

VALUE CHAINS AND DOMESTIC COMPETITIVENESS

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With international trade increasingly undertaken within vertically fragmented supply chains, this paper considers the impact of changes in trade costs on domestic output. In the context of the UK's exit from the EU we show that the negative impact on UK output will depend on changes in both domestic and export competitiveness. Since for many firms the majority of their sales are to the domestic market, the domestic competitiveness impact may be quantitatively more important. The impact on output will be more significant the greater the integration of firms in international supply chains, and the greater the asymmetric impact of leaving the EU on UK firms relative to EU firms.

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JEL codes: F6; F14; F15; F17; F42.

I. Introduction

The seminal paper on vertical specialisation by Yi (2003) provided a framework which helped explain the rapid growth of the world share of trade in output, and this rise in value chains has been well documented (Baldwin and Gonzales, 2015). Much of the subsequent literature on global value chains (GVC) stresses the importance of supply chain linkages in production and how these may have an impact on firms' productivity, and through this on their international competitiveness. The focus in these discussions is primarily on how reductions in trade barriers have enabled greater integration of international supply chains leading to greater competitiveness in export markets. This 'pro-competitive' impact of supply chain integration enables the exporting country to gain from specialisation, and also from scale economies, technological spillovers, and induced investment.

There has been less of a focus on the impact on domestic competitiveness. However, changes in the costs of imported intermediate inputs in fragmented supply chains will also affect the competition between domestic production and imports in the home market. Highlighting the importance of both domestic and foreign market competitiveness effects is the focus of this paper.

It is worth noting that, at the time of writing, the sensitivity of firms and sectors domestically and internationally to international supply chains has been brought into stark relief during the current COVID-19 crisis. For example, at an early stage in the pandemic, some economic activities in Europe and the USA were curtailed by the unavailability of intermediate inputs from China; and as the pandemic develops, GVCs will be one of the main channels of the international transmission of the negative economic effects of COVID-19.

Given the substantial growth in vertical specialisation in world trade over the last 15–20 years, it is not surprising that much of the GVC literature is concerned either with measuring international competitiveness in a world of supply chain fragmentation, or with the impact of supply chain fragmentation on outcomes such as productivity, or with understanding the importance of where firms/industries are positioned in the supply chain (Crisuolo and Timmis, 2018). Focussing on competitiveness, Di Mauro and Forster (2008) find that the revealed comparative advantage of EU countries appeared to change little over the 1990s and 2000s, and express doubts about the ability of gross trade flows to capture countries' competitiveness. To overcome

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the shortcomings of using gross trade flows, Timmer *et al.* (2013) propose a measure of competitiveness based on WIOD value-added trade data. Using value-added measures and considering the integration process of EU countries over the period 1995–2008, they find strong effects of production fragmentation on countries' competitiveness, and that "...the 'super-competitiveness' of the German economy (Marin, 2010) is in large part derived from increasing use of imported intermediates".

A common message from this literature is that lower trade costs from increased integration of international supply chains generate benefits as firms can source intermediate inputs at a lower cost from more efficient producers. This implies an increase in productivity for the producer of the final product (whether a good or a service), an increase in competitiveness, and hence an increase in exports. Kowalski *et al.* (2015) suggest (p.11) that "The principal message for policy makers is that, in the GVC world, export competitiveness is inextricably linked to having access to competitively priced intermediate imports".

Much of the literature focusses on export competitiveness (and implicitly and explicitly) the consequent impact on output. However, engagement in GVCs also has an impact on import competitiveness, and the net effect of GVC engagement on total domestic output and welfare depends on firms' competitiveness in both the domestic market and foreign markets. Indeed, since for many firms the majority of their sales are to the domestic market, the domestic competitiveness impact may be quantitatively the more important, even though the focus has been primarily on export competitiveness.

In this paper we aim to identify the potential importance of both domestic and foreign competitiveness on net output effects. To do so we work with an extended partial equilibrium model for 148 agricultural, manufacturing and services sectors in which we allow for intermediate input costs. We show how different competitiveness effects related to GVCs can be assessed in such a setting. For the modelling we run an illustrative experiment in which we simulate the departure of the UK from the European Union accompanied by a comprehensive UK-EU free trade agreement.

