WHAT SHALL WE DO IF THE EU WILL NOT PLAY BALL?

UK WTO Trade Strategy in A Non-Cooperative Continent

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SUMMARY

- During repeal of the Corn Laws, Cobden and Bright showed that the doctrine of Mercantilism was wrong because tariffs cause 'self-harm' as they raise internal prices above world prices, making consumers worse off and distorting the allocation of internal resources. Subsequently, Britain led the way in industrialisation as cheaper food and lower living costs raised consumer welfare and triggered reallocation of resources towards their best use. Trade within the low tariff British Empire thrived and ushered in lower tariffs by other countries.

- The prize from the UK adopting global free trade today is an additional long-term GDP gain of 4% and a fall of 8% in consumer prices, compared to remaining in the Single Market. These gains are achieved even if other countries do not reduce their tariffs against the UK. This does not include additional benefits gained from decreased regulation, eliminating annual EU budget contributions, etc.

- The government has set out an eminently reasonable strategy to achieve free trade with the rest of the world. This involves negotiating a free trade agreement (FTA) with the EU allowing free trade between the UK and the EU but without imposing free migration, EU Single Market regulations, or the EU's Customs Union trade barriers. The government would then proceed to sign FTAs with other major trading partners around the world, including some of those with whom the EU has agreed existing FTAs.

- Unfortunately, the government has little, if any, control over the possibility that the EU will not agree to any such FTA that observes the government's post-referendum 'red lines'. Fortunately, leaving the EU under WTO rules is a practical necessity – regardless of what is agreed with the EU. Therefore, trading under WTO rules provides a ready-made 'fall-back' strategy to achi**e**ve global free trade if no attractive agreement can be reached with the EU.

- Three key decisions during exit negotiations will shape the nature of the post-Brexit WTO framework and will determine whether the UK realises the full gains from global free trade

    - **Avoiding 'Tit-for-Tat' Tariffs against the EU**. If no FTA is agreed with the EU and the EU raises import tariffs against the UK, the UK should not reciprocate, as this will lose half the gain from achieving global free trade, will disrupt manufacturing supply chains, and is likely to harden the EU's resolve not to climb down over the long-term.
    - **Achieving Global Free Trade via Unilateral Free Trade (UFT) vs Pursuing Global FTAs**. Conceptually, either route can lead to achieving global free trade. However, UFT is simpler, achieves full gains from free trade immediately, and is more certain. Achieving global free trade by pursuing global FTAs may feel more orthodox and politically safer since it looks responsive to protectionist producers, is more gradual, and appears to offer 'bargaining chips' to other countries.
    - **Eliminating CAP and Agricultural Tariffs.** It is critical that the UK withdraws totally from the CAP and its associated tariffs as the knock-on effect on farmers' and land prices would, by themselves, cause a reduction in consumer welfare and GDP relative to the UK's current situation

- Consumers benefit from global free trade and analysis demonstrates that producers can prosper

    - **Manufacturing**. Macroeconomic analysis shows the combined effects of lower Sterling, lower input costs, and small improvements in labour productivity offset the effects of

increased market competition and EU import tariffs. Detailed analysis of the auto manufacturing sector confirms these macroeconomic conclusions.

- **Financial Services.** Detailed sector-by-sector analysis of financial services demonstrates that only an immaterial amount of financial services business is vulnerable to the potential loss of passporting rights, that fundamental constraints will inhibit potential EU punitive action, and that UK financial services will grow post-Brexit due to improved regulation and by exploiting the UK's inherent comparative advantages and the unique strengths of the 'City'.

- An optimal exit strategy should not compromise on free trade from the UK's side, all EU protectionism in agriculture and manufacturing should be dismantled, and no 'tit-for-tat' import strategy should be pursued.

    - An optimal strategy with goods could be the government announcing that it is (1) unilaterally adopting WTO rules with zero import tariffs and (2) at the same time, embarking on establishing FTAs with like-minded countries that wish to eliminate the more important and broader areas of non-tariff barriers and other trade distortions. Thus, the UK can indeed step up to being a global leader of free trade.
    - In the event that EU protectionism extends to financial services, the UK should not retaliate; instead, the City should pursue an Enhanced Equivalence agreement and simultaneously position itself as a world financial centre with appropriate global regulation.

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The aim of the government has been plainly set out: to negotiate a free trade agreement (FTA) with the EU that will allow free trade between the UK and the EU but without imposing free migration, EU Single Market regulations, and the EU's Customs Union trade barriers. Having done this FTA with the EU, it would then proceed to sign FTAs with other major trading partners around the world, including some of those with whom the EU has agreed existing FTAs. It would do this as rapidly as possible in order that the UK should achieve broad free trade with the rest of the world as soon as possible.

Unfortunately, this eminently reasonable approach faces a major obstacle over which the government has little, if any, control: the possibility that the EU will not agree to any such FTA, instead insisting that only full adherence to the Single Market and Customs Union as currently constituted is available with its existing obligations of free migration, subjection to EU regulation, and budget contributions. There are several variants on this position, such as agreeing to an FTA outside the Customs Union but only with free migration and EU regulation. Any such position that insists on free migration and EU regulation breaches the post-referendum 'red lines'.

As for what the EU will agree to or not, there is huge uncertainty given the current divisions within the EU's 27 countries; furthermore, the EU may well 'play hard ball', thinking that it will be supported in this by the UK Remain camp. It is not the object of this paper to discuss whether this is likely or not; nor is it to discuss HMG's negotiating strategy with the EU over reaching an FTA.

The object of this paper instead is to

- Quantify the benefits – using a full world trade model - of the UK achieving free trade with the rest of the world
- Evaluate the economic implications of the key options for trading under World Trade Organisation (WTO) rules, which must be employed even if we achieve an attractive FTA with the EU in a reasonable amount of time – and particularly if we do not
- Assess the implications of free trade under WTO rules on producers in two important sectors often cited as post-Brexit victims – manufacturing and financial services
- Outline an optimal WTO exit strategy

We will point out that, whatever happens with the EU negotiation, leaving the EU under WTO rules is a practical necessity. Thus, in the event of no agreement with the EU, there is a good 'fall-back' strategy available employing WTO rules the government can adopt, which we will define. Failure to reach an FTA would harm the EU itself; and in the fullness of time, we believe the EU is likely to modify its trade barriers against us and others in its own interests.

THE BENEFITS OF ACHIEVING FREE TRADE

The Lessons of Cobden and Bright

One hundred and seventy years ago, Robert Peel repealed the Corn Laws (which imposed import tariffs on wheat, keeping prices high to the benefit of British producers and landowners) even though other countries would not consider reciprocal reduction of their agricultural tariffs. He did

so following the free trade arguments advanced by Richard Cobden and John Bright the leaders of the Anti-Corn Law League and intellectual forefathers of the free trade movement. As history later showed, Britain led the way in industrialisation as cheaper food and lower living costs raised consumer welfare and triggered reallocation of resources towards their best use. Trade within the low tariff British Empire thrived and ushered in lower tariffs by other countries wishing to participate.

The genius of Cobden and Bright lay in explaining that tariffs caused 'self-harm' because they simply raised prices internally above world prices, making consumers worse off and distorting the allocation of internal resources. At that time, politicians thought that tariffs gave you more power because they reduced imports and built up your own industry, while if you got others to reduce tariffs you would gain by exporting more and so also building up your industry. This was the doctrine of Mercantilism, which history has shown was exactly wrong.

What Mercantilism ignored was the way in which trade rearranges itself in the long term, given that world trade is highly competitive and goods are priced to make world supply and demand equal. No one country can influence this world price by its tariffs: the effect on world demand is zero or trivial because all tariffs do is reduce demand for, say, corn from foreign suppliers and switch it to home suppliers. But the total demand for corn worldwide is the same, as is supply. So, the world price is the same and all that happens is home prices are raised by the tariff. This rise in home prices makes consumers worse off and causes resources to flow into the protected industry away from other industries where they would be better used.

What the Prize of Free Trade is Worth

Our analysis – based on the trade and macro models of the Cardiff University Macroeconomics Research Group - shows the UK adopting global free trade creates an additional long-term GDP gain of 4% for the UK and a fall of 8% in consumer prices, compared to remaining in the Single Market. Note, this 4% does not include any benefits gained from other aspects of leaving the EU – eg, decreased regulation, no longer contributing to the EU budget, and so on.

How is this 4% made up? About half is gained from leaving the EU's trade barriers - ie, eliminating our tariffs on goods imported from non-EU countries, abolishing non-trade-barriers left over from EU rules, and eliminating tariffs and other levies of the CAP. What is left are the tariffs on manufactured goods with the EU that average between 3% and 5%, depending on the exact pattern of imports in each direction. On our exports to the EU, the figure is about 3.5%; on their exports to us it is about 4.8%. If we do not implement our 4.8% tariffs on the EU, then we will achieve the Full Monty of those 4% gains from free trade.

Much ink has been spilt by Remain factions on studies by other modellers claiming negative outcomes for the UK under the WTO option; but we and others have explained - at some length - how these studies (a) are, in some cases, based on implausible models such as the 'gravity' model that assume a country's trade faces quite limited long run competition from the world market and (b) use highly damaging assumptions about Brexit policies, especially that the UK would adopt protectionist trade barriers against the EU and the Rest of the World. Appendix A contains fuller details.

Where the Mercantilists went wrong is they stopped their calculations at the 'first round' of effects on the economy. Yes, in the first round, if you put on a tariff, output in the protected industry goes up. But that is not the full final effect. We need to go on and examine the effects of the higher

prices on consumers and on other industries: these 'indirect effects' provide the full picture of total effects – ie, the 'general equilibrium' effects on the economy.

Similarly, if the other country lowers its tariff on you, you do sell more in that market. But again, this is just the first round effect. The subsequent indirect effects are - because world prices are the same - that the output of other suppliers in the country is diverted into other world markets, just as your output is diverted into their home market. In the end, nothing changes for you except the pattern of trade: 'trade diversion'. But the other country does, indeed, gain welfare from lowering its tariff because its consumers are better off and its resources flow into better industries. Again, lowering its tariffs reduces its own self-harm.

This was what Cobden and Bright taught Britain and the demonstration of the resulting UK enrichment caused free trade to proliferate as others imitated us. Today, the same Mercantilist fallacies are once again gaining credence and can cause damage to our interests in our negotiations with the EU and other countries.

WHAT KIND OF WTO?

Much concern has been evidenced by Remainers, the media, and many parliamentarians about the risk of the UK being 'forced' to leave the EU under WTO rules. This has been presented as a calamitous event.

The reality is, at the end of the two-year Article 50 negotiating period - regardless of what has or has not been negotiated with the EU - the UK initially almost certainly will leave the EU employing the existing WTO Most-Favoured-Nation (MFN) tariff schedules. These schedules are the WTO trading rules that, via the EU, currently govern our trading with the rest-of-the world. As we remain a founder member of the WTO, this is straightforward to do. Thus, the same import tariffs employed today by the EU would be employed initially by the UK. Once we leave the EU, these rules would apply also to our trading relationships with the EU 27.

If the UK were not to leave under WTO rules, there would be no framework in place to govern our trading relationships with other countries (now including the EU). And, it would be unthinkable for the UK to attempt to negotiate a new WTO tariff schedule as this would require a long, tortuous process requiring agreement of all WTO members. Therefore, the only practical way to exit the EU is initially to adopt the existing WTO MFN schedule for the EU. Once out under WTO rules, the UK easily can reduce or eliminate tariffs (but not increase them).

