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Free Trade under Brexit: Why its benefits to the UK have been widely underestimated

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One of the central planks of the government's post-Brexit policy agenda is the negotiation of free trade agreements (FTAs) with non-EU countries around the world. So far it has rolled over almost all the FTAs between the EU and non-EU countries so that they now apply to the UK; it has also negotiated fresh and much wider FTAs with Australia and New Zealand and has formally applied to join the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the Asia-wide trade pact.

It therefore is surprising that the official calculations of the gains to the UK from some of these FTAs are extremely small. Thus the DIT document setting out the case for the Australia FTA states about scenario 2, which 'represents a deeper trade agreement, with full tariff liberalisation and a 50% reduction in actionable NTMs [non-tariff measures] and regulatory restrictions to services', that:

> 'A trade agreement with Australia could increase UK GDP in the long run by around … 0.02% under scenario 2. This is the equivalent to an increase of [£500 million] compared to its 2018 level. This increase reflects changes to the underlying economy brought about by a reduction in barriers with Australia through an FTA. These reduced costs for firms and consumers, result in changes to domestic specialisation and the composition of imports[1].'

Admittedly the DIT have increased their estimate as stated to the *Daily Express*:

> 'An independently-verified, updated assessment of the deal we signed with Australia shows it is estimated to increase UK GDP by around £2.3 billion by 2035 [equivalent to 0.08 percent of GDP] – significantly higher than the previous assessment published earlier in the year[2].'

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[1] https://www.gov.uk/government/publications/uks-approach-to-negotiating-a-free-trade-agreement-with-australia/uk-australia-free-trade-agreement-the-uks-strategic-approach
[2] https://www.express.co.uk/news/uk/1539845/Brexit-news-Britain-benefits-economist-2022-forecast

Nevertheless, this still remains an absurdly low estimate.

Furthermore, other published estimates by academics are similarly low. For example, Winters and Labalestier (2021) at Sussex University agree that the gains are essentially trivial.[3]

Considering that Australia is a major agricultural export country which can supply a wide range of food imports, virtually across the board, where these are currently protected under EU tariffs and NTMs by 20 per cent according to our best estimates (Minford et al, 2015), the latest DIT estimate is low in the extreme. Using our Cardiff world trade model, and assuming that Australian imports which span most foods, could drive down UK food prices by say 2 per cent, we come up with a gain in UK GDP of 3 per cent, because of consumer gains and a sharp reduction in the costs of land – remembering that, though agriculture provides less than 1 per cent of GDP, it is heavy use of land greatly drives up land prices. Our model finds that the indirect effect of land prices is a strong one.

What is the source of such low estimates by these others? What I will try and analyse in this paper is the way in which a combination of trade modelling and policy assumptions have combined to downgrade the estimates of the gains from free trade with non-EU countries.

Gravity Trade models and Brexit: a review

At the heart of the trade debate there is a fundamental disagreement about how trade works and affects the economy. In the last few years, debate has raged over whether EU trade arrangements were beneficial, in particular to the UK as a member. The EU is a customs union and so erects trade barriers around its Single Market, where economic activity is regulated according to EU rules. The welfare effects of a customs union have always been controversial. According to classical trade theory, global welfare is reduced compared with free trade, as is the average welfare of citizens inside the customs union; however, one country's citizens may gain from the union if it is a net exporter to others in the union, as then its terms of trade gain may offset the losses experienced by its consumers (Meade, 1955). Needless to say, the UK as a net importer from the EU is worse off than the average.

However, in recent times a new line of reasoning has become popular among trade economists: this 'gravity model' (Costinot and Rodriguez-Clare, 2014) regards trade as an outcrop of internal trade, the only difference being that it crosses borders. Otherwise, it grows naturally due to the specialisation and division of labour within neighbouring markets. Viewed through the lens of the gravity model, a customs union merely makes official what is already a fact of neighbourly inter-trade. Other sorts of trade, with more distant markets, grow analogously but more weakly, the greater the distance; the size of distant markets may make up for their distance to some extent, because they are a 'neighbourhood' that naturally leads to inter-trade. As part of this view of trade as dominated by inter-trade, substitutability between heterogeneous goods and services of different origins is treated as fairly low.