We report the main simulation results for the UK in table 1, leaving the description of the model and the table for later. For now we want to focus on the difference in the simulated output changes with and without the inclusion of intermediates (columns 1 and 2). In a model without intermediate inputs, aggregate output declines by 1.83

Table 1. Simulation results for the UK

	Without inter- mediates	With inter- mediates	Ratio (2)/(1)
	(1)	(2)	(3)
A Output % change	-1.83	-4.26	2.34
B Exports % change	-11.90	-16.35	1.37
C Imports % change	-6.84	-4.84	0.71
B-C	-5.06	-11.52	2.28

per cent. When we include intermediates, the effect more than doubles to a 4.26 per cent output decline. Leaving aside the absolute size of these effects, the difference between the two is substantial and cannot be explained by the relative difference between the respective export declines of 11.9 per cent and 16.35 per cent, as seen in the second row of the table.

Explaining and illustrating this increased impact on output is the focus of the remainder of this paper. We argue that such a large difference is explained by the increase in the cost of intermediates leading to a loss of competitiveness of British firms in both home and foreign markets. Our results show that the GVC effects on domestic competitiveness can be very large and deserve the attention of policy makers.

2. Understanding output effects with intermediates

The model

We work with a partial equilibrium model, based on monopolistic competition and with a Dixit-Stiglitz CES demand structure (Gasiorek *et al.*, 2018). We apply the model to 28 agriculture and food processing sectors, 104 manufacturing sectors, and 16 services sectors based on the 4-digit classes of the ISIC Rev. 4 classification. Information on trade and production derives from national and international data sources (COMTRADE, UNIDO, ONS). Trade costs include both tariff and non-tariff measures, and the data on tariffs are taken from the TRAINS dataset. For goods our measures of non-tariff barriers derive from the work of Cadot and Gourdon (2016), and for services, our measure of trade costs is based on the OECD STRI data. We are in the process of refining and updating our dataset, so for the purposes of this paper our results are merely intended to be illustrative of the mechanisms at work triggered by the inclusion of intermediates in production and the consequent effects on competitiveness.

Full details of the model can be found in Gasiolek *et al.* (2018), but it is important to explain our modelling of intermediate inputs. We follow Ethier (1979, 1982) in applying the Dixit and Stiglitz (1977) approach to the demand for intermediates. To account for intermediate input costs we need information on the share of intermediates in production for each of our 148 4-digit ISIC sectors and also on the share of imported intermediates from each of the countries in the model. For this we use the WIOD data (see www.wiod.org). Each of the 148 ISIC sectors is modelled as purchasing intermediates from the 56 WIOD intermediate input sectors. Firms' variable costs are then represented by a CES index of the cost of primary factors and of the aggregate cost of intermediates. The aggregate cost of intermediates is a CES index of each of the intermediates bought from the 56 sectors and from each country/supplier.

The process therefore entails matching our ISIC 4-digit sectors to the WIOD input-output industries. We then use the WIOD data to generate supplier-share coefficients. For each country and industry, these coefficients tell us the share of intermediates being bought from each industry and country. For example, one coefficient gives the share of Chinese 'basic metals' (WIOD C24) in the production of US 'fabricated metals' (WIOD C25).

For each WIOD input we need to apply the relevant tariff (or non-tariff barrier) on that input. In the previous China-US example we need the US tariffs on Chinese 'basic metals' (WIOD C24). We calculate this from the tariffs for each of the ISIC 4-digit industries which make up 'basic metals'. The WIOD tariff is therefore a weighted average of the 4-digit tariffs, with weights given by the shares of US imports from China for each of the ISIC 4-digit industries. We calculate both the initial (base) tariffs, and the new (simulated) tariffs in this fashion. For example, the US trade cost on imports of Chinese WIOD C24 (which corresponds to ISIC 2410, ISIC 2420 and ISIC 2431) is given by:

$$\tau_{ij}^{c24} = w_{ij}^{2410} t_{ij}^{2410} + w_{ij}^{2420} t_{ij}^{2420} + w_{ij}^{2431} t_{ij}^{2431} \quad (1)$$

where w_{ij}^k are the imports weights of country i (the USA) from j (China) in ISIC industry k , and t_{ij}^k is the applied trade cost.