The issue then becomes, "What kind of WTO?" The answer will depend – in part – on whether, prior to leaving, the UK is successful in negotiating an FTA with the EU. To avoid economic problems stemming from business uncertainty and potential delays to delivering consumer/voter benefits, the government should place a strict time limit on its initial offer to the EU (say, six months) with a clear and publicly-stated up-front position that the UK is content to revert to WTO rules in our trading relationship with the EU if a deal acceptable to the UK is not agreed on a timely basis – even if the EU insists on erecting import tariffs against us ("no deal is better than a bad deal"). Thus, trading with the EU under WTO rules becomes the government's default position.

There then will be three key decisions the government must make:

- If no FTA is agreed with the EU prior to exiting the EU and the EU raises import tariffs against us, should we retaliate against the EU by erecting our own import barriers against the EU (the 'Tit-for-Tat Strategy')?

- Should global free trade be pursued on the basis of negotiating FTAs with the rest of the world or by unilaterally dropping our import barriers to zero?
- What policy should be followed with regard to the Common Agricultural Policy (CAP) and its associated tariffs on food? While we address this question below, in what follows we generally assume the UK will abolish the EU's high agricultural tariffs (a key part of the CAP's mechanisms)

"Tit-For-Tat"

It might be thought, in order to encourage the EU to 'come to the table', we should keep our 4.8% average tariff on their manufactures, if they decide to apply their 3.5% average tariff on ours. However, as the example of the Corn Laws shows, that is false logic. If they have not agreed to an FTA, our tariffs on them will not dissuade them, as they will have done so essentially on political grounds, despite pleas from their own industries not to do so. Furthermore, the entire history of the EU suggests they are not sensitive to the hardships their policies inflict on EU consumers.

In the longer term, as in the Corn Laws example, they may learn to initiate free trade in their own interests: import tariffs only harm themselves. But this incentive is likely to kick in only over the long term; as noted, we will not dissuade them in the short term by 'tit-for-tat'. Indeed, in political terms, we are more likely to encourage them to keep their own tariff barriers in the long term if we act aggressively towards them: backing down will be harder for them.

The fundamental point is, if we opt for 'tit-for-tat', we will harm ourselves, denying ourselves that other half of our 4% gain in GDP and consumer welfare. In addition, we run the risk of creating havoc in the supply chains of key industries. It is well-known that these supply-chains are extremely sensitive to small tariffs. Under 'tit-for-tat', the damage to supply-chains could be great as the EU has no tax system to use to alleviate the effects, and, under Single Market rules on competition, no national government can support its own industry. UK firms would tend to stop buying inputs from EU firms and would switch to rest-of-world suppliers, once free-trade is established with them. This, in turn, would encourage EU-wide firms to relocate UK plants to within the EU avoid the hit to EU input plants from UK switching. The end result would be a needless case of self-harm.

It is important to put EU tariffs into context when making these decisions. If the UK leaves the Single Market with no zero tariff agreement with the EU, the cost of EU tariffs on UK exports (excluding agriculture) would be only around £3.5 billion a year - about 0.5% of Government spending and a minority of the £10-£11 billion net dividend the UK will receive from no longer making its annual EU budget contribution.

Furthermore, it should be noted – as a consequence of our many years in the Single Market – non-tariff barriers in goods will not be an issue when we leave. These barriers are created via regulations of 'quality' and anti-dumping duties: they do not exist today between us and the rest of the EU and the creation of any such new barriers cannot be justified. Neither side could make a case for such things; any attempt to do so could be challenged in the WTO courts where all countries desire to maintain good reputations because of continuing WTO disputes in many areas.

Finally, manufacturers are benefiting from the low exchange rate ushered in by Brexit. Even including potential EU tariffs, manufacturers are more competitive today than they were before the referendum vote.

Ultimately, if Sterling regains pre-Brexit parity and industry has not yet adjusted to a post-Brexit environment, the government's industrial strategy can take measures that support our industries.

We would want any way to help our manufacturers adjust to the new post-EU world of more competition and less protection.

In summary, not only does 'tit-for-tat' deprive us of half the gains from free trade and potentially cause substantial short-run disruption to supply-chains, but it also creates an added aggression that could make it difficult for the EU to climb down in the longer term.

Unilateral Free Trade versus Pursuing FTAs

The government has embraced becoming a leader in global free trade. Broadly speaking, there are two principal routes to achieving this:

1. **Unilateral Free Trade (UFT).** Once Article 50 is triggered, the UK would leave the Single Market, take up its full membership of the WTO, and set zero import trade barriers unilaterally, without seeking concessions from others as a condition of doing so. This is simple to carry out – both conceptually and in practice - and is the swiftest route to tariff-free trade. As the analysis in the first section above shows, even if other countries do not reciprocate by dropping their barriers in return, the UK – as a major net importer - will still be better off economically than by staying in the Single Market. This scenario creates a long-term GDP gain of 4% and a fall of 8% in consumer prices, compared to remaining in the Single Market. As noted above, other economic groups who have produced forecasts for the WTO option have almost universally refused to model a fully free trade policy scenario.

   Because benefits will begin accruing immediately through lower prices and higher disposable income, the economy will grow more swiftly than through any other route. Therefore, this scenario will enable us to gain these economic advantages more rapidly than any other scenario with the least risk of not doing so. In addition, we envisage the UK continuing to seek FTAs around the world but focused on wider issues of free trade – eg, further removal of non-tariff barriers and other non-tariff trade distortions on goods, broader market access for services, elimination of agricultural quotas, better investment security, and improved property rights. This will provide a strong signal that the UK is serious about being a leader in global free trade. If the EU insists on raising import tariffs against us, we should accept this as explained earlier. Eventually, the EU is likely to realise this is self-harm.

2. **Pursuing FTAs.** Under this approach, the UK would not unilaterally eliminate import barriers but, instead, would attempt to achieve the same objective via negotiating FTAs with other countries. This is more complicated to do, as we do not know which countries might ultimately agree an FTA, what the result of these negations might be, or how long the negotiations might take. Because the UK would be forced to maintain import barriers during this period against all the countries that haven't agreed FTAs, most of the gains will not accrue for some considerable time. Thus, by definition, the realised benefits will always be lower than with UFT.

   A further problem with this route is it commits the UK to indefinite tariff protection against the EU, so raising prices on a wide swathe of our imports. This, as explained above, reduces the long term gain from our trade policies to just half of the full 4% gain achievable, even if we have concluded FTAs with the rest of the world. Consequently, the desired economic benefits will not accrue to the consumer/taxpayer and criticism from those who want to return to the Single Market will be much in evidence. All of this

will create uncertainty. More worrying, the UK de-facto effectively becomes a tariff-setting sovereign, so obviously not appearing to be a global leader in free trade**.**

The main argument for adopting this approach is political. It appears more orthodox and gradualist than UFT and looks responsive to protectionist producers - so it may feel easier and politically safer to pursue. But these apparent advantages must be placed in the context of the economic benefits foregone by consumers and the losses to the national interest.

An additional potential motivation for the government may be *pour encourager les autres* in FTA negotiations – ie, by providing 'bargaining chips'. However, this alleged benefit is exaggerated as tariffs represent a relative small part of total trade barriers. Most countries understand this point and realise that the real prize to be won in FTA negotiations is from reducing non-trade barriers and trade distortions in a much broader sense as noted above– including the removal of non-tariff barriers and the wide agenda of access to services and agricultural markets and property rights protection.

Nevertheless, should the Government go down this route of maintaining the full current EU tariff as its MFN tariff schedule on all countries including the EU, then it will be essential to move rapidly to FTAs on non-EU countries so that the gains in eliminating protection from these sources are reaped as soon as possible. In this context, an FTA with the US will be particularly important as the US is the lowest cost source for not only almost all food products (so nullifying the CAP tariff effects on food prices) but also for a wide swathe of manufactures, from furniture through printing and publishing products to the whole machinery market. US products could therefore replace at world prices the vast bulk of the products currently bought at well above world prices from the EU. Add in FTAs with major food suppliers Australia and New Zealand, and with South Korea as another key world supplier of manufactures, and we would have indirectly eliminated the bulk of the EU protectionism on our goods imports.

The Critical Importance of Leaving the CAP and Eliminating its Tariffs on Food

The CAP involves the government in contributing to EU farm subsidies, only a small part of which returns to UK farmers: this money forms part of our EU budget contribution.

It is absolutely essential, whatever other decisions are taken, that the UK government withdraws totally and unconditionally from the CAP and all its associated tariffs on agricultural products. The key damage to the UK economy from the CAP comes from the massive raising of farmers' prices by some 20%, according to our and OECD estimates. The knock-on effect on the economy comes through increasing land and consumer prices, both of which have large indirect effects on both the structure of the economy and on consumer welfare.

We have calculated through our World Trade Model that any policy retaining the CAP's tariffs causes substantial damage to the economy (between a 1% and 4% reduction in consumer welfare compared with the current situation), even if unaccompanied by UK tariffs on manufactured imports (see Appendix B). This is because the rise in land prices induced by CAP tariffs greatly distorts the shape of the economy and because it raises consumer prices by around 7% - about the same as the whole of current EU protection on both it and manufacturing. Details of these and all our other calculations, as well as of the World Trade Model on which they are largely based, can be found in Appendix B.

Given this damage to our economy from the CAP, support that the government gives to farmers via CAP on social and environmental grounds should be channelled directly to them. The effects of such direct support can be economically neutral and of quite limited budgetary cost if it is untied to the size of farms or crops but linked instead to particular goals such as preserving the rural environment and enabling farmers to reach adequate incomes in return for carrying our such goals.

Summary

The table below summarises the key outcomes to consumers and government revenue, depending on the decisions government makes with regard to the three questions discussed above. They are listed in order of decreasing economic attractiveness.

Outcomes of WTO Options vs the Status Quo [1]

	Consumer Welfare	CPI	HMRC Revenue
1. Global Free Trade [2]	**+4%**	**-8%**	**+7.3%**
2. Global Free Trade but EU levies import tariffs [3] against UK	**+4%**	**-8%**	**+7.3%**
3. UK reciprocates with import tariffs [3] against EU ('tit-for-tat') [4]	**-4%**	**-1%**	**-2.2%**

[1] All options assume UK non-tariff barriers have been eliminated
[2] Assumes no import or export tariffs globally
[3] Goods and agriculture tariffs
[4] WTO rules would require goods & agriculture tariffs also to be levied against ROW

It is clear that Option 1 (Global Free Trade) is far and away the best economic outcome for the country, increasing GDP/Consumer Welfare by 4%, reducing prices by 8%, and augmenting government revenue by 7.3%, relative to remaining in the EU. While this outcome can in theory be achieved either via implementing unilateral-free-trade or by agreeing FTAs with the rest-of-the-world, it is obvious that the gains will be realised much more quickly unilaterally, the FTA route will never obtain 100% of the gains delivered by UFT, and this approach will risk not coming to agreement with some important countries.

If we cannot agree free trade with the EU (Option 2), we lose half of the welfare gain and some of the other gains.

More importantly, if we cannot agree free trade with the EU and, in addition, reciprocate by raising 'tit-for-tat' import tariffs against the EU (Option 3), our welfare drops by 4% relative to today (and 8% compared to the Global Free Trade option), there is virtually no decrease in prices, and government revenue decreases. This is a disastrous approach and leaves us worse off than remaining in the EU.

Thus, the decisions government takes with regard to WTO will have a defining impact on our prosperity outside the EU.