'Gravity' in trade creation can be thought of as a function of distance and size. In this view of trade, it makes no sense to put obstacles in the way of trade with close neighbours such as

[3] https://blogs.sussex.ac.uk/uktpo/2021/11/08/the-uks-new-trade-agreements-curb-your-enthusiasm/

the EU in the hope of boosting trade with distant markets via new trade agreements that lower trade costs. The disruption from the former will reduce welfare, while the gains from the latter will be small, simply because the reduced trade costs will have little effect in switching demand from existing products in the presence of low substitutability. Furthermore, protection is seen in a fairly positive light in the gravity model, because low substitutability between countries' goods implies that there is scope for protection to improve the terms of trade – the 'optimal tariff' mechanism. He et al (2017) show that it pushes optimal tariff rates before and after retaliation above 100 per cent – clearly a worrying policy implication, which in itself casts doubt on the model's realism since there are few examples of such high tariffs.

Before we go further into the technicalities of different models and calculations of trade policy effects, it is worth spending a little thought on what light the history and structure of UK trade throw on the matter. For centuries the UK has been regarded as the archetype of a 'trading nation', in that its great trading companies, such as the East India Company, sought out trading opportunities around the world, and in the process founded the British Empire, with trading links all over the world. European neighbouring countries had little to do with it, other than the Dutch, with whose Indies trading fleets the UK fought several wars, settled by the Treaty of Westminster in 1674.

In recent years, UK trade has been dominated by services, whose weightlessness implies a total lack of 'gravity'; furthermore, the containerisation of goods transport has brought shipping costs down to almost trivial levels. The role of gravity, in relation to distance x size, seems on the face of it to be small in UK trade. For the years 1913 and 1925, Foreman-Peck (2021) finds no relation between UK trade and distance across countries; this, he suggests, implies no relationship today, when distance costs are much smaller.

As for European trade, in spite of high EU tariffs against non-EU suppliers, the share of EU trade (imports plus exports) in UK trade has never gone over 25 per cent of UK GDP. Currently, it is running at 20 per cent against around 30 per cent with the non-EU world; so, UK trade with the EU is about 40 per cent of all its trade, in spite of massive trade barriers (around 20 per cent in both food and manufactures) against non-EU countries. Furthermore, Burrage (2014) finds that UK export growth to EU members has grown much more slowly since 1960 than exports to non-EU members, suggesting little effect from either European closeness or our membership of the EU Single Market – tendencies found also by Radford (2021) for recent trade performance in the two decades from 2000. It does not look as if gravity has much to do with it all. It would certainly be unsurprising if our test of UK trade rejected the gravity model; as we will see that it does (Minford and Xu, 2019; Chen et al, 2021).

It might reasonably be asked how it came about that the acknowledged 'classical' theory of international trade based on comparative advantage derived from the economy's resources, including labour, land and institutions, has been largely replaced among trade economists by this gravity-based theory in which the main determinants of trade are demands (GDPs) of the trading countries and their relative costs, partly the result of transport distance. The answer mainly lies in the 'gravity trade regressions' due first to Tinbergen (1962), and subsequently repeated on a mass of micro data. These regressions take data on trade at the micro level, that is, imports product by product and country by country, and regress imports on the GDP of the importing country and relative prices of the country product to those of other country-products (which are affected by transport costs, that is, distance, and trade barriers). This gives rise to a mass of micro-based regressions. In later work this was replicated in large panel (that is, across time and space) regressions – examples of these for the UK are in the Treasury's 2016 report on Brexit.[4]

It is argued by Costinot and Rodriguez-Clare (2014), much like many others, for example Dhingra et al (2016), that an underlying model of trade which could deliver such relationships would be one in which consumers had a two-level (Armington, 1969) utility function, one level being the commodity, the other being the country of origin. What this means is that consumers treat not merely different commodities as distinct but also treat goods of different countries as being different – choosing between them all on the basis of relative price and quality.

Yet a cornerstone of the classical theory, which it must be emphasised applies to the long run, is that competition will drive products to be homogeneous in the long run. Poor quality products will be eliminated as consumers switch to choosing only the best; poorer productivity firms will be driven out by the expansion under free entry of the most productive firms. Hence the assumption of product and firm homogeneity in the classical model, under perfect competition and free entry. Nevertheless, the role of gravity (that is, distance creating transport costs) has always been a central element in classical trade theory, tilting trade/GDP towards nearer economies; also, since trade relates to GDP, it is also naturally scaled-up by the GDPs of the two trading economies. This gravity effect can be seen as the reason that the 'gravity trade regressions' were first carried out by Tinbergen in 1962 – no contradiction being seen with classical trade theory. Hence it is not the existence of gravity and resulting transport costs that is the current issue in trade theory; it is whether gravity dominates trade through the addition of elements, to be discussed next, inspired by the gravity and associated regressions on micro data so that 'escape from gravity' is largely impossible.

The cornerstone of long run product homogeneity has been jettisoned in the trade theory now widely adopted by trade theorists and modellers, inspired by these regressions and their successor studies. In this work it is found that the relative price elasticities are moderate to low, reflecting short- and medium-term behaviour. These regressions are taken as evidence against the classical product homogeneity assumption in the long run, to which they plainly do not apply. For example, it is usual to find that long run homogeneous commodity groups may show limited substitution in the short run if different grade prices get out of line temporarily. Minford (1975) demonstrates this for natural and manmade fibres whose prices converge in the long run due to the perfect substitutability, well known in this case within the industry as coming from chemical engineering, and yet whose short run elasticity of substitution is moderate. These

[4] HM Treasury (2016), www.gov.uk/government/uploads/system/uploads/attachment_data/file/517415/treasury_analysis_economic_impact_of_eu_membership_web.pdf; see also Breinlich et al (2016).

relationships between the trends of prices within defined commodity groups are well documented.

Yet in the light of the evidence from these gravity regressions, the majority of trade modellers have substituted into their trade models the assumption of product heterogeneity in the form of low substitutability between products of different country origin – notably between home and imports, and between different import origins. The Armington (1969) paper noted above provides a neat model of layers of substitution of this sort; this model was intended for open economy macroeconomics, with its focus on the short- to medium-term and not for trade models, which are intended to explain long run trade behaviour since trade policy changes are generally intended to be permanent and 'institutional'. But this 'Armington assumption' has been taken over widely in trade models to model product heterogeneity (Costinot and Rodriguez-Clare, 2014; Corong et al, 2017; Felbermayr et al, 2020). In some models, this assumption is complemented by one of widespread imperfect competition, again based on micro-data regressions – the 'Krugman model' (Krugman, 1980). But this is less prevalent.

Thus, in recent times the dominant approach has been to find such micro relationships across countries and then use them to modify complete computable models of trading economies – termed 'Computable General Equilibrium' or CGE models – into what we will call, for simplicity, 'Gravity' CGE trade models.

It should be noted, however, that these micro relationships are between solved-out ('reduced form') values of the 'endogenous' variables determined in the model by the 'exogenous' factors driving change from outside the model, since trade prices and GDP are all determined by the CGE model. While one can reverse engineer a CGE model in which an Armington demand system generates them, this does not establish this ('identify it') as the true model. Other CGE trade models – including the classical trade model unmodified – can also generate them. To test the different CGE models requires an empirical comparison to be made in terms of the different models' ability to match these regressions on endogenous variables.

The Armington assumption has been the key 'gravity-based' modification of the classical trade model. In addition to the Tinbergen-type regressions, there have been similar ones (originating with Melitz, 2003) relating heterogeneous micro firm productivity behaviour to factors like foreign direct investment (FDI), innovation and competition. (Again, examples of this for the UK are given in the 2016 Treasury report, HMT (2016); see also Feyrer, 2009, 2011; Pain and Young, 2004; Dhingra et al, 2016; Cai, Li and Santacreu, 2019.) It is also found in such regressions that FDI and innovation are related to the trade share in the economy. Accordingly, a mechanism linking productivity to trade intensity can be built into the gravity trade model – as we do in our version. Trade theorists doing this have interpreted these regressions as showing that trade, as an exogenous factor determined by demand and distance, determines FDI, patents and so forth, and so also determines productivity. However, again, these reduced form relationships can emerge from a classical model where the exogenous variables are countries' factor supplies and policies determining productivity; the identification is entirely different, usefully distinguishing the gravity CGE version from the classical version.

Hence, we face here a distinct choice of underlying causal (that is, CGE) models which could be generating these regressions, that is, data correlations. These last in turn cannot tell us on their own what the causal processes are. As is well known, correlation cannot establish causation.

Another way of viewing Gravity models: not as trade models but as macro models

It is worth pausing at this point to notice how gravity trade theory has swung from one focused on the long run – in which competition and free entry are assumed to have eliminated country-origin differences in quality and industry differences in productivity – to a theory much closer to the business cycle (short and medium run) macroeconomics of an open economy in which demand and country competitiveness determine trade. If these gravity theorists were to add the missing 'dynamic' (that is, change-related) elements of rational expectations, adjustment costs, inflation and capital flows, they would have replicated a modern New Keynesian Dynamic Stochastic General Equilibrium model, which has been shown to successfully match macro behaviour in several open economies (Minford and Peel, 2019). What this brings out rather clearly is that these gravity models, to successfully replicate reality, cannot be trade models at all by construction focused on the long run. Really, they have to be short run macro models with some key elements missing.

It may well therefore not come as much of a surprise that these short run-focused gravity trade models do a bad job of matching the trend relationships in the data, while the classical model does so rather well. These gravity models are focusing on the short- to medium-term macro effects of trade policy changes, rather than the long run effects of removing trade policy distortions – the whole point of trade policy. It is the role of fiscal and monetary policy to offset short run macro effects ('disruption') due to trade policy changes, allowing the long run effects of removing distortions to become established. What we are interested in for judging the welfare effects of trade policy is model estimates of these long run effects. These two models, the classical and the gravity models, give very different estimates of these long-run effects, as we will explain in detail later. Accordingly, we need an empirical test that can discriminate powerfully between them.

We now turn to such a test of these two long run models of trade: classical and gravity.

Why the Gravity model should not be used to assess long run trade effects. The Classical model should be. The latest results from testing models on UK and other countries' trade behaviour

While, as we will see, one key element in understating free trade gains has been the use of false policy assumptions biasing calculations towards the negative even on gravity models, nevertheless it has mainly been the 'Gravity' models used widely by trade economists that have implied modest free trade gains.

As we have explained, these two models, the classical and the gravity models, are critically different and so have very different welfare implications. However, while trade economists have recently tended to favour the gravity model over the classical, there has been no convincing empirical test of the two models as overall predictors of the data. As we have seen, we face here an 'identification' problem: two models can both generate the same data, at least that would be the claim of their proponents. We need an empirical test that can discriminate powerfully between the two models. In our Cardiff research we have developed such tests using indirect inference (Le et al, 2011, 2016), and they reveal that the gravity model is rejected for the UK, while the classical model largely fits the UK facts (Minford and Xu, 2018). Chen et al (2021) show that this extends also to other major countries and groups, including China and the EU – for the US, gravity makes little difference. More on their results below.

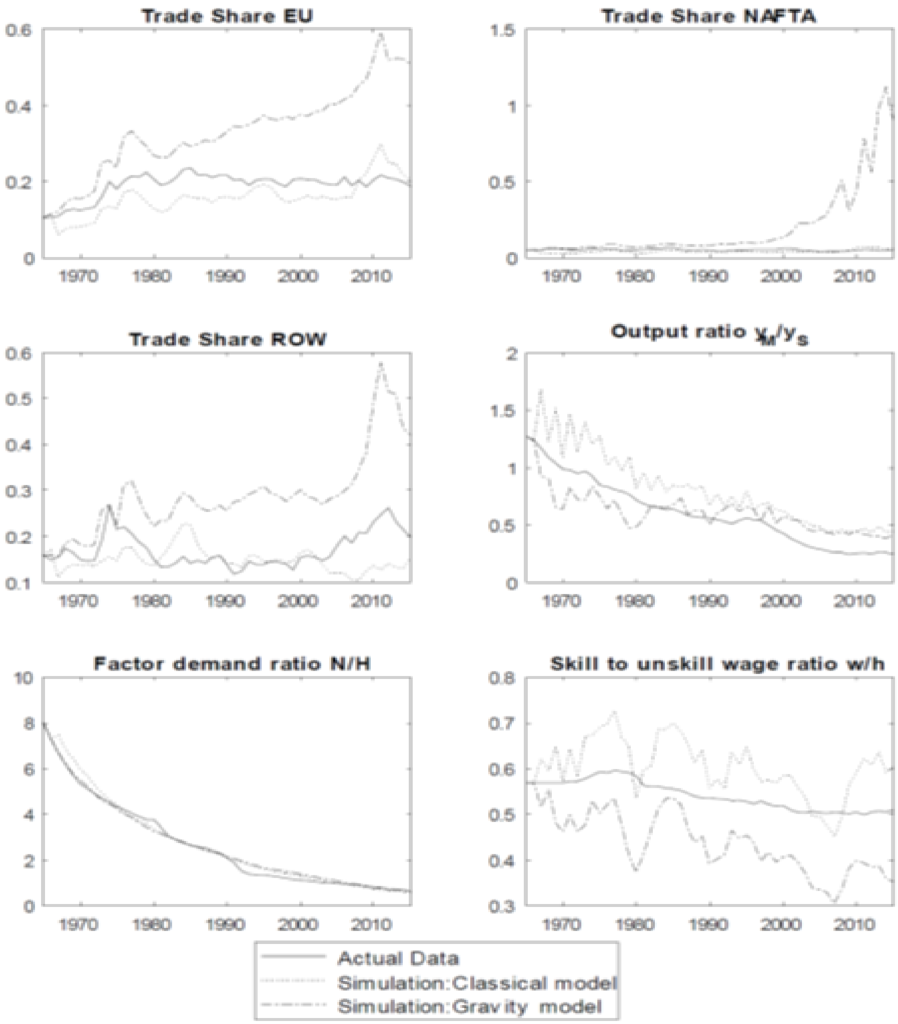
The process of testing general equilibrium trade models, including the today widely-used gravity models, has up to now mainly taken the form of predicting cross-country variation in trade behaviour (Evenett and Keller, 2002 and Carrere et al, 2019). Thus, in his recent presidential Royal Economic Society speech and the associated *Economic Journal* article (Carrere et al, 2019), Neary points out that country-relative trade volumes are well predicted by gravity, among other controlling 'country effects'. But a model may explain the historical cross-section pattern of trade because the many country-specific constant factors can accurately pick up these patterns. Nevertheless, it may fail to predict the effects of changes in trade and other key parts of trade behaviour over time.

Policy changes, like changes in transport costs and in productivity, produce reactions over time – and models need to accurately predict changes in trade patterns over time if we are to have confidence in their ability to evaluate policy changes. For this we need tests on time series to establish whether these models can predict the effects of these changes accurately. Without them showing the ability to match the time-series of recent (post-war) history, we can have no faith in these models as guides to optimal policy. One of the peculiarities of the correlation of distance with UK trade volumes is how it has changed since 1913 and 1925, when Foreman-Peck (2021) shows that there was no significant relationship at all; it looks as if commercial policy changes – abolition of Imperial Preference, joining the EU – may have been responsible for the trade shift away from a distant empire towards a closer Europe. Plainly, it cannot have been the effects of distance since transport costs have fallen massively since then. Much else has been at work in changing trade patterns and other trade-related variables that our candidate gravity and classical models need to explain.

The indirect inference tests we use on time-series data compare the simulated behaviour of our models with the actual behaviour of the data. The latter's probability under the model, the p-value, can be assessed from this comparison; if this falls below five per cent, we reject the model. Basically, one can see informally how well the two models do in the test by comparing the trends in the data with the average simulated trends from the model. The charts below (Figure 1.1) show this for the UK. If you examine the trade shares, you can see that the average gravity simulations depart sharply from the data, while the classical broadly mirror the data. It is not surprising therefore that for the UK, the gravity model is strongly rejected. Similar charts occur for China, where the gravity model is also rejected.

Figure 1.1

Figure 2: Actual and average of simulated data



Source: *Cardiff Working Paper version of Minford and Xu (2018), Cardiff Economics Working Papers, Working Paper No. E2017/10, Classical or Gravity? Which trade model best matches the UK facts? Patrick Minford and Yongdeng Xu, November 2017, http://carbsecon.com/wp/E2017_10.pdf (Figure 2), p.24.*

The classical model, when simulated over past histories, thus comfortably fits the data of actual history for the UK (Minford and Xu 2018). This implies that the classical model is likely to be close to the true model for the UK; and so is a reliable guide to the policy effects of the government's programme of free trade deals around the world, as discussed in the last section.

We have, as noted, recently been extending our tests to other major countries or groups, namely the US, China and the EU (Chen et al, 2021). We do this through simulating each country model on its own, with world variables simulated by a separate statistical model of world behaviour (for the UK this is not needed, as the UK is too small to affect world activity and prices); this 'Part of Model' indirect inference test (Minford, Wickens and Xu, 2019) can tell us how likely the trade behaviour of each country is to come from either the classical or gravity model of its own trade. Table 1.1 below summarises our findings in the form of the p-values.

Table 1.1: PART-OF-Model tests for major countries- p-values

	Classical	Gravity
UK	0.09	0.000*
US	0.07	0.07
EU	0.115	0.075
CHINA	0.11	0.034*

***Model rejected at 5% level.**

One can see that for all these countries the classical model is accepted; and also that the gravity model is in all cases either as or less probable than the classical. In two cases, the UK and China, the gravity model is strongly rejected. For the UK, the rejection is extremely strong; the test we have used implies that the classical model cannot be more than five per cent inaccurate for the UK. In other words, a model very close to the assumed classical one is virtually certain to be the true one. For all the other countries, the test used implies the classical model cannot be more than 20 per cent inaccurate – so a model close to the classical is very likely to be the true one.

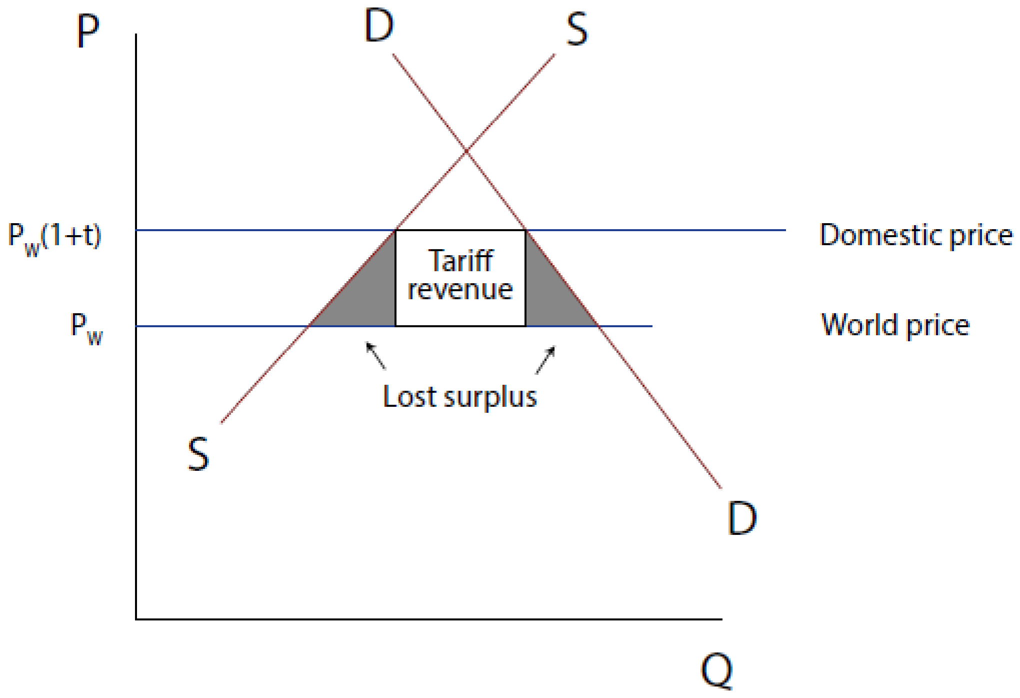
Finally, in a very recent paper, Minford, Xu and Dong (2021) have tested the full Global model of all countries on average world behaviour. The p-values are 0.31 for the classical model and 0.026 for the gravity model – a result decisively accepting the classical and rejecting the gravity version.

I next review the various attempts that have been made by different groups of economists, using these two different approaches, to evaluate the long-run effects of the FTAs emerging from Brexit.

Estimates of FTA trade effects under the two approaches

The effects of trade policies such as tariffs can be understood with the help of a simple diagram showing demand and supply of imports. A tariff raises the home price of imports over the world price. Assume for now the world price stays the same. Then the loss of welfare is shown by the shaded area of reduced consumer surplus (the difference between the market price paid for the product and its true value). This shows the loss to consumers from higher prices, causing lower consumption, and also their loss as producer households from over-production – in which the extra output's true value does not cover the rising costs of production. In effect, the tariff revenue, redistributed by the Treasury to households after paying more to producers for uneconomic output expansion, fails to compensate households for their higher costs of purchase.

Figure 1.2



If the tariff causes world import prices to fall, there is a countervailing gain from better terms of trade, viz. lower import/export prices. The size of this gain depends on substitutability between goods, as measured by the 'elasticity of substitution'– the lower, the bigger the gain, because as import demand falls due to tariffs import, prices must fall for product import volume to be maintained. In a classical model, there is only substitutability between different commodity types. So, to get a reduction of import prices, a tariff-raising country has to reduce demand for the commodity worldwide. The reduction in world prices will be its tariff times its world market share. The import country's world market share is typically very low so that the overall effect on prices is small.

However, in the gravity model, it is assumed that the substitutability between goods of different origins is quite low. So, our diagram above applies to many different imports from differing origins. We can now compute consumer surplus costs for each country-facing tariff; but also the terms of trade gain for each country-origin import, this being given by the tariff times the import share in that country-origin supply. This import share is typically high, so the terms of trade effect is correspondingly high.

We see therefore that the temptation under gravity models to raise tariffs is high, owing to the low substitutability these models assume between goods of different origins. On the one hand, there are losses of consumer surplus, but on the other there are terms of trade gains from protection. While all models differ in their exact assumptions, we can discern a pattern in the welfare estimates: gravity models will find a greater gain from the protection given by the EU customs union against the non-EU world, while it will find a consumer surplus loss from this and also from any EU-UK barriers. Because these barriers are mutual, terms of trade effects favour the largest importer, namely the EU.

Hence, we find that within a gravity model of the CGE type, there is a bias towards protectionism. The latest Treasury calculations after the referendum, in which the Treasury uses the Global Trade Analysis Project (GTAP) model (Corong et al, 2017) – a gravity model in respect of low assumed origin substitutability – discarded its earlier pre-referendum methodology (that directly used the micro correlations in the data) in response to our and others' criticism which find that Brexit is damaging in its trade effects.

However, in addition to using this gravity model, it also uses policy assumptions about Brexit FTAs, including an FTA with the EU, that we cannot accept as realistic. First and foremost, it assumes that there will be little adoption of free trade with the rest of the world. Whereas on this GTAP model, the full elimination of the existing 20 per cent EU trade barriers against non-EU countries (tariff and non-tariff) on food and manufactures would boost UK GDP by four per cent. However, the Treasury assumes that only a twentieth of this would be eliminated in practice, so that the gain falls to 0.2 per cent. As we will see, in our work we assume half this trade barrier would be eliminated, given political opposition to changes in standards; this would still yield two per cent gains under the GTAP model.

Second, it assumes that the EU will erect non-tariff barriers, both via standards and border difficulties, even with a UK-EU 'Canada-plus' FTA. This causes a loss to the UK of no less than 5.4 per cent of GDP. Yet this assumption is in fact illegal under WTO rules against discrimination and border inefficiency – so, in effect, it would not be allowed under the laws recognised by both the UK and the EU; under WTO rules there would also be tariffs causing a cost of 1.4 per cent of GDP in this GTAP model; and under a UK-EU FTA there would be no cost at all. Thus, under the Treasury's GTAP model, if realistic Brexit assumptions are inputted on all these trade arrangements, then according to that model, there would be a welfare gain to the UK from Brexit due to the trade effects of 0.6 per cent of GDP in an exit under WTO-rules, or two per cent in an exit with a Canada-plus EU FTA. The Treasury assumptions yield losses under WTO rules of 6.6 per cent of GDP, and under Canada-plus of 5.4 per cent of GDP. So, it can be seen that the Treasury's assumptions add an unwarranted seven per cent of GDP to the cost of Brexit trade arrangements, even if one accepts the gravity model.