In the simulations we do not model intra-sectoral substitution between intermediates of different origin and therefore assume that the country import weights (w_{ij}^k) remain constant. In the experiment we are then interested in the impact of the change in intermediate costs arising from a change in trade costs – be this tariffs

and/or non-tariff measures. This change in intermediate costs is derived by taking the change in the WIOD-level aggregate tariff arising from the experiment applied to the 148 4-digit ISIC sectors. Substitution between different intermediates, between intermediates and primary inputs, and between final goods is modelled Dixit-Stiglitz-style with CES functions as we have described above.

Aggregate and sectoral results

We apply this framework to simulate the effect of the UK's departure from the EU accompanied by a free trade agreement between the UK and the EU. For the experiment we assume that the free trade agreement is comprehensive and no tariffs between the UK and the EU are introduced. We model the UK's departure from the Single Market as an increase in non-tariff barriers between the UK and the EU. In all these experiments EU and UK trade costs with the rest of the world (ROW) are unchanged.

Table 1 (above) reports on the resulting percentage changes in output (A), exports (B) and imports (C) for the UK, together with the difference between the import and export changes (B–C). The first column shows the simulation results without allowing for changes in intermediates costs, while the second column reports the results with intermediates cost changes. Our focus is not so much on the actual size of changes as on the effect of including intermediates, illustrated in column (3) by the ratios between the two sets of simulated effects.

Without considering intermediates in production, the effect on output is –1.8 per cent. The reduction in exports is 11.9 per cent, and the effect on output is partially offset by a decrease in imports by 6.8 per cent. The decrease in imports occurs because the rise in non-tariff barriers between the UK and the EU gives some protection to UK industries which reduces imports from the EU. When we include intermediates (column 2) the effect on output more than doubles (–4.3 per cent). Exports follow a similar pattern, with the inclusion of intermediates resulting in a bigger decrease in exports, but the proportionate change is considerably smaller than the change for output.

The relative effects on imports are different: the decline is smaller (–4.8 per cent) when we allow for intermediate input costs linkages than without these linkages (–6.8 per cent). It is this difference between the export and import effects which drives the 'doubling' effect on output. This can be seen clearly from the last line of table 1, which gives the difference between the percentage change in exports and imports across the two variants of our experiment. Without intermediate cost linkages (first column), the

difference is –5.1 per cent. With the intermediate cost linkages the difference more than doubles to –11.5 per cent. Hence exports are declining by more with the costs linkages, while imports are declining by less. This needs some explanation.

The bigger impact on exports is relatively easy to understand – UK firms' costs go up because the price of imported intermediates has gone up, and so they are less competitive in export markets. This ties in nicely with the standard GVC and competitiveness narrative discussed earlier. Hence in the simulation with intermediates UK exports decline by more both to the EU and to third markets. The UK's exit from the Single Market also raises EU intermediate costs so EU exports to third markets decline by more when we include intermediates in the simulation.

The smaller impact on UK imports is less obvious. It can be understood by comparing the effect of the UK exit from the Single Market on EU firms' intermediate costs with the effect on UK firms. Intermediates from the EU are a larger share of UK firms' costs than intermediates from the UK are for EU firms. While costs of both UK and EU firms rise, the effect is larger in the UK, so UK firms' domestic competitiveness declines, giving the EU (and the rest of the world) a bigger share of the UK market. Without intermediates UK's domestic absorption (UK consumption of UK products) sees an increase of 2.1 per cent, while allowing for intermediates price changes the effect is 1.8 per cent because of the negative effects on UK producers' competitiveness in the UK.

The effect is not only bilateral: the UK becomes less competitive also relative to the rest of the world (ROW) which can sell more of its production in the UK. Since ROW producers face no increased intermediate costs as a result of the UK's exit from the Single Market, the effect of the intermediate cost changes is proportionately larger

for UK-ROW trade than for UK-EU trade. UK imports decline overall because the EU is a larger exporter to the UK than the rest of the world is.

To summarise, table 2 shows the magnitude of the effects on UK imports from the EU27 and from ROW. The arrows show the direction of the change, with one arrow representing a small change and two arrows a large change. Imports from EU27 decrease while imports from ROW increase. However, because the UK imports more from the EU than from ROW, the overall effect is negative.

We have up to this point been discussing the net effects across all sectors, and explaining the intuition behind the aggregate results. However, the effects in specific sectors will depend on the underlying patterns of trade and of the extent of imported intermediate usage – i.e. of the depth of the underlying international value chain. Results for the selected sectors show some interesting variation.