IMPLICATIONS OF WTO FOR PRODUCERS

Thus far, we have evaluated the impact of Brexit and trading under WTO rules from a national macroeconomic perspective. It is clear that the optimal strategy from the country's economic perspective and that of consumers is to embrace unilateral-free-trade and, if an attractive FTA with the EU is not forthcoming and the EU raises import tariffs against us, we should not raise imports tariffs against them.

But, what about the perspective from producers? Is this a zero-sum-game in which, if the country prospers, producers cannot? In the sections below, we evaluate the post-Brexit prospects of two sectors that are often cited as post-Brexit victims – manufacturing and financial services.

Allowing High-Value-Added Manufacturing to Thrive

During our membership of the Single Market, manufacturing as a share of UK employment has fallen from around 35% to 8%. It is a dangerous fallacy to believe either that the EU has been good for UK manufacturing or that today's diminished manufacturing status quo would somehow be preserved in aspic were we to stay in the EU. It is furthermore worth noting that this is not a "British problem" relating to free market economics. France, which has had mainly interventionist and socialist policies for the last thirty years, has had an almost identical re-balancing of its economy away from traditional manufacturing.

Looking to the future, analysis at both the macroeconomic and sectoral levels confronts the myth that manufacturing cannot deal with the elimination of EU protection. The manufacturing sector will benefit massively in the short to medium-term from the post-Brexit fall in Sterling, giving it a useful transition period in which to raise its productivity to the degree needed to offset a more competitive home market and the impact of any EU import tariffs. This would continue the long term trend of going up the value-added chain to a more hi-tech industry as already demonstrated by JLR, Dyson, and JCB.

Macroeconomic Perspective. The WTO Option in our World Trade Model assumes that initially, following the loss of EU protection, UK manufacturing prices will fall by 20% in the home market compared with current EU prices but eventually over, say 10 years will settle to 10% lower than prices within the EU. This is because the EU is assumed to follow a slow trend towards reduced protectionism. It also assumes that our exports to the EU face the current EU MFN tariff but that a general pro-business industrial strategy support package is put in place by the government to allow industry to absorb this without putting up EU prices. The Sterling exchange rate has fallen about 15% post-Brexit: Cardiff-macro-models suggest this could continue for around five years but Sterling is likely to revert to its pre-referendum value within a decade. Under these assumptions, we can assess the effects on the manufacturing sector's profits as shown in detail in Appendix B.

The total manufacturing home market is around £100 billion; total manufacturing exports to the EU are around £110 billion and to the ROW about the same at £115 billion. So, for five years, as shown below, manufacturing makes profit gains of £25 billion, on total gross value added of about £160 billion equating to 16% extra gross margin on value added.

	Home Market (£100 bn)	EU Market (£110 bn)	ROW Market (£115 bn)	TOTAL
Price Impact	-20%	0	0	
EU Tariff Impact	0	-3.5%	0	
Sterling Impact	+15%	+15%	+15%	
TOTAL	**-£5 bn**	**+£12.6 bn**	**£17.2 bn**	**+£25 bn**

After a decade, assuming the exchange rate reverts to the pre-Brexit level, manufacturing profit declines by £14 billion, or a 9% reduced gross margin.

	Home Market (£100 bn)	EU Market (£110 bn)	ROW Market (£115 bn)	TOTAL
Price Impact	-10%	0	0	
EU Tariff Impact	0	-3.5%	0	
Sterling Impact	0	0	0	
TOTAL	**-£10 bn**	**-3.8 bn**	**0**	**-£14 bn**

Thus, for five years, manufacturing will enjoy a transition period with higher than pre-Brexit profits due to the exchange rate. During this time, it can focus on raising productivity so that it can, at least, maintain pre-Brexit profitability when the beneficial effects of lower Sterling run out. This would require a once-off labour productivity increase of only around 9% - or an annual productivity improvement on the order of 0.9% a year. This compares with average manufacturing labour productivity growth since 1970 of 2.9% per annum. This seems to be something the industry can easily take in its stride, continuing its march 'up the value-added chain' towards a hi-tech manufacturing sector.

Some may say that it is not correct to include this 0.9% productivity increase since manufacturers would have achieved it in any case. However, we believe this required productivity increase is a small portion of the productivity gains normally achieved and is likely to be subsumed by extra productivity gains enabled by leaving the EU. Furthermore, the above analysis does not explicitly account for lower input prices resulting from the elimination of import tariffs or opportunities for UK manufacturers to source less expensive components from ROW suppliers (the auto manufacturing analysis below does take these factors into account).

Sectoral Perspective. How does the national macroeconomic scenario work out at the level of a specific industrial sector – for example, auto manufacturing? This industry is often cited as being a major victim of Brexit given that it exports over half of its product to the EU and imports more than a third of its purchased goods from the EU.

In Appendix D, we show a detailed calculation for a prototypical auto manufacturing company illustrating how it will fare under the WTO 'tit-for-tat' option, as well as under the WTO Zero Tariff option in the short, medium, and long-term. This analysis strongly confirms the conclusions of the macroeconomic analysis above and, in fact, demonstrates that the UK automobile manufacturing

industry has nothing to fear from Brexit. Indeed, under post-Brexit WTO rules, it can prosper, even without any government support to offset EU import tariffs:

- In the short-term, under the 'WTO 'tit-for-tat' option, the industry would increase its profits because it would be partially protected from import competition. However, this analysis does not account for potentially disruptive effects on supply chains.

- With WTO Zero Tariffs, the industry would suffer a marginal decrease in short-term profitability as the effects of increased import competition slightly overwhelm the beneficial effect of Sterling's devaluation. However, profitability improves markedly over the medium and longer term - even if Sterling regains its pre-Brexit parity - due to (easily achievable) labour productivity improvements and the opportunity to source components outside of the EU at better value.

Note that both of the above analyses are "static" – ie, they implicitly assume there is no volume growth, no new products, no changes in technology (eg, no electric or driverless cars), no regulatory improvements, and so on. Because of this, we believe the conclusions understate the positive opportunities available to UK manufacturing outside the EU. We believe UK manufacturing can thrive.

Financial Services - The UK as A World Financial Centre

There is much misunderstanding of the prospects for financial services after Brexit. Some Remainers suggest that 'the City' could be hit by large-scale relocation of banks and other financial houses to the Continent as large amounts of EU business is lost due to the potential loss of passporting rights. This is quite wrong. These concerns fail to understand the fragmentation of the EU financial services market and exaggerate the extent that passporting matters, they do not appreciate how the City's strong position severely constrains potential EU punitive action, and they do not see the nature of EU protectionism in perspective. Consequently, they too easily dismiss the advantages of the City's enhanced freedoms outside the EU.

Immaterial impact from passporting loss. There are no tariffs for financial services. The vast bulk of service regulation in the EU hitherto has been done by national governments and only a small start has been made in regulating trade in services - essentially there is no single market in services to leave. The only real achievement has occurred in financial services with 'passporting, which is a reduction in existing EU nationally-based protection that thereby benefits EU consumers. Passporting provides relief from some but not all business sectors and from some but not all of the national barriers erected over the years by EU countries.

The assertion that the success of the City is based on full and complete "access" to the EU's financial services markets because of passporting is not true. The insurance and asset management sectors are almost entirely independent of passporting – overall, we estimate that only about 9% of the City's total revenue is at risk from the loss of passporting (see Economists for Brexit, 2016b) For this "at risk" business to be lost, one would have to believe that all passporting rights would be lost, that none of the "passported" rights lost would be compensated by the continuation or evolution of existing "Equivalence" schemes, and that centuries of City creativity and innovation would not be able to discover "work-arounds".

Significant constraints on EU punitive action. Many are concerned that, post-Brexit, the EU will resort to hostile behaviour toward the City; for example, taking an unreasonably aggressive line with

regard to granting Equivalence to City firms. However, there are fundamental constraints limiting the EU's ability to take such hostile actions. For example,

- Historically, under the Maastricht Treaty, the EU has aimed for free movement of capital and it also participates in the Bank for International Settlements, which aims similarly to ensure that financial markets remain open and non-discriminatory
- Under various pieces of existing EU legislation, financial services companies from a wide range of other countries, including the US, Japan, Singapore, Switzerland, Canada, and Mexico, enjoy 'equivalence' status, allowing them access to the EU's financial services market
- The City competes strongly in highly competitive world markets and is the world's number one financial centre by most accounts. It has consistently traded at world prices in world markets as a full competitor; it enjoys no protection from the EU.
- The EU knows that its economic interest is served by free trade with the City as its most efficient and lowest cost supplier of financial services. It is virtually impossible to imagine that such minor financial centres as Frankfort (19th in the world positioned between Dubai and Vancouver) could ever fulfil Europe's financial needs.
- Banks and other financial institutions will continue to prize London's enormous strengths and will actively seek to minimize any moves away from London. For example, there are significantly more "inbound" passports awarded to EU financial services firms' desiring to do business in the UK than "outbound" passports to UK firms.

If the EU for some reason decides to act against its own economic interests by engaging in protectionism against the UK, the City has nothing to fear: the business affected is likely to be small and even in the short run is unlikely to cause any significant losses. In the long run, this protectionism will have no effect on world prices for financial services, so the City can divert output to world market as necessary and at no long run cost.

Better UK-based regulation helps City exploit competitive advantages. The City will continue to rely on world markets after Brexit and it will have the new advantage of UK-based regulation by the Bank of England in place of the erratic and often hostile regulation from the EU. Leaving the EU brings definite advantages to the City; for example, the end of the bonus cap and the short selling ban, as well as most likely avoiding the Financial Transactions Tax. Accordingly, an EU exit also is likely to expand some financial services business and jobs in London. As the country's largest traded service sector, the City exemplifies the UK's comparative advantage in traded services as a skill-intensive activity for a country well endowed with skilled workers. With protection removed from other sectors it will attract resources from them in the long run and expand further.

We conclude that the UK's financial services industry - rather than concentrating on maintaining the relatively narrow regulatory feature of passporting - should instead embrace a post-Brexit future as a World Financial Centre establishing its own financial regulatory regime attuned to the requirements of global financial markets. This idea – together with the notion of establishing an "Enhanced Equivalence" regime with the EU - has been set out in great detail by Barnabas Reynolds for Politeia (for further details see Barnabas Reynolds, *A Blueprint for Brexit*, Politeia, Jan 2017 and EFB evidence to the International Trade Committee of the House of Commons).

AN OPTIMAL WTO EXIT STRATEGY

While one must hope that the EU will approach the Brexit talks in a cooperative spirit, the omens are not propitious. Therefore, it makes sense for the government to prepare a full back-up exit strategy

if no acceptable agreement can be reached. It is important to remember that – in any likely eventuality – the UK will need to exit the EU trading under WTO rules.

In this paper, we have argued that an exit strategy should not compromise on free trade from the UK's side: we should proceed to dismantle all EU protectionism in agriculture and manufacturing. We should not pursue a 'tit-for-tat' strategy, as this will reduce the UK's gains from Brexit by around half, is likely to disrupt manufacturers' supply chains, and is unlikely to achieve any moderation of the EU's position, indeed it could cause it to harden over the long term.

With goods, the Government's optimal exit strategy is likely to be an intelligent hybrid of the unilateral-free-trade and FTA routes to achieving global free trade. For example, we believe an optimal exit strategy would be for the Government to announce simultaneously that it is

- Unilaterally adopting WTO rules with zero import tariffs

  and

- Embarking on establishing FTAs with like-minded countries that wish to eliminate the more important and broader areas of trade distortions mentioned earlier – eg, removal of non-tariff barriers and other trade distortions on goods, facilitating trade in non-goods sectors such as broader market access for services and elimination of agricultural quotas, enabling competitive public procurement, guaranteeing full legal protection for foreign direct investment, improving protection of intellectual and other property rights, and so on.

Outside the EU, the UK, as a free trading nation, will have much greater flexibility to enter into such agreements – and, consequently, will be able to offer substantive 'bargaining chips' in such areas as services, agriculture, intellectual property, and government procurement. This will demonstrate that the UK is stepping up to being a global leader of free trade.

This approach, in which we simply get rid of our own tariffs on the EU and also on others, has the further benefit that we will minimise short run disruption to manufacturing supply chains that now proliferate. We can reduce the need to alter them, through pro-business policies and by placing no tariffs ourselves.

In the event that EU protectionism extends to financial services, again we should not retaliate as this would compromise the City's long term gains from Brexit; instead, the City will naturally replace any lost trade with the EU (which accounts only for a small minority of the City's business) with greater revenue elsewhere through the normal workings of the market - so as in EU protection of goods, the only result will be a shift in the pattern of trade away from the EU. The City should position itself as a world financial centre with regulation matched to that objective.

If for political reasons the Government nevertheless feels the need to maintain existing EU tariffs as its MFN tariff schedule against all including the EU, then it must move at the greatest speed to negotiate FTAs with non-EU countries so that their supplies reach our consumers at world prices. This will mean- through indirectly replacing high-priced EU sources of supply- we can reap the gains from worldwide free trade. The more we can do so, the closer we can get to the full gains of global free trade calculated in this paper.

APPENDIX A

How the Remain Side Used Different Models and Different Assumptions to Paint Brexit Black

As is well-known, other modellers produced negative effects of leaving the EU, which was heavily publicised by the Remain side as a 'consensus', even an 'economic fact'. How did this arise? During the referendum, two major reasons became evident for such a consensus.

First, prominent modelling groups, notably the Treasury, the IMF and LSE, used a 'gravity' model that created a strong bias against leaving the EU, owing to the way it was estimated and used: Essentially a gravity model assumes that current trading patterns are hard to alter because 'gravity' (interpreted as geographic closeness) determines trade patterns; consequently, UK suppliers can be thought of as having 'niche' markets and a high degree of monopoly power in their existing markets but as facing other suppliers in other markets who also have the same monopoly power. This basic assumption runs counter to the strong evidence of high competition and free entry in world markets- as illustrated by the collapses of Blackberry and Nokia. The World Trade Model used for our assessment of the long run effects of Brexit assumes, in line with a long classical tradition in trade theory going back to Ricardo, Hecksher and Ohlin, that there are no obstacles to competition in wholesale world markets, while local distribution margins and trade barriers define the prices that consumers face. This model has a good track record for analysing large regime changes such as globalisation, as well as being an entirely plausible theoretical account of how comparative advantage is formed in world markets - see Minford et al (1997, 2015). By contrast the gravity model merely describes the well-known facts of trade flows simplistically, without using a convincing causal model within which big shifts in regime like Brexit can be analysed. An implication of the gravity model approach is that protectionism is desirable for a country to exploit its monopoly power as producer and consumer unless it provokes retaliation: thus, it prolongs the discredited mercantilist philosophy of an earlier era of world history.

The second reason why modellers found a negative effect of Brexit is some groups assumed the UK would maintain high EU-style protection after Brexit. Even though groups**,** such as Oxford Economics and PWC for the CBI, used a model closer to ours, they still found a negative effect: The reason for this, it emerged from an NIESR conference in late May, was they assumed the UK would maintain EU protectionism after Brexit, such as import tariffs. This factor also caused the gravity modellers to find an even more negative effect, so it was the most general factor for a negative result. More details of these points can be found in Minford (2016b and c), Blake (2016) and Dowd (2016). More recently Minford and Howe gave evidence to the House of Commons International Trade Committee (Economists for Brexit, 2016c) in which the model findings were debated in some detail with Dr. Dhingra of LSE and Professor Rollo of Sussex University.

In an important detail, Minford noted (answer to Q84 in the oral evidence, Economists for Brexit, 2016c) that the LSE calculation under their Brexit model of the positive effects from the UK abandoning the EU protectionist barriers would be around +2%, roughly double the negative effect they calculate from leaving the EU Single Market: they report only 0.3% because they omit the non-tariff barriers levied by the EU. Together with non-tariff barriers, the EU's protection rate is 20% (on both their estimates and ours), as against the 3% they assumed for the tariff barriers alone. LSE is the only group to have made this calculation: all the others simply assume that, under Brexit, the UK maintains existing EU protection. However the LSE calculation does reveal the importance of this assumption, even in a gravity model, in turning the Brexit effect negative.

When challenged on why they made this Brexit protectionism assumption modellers said that 'unilateral free trade is politically impossible'. In the context of a referendum where voters were being presented with analysis to make up their minds, this was a strange decision: economics should present all options and allow voters to decide. More practically, in a referendum, the vast majority of voters who are *not* protected producers should naturally favour the elimination of protection and the resulting lower prices. However it is plain that modellers did not question the normal political assumption of producer dominance. In effect, they looked forward to a post-referendum government decision in which producer lobbies would push successfully for continued protection and thwart the democratic will of the consumer-voter. This is precisely what the government is battling to prevent, as the Remain lobbies ceaselessly demand a 'soft Brexit'- ie, the closest possible outcome to the status quo.

What this discussion shows is that the Remain economics consensus was derived from models and more importantly assumptions that favoured producer interests. Ours ,on the other hand, and that of a small handful of others including Open Europe considered the effects of the consumer-led free trade option for a Brexit in which voters' wishes for the best outcome would actually be implemented.

APPENDIX B

UK Tariff Policies: Calculating the Costs

In this appendix we examine the net benefits and costs of different tariff policies pursued by the UK. The default case not shown is the Base Case of full UK free trade- i.e. zero tariffs on all sectors. Hence the Tables all show comparisons with this Base Case.

Assumptions and Models

The main point of economic activity is the welfare of our citizens and we measure this by their consumption or 'living standard'. An economy has finite resources and the aim of economic policy is to maximise their consumption potential from these resources. Sometimes you hear commentators talking about investment as an aim of policy but this is nonsense! Investment is a cost; it is consumption deferred whose only justification is a return in higher future consumption. We take account of the need to invest when we measure consumption benefits; because these are only included after deducting the costs of necessary investment and maintenance.

Trade contributes to this consumer welfare aim by increasing the value of what can be consumed from what is produced by exchanging it in trade with other countries. In much of the discussion of Brexit from the Remain side the emphasis was on the problems of producers, notably how important to them was the Single Market. Remarkably none was focused on the problems of consumers in accessing best value from the rest of the world.

Yet the key fact about the EU is its promotion of protectionism via its customs union barriers against the non-EU world. It is odd that the EU should be protectionist externally when it aims to increase competition and free trade internally. The reasons for this take us too far back into the origins of the EU in the thought of economists like Jean Monnet: essentially something akin to mercantilism, the theory popular in the 18th century that an economy's strength depends on how large its exports are, seems to have prevailed in this thinking, that the EU's best interests were promoted by protecting its own industries and fostering its exports, while using imports as a source of scarce revenue for the infant state and to help pay for measures like the Single Market.

The most well-known, indeed egregious, example of the EU's protectionism is in food, where the Common Agricultural Policy creates a system of variable tariffs and export subsidies designed to keep the internal price of food at target levels. The latest estimate of the average tariff-equivalent for food from the OECD is around 20 per cent.

Less well-known is the protection of manufactures, mainly via non-tariff barriers. The average of the tariffs on manufactures, depending on how you weight them, is between 2 and 4 per cent. But comparisons of EU prices with lowest world prices suggest that non-tariff barriers make up another 16-18 per cent; it could be much more if we use crude estimates of Chinese prices. However these are not well researched and if we base our estimates solely on OECD prices which have been gathered with great thoroughness we obtain a price discrepancy at the border or factory level of around 20 per cent. The big fuss made by UK producers over being inside the Single Market largely reflects the fear of losing such protection and having to sell into the EU from outside the Customs Union; if the Customs Union protection around the SM was negligible it would be of little consequence. Those who criticise our estimates as too high have still come up with big estimates of the effects on our exports of being excluded from the SM!

To calculate the effects of EU membership on goods trade we assume that the UK leaves the EU Customs Union and its associated single Market entirely, and substitutes unilateral free trade, thus sweeping away the EU protectionist arrangements in favour of free entry for foreign products under standard UK regulations for product standards in the UK market. We review this using a standard world trade model in which trade is determined by comparative advantage under full competition. In this model all markets for goods and services 'clear', in the sense that prices move to equate demand and supply; this final situation or 'general equilibrium' is discovered by computer methods and hence the model is known as a Computable General Equilibrium (CGE) model. We chose this model for two reasons- a full explanation of the choice and a critique of alternative choices made by other modellers can be found in Minford et al (2015). For a detailed description of this model, see Appendix C.

First, it corresponds to the realities of the long run behaviour in which we are interested for the analysis of a long run change in trade regime like leaving the EU. Those who trade in world markets are well informed about the qualities of the products they buy for onward sale to distribution chains in each country. Little 'imperfection' can survive this knowledge. Different types of laptop or luxury car or refrigerator are ruthlessly evaluated by their characteristics and each characteristic is priced. Besides good information there is ample competition, with traders from many countries selling into many countries. Under these conditions the products a country will sell depends on the resources that it has within its borders. We can assume that capital flows freely between countries because in the modern world there are few controls left on how savers invest around the world. But a country's supplies of unskilled and skilled labour depend on how its training and education system has developed over time, while its supply of natural resources is essentially God-given. It is these last three resource supplies that govern what it will produce according to 'comparative advantage'.
Second, this model does well in analysing trends in world markets over time. The biggest trend in recent decades has been the emergence of globalisation, with manufacturing production shifting in large quantities to the 'emerging market' economies. At the same time we have seen big changes in wages and employment in developed countries, with rising inequality and unemployment. Another factor in the mix was the progress of computerisation of manufacturing production. In a major piece of work (Minford, Nowell and Riley, 1997) we used this world trade model to examine these changes and whether they could be accounted for. We found that an equally-weighted combination of globalisation and computerisation could give a good empirical account of all these changes.

These two factors, theoretical and empirical, gave us reasonable confidence in using this model for the major trade regime change for the UK of leaving the EU, with its implications for our trade not just with the EU, with which just over 40 per cent of our trade takes place, but with the rest of the world for the other 60 per cent.

The Cost of Goods: World Prices, Tariffs and a Country's Prices - Calculating the Tariff Effects

We now turn to our CGE model of trade to obtain measures of the cost to the UK and the EU of this protectionist policy. First we explain in more detail just what this CGE model is, before going on to explain how the model works in outline.

A CGE model of international trade, as used here, is intended to contain the relevant relationships that will hold in economic theory across economies and will determine the pattern of trade and the prices at which it takes place. These relationships are numerical so that we can extract meaningful estimates of the quantitative effects of changing trade policies in the long run. For this purpose we cannot aspire to any 'exact realism' but we do want to obtain estimates that a) are consistent with good uncontroversial economic theory b) give a reasonable idea of potential orders of magnitude for the long run. The way it is done is to construct a 'base line' set of estimates that correspond to the

actual known facts; the model is set up so that it fits these facts. Then the alternative set of policies is injected into the model to find out what the alternative facts would look like. We are concerned about long run effects for the obvious reason that these policy changes stay in effect for very long periods, indeed can often be permanent; thus joining the EU occurred more than forty years ago and if we leave the move will undoubtedly not be reversed in a hurry. Experience shows that large-scale changes in trade arrangements have quite radical effects on the shape of economies; therefore we need a model that can work out what these effects might be. The Table below shows the CGE model estimates of being in the EU, in terms of the percentage effects on a wide range of economic variables.