Using the classical model, as estimated in Cardiff research, in place of the gravity model, one adds further to the calculated gains of Brexit free trade arrangements. If we assume that only half of the existing EU 20 per cent protection of food and manufactures is abolished, which seems a reasonable assumption given the difficulties in abolishing all non-tariff barriers related to consumer standards, then the gain to UK GDP is five per cent (Minford and Xu, 2018) – partly because consumer prices fall six per cent and partly because output switches to more productive sectors. This gain occurs under both under the WTO-rules exit and the Canada-plus EU FTA case. In addition, there is a further gain from tariff revenue under WTO rules. The reason is that once the UK has driven UK prices to world prices via FTAs with the non-EU world, EU producers, like our own home consumers and producers, can only sell and buy in our markets at world prices; EU trade barriers will simply be passed on to EU consumers, while UK trade barriers must be absorbed by EU suppliers. Paradoxically, this implies that the UK Treasury can levy tariffs on the EU and gain at EU expense, while the EU can only raise any tariff revenue it gets from UK imports from its own consumers; this turns out to add 0.6 per cent to UK gains under a WTO-rules exit.

We summarise these results in the following table showing the gains/losses in percentage of GDP under the different model/FTA assumption combinations. We label the assumptions we have argued reasonably represent the policy reality as 'Realistic', which of course contrast with those used by the Treasury. As can be seen, the failure to compute sufficient gains in trade from Brexit come about half from poor policy assumptions, half from the gravity modelling mistake.

Summary Table 1.2: Assumptions/Models: differing estimates of gains/losses (% of GDP) from Brexit

Model:	**Cardiff Classical**		**GTAP/Treasury Gravity**			
Policies ass:	Realistic ass.		Realistic ass.		Treasury ass.	
Trade Deal	WTO	Can+	WTO	Can+	WTO	Can+
Total gains	**5.6**	**5.0**	**0.6**	**2.0**	**-6.6**	**-5.2**
Of which due to:						
ROW FTAs	5.0	5.0	2.0	2.0	0.2	0.2
EU barriers	0.6	-	-1.4	-	-6.8	-5.4

The policy implications of the test results generally in favour of the classical model are, as we have argued above, of great importance for the UK and its free trade policies, as well as more widely for trade policies. Policies of free trade deliver the best welfare results for all countries; protection implies self-harm. According to the Cardiff classical model, a 10 per cent tariff equivalent on food and manufacturing (the EU's is 20 per cent) causes welfare to fall by between 6.4 per cent (EU) and 9.4 per cent (US); the cost to China is 8.1 per cent, and to the UK, five per cent (as detailed in the last section). Clearly, the model condemns protection severely. The customs union also damages the totality of members signing up, as set out in Meade (1955) and illustrated for the EU, where the customs union choices made (that is trade protection of food and manufactures) of double the 10 per cent illustrative tariff above, are assessed to reduce welfare by 12.8 per cent. However, it can of course benefit particular members whose exports are the most protected, but then others are better off refusing to join.

Conclusions

Economists in the UK and in international organisations, as well as in the British Treasury and civil service, have widely claimed that Brexit FTAs with the non-EU world would give only trivial gains, while moving to an EU FTA would cause losses, compared with the status quo. To support these claims, they have used trade models in which 'gravity' dominates. According to this gravity theory, trade is caused mainly by size and proximity, not by comparative advantage; productivity is driven by trade, and there is little substitutability between the products of different countries. However, the model does not fit the UK trade facts. The classical model based on comparative advantage does fit them. According to this model, there are big gains from free trade with the rest of the world and no loss from moving from the EU status quo to an FTA with the EU.

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