Intermediaries with Market Power and the Impact of Agricultural Trade Liberalisation

Daniel E. May[1] and Steve McCorriston[2]

[1] Harper Adams University, Business School. Newport, Shropshire, TF10 8 NB, UK
[2] University of Exeter, Department of Economics. Rennes Drive, Exeter, EX4 4PU, UK

Contributed Paper prepared for presentation at the 99th Annual Conference of the Agricultural Economics Society, Bordeaux School of Economics, University of Bordeaux, France

14 – 16 April 2025

*Corresponding author: Daniel E. May. dmay@harper-adams.ac.uk

Abstract

The issue of market power in agricultural and food markets is typically addressed in the context of domestic markets. In this paper, we consider the impact of market power in the outcome of trade agreements involving a number of countries. The issue of market power is set in the context of growth of preferential trade agreements has been one of the main features of trade policy over the last 20 years. To address these issues, we present a network model of trade where intermediaries in each country can have both seller and buyer power. Buyer power is of particular relevance to this framework since we know from standard trade theory that trade reform can bring pro-competitive effects from trade. However, the exercise of buyer power can potentially offset the potential gains from trade liberalisation. We show in this paper that the impact of buyer power on expanding trade agreements will depend on the nature of trade between countries, whether countries differ in market size, and the existence of already established trade agreements. We highlight the insights from the network trade model with an empirical example of a trade agreement between the UK and the US.

Keywords Agricultural Trade; Intermediaries; