main by using a model from the class of general equilibrium models known as New Quantitative Trade Models (NQTMs). Academic economists now typically use NQTMs for the analysis of trade policy changes, ranging from entry into a trade agreement[20] to joining the WTO.[21] The model used here is based on articles published in leading academic journals, and has previously been applied in peer-reviewed research to, for instance, analyse the economic impacts of improvements in trade facilitation.[22]

NQTMs, like all economic models, have a complex structure embodied in a large set of equations linked to a dataset. However, the basic logic is straightforward, and is based on a widely shared understanding of how policy changes affect trade flows and prices, and how they in turn affect economic welfare. Figure 1 summarizes the NQTM's approach to turning inputs (changes in policies, expressed as ad valorem equivalent trade costs; see main text for details of calculations) into outputs (changes in real Gross National Income, GNI, as a measure of economic welfare, as well as intermediate variables like prices and trade values).

In essence, the policy change leads to a change in relative prices, which feeds directly through to consumer prices, and also indirectly through its effect on production costs. These price changes then influence each country's terms of trade — the price of its exports in terms of its imports—and the composition of its trade, meaning exports and imports in particular sectors and with individual country partners. The net outcome of these different effects, which are complex at a micro-level, is measured by changes in real GNI. A key feature of all general equilibrium trade models, including this one, is that expansions in import competing sectors due to an increase in their relative price must necessarily draw resources from exporting sectors; trade economists therefore universally acknowledge that "a tax on imports is a tax on exports".

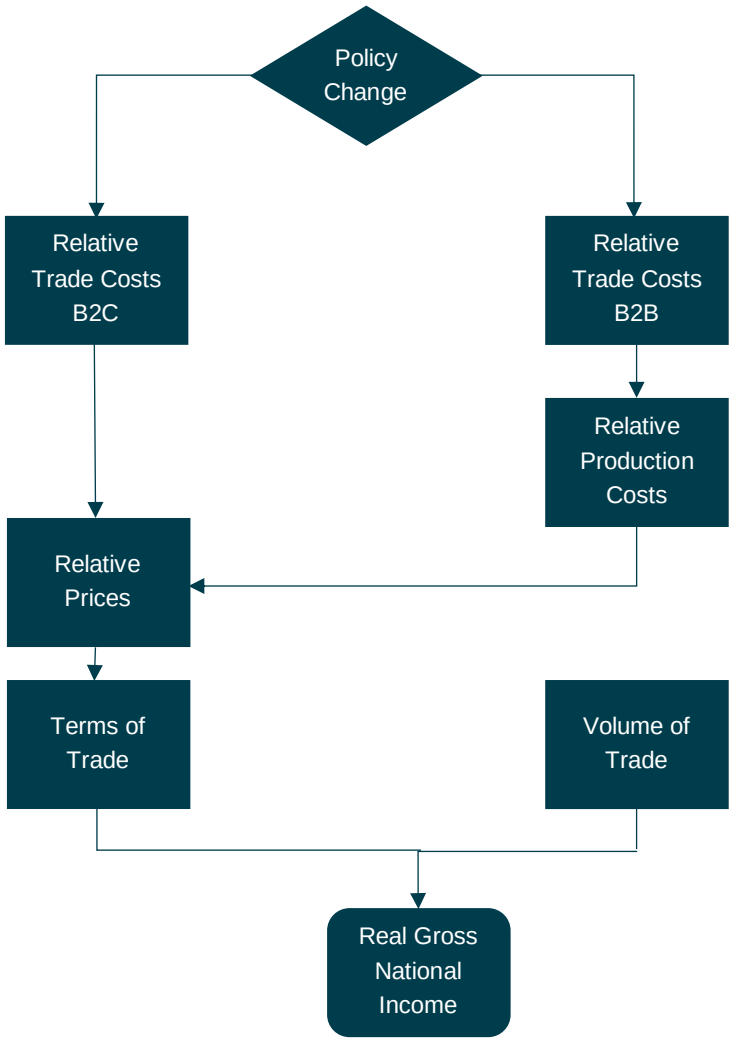
The net outcome of any policy change fed into the model is ambiguous due to the large number of effects at play. In particular, terms of trade effects and volume of trade effects can act in opposite directions, or they can act in different ways for different countries. So, the model solves for an equilibrium of the world economy in which a set of macroeconomic constraints hold, and reported results are based on this equilibrium.

[20] Caliendo, L. & F. Parro. 2015. "Estimates of the Trade & Welfare Effects of NAFTA." Review of Economic Studies, 82(1): 144.

[21] Aichele, R., and I. Heiland. 2018. "Where is the Value Added? Trade Liberalization and Production Networks." Journal of International Economics, 115(C): 130-144.

[22] Shepherd, B. 2022. "Modelling global value chains: From trade costs to policy impacts", World Economy, 45(8): 2478-2509.

Figure 9: Simplified flowchart of the NQTM



In the version of the model used here, there are 21 sectors and nine countries. This arrangement is based on an aggregation of the OECD-WTO Trade in Value Added Database (TiVA), which is based on a global input-output table of the type needed by the NQTM. Country coverage is based on identification of major global traders including the EU and its main partners, with other countries summed into an aggregate "rest of the world" (ROW) region.[23] Sectoral coverage is based on individual treatment of sectors that are subject to policy changes under the scenarios discussed above; remaining sectors are summed into aggregates.

The model therefore works with a large database, and produces both macro-level results such as changes in real Gross National Income (GNI), as well as micro-level findings such as changes in exports of a particular sector between two countries.

Like any economic model, however, the NQTM used here has important limitations. Its most appropriate use comes from comparing scenario outcomes in relative terms: they summarise

[23] For technical reasons, very small economies are also aggregated. The model therefore uses "BLX" to indicate an aggregate of Belgium, the Netherlands, and Luxembourg, and "OEU" to indicate Malta and Cyprus.

the relative extent of changes in economic variables for a constant model structure, and therefore give a useful indication of the relative magnitudes of changes. Interpretation in absolute terms is less helpful, as model structure clearly plays a role in determining results.

Comparative static, all else constant

The model compares equilibria under the baseline (observed) state of the world economy (2018 in this case), and a counterfactual economy in which trade costs change due to a set of policy changes, but all other factors remain constant. As such, there is no time dimension to the model, and it does not describe the dynamic path by which an economy moves from one equilibrium state to another. Results can therefore be interpreted as answering the question "how different would the 2018 world economy look if policies changed in a defined way, but everything else stayed the same?". Results are an annual change in variables concerned, but they should not be likened to predictions, projections, or forecasts.

No savings or investment

Linked to the comparative static structure of the model is the fact that there is no modelling of savings and investment decisions. As such, each country's aggregate trade balance is identical in the baseline and counterfactual equilibria. The absence of savings and investment decisions means that there is no accumulation effect over time, as changes in trade costs affect the decision whether to consume or save/invest.

Single factor of production, full employment

The NQTM has labour as the only factor of production, and assumes full employment. As such, it cannot produce results on sectoral or aggregate changes in employment.

Variable cost changes only

Both the procedure adopted above for translating policy changes into cost impacts and the NQTM itself assume that policy changes only affect variable (ad valorem) trade costs. The model does not consider economic effects that the policies could have over and above this. In particular, it does not analyse changes in marketplace competition that could be associated with a broader range of policy effects, such as changes to entry conditions.

Consumption side

The consumption side of the model comes from Caliendo and Parro (2015). A measure Ln of representative households in N countries (subscript) maximize Cobb Douglas utility by consuming final goods in J sectors (superscript), with consumption shares a_n^j summing to unity.

$$(1)\ u\left(C_n\right) = \prod_{j=1}^{J}\left(C_n^j\right)^{\alpha_n^j}$$

Production side

The production side of the model also comes from Caliendo and Parro (2015) via Aichele and Heiland (2018), which can be seen as a multi-sector generalization of Eaton and Kortum (2002). As in Aichele and Heiland (2018), there is provision for different shares in intermediate and final consumption.

Each sector produces a continuum of intermediate goods $\omega^j \in [0,1]$. Each intermediate good uses labor and composite intermediate goods from all sectors. Intermediate goods producers have production technology as follows:

$$(2)\ q_n^j\left(\omega^j\right) = z_n^j\left(\omega^j\right)\left[l_n\left(\omega^j\right)\right]^{\beta_n^j}\prod_{k=1}^{J}\left[m_n^{k,j}\left(\omega^j\right)\right]^{\gamma_n^{k,j}}$$

Where: $z_n^j\left(\omega^j\right)$ is the efficiency of producing intermediate good ω^j in country n; $l_n\left(\omega^j\right)$ is labour; $m_n^{k,j}\left(\omega^j\right)$ are the composite intermediate goods from sector k used for the production of intermediate good ω^j; and β_n^j is the cost share of labour and $(1-\beta_n^j)\gamma_n^{k,j}$ is the cost share of intermediates from sector k used in the production of intermediate good ω^j, with $\sum_{k=1}^{J}\gamma_n^{k,j} = 1$.

Production of intermediate goods exhibits constant returns to scale with perfect competition, so firms price at marginal cost. The cost of an input bundle can therefore be written as follows:

$$(3)\ c_n^j = \Upsilon_n^j w_n^{\beta_n^j}\left(\prod_{k=1}^{J}\left(P_n^{k_m}\right)^{\gamma_n^{k,j}}\right)^{1-\beta_n^j}$$

Where: $P_n^{k_m}$ is the price of a composite intermediate good from sector k; w is the wage; and Υ_n^j is a constant.

Producers of composite intermediate goods in country n and sector j supply their output at minimum cost by purchasing intermediates from the lowest cost suppliers across countries, similar to the mechanism in the single sector model of Eaton and Kortum (2002).

Composite intermediate goods from sector j are used in the production of intermediate good ω^k in amount $m_n^{j,k}(\omega^k)$ in all sectors k, as well as final goods in consumption C_n^j. The composite intermediate is produced using CES technology:

$$(4)\ Q_n^j = \left[\int r_n^j\left(\omega^j\right)^{1-\frac{1}{\sigma^j}} d\omega^j\right]^{\frac{\sigma^j}{\sigma^j-1}}$$

Where: r is demand from the lowest cost supplier, and σ is the elasticity of substitution across intermediate goods within a sector.

Solving the producer's problem gives an expression for demand:

$$(5)\ r_n^j(\omega^j) = \left(\frac{p_n(\omega^j)}{P_n^j}\right)^{-\sigma^j} Q_n^j$$

Where: $p_n(\omega^j)$ is the lowest price of a given intermediate good across countries; and $P_n^j = \left[\int p_n(\omega^j)^{1-\sigma^j} d\omega^j\right]^{\frac{1}{1-\sigma^j}}$ is the CES price index.

Trade Costs and Equilibrium

Trade costs consist of tariff and NTM components as in Aichele and Heiland (2018), in the standard iceberg formulation for imports by country n from country i, with trade costs potentially differing by end use (intermediate, m, or final, f):

$$(6)\ \kappa_{ni}^{j\upsilon} = \left(1 + t_{ni}^{j\upsilon}\right) * \tilde{t}_{ni}^{j\upsilon}, \upsilon \ni (m, f)$$

Where t is the ad valorem tariff, and $\tilde{t}$ is NTM-related trade costs, including potentially policy measures but also geographical and historical factors that drive a wedge between producer prices in the exporting country and consumer prices in the importing country (Anderson and Van Wincoop, 2004). Unlike in Caliendo and Parro (2015), we assume that all sectors are tradable; this assumption accords with the reality in our data, where sectors are sufficiently aggregate that trade always takes place, at least to some degree.

With this definition of trade costs, the price of a given intermediate good in country n is:

$$(7)\ p_n^j(\omega^j) = \frac{c_i^j \kappa_{ni}^{jm}}{z_i^j(\omega^j)}$$

As in Eaton and Kortum (2002), the efficiency of producing ω^j in country n is the realization of a Fréchet distribution with location parameter $\lambda_n^j \geq 0$ and shape parameter $\theta^j > \sigma^j - 1$. The intermediate price index can therefore be rewritten as:

$$(8)\ P_n^{jm} = A^j \left[\sum_{i=1}^{N} \lambda_i^j \left(c_i^j \kappa_{ni}^{jm}\right)^{-\theta^j}\right]^{-\frac{1}{\theta^j}}$$

Where A^j is a constant.

Then from the utility function, prices are:

$$(9)\ P_n^f = \prod_{j=1}^{N} \left(\frac{P_n^{jf}}{\alpha_n^j} \right)^{\alpha_n^j}$$

Bringing together these ingredients gives a relationship for bilateral trade at the sector level that follows the general form of structural gravity, but developed in an explicitly multi-sectoral framework and with different relations for intermediate and final consumption:

$$(10)\ \pi_{ni}^{jv} = \frac{X_{ni}^{j\upsilon}}{X_n^{j\upsilon}} = \frac{\lambda_i^j \left[c_i^j \kappa_{ni}^{j\upsilon} \right]^{-\theta^j}}{\sum_{h=1}^{N} \lambda_h^j \left[c_h^j \kappa_{nh}^{j\upsilon} \right]^{-\theta^j}}$$

For analytical purposes, a key feature of the gravity model in equation 10 is that the unit costs term depends through equation 3 on trade costs in all sectors and countries. This result is an extension of the multilateral resistance reasoning in Anderson and Van Wincoop (2003) to the case of cross-sectoral linkages.

Goods market equilibrium is defined as follows, where Y is the gross value of production:

$$(11)\ Y_n^j = \sum_{i=1}^{N} \frac{\pi_{in}^{jm}}{1+t_{in}^{jm}} X_i^{jm} + \sum_{i=1}^{N} \frac{\pi_{in}^{jf}}{1+t_{in}^{jf}} X_i^{jf}$$