In this particular CGE model there is full competition in all products with free entry. There are world markets for the three traded goods, agriculture, manufactures and services; world supply and demand fix the relative prices of these goods, hence two relative prices - of agriculture/manufactures and services/manufactures. Tariffs (or equivalent measures) raise home prices in the country, raising them above their world price. For an individual country therefore, prices of traded goods are set in world markets plus the effect of its own tariffs. In each country there is also a non-traded good, produced under full competition at its long-run average cost.

We now consider what happens in each country to its supplies and costs. Because of competition all prices equal long-run costs; hence prices of skilled and unskilled labour and land, the domestic production inputs entering each commodity, are driven to levels that satisfy this equality, that is they are priced so that they are competitive given the traded goods prices set in the world market. There are three traded goods and three prices of factors of production that are set in the country. The price of capital is set worldwide and capital circulates at this price to wherever it is needed. For simplicity we set this price as fixed at a constant world real interest rate times a fixed world price of production in manufacturing (of 1). Effectively we are assuming that in the long run (the focus of the model) savings are always made available as required at a fixed rate of interest. The wage and land costs, once fixed by traded goods prices, then determine non-traded goods prices.

Effects of UK Tariff of 10 Per Cent On Agriculture And Manufacturing
(Per Cent Changes From Base)

per cent changes	UK	EU	NAFTA	ROW
y	-3.99	0.04	0.04	0.03
y_A	0.00	0.00	0.00	0.00
y_M	113.01	-2.17	-2.97	-1.97
y_S	-32.07	1.19	1.13	1.33
y_D	-3.90	0.04	0.04	0.03
E_A	-12.04	0.05	0.09	0.15
E_M	-0.61	0.01	0.01	0.04
E_S	-5.37	0.05	0.05	0.01
w	14.37	-0.19	-0.19	-0.19
h	-11.05	0.66	0.66	0.66
l	47.18	0.11	0.11	0.11
N	1.35	-0.02	-0.02	-0.02
H	-2.48	0.08	0.08	0.08
L	-28.14	0.00	0.01	-0.01
K	6.79	0.07	0.08	0.06
CPI	7.51	0.13	0.13	0.12
P_A	10.07	0.07	0.07	0.07
P_M	10.00	0.00	0.00	0.00
P_S	0.31	0.31	0.31	0.31

Pw_A	0.07	0.07	0.07	0.07
Pd	11.7	0.6	0.6	0.6
Welfare	-3.3	-0.00	0.01	-0.01

Glossary: y= output; E=expenditure; w= wages of unskilled; h=wages of skilled; l= rent on land; N=unskilled labour; H= skilled labour; L= land; K= capital; CPI=consumer prices; P=price of commodity; suffixes: A=agriculture;M=manufacturing;S=services;W=world; D=non-traded

With all prices set in this way by world prices, tariffs and production technology, we go on to determine how much is produced of each type of good. This is fixed by available supplies of factors of production - assumed to be unskilled and skilled labour. Land we assume is provided freely as needed by planners subject to a restriction placed on agricultural land, such that agricultural production is controlled to a fixed amount. Non-traded production has to be equal to non-traded demand, which depends on total GDP and relative non-traded prices. With these restrictions on agriculture and non-traded output we can work out the size of each sector that will exactly exhaust available supplies of the two sorts of labour. Then from that we can work out how much capital and land is needed by each sector.

So to summarise, world prices (determined by world demand and supply by all countries, as resulting from their country solutions) plus tariffs fix country prices and so costs of labour and land. Given these costs and each sector's resulting demands for these factors per unit of output, the sizes of each sector adjust so that the available supplies of the two types of labour are equal to sectoral demands.

Detailed Calculations for Different Tariff Combinations

The preceding analysis would suggest that in the case of manufacturing, a tariff on manufactures for example acts to raise a country's price of manufactures. Then because manufactures use a lot of unskilled labour its expansion drives up unskilled wages. In order to force other industries to economise on the unskilled labour manufacturing needs for its expansion, the other traded sectors contract. The non-traded sector's size moves close to proportionally with the whole economy as demand for non-traded goods is related proportionally to total income, apart from any effect of its changing relative costs brought about by the tariff. The rise in tariff raises consumer prices so that consumers are less well off than they would have been buying the manufactures more cheaply from abroad.

In reaching our estimates for the long run effects of Brexit under the WTO free trade assumption we assume that over the next decade or so (our 'long run') the existing 20 per cent protection gradually gets whittled down to 10 per cent by general international pressure - much as can be observed in previous decades. We therefore apply a tariff -equivalent rate of 10 per cent to the CGE model.

It might seem on the face of it that 10 per cent protection in agriculture and manufacturing is not a very large or significant amount. It raises prices in these two sectors by 10 per cent over the world price, while leaving service prices at world levels. For those used to macro models of short to medium run behaviour relative price movements of different sectors of this order occur regularly; for example world raw material prices can double or triple and greatly affect retail prices of sectors using those materials. Yet we do not observe huge sectoral output swings in the economy.

The difference here is that we are computing the long run effect of permanent relative price changes of these sectors. The sectors with higher prices pay higher wages, both skilled and unskilled, for the workers they need; they pay more for land and they use more capital whose price is fixed in world markets. What our CGE model shows in the Table is that resources are heavily attracted out of the service sector into agriculture and manufacturing. In fact we assume that output in agriculture is

capped (effectively by control on the land that can be used in this sector) in our model by government policy; so that the attraction into this sector is frustrated by rising land prices. However for manufacturing no such limit is placed and the result is a substantial boost to manufacturing at the expense of services.

The Table goes on to show that the effect of raising prices for these two sectors by 10 per cent is first a substantial, 7.5 per cent, rise in the cost of living. Wages of unskilled workers go up more than this, 14 per cent, because they are disproportionately used in manufacturing. But skilled workers' wages fall by 11 per cent, being disproportionately used in service industries. Landowners do well, with land prices soaring 47 per cent. We see in these figures how the politics of vested interests works; unions representing unskilled workers, farmers and other landowners, as well as manufacturing businesses, will clearly support being inside the EU.

Yet the effect of shifting output into sectors where their productivity is less than the price paid by consumers is an overall loss of welfare for UK citizens; these citizens would value more the output lost in services whose production contracts 32 per cent. The loss of welfare, measured by the loss of potential consumption by UK households, is 3.3 per cent. This potential consumption change is measured as the change in the value of all output deflated by its consumer price cost (i.e. the change in [nominal GDP/CPI]), minus the change in the value of resources used to generate it). In other words the welfare effect is the percentage change in the resources available for consumption to UK households.

This cost is computed as if the protective measure is a tariff. However the customs union acts as a tariff in its effect on outputs and consumption; but the equivalent of the 'tariff revenue' (i.e. the extra cost of imports due to the protection) is disposed of differently. There is revenue on imports from outside the EU; this revenue (paid by UK consumers) accrues to the EU itself but it is already counted in the UK's net contribution (after rebate and EU spending on UK projects). There is also 'revenue' accruing to EU businesses that sell protected goods to the UK because they can charge higher prices: this revenue is not counted elsewhere and is a cost to UK consumers. Our businesses also gain more from other EU consumers on their exports; so the 'net revenue' paid by UK consumers to EU consumers is the tariff times the net imports by the UK. For manufacturing where we have large net imports (about 8 per cent of GDP) this net revenue transfer amounts to 0.8 per cent of GDP on the 10 per cent tariff-equivalent we have assumed. This amount is not included in our Table calculation and so has to be added to it. For agriculture the workings of the CAP on transfers between countries for agriculture are complex and are already counted in the net UK contribution. So in sum the total cost to the UK of the protection of agriculture and manufacturing is 4.1 per cent of GDP.

Some politicians attach totemic significance to manufacturing; we have heard quite a few arguments since the 2010 election that the economy should be 'rebalanced' towards manufacturing. One can see why the vested interests listed above would want this; it is no doubt to appeal to these interests that politicians make these arguments. But there is no economic case for encouraging output in sectors which market forces would contract. For such a case there would have to be some disparity between social and market values; yet there is no such disparity. Similar arguments were made two centuries ago for preserving agriculture with a similar lack of basis.

Leaving the EU and eliminating this protection would, according to these figures, raise service output and greatly reduce manufacturing as narrowly defined here in the long run. The reason for this is fairly simple: as the UK has developed in the decades since the economy began to be liberalised in 1979, there has been a big rise in the share of skilled labour in the workforce. By now approximately 50 per cent of university-age people go to some form of higher education or equivalent. This has

favoured the expansion of skill-intensive industries of which the service industries are the principal examples. We can also include in these industries the design or hi-tech element of manufacturing, which is a service industry; 'manufacturing' in the national accounts includes this, inside the manufacturing firms it comprises. So the hi-tech service activity currently included in manufacturing (on some measures it may be as high as one third) would not be reduced but just reclassified. These workers are engaged in jobs that require the use of their brainpower and associated skills. The actual making of things, manufacturing in the original sense of 'metal-bashing', has contracted hugely in the UK. What the CGE model tells us is that in the absence of EU protection this type of manufacturing would largely disappear, leaving only the hi-tech manufacturing that uses skilled labour intensively.

This result should not be regarded as very shocking. The strongly declining share of manufacturing in GDP has been an unremitting trend feature of the UK since the 1980s; it would be intensified by leaving the EU, and eventually we would be left only with those parts of manufacturing that involve design and hi-tech skills, as one would expect in a relatively small country heavily endowed with skilled and educated labour.

We can note that there is a good demand for unskilled workers in the non-traded service sector (distribution, construction, utilities and so on) which cannot be substituted for by bringing in cheaper substitutes from abroad. As this non-traded sector is around half of the economy, one can see that if roughly half the labour force is unskilled it will be fully employed in the non-traded sector and there will be little of it left over for the manufacturing sector. Plainly EU protection, as we have seen, raises the wages of unskilled workers; but if there was a case for redistribution to these workers because they were poor, then this would already be done by public redistribution policy. This policy area is extremely active in the UK, as evidenced by the high progressivity of the tax-benefit system. There is no case for using protection to help carry out this policy since it is clumsily directed at the issue and so as we have seen creates a big cost for the economy as a whole.

It turns out that the costs to EU citizens of the EU tariff on agriculture and manufacturing are roughly the same as those for the UK. Thus when the 10 per cent tariff is levied EU-wide including in the UK, the UK effects shown below are more or less replicated in the rest of the EU. The only difference for the rest of the EU is that there is a small net revenue gain due to the net revenue transfer from UK to Rest of EU (RoEU) consumers; but as a percentage of the much larger RoEU GDP total it is only 0.15 per cent of their GDP. Thus the total welfare cost to RoEU is just under 3 per cent of GDP. What we see here is that the dominant ideology of the EU is corporatist and mercantilist, aiming to benefit producers of manufactures and food at the expense of consumers. If we take this analysis and apply it to Brexit under the WTO free trade option we can see that these costs are eliminated as compared with the status quo and therefore with the EEA-status quo option now being touted by Remainers and the old establishment consensus. In summary the gains from trade given by our full Brexit comes to 4 per cent of GDP.

Various Alternative Tariff Regimes

The CGE model can also be used to calculate the effects of different combinations of tariff protection on agriculture and manufacturing: manufacturing alone, agriculture alone, and a combination of 5% protection on manufacturing and 10% protection of agriculture. We show these three. What is interesting is how all of them greatly damage consumer welfare but with quite different effects on GDP as well as of course on sectoral outputs. It is consumer welfare that we use as our key measure of both welfare and 'potential GDP'; this measures the extra consumers can buy from the economy net of inputs.