Table 3 presents the results for three sectors. 'Motor Vehicles' (ISIC 2910) is the industry with the largest share of intermediates coming from the EU (18.3 per cent, WIOD industry C29). For this sector the results are broadly in line with those of the aggregate changes, with the change in output more than doubling when intermediates effects are modelled.

Table 2. Magnitude of imports changes for the UK

	Without intermediates	With intermediates
UK import from EU27	↓↓	↓
UK imports from ROW	↑	↑↑

Table 3. Sectoral results

	Motor vehicles		Basic chemicals		Financial Services	
	Without intermediates	With intermediates	Without intermediates	With intermediates	Without intermediates	With intermediates
	(1)	(2)	(1)	(2)	(1)	(2)
Output % change	–5.80	–16.55	–21.28	–43.56	0.08	–0.85
Exports % change	–9.43	–16.96	–27.92	–16.35	–2.82	–4.77
Imports % change	–4.04	–1.59	–5.59	3.64	–14.38	–12.95
Share of EU intermediates in production	18.26		16.60		2.61	

On the other hand, 'Basic Chemicals' (ISIC 2011, included in WIOD C20) shows a different story including a sign change when we allow for intermediates cost changes – imports decrease when we do not include intermediates, but increase when we include intermediates.

These mechanisms of course also apply not only to manufacturing industries, but also for services. The last two columns report on the results for Financial Services (WIOD K64). Here the share of EU intermediates in production is low at 2.6 per cent. However, the impact on output changes significantly if intermediates effects are modelled. The change in output is positive in the absence of intermediate inputs, but the larger reduction in exports and the smaller change in imports resulting from including intermediates leads to a negative change in output in the second column. This shows that even a relatively small share of intermediates can play an important role in shaping the outcomes.

In the simulation of the UK's departure from the EU presented in this paper we find that the introduction of intermediates and changes in imported intermediate input costs results in a smaller reduction in UK imports for every sector. However the same effect in the EU economy – which sees a decrease in competitiveness with respect to ROW but a gain with respect to the UK – has mixed outcomes. For the EU we find that modelling intermediates reduces the import effect in 105 out of 148 sectors, while for the remaining 43 industries the introduction of intermediates magnifies the reduction in imports.

The actual magnitude of our results will be mainly driven by three variables: the elasticity of substitution, the share of imported intermediates in production and the share of domestic sales in consumption. A large elasticity of substitution implies that domestic products can be easily substituted for foreign products. The share of imported intermediates in production influences the effect of changes in input costs on production and thus determines the effect on the competitiveness of domestic firms. Finally, a high share of domestic products in consumption can be eroded by increased foreign competitiveness, so the introduction of intermediates has a strong impact on imports.

3. Conclusions and policy implications

This paper has focused on the consequences of changes in intermediate input costs in global value chains on production. We consider effects on domestic competitiveness as well as the changes in external competitiveness. Integration in the global supply chain

can help domestic industries by reducing the cost of inputs. This then has an effect on a country's exports and imports, which in turn determine the effect on national output. Reductions in trade costs on intermediate inputs may also allow domestic firms to become more competitive in the international market, and allow them to export more and, at the same time, retain or expand their shares of the domestic market. However, conversely, an increase of trade barriers reduces a country's exports both through the direct effect of trade barriers and through the decrease in competitiveness from the higher costs of imported intermediates. Importantly, however, firms may lose domestic share to the extent that the changes in intermediate costs hit domestic firms more than foreign firms.

While our simulation results are illustrative, the UK leaving the EU will inevitably increase the cost of imported intermediates more for the UK than the EU. Given the high share of EU imported intermediates for UK firms, the impact on domestic and not just international competitiveness should not be underestimated.

The issue of the change in domestic competitiveness highlighted in this paper is closely related to the concept of the 'effective rate of protection' (ERP). The ERP measures the effect of protection on both intermediate and final goods on the value-added of a specific industry.¹ The ERP was developed to show that looking at tariffs on final products alone can provide a misleading picture of the extent to which any given industry is protected, and hence of the impacts of changes in trade policy. The literature on effective rates of protection show how tariffs (or trade costs more generally) on intermediates, by raising costs of production, lead to a reduction in the protection of a sector and erode the value added of domestic firms.