With:

$$(11)\ X_n^{jm} = \sum_{k=1}^{J} \frac{\pi_{in}^{jm}}{1+t_{in}^{jm}} \gamma_h^{j,k} \left(1 - \beta_h^k \right) Y_h^k$$

$$(12)\ X_n^{jf} = \alpha_n^j I_n$$

National income is the sum of labour income, tariff rebates, and the exogenous trade deficit:

$$(12)\ I_n = w_n L_n + R_n + D_n$$

The model is then closed by setting income equal to expenditure:

$$(13)\ \sum_{j=1}^{J} X_n^{jm} \sum_{i=1}^{N} \frac{\pi_{ni}^{jm}}{1+t_{ni}^{jm}} + \sum_{j=1}^{J} X_n^{jf} \sum_{i=1}^{N} \frac{\pi_{ni}^{jf}}{1+t_{ni}^{jf}} - D_n = \sum_{j=1}^{J} Y_n^j$$

Where: I represents final absorption as the sum of labour income, tariff revenue, and the trade deficit; R is tariff revenue, and trade deficits sum to zero globally and to an exogenous constant nationally. So aggregate trade deficits are exogenous, but sectoral deficits are endogenous.

Caliendo and Parro (2015) show that the system defined by equations 3, 8, 10, 11, and 13 can be solved for equilibrium wages and prices, given tariffs and structural parameters.

Counterfactual Simulation

Using exact hat algebra (Dekle et al., 2007), it is simpler to solve the model in relative changes than in levels.

This process is equivalent to performing a counterfactual simulation in which a baseline variable v is shocked to a counterfactual value v', and the relative change is defined as $\hat{v} = \frac{v'}{v}$. Aichele and Heiland (2018) show that counterfactual changes in input costs are given by:

$$(14)\ \hat{c}_n^j = \hat{w}_n^{\beta_n^j} \left(\prod_{k=1}^{J} \hat{P}_n^{k_m \gamma_n^{k,j}} \right)^{1-\beta_n^j}$$

The change in the price index is:

$$(15)\ \hat{P}_n^{j\upsilon} = \left[\sum_{i=1}^{N} \pi_{ni}^{j\upsilon} \left[\hat{\kappa}_{ni}^{j\upsilon} \hat{c}_i^j \right]^{-\theta^j} \right]^{-\frac{1}{\theta^j}}$$

The change in the bilateral trade share is:

$$(16)\ \hat{\pi}_{ni}^{j\upsilon} = \left[\frac{\hat{\kappa}_{ni}^{j\upsilon} \hat{c}_i^j}{\hat{P}_n^{j\upsilon}} \right]^{-\theta^j}$$

Counterfactual intermediate goods and final goods expenditure are given by:

$$(17)\ X_n^{jm'} = \sum_{k=1}^{N} \gamma_n^{j,k} (1 - \beta_n^k) \left(\sum_{i=1}^{N} X_i^{km'} \frac{\pi_{in}^{km'}}{1+t_{in}^{km'}} + X_i^{kf'} \frac{\pi_{in}^{kf'}}{1+t_{in}^{kf'}} \right)$$

With:

$$(18)\ X_n^{jf'} = \alpha_n^j I_n'$$

$$(19)\ I_n' = \hat{w}_n w_n L_n + \sum_{j=1}^{J} X_n^{jm'}\left(1 - F_n^{jm'}\right) + \sum_{j=1}^{J} X_n^{jf'}\left(1 - F_n^{jf'}\right) + D_n$$

The trade deficit condition requires:

$$(20)\ \sum_{j=1}^{J} F_n^{jm'} X_n^{jm'} + \sum_{j=1}^{J} F_n^{jf'} X_n^{jf'} - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N} X_i^{jm'} \frac{\pi_{in}^{jm'}}{1+t_{in}^{jm'}} + \sum_{j=1}^{J}\sum_{i=1}^{N} X_i^{jf'} \frac{\pi_{in}^{jf'}}{1+t_{in}^{jf'}}$$

The change in welfare is given by the change in real income:

$$\hat{W}_n = \frac{\hat{I}_n}{\prod_{j=1}^{J}\left(\hat{p}_n^{jf}\right)^{\alpha_n^j}}$$

The relative change in trade costs is given by the definition of the counterfactual simulation, and in our specification can cover NTMs as well as tariffs. Solving the model using exact hat algebra makes it possible to conduct the counterfactual experiment without data on productivity, and importantly, without trade costs data other than those that are being simulated; due to the multiplicative form of iceberg trade costs, solution in relative changes means that trade cost components, such as geographical and historical factors, which are constant in the baseline and counterfactual simply cancel out.

> The parameters β_n^j (cost share of labour), $(1-\beta_n^j)\gamma_n^{k,j}$ (cost share of intermediates), and α_n^j (share of each sector in final demand) can be calibrated directly from the baseline data, as can value added ($w_n L_n$). Egger et al. (2018) provide updated estimates of the trade elasticity θ^j at the same level of disaggregation used in our data.

Caliendo and Parro (2015) develop an iterative procedure for solving the model, which we follow here in the modified version developed by Aichele and Heiland (2018).

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