The main effect of agricultural protection under our assumption that the sector is kept at the same size throughout for social reasons is on the price of land. When no other sector is protected this is driven up sharply and this effect in turn causes changes in the demand for land by other sectors, a demand that is supplied through the planning system- or in this case contracted via it. Prices of all sectors then reflect this land price.

When manufacturing alone is protected, the main effect is to drive up the wages of unskilled labour; the price of land is driven down as resources are attracted from other sectors including agriculture into manufacturing. Costs in general however rise little and so the CPI too moves only a little.
Protection of both agriculture and manufacturing has a more balanced effect on the economy, raising land prices and unskilled wages and the CPI. The case where both are equally protected is our benchmark case for the assumed EU protection regime.

These different effects are mirrored in our summary Table of effects on the economy of various HMG policies on tariffs. Notice that throughout we assume that HMG implements no NTBs and this reduces manufacturing protection simply to the tariff element implied by the existing EU tariff (around 5% when applied to UK imports from the EU).

UK Tariffs Effect on UK (%)	**10% Mfg**	**10% Agric**	**10% Agric, 5% Man**
y	9.43	-12.45	-8.6
y_A	0.00	0.00	0.0
y_M	171.11	-45.41	-12.7
y_S	-28.54	-5.30	-8.1
y_D	9.21	-12.17	-8.4
E_A	25.94	-35.47	-24.9
E_M	1.25	-1.70	-30.4
E_S	12.88	-16.95	3.5
w	23.87	-7.69	3.0
h	-5.39	-5.93	-8.5
l	-65.28	324.36	146.7
N	2.16	-0.80	-4.5
H	-2.66	0.19	4.0
L	215.37	-77.22	-59.3
K	14.00	-6.11	-6.2
CPI	0.88	6.56	6.8
P_A	0.18	9.90	10.0
P_M	10.00	0.00	5.0
P_S	0.43	-0.09	0.13
Pd	-1.1	13.6	12.7
Welfare	-8.94	-4.87	-8.15

These figures are carried over into our Summary Table, as follows.

Brexit Policy Outcomes Relative to the Status Quo

WTO Scenario	Welfare%	CPI%	HMRC Rev%	Manufacturing Profit Change% [a]	Manufacturing Required Productivity [b]
1. **Global Free Trade (GFT)**	+4%	-8%	+47.5%	+18%	+6%
2. GFT but EU import tariffs levied	+4%	-8%	+47.5%	+16%	+9%
3. 2+UK levies mfg tariffs only	0	-7%	+16.5%	+14% (supply chain)	+10%
4. **2+UK levies agric tariffs only**	-1%	-1%	+6.5%	+16%	+9%
5. 2+UK levies agric & mfg tariffs	4%	-1%	-14.5%	+14% (supply chain)	+10%
6. 3+FTAs with ROW	+2%	-7.5%	+34.0%	+14% (supply chain)	+9%
7. **Status Quo**	0	0	0	0	0

[a] Short-term change in manufacturing profit margin

[b] One-time increase in labour productivity required to maintain pre-Brexit profitability

Notes on scenarios:

1. WTO Option with UK free trade with all countries. UK eliminates its non-tariff-barriers (NTBs) with all countries. Broad free trade agreements to be pursued (on investment, agriculture services, property rights, etc) with ROW. EU agrees zero tariff FTA with UK without conditions; imposes no NTBs on UK (cannot anyway). UK leaves CAP and zeroes agricultural tariffs. Manufacturing calculations as in text tables: in short run manufacturing profits rise by 18% of value added mainly because of exchange rate gain, in long run this assumed to disappear and home market competition plus productivity growth kick in to keep profits unchanged. Table shows percentage rise in short-term margin on revenue and long-term required productivity increase to keep margins constant. HMRC elasticity of revenue to GDP assumed to be 1.5; UK gets back EU budget net contribution of 0.5% of GDP (= 1.3% of HMRC revenue=£8 bn).
2. WTO Option as in 1, but no FTA with EU: EU imposes tariffs on UK, not NTBs (cannot). Manufacturing firms absorb EU tariffs (£3.8 billion, 3.5%). Short-term disruption of supply chains avoided.
3. WTO Option as in 2. But now UK imposes tariffs (not NTBs) on EU and ROW (WTO MFN) in manufactures only (HMRC revenue is £6 bn EU +£2 bn ROW=£8bn). This causes potential short-term disruption of supply-chains as UK firms pay tariff on inputs from EU and ROW- try to relocate to UK suppliers in long term. Also raises costs of manufactured goods to consumers by extent of UK tariff. Loss of GDP compared with 2 reduces HMRC revenue by 6% (4% x 1.5) = £39 billion.
4. WTO Option as in 2. But instead now UK imposes same agricultural tariffs as EU on ROW including EU: cost of food stays up as in status quo, almost eliminating consumer price gains for poor households and reducing GDP by 5% compared with 2. Extra HMRC tariff revenue on agric (EU and ROW) = £8 bn. Loss of HMRC general revenue compared with 2 by 7.5% (5% loss on GDP times 1.5= £49 bn.)
5. WTO Option as in 2. But now UK imposes same goods and agricultural tariffs as EU on ROW including EU: cost of food stays up as in status quo, almost eliminating consumer price gains for poor households and reducing GDP by 4% compared with 3 and by 8% compared with 1. Extra HMRC tariff revenue on agric (EU and ROW) = £8 bn. Loss of HMRC general revenue compared with 3 by 6% (4% loss on GDP times 1.5= £39 bn.)
6. As 3 but now FTAs included with ROW giving zero tariffs. HMRC revenue from tariffs reduced to £6bn. But higher GDP than 3 raises general revenue by 3%=£19.5 bn. Now supply-chains potential disruption in short-term as firms try to relocate EU suppliers to either UK or ROW suppliers in long term.

Short and Long Term Effects on Manufacturing Revenues

What would be the situation for manufacturing firms? For a typical manufacturing firm, the overall situation after Brexit would be influenced by a combination of four main elements – (1) price decreases from enhanced world competition, (2) improved competitiveness resulting from the lower value of sterling – currently 15% (Cardiff-EfB macro-models suggest this could continue for around five years), (3) the payment of EU tariffs and (4) the payment of UK tariffs on EU/ROW inputs. These elements would interact differently, depending on the destination market for the firm's products:

1. In the home market, firms would face stronger competition from the rest of the non-EU world; on average, prices could fall in the short-term by around 20% and long-term by a lesser amount of about 10%. Against this - for about five years - the competitive effect would be offset partially by the lower value of sterling.
2. As far as the EU market is concerned, the situation would be similar: firms would lose the 3% tariff revenue paid to the EU but enjoy the drop of 15% in sterling. While EU competitors' prices would remain at current levels in Euros because of continued EU protection against the rest of the world via both tariff and non-tariff barriers (EfB projects this long term at

about 10%), UK firms would not face non-tariff barriers, as UK firms, by definition, already satisfy these and new non-tariff barriers could not be levied on the UK for either regulatory or anti-dumping reasons. Thus, UK Firms could keep their Euro prices the same while remaining competitive in the EU market thereby increasing their profits per item sold by 12% of gross value from the exchange rate fall minus the EU tariff imposition.

3. Economics similar to those in EU markets would apply to markets in the rest of the world where UK firms are already competitive at world prices but they would enjoy higher sterling prices and profits due to the exchange rate fall.
4. Firms would pay UK tariffs on inputs from EU and ROW. We assume UK input tariff rate is 3.5% on inputs of £325bn (total output) minus £160 bn (value added)=£165 bn., making a tariff input payment of £5.8bn. However for the proportion of output being exported a full rebate applies: this proportion is 69% and so only 31% of this is payable= £1.8 bn

Therefore, for, say the first five years post-Brexit, UK manufacturing would make profit gains on the order of £24.8 bn, or 16% of extra gross-margin on manufacturing industry's total gross value added of £160 bn

	Home Market (£100 bn)	**EU Market** (£110 bn)	**ROW Market** (£115 bn)	**TOTAL**
Price Impact	-20%	0	0	
EU Tariff Impact	0	-3.5%	0	
Sterling Impact	+15%	+15%	+15%	
Subtotal	**-£5 bn**	**+£12.6 bn**	**£17.2 bn**	**+£25 bn**
UK Tariff Impact				**-£1.8 bn**
			TOTAL	**+£23 bn**

After ten years, assuming the exchange rate reverts to pre-Brexit levels, the impact on manufacturing industry would be negative by about £14billion, a 9% reduced gross margin on total gross value added.

	Home Market (£100 bn)	**EU Market** (£110 bn)	**ROW Market** (£115 bn)	**TOTAL**
Price Impact	-10%	0	0	
EU Tariff Impact	0	- 3.5%	0	
Sterling Impact	0	0	0	
TOTAL	**-£10 bn**	**- 3.8 bn**	**0**	**-£14 bn**
UK Tariff Impact				**0**
			TOTAL	**-£14 bn**

***Relocates EU inputs to ROW which is tariff-free under ROW FTAs, eliminating UK tariff charge on inputs.**

We assume with Case 6 in the above table of policy outcomes that firms manage to resource their inputs to ROW sources at zero tariffs (compared with assumed UK tariff on inputs of 3.5%); this eliminates the UK tariffs paid on inputs. Thus, for five years, manufacturing would enjoy a highly

profitable transition period due to the exchange rate. If, during this five-year period and the subsequent five years, the industry were to raise its productivity by 0.9% annually, it would be able to erase any negative impact from Brexit. This compares with average manufacturing labour productivity growth since 1970 of 2.9% per annum. Such an increase in productivity seems to be something the industry - freed from EU constraints - could easily take in its stride, continuing its march 'up the value-added chain' towards a hi-tech manufacturing sector.

Some may say that it is not correct to include this 0.9% productivity increase since manufacturers would have achieved it in any case. However, we believe this required productivity increase is a small portion of the productivity gains normally achieved and is likely to be subsumed by extra productivity gains enabled by leaving the EU.

In cases 2,3 and 5 where there are no FTAs with the rest-of-the-world, the above relocation of inputs to ROW does not occur and so manufacturing profits are lower by £1.8bn, requiring productivity to grow 0.25% more.

APPENDIX C

The Computable General Equilibrium Model for Trade

The model we have used for the evaluation of general equilibrium effects of trade policy is based on one we developed for assessing the effects of globalisation on the world economy- Minford et al, 1997. This model performed well empirically in accounting for the trade trends of the 1970-1990 period; we identified a group of major causal 'shocks' during this period which between them gave a good fit to the salient features of the period- including terms of trade, production shares, sectoral trade balances, relative wage movements and employment/unemployment trends.

The model adopts the key assumptions of the Heckscher-Ohlin-Samuelson set-up. Production functions are assumed to be Cobb-Douglas and identical across countries, up to a differing productivity multiplier factor; thus factor shares are constant, enabling us to calibrate the model parsimoniously from detailed UK data that we were able to gather. There are four sectors: non-traded and three traded ones, viz. primary, basic (unskilled-labour-intensive) manufacturing and services and other (skilled-labour-intensive) manufacturing. Three immobile factors of production are identified: unskilled and skilled labour and land. Capital is mobile. All sectors are competitive and prices of traded goods of each sector are equalised across borders.