What we have shown in this paper is that the impact on total domestic output will depend on the changes in domestic and export competitiveness not just of the home economy (the UK in our example), but relative to the partner countries. In our simulation, the fact that the EU27's prices (production costs) increase by less than the British ones implies that domestic producers in the UK market face a lower international price relative to theirs and a reduction in effective protection (value added). By not being able to compete with the international price, they exit the market. As a result, national production decreases while imports increase.

While it is important to consider the entire tariff and non-tariff structure to understand the effects of trade

policy, one cannot look at domestic effects only, but also at the change in competitiveness of foreign economies. Policymakers should account both for the direct effect of intermediate tariffs on domestic value added, and also consider what happens to international prices. The final result will be different across country and will depend on the current (pre-policy) structure of trade and production and from the characteristics of each sector or industry. An *a priori* answer to what will happen to competitiveness and net output effects is not possible.

In the tariff consultation launched in February 2020, the UK government proposed the removal of tariffs on intermediate goods in order to improve UK firms' competitiveness.² As the UKTPO noted in its response to that consultation, the impact on domestic firms will also depend on any simultaneous changes being made to tariffs on final goods, and hence on changes in the effective rate of protection.³ While not explicitly modelled, the analysis in this paper suggests that reductions in UK tariffs on intermediate goods may partially offset the negative impacts on domestic competitiveness arising from the asymmetric impact of changes in non-tariff barriers.

More broadly, however, the results in this paper underline the importance for the UK of detailed GVC-focused industry-specific analyses in order to identify the sectors and industries which are most likely to be affected by a Brexit-induced decline in domestic competitiveness as well as export competitiveness. This could then lead to policy interventions, such as support for industries and/or the regions they are affected in (subject, of course, to WTO obligations), to trying to improve access to export markets in those industries as an offsetting measure, or to assessing the extent to which the imported intermediates could be sourced more readily from elsewhere.

Further, the potential Brexit-related challenges facing many industries are currently being dwarfed by the impact of COVID-19 on economic activity and international trade. COVID-19 has resulted in a simultaneous dramatic reduction in both demand and supply within economies. GVCs are central to the effects of COVID-19 on the international economy, and will be a principal transmission channel of the consequent negative economic effects.

The current focus of policymakers is primarily on shielding domestic workers and business from the dramatic declines in demand and supply, and to date it is uncertain how short or long-lived this will be. As the world economy recovers from COVID-19, the first priority of policymakers will simply be to facilitate the revival of as much as possible of pre-COVID economic activity, and maintaining and re-establishing supply chains will be important.

But thoughts will also turn to whether the post-COVID economy should be less vulnerable to external shocks. From a policy perspective, an interesting question is the extent to which governments will and should seek to reduce the dependence of their economies on GVCs. These considerations have much deeper ramifications than the significant changes in relative domestic competitiveness highlighted in this paper. Even in the context of Brexit, UK government 'sources' were quoted on 25 February 2020 by the journalist Andrew Neil as welcoming 'the end of complex, cross-border supply chains'. That sentiment will doubtless now become more widespread, as the potential vulnerability of (some) supply chains emerges.

There is a real possibility that post COVID-19 there will be a greater degree of commercial risk-aversion or active government discouragement of reliance on imported inputs. This will have different effects on different countries and on different sectors, and those effects will arise because of the impact on both domestic and international competitiveness. A model such as the one outlined in this paper can provide a first pass at the impact effects internationally and intersectorally of a general discouragement of reliance on GVCs.

It is likely to be harder to answer the longer-term question of what would be the economic costs of a move to less globalised supply chains. Our thinking about and our estimates of the benefits of international specialisation according to comparative advantage are still very much oriented towards markets in final goods. We can use market data to provide order-of-magnitude estimates of, say, increased barriers to trade in motor vehicles. However, we probably need to understand more about the economic drivers of intra-company and inter-company supply chains for intermediates if we want to think about the economic consequences of a general withdrawal from globalised sourcing of inputs.

NOTES

- 1 To our knowledge, the earliest reference is Corden (1966).
- 2 See <https://www.gov.uk/government/consultations/the-uk-global-tariff>.
- 3 <https://blogs.sussex.ac.uk/uktpo/publications/recommendations-on-the-uk-governments-global-tariff-proposals/>.

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