This set-up gives rise to a well-known set of equations (see below for a full listing):

1. Given world prices of traded goods, price=average costs determine the prices of immobile factors of productions
2. These factor prices induce domestic supplies of these factors.
3. Outputs of each sector are determined by these immobile factor supplies; non-traded sector output is fixed by demand, the traded sector outputs by the supplies of immobile factors not used in the non-traded sector.
4. Demands for traded goods are set by the resulting level of total GDP.
5. World prices are set by world demand=world supply

The world is divided into four blocs: UK, REU (rest of EU), US+rest of NAFTA, ROW (rest of world). Data for the model base run is taken from 1998, the latest generally-available information that was comprehensive at the time we started this work.

In each country we assume that for the primary sector output is politically controlled (eg by quotas) because of the high degree of protection of agriculture and the accompanying requirement to limit the extent of output response. The supply of land is adjusted (via planning and other controls) to adjust to this and other output requirements; in other words the supply of land is demand-determined. While this assumption is crude in overriding all incentive effects on output, the reality of agricultural production is closer to this than to the uncontrolled alternative: we were unable to implement any finer assumption.

Listing Of the General Equilibrium 4-Bloc Trade Model

1-4 Prices, UK, Rest of EU, NAFTA, Rest of World p_M, p_S, p_A, p_D. p_M,p_S, p_A, p_D domestic prices, solve for *w*, *h*, *l* and p_D respectively.

$$p_M = w^{0.52234} \cdot h^{0.14366} \cdot l^{0.035} \cdot (p_M \cdot r)^{0.299} \cdot \pi_M^{-1}$$
$$p_S = w^{0.21168} \cdot h^{0.51832} \cdot l^{0.033} \cdot (p_M \cdot r)^{0.237} \cdot \pi_S^{-1}$$
$$p_A = w^{0.147} \cdot h^{0.132} \cdot l^{0.079} \cdot (p_M \cdot r)^{0.642} \cdot \pi_A^{-1}$$
$$p_D = w^{0.38024} \cdot h^{0.17576} \cdot l^{0.113} \cdot (p_M \cdot r)^{0.331} \cdot \pi_D^{-1}$$

$$\ln(w) = \left(\frac{1}{0.52234}\right) \cdot \{\ln(p_M \cdot \pi_M) - 0.14366 \cdot \ln(h) - 0.035 \cdot \ln(l) - 0.299 \cdot \ln(p_M \cdot r)\}$$
$$\ln(h) = \left(\frac{1}{0.51832}\right) \cdot \{\ln(p_S \cdot \pi_S) - 0.21168 \cdot \ln(w) - 0.033 \cdot \ln(l) - 0.237 \cdot \ln(p_M \cdot r)\}$$
$$\ln(l) = \left(\frac{1}{0.079}\right) \cdot \{\ln(p_A \cdot \pi_A) - 0.147 \cdot \ln(w) - 0.132 \cdot \ln(h) - 0.642 \cdot \ln(p_M \cdot r)\}$$

5-7 Factor demands, UK, Rest of EU, NAFTA, Rest of World *N*, *H*, *L* :

$$N = w^{-1} \cdot (0.38024 \cdot p_D \cdot y_D + 0.52234 \cdot y_M \cdot p_M + 0.21168 \cdot p_S \cdot y_S + 0.147 \cdot p_A \cdot y_A)$$
$$H = h^{-1} \cdot (0.168 \cdot p_D \cdot y_D + 0.14366 \cdot y_M \cdot p_M + 0.51832 \cdot p_S \cdot y_S + 0.132 \cdot p_A \cdot y_A)$$
$$L = l^{-1} \cdot (0.113 \cdot p_D \cdot y_D + 0.035 \cdot y_M \cdot p_M + 0.033 \cdot p_S \cdot y_S + 0.079 \cdot p_A \cdot y_A)$$
$$y_M = \left(\frac{1}{0.52234 \cdot p_M}\right) \cdot \{N \cdot w - 0.38024 \cdot p_D \cdot y_D - 0.21168 \cdot p_S \cdot y_S - 0.147 \cdot p_A \cdot y_A\}$$
$$y_S = \left(\frac{1}{0.51832 \cdot p_S}\right) \cdot \{H \cdot h - 0.168 \cdot p_D \cdot y_D - 0.14366 \cdot p_M \cdot y_M - 0.132 \cdot p_A \cdot y_A\}$$

$$y_A^{UK} = 71.00$$
$$y_A^{EU14} = 306.00$$
$$y_A^{NAFTA} = 503.00$$
$$y_A^{RofW} = 3460.00$$

8 *K*

$$K = 0.2 \cdot \frac{1}{(p_M \cdot r)} \cdot \{0.331 \cdot p_D \cdot y_D + 0.299 \cdot p_M \cdot y_M + 0.237 \cdot p_S \cdot y_S + 0.642 \cdot p_A \cdot y_A\} + 0.8 \cdot K_{t-1}$$

9-11 Factor supplies:

$$N = a_N \cdot \left(\frac{w}{b}\right)^{0.1} \cdot POP^{0.5} \cdot G^{0.5}$$

$$a_N^{UK} = 0.486815$$
$$a_N^{EU14} = 1.105789$$
$$a_N^{NAFTA} = 1.309601$$
$$a_N^{RofW} = 71.594820$$

$$H = a_H \cdot \left(\frac{h}{w}\right)^{0.1} \cdot G^{0.5}$$

$$a_H^{UK} = 1.273294$$
$$a_H^{EU14} = 3.789872$$
$$a_H^{NAFTA} = 5.157474$$
$$a_H^{RofW} = 84.815077$$

$$L = l^{-1} \cdot (0.113 \cdot p_D \cdot y_D + 0.035 \cdot y_M \cdot p_M + 0.033 \cdot p_S \cdot y_S + 0.079 \cdot p_A \cdot y_A)$$

12 y_D

$$y_D = 0.50 \cdot E^{1.0} \cdot \left(\frac{p_D}{p_T}\right)^{-0.5}$$

13 y

$$y = y_D + y_M + y_S + y_A$$

14 E

$$E=y$$

15 C

$$C=E-\Delta K$$

16 E_T

$$E_T = E - y_D$$

17 E_M

$$E_M = E_T - E_S - E_A$$

18 E_S

$$E_S^{UK} = 0.9 \cdot E_T^{UK} - 238.90 - 12.0 \cdot (p_S^{UK} - p_T^{UK})$$
$$E_S^{EU14} = 0.9 \cdot E_T^{EU14} - 1180.30 - 12.0 \cdot (p_S^{EU14} - p_T^{EU14})$$
$$E_S^{NAFTA} = 0.9 \cdot E_T^{NAFTA} - 1335.00 - 12.0 \cdot (p_S^{NAFTA} - p_T^{NAFTA})$$
$$E_S^{RofW} = 0.212 \cdot E_T^{RofW} + 1757.60 - 3.0 \cdot \left(p_S^{RofW} - p_T^{RofW}\right)$$

19 E_A

$$E_A^{UK} = 0.05 \cdot E_T^{UK} + 47.95 - 5.0 \cdot (p_A^{UK} - p_T^{UK})$$
$$E_A^{EU14} = 0.05 \cdot E_T^{EU14} + 217.65 - 5.0 \cdot (p_A^{EU14} - p_T^{EU14})$$
$$E_A^{NAFTA} = 0.05 \cdot E_T^{NAFTA} + 247.00 - 5.0 \cdot (p_A^{NAFTA} - p_T^{NAFTA})$$
$$E_A^{RofW} = 0.413 \cdot E_T^{RofW} - 1168.35 - 15.0 \cdot \left(p_A^{RofW} - p_T^{RofW}\right)$$

20 p

$$p = p_M \cdot \left(\frac{E_M^{base}}{E^{base}}\right) + p_S \cdot \left(\frac{E_S^{base}}{E^{base}}\right) + p_A \cdot \left(\frac{E_A^{base}}{E^{base}}\right) + p_D \cdot \left(\frac{E_T^{base}}{E^{base}}\right)$$

21-23 p_M, p_S, p_A

$$p_M = p_M^{World} \cdot (1 + T_M)$$
$$p_S = p_S^{World} \cdot (1 + T_S)$$
$$p_A = p_A^{World} \cdot (1 + T_A)$$

World prices. Sums are over four blocs.
Variables without superscripts are bloc variables.
p_A^{World} is derived from the relationship :

$$\sum y_A = \sum E_A$$

The RHS is expanded using the expression for E_A in Equation 19 and the expression for p_A in Equation 27. a_1, a_2 and a_3 are the coefficients from the RHS of the equation for E_A

$$\sum y_A = \sum \{a_1 \cdot E_T + a_2 + a_3 \cdot (p_A - p_T)\}$$
$$\sum y_A = \sum \left\{a_1 \cdot E_T + a_2 + a_3 \cdot (1 + T_A) \cdot p_A^{World} - a_3 \cdot p_T\right\}$$
$$\sum y_A = \sum \{a_1 \cdot E_T + a_2 - a_3 \cdot p_T\} + p_A^{World} \cdot \sum a_3 \cdot (1 + T_A)$$
$$p_A^{World} = \frac{\sum y_A - \sum \{a_1 \cdot E_T - a_2 + a_3 \cdot p_T\}}{\sum a_3 \cdot (1 + T_A)}$$

p_A^{World} is derived similarly.
b_1, b_2 and b_3 are the coefficients from the RHS of the equation for Es :

$$\sum y_S = \sum E_S$$

and

$$p_S^{World} = \frac{\sum y_S - \sum \{b_1 \cdot E_T - b_2 + b_3 \cdot p_T\}}{\sum b_3 \cdot (1 + T_S)}$$

Glossary: y= output; E=expenditure; w= wages of unskilled; h=wages of skilled; l= rent on land; N=unskilled labour; H= skilled labour; L= land; K= capital; CPI=consumer prices;P=price of commodity; suffixes: A=agriculture;M=manufacturing;S=services;W=world

Note on model constants: these will be varied according to the Base Case assumptions and those here are for illustration only.

APPENDIX D

THE IMPACT OF WTO OPTIONS ON THE AUTOMOBILE MANUFACTURING SECTOR

This Appendix examines the impact of various WTO scenarios on a typical UK manufacturer of automobiles. The analysis takes into account the combined impact of the following potential post-Brexit effects:

- The result of reducing existing UK import trade barriers with regard to the negative impact of a more competitive home market (ie, lower prices in the home market), as well as the favourable impact of lower costs on imported parts and raw materials
- The negative impact of the EU raising import tariffs against the UK
- The negative impact of potential UK import barriers raised against the EU (the 'tit-for-tat' strategy)
- The positive and negative impacts of Sterling's devaluation
- The positive impact of ongoing manufacturing productivity and supply chain improvements over time

The overall impact of these effects will vary according to the particular post-Brexit WTO scenario under consideration - we have analysed the four scenarios listed below.

1. The immediate post-Brexit impact under a WTO 'tit-for-tat' scenario – ie, the UK trades under WTO MFN rules and levies current EU tariffs on imports from both the EU and the ROW
2. The immediate post-Brexit impact under a unilateral-free-trade scenario - ie, the UK trades under WTO rules with zero import tariffs
3. The post-Brexit impact under a unilateral-free-trade scenario after 5 years
4. The post-Brexit impact under a unilateral-free-trade scenario after 10 years when it is assumed that Sterling has regained its pre-Brexit parity

The underlying assumptions with regard to the auto manufacturing sector are taken from an analysis by the Boston Consulting Group (Boston Consulting Group, et al (2016)) and are shown in Exhibits C-1 and C-2.

The assumed post-Brexit assumptions are as follows:

- In all scenarios, the EU raises the EU Common External Tariff against the UK, which is 10% for automobiles
- In the WTO MFN scenario, the UK maintains the EU Common External Tariff of 10% for imported automobiles and 3.8% for imported automobile components
- UK home market prices decrease by 10% in the WTO MFN scenario even though the EU Common External Tariff is maintained on imports because it is assumed the UK will not enforce any non-tariff barriers. Under the WTO Zero Tariff scenarios, it is assumed that UK home market prices will decrease by 20%
- Sterling's current 15% depreciation against its pre-Brexit level will remain for at least 5 years but will have disappeared by 10 years
- Average labour productivity is 4.5% pa (the average achieved in the UK transport equipment sector for the past 35 years)
- Components currently sourced from the EU can be re-sourced to ROW suppliers so that they are purchased at lower world market process (assumed to be 20% lower than EU prices after 5 years and 10% lower after 10 years)

- Automobile import tariffs are assumed to be unchanged at 2.5% for exports to the US and 25% in China

Exhibits C-1 and C-2 show detailed calculations of how the above assumptions impact the P&L of a prototypical auto manufacturing company under each WTO scenario, relative to the pre-Brexit level. Thus, Earnings-Before Interest & Taxes (EBIT) are as follows:

EBIT under Various Post-Brexit Scenarios

	EBIT
Pre-Brexit	**8.0%**
1. WTO MFN Scenario – Immediate Impact	**9.8%**
2. WTO Zero Tariff Scenario – Immediate Impact	**7.1%**
3. WTO Zero Tariff Scenario after 5 years	**13.9%**
4. WTO Zero Tariff Scenario after 10 years	**8.2%**

The Source-of Change Analysis between each post-Brexit scenario, showing the impact on EBIT of various factors is shown below:

	Immediate Impact		**Zero Tariff**	
	MFN	**Zero Tariff**	**5 Years**	**10 Years**
Lower Home Market Prices	**-2.5**	**-5.0**	**-5.0**	**-2.5**
Currency Devaluation	**+9.4**	**+9.1**	**+9.3**	**0**
EU Import Tariffs	**-5.0**	**-5.0**	**-5.0**	**-5.0**
UK Import Tariffs	**-0.2**	**0**	**0**	**0**
Resourcing of EU-Components	**0**	**0**	**+3.2**	**+1.6**
Productivity Gains	**0**	**0**	**+3.4**	**+6.1**
Net Total	**+1.8**	**-0.9**	**+5.9**	**+0.2**

Immediate Impact

The immediate post-Brexit impact on profitability of the WTO 'tit-for-tat' scenario is, in fact, positive. Even though this scenario assumes that prices in the home market will drop substantially because the UK - as a free-trading nation – will not enforce non-tariff-barriers currently employed by the EU, Sterling's devaluation more than compensates for this, as well as for the effects of newly raised EU and UK import tariffs. However, this is not the entire story. Even though the impact on the company of the UK raising 'tit-for-tat' import barriers is not large in cost terms, it could prove disruptive to the supply chain since almost sixty per cent of purchased goods are imported – mostly from the EU. Furthermore, this "micro" analysis does not take into account the impact increased import tariffs has on the national interest – eg, relatively higher consumer prices and GDP, as discussed in the paper.

The immediate impact of the WTO unilateral-free-trade scenario is slightly negative with pre-tax profits decreasing from 8.0% to 7.1%. This is because home market prices drop more under this scenario than under the 'tit-for-tat' scenario be as the UK has now dropped all import barriers – tariffs, as well as non–tariff barriers. The beneficial effect of Sterling's devaluation cannot quite make up for this additional negative impact and the industry has had no time to adjust to its new circumstances. Nevertheless, the industry is still robustly profitable (an EBIT of 7.1%) and GDP is

higher and consumer prices lower than with either the 'tit-for-tat' WTO scenario or remaining in the EU. Of course, outside the EU, it will always be in the gift of the government's industrial strategy to provide indirect industry support that, in effect, would compensate for the new EU import tariffs. If this were to be done, the industry's profitability would be markedly higher than at present (12.1%).

Longer-Term Impact

Clearly, the immediate impacts discussed above are just "snapshots". Over time, other factors will influence profitability. An important factor will be the degree to which Sterling rises or falls against relevant currencies. Another will be actions that management take – for example, taking advantage of post-Brexit opportunities to improve productivity and optimise supply chains.

We believe Sterling's valuation is likely to remain at current levels for at least five years (or perhaps move even lower) but it is likely to regain its pre-Brexit parity by 10 years. We also believe, outside EU regulation, the automobile industry should be able to achieve, at least, its average long-term labour productivity trend. Furthermore, if the EU continues to maintain current Single Market regulations, as well as the protectionist Customs Union, we believe UK manufacturers will be able - over a 5 year period – to re-source (or renegotiate) agreements with their existing EU-based suppliers to take advantage of higher quality/lower cost suppliers from non-EU suppliers, such as those in Asia.

Using these assumptions, we have evaluated the WTO unilateral free trade scenario over 5 and 10 year periods. The outcomes are strikingly positive:

- **Over 5 years, profitability increases sharply** (by about 75%) driven by reduced labour costs from productivity gains and better prices from new UK/ROW suppliers replacing those from the EU (or, alternatively negotiating lower prices with them)
- **Over 10 years, profitability remains higher than the pre-Brexit level** in spite of Sterling's value increasing back to pre-Brexit levels

This analysis – carried out at the level of an auto manufacturer's P&L - is consistent with and provides strong support for the macroeconomic analysis discussed in the paper. It demonstrates - even without government assistance – the automobile industry is likely to fare well in a post-Brexit WTO unilateral free trade environment. Because the analysis is implicitly static – eg, it assumes no growth in manufacturing volumes or no new products (eg, driverless cars) – it likely understates the opportunities that will be afforded to the industry when freed from the EU. For all these reasons, the industry has little to fear from Brexit.

APPENDIX D – Exhibit D-1

Auto Manufacturer's EBIT under WTO MFN and WTO Zero Tariff Scenarios Immediately After Brexit

	PRE-BREXIT P&L			POST-BREXIT WTO WITH MFN TARIFFS (Immediate)			POST BREXIT WTO WITH ZERO IMPORT TARIFFS (Immediate)		
			Tariff Paid						
Revenue		**100**				**106.4**			**103.5**
UK	25				25			25	
(UK revenue drops to reflect world prices)					-2.5			-5	
(Positive impact of 15% currency devaluation against the Euro & Dollar)					3.4			3.0	
EU	55				55			55	
(EU market revenue of 55 less 10% tariff on export sales of 50)					-5			-5	
(Positive impact of 15% currency devaluation against the Euro)					7.5			7.5	
ROW	20		3.59		23			23	
China	10		3.33	10			10		
(Positive impact of 15% currency devaluation against the Remimbi)				1.5			1.5		
US	10		0.26	10			10		
(Positive impact of 15% currency devaluation against the Dollar)				1.5			1.5		
Cost of Goods Sold		**69**				**73.6**			**73.4**
Conversion	17				17			17	
(4.5% pa productivity increase over 5, 10 years)					0			0	
Purchased Goods (PGs)*	52		0.09		52.2			51.9	
(Negative impact of 15% currency devaluation against the Dollar. Remimbi, & Euro)					4.5			4.4	
Car Components	44		0.09	44			44		
(Additional 3.8% UK tariff in imported PGs from EU less relief on goods exported to EU and ROW)				0.2			0		
(Import duties on imported PGs)				0			-0.1		
(EU PGs cost reduced to reflect restructured EU supply chains)				0			0		
Steel	8		0	8			8		
Gross Profit		**31**				**32.8**			**30.1**
R&D		**9**				**9**			**9**
SG&A		**14**				**14**			**14**
EBIT		**8**				**9.8**			**7.1**

*** Geographical Source of Purchased Goods**		**NB: Embedded Tariffs**		
			Mkt Sales	Tariff	Realised Sales
UK	43%	China Sales (25% tariff)	13.33	3.33	10.00
EU	36%	US Sales (2.5% tariff)	10.26	0.26	10.00
ROW	21%		Gross Tariff (3.8%)	on Exported Goods	Net Tariff
		PGs from ROW	0.35	0.26	0.09

SOURCE OF CHANGE ANALYSIS FOR EBIT vs PRE-BREXIT			
Revenue change due to competing on world prices in home market			-5
Net impact of currency devaluation			9.1
Impact on revenue	13.9		13.5
Impact on costs	-4.5		-4.4
Impact of EU import tariffs		-5	-5
Impact of UK import tariffs		-0.2	0
Impact of re-sourcing EU PGs to obtain world prices		0	0
Impact of productivity gains		0	0
TOTAL		**1.8**	**-0.9**

APPENDIX D– Exhibit D-2

Auto Manufacturer's EBIT under the WTO Zero Tariff Scenario after 5 and 10 Years

	PRE-BREXIT P&L				WITH ZERO IMPORT TARIFFS AND IMPROVEMENTS (5 Years)			WITH ZERO IMPORT TARIFFS AND IMPROVEMENTS (10 Years)		
			Tariff Paid							
Revenue		**100**		**103.5**			**92.5**			
UK	25			25			25			
(UK revenue drops to reflect world prices)				-5			-2.5			
(Positive impact of 15% currency devaluation against the Euro & Dollar)				3.0			0			
EU	55			55			55			
(EU market revenue of 55 less 10% tariff on export sales of 50)				-5			-5			
(Positive impact of 15% currency devaluation against the Euro)				7.5			0			
ROW	20		3.59	23			20			
China	10		3.33	10			10			
(Positive impact of 15% currency devaluation against the Remimbi)				1.5			0			
US	10		0.26	10			10			
(Positive impact of 15% currency devaluation against the Dollar)				1.5			0			
Cost of Goods Sold		**69**				**66.6**				**61.3**
Conversion	17			17.0			17.0			
(4.5% pa productivity increase over 5, 10 years)				-3.4			-6.1			
Purchased Goods (PGs)*	52		0.09	48.7			50.3			
(Negative impact of 15% currency devaluation against the Dollar. Remimbi, & Euro)				4.2			0			
Car Components	44		0.09	44.0			44.0			
(Additional 3.8% UK tariff in imported PGs from EU less relief on goods exported to EU and ROW)				0			0.0			
(No import duties on imported PGs)				-0.1			-0.1			
(EU PGs cost reduced to reflect restructured EU supply chains)				-3.2			-1.6			
Steel	8		0	8			8			
Gross Profit		**31**				**36.9**				**31.2**
R&D		**9**				**9**				9
SG&A		**14**				**14**				14
EBIT		**8**				**13.9**				**8.2**

*** Geographical Source of Purchased Goods**			**NB: Embedded Tariffs**		
UK	43%		Mkt Sales	Tariff	Realised Sales
EU	36%	China Sales (25% tariff)	13.33	3.33	10.00
ROW	21%	US Sales (2.5% tariff)	10.26	0.26	10.00
			Gross Tariff (3.8%)	Relief on Exported Goods	Net Tariff
		PGs from ROW	0.35	0.26	0.09

SOURCE OF CHANGE ANALYSIS FOR EBIT vs PRE-BREXIT					
Revenue change due to competing on world prices in home market			-5		-2.5
Net impact of currency devaluation			9.3		0
Impact on revenue		13.5		0	
Impact on costs		-4.2		0	
Impact of EU import tariffs			-5		-5
Impact of UK import tariffs			0		0
Impact of re-sourcing EU PGs to obtain world prices			3.2		1.6
Impact of productivity gains			3.4		6.1
TOTAL			**5.9**		**0.2**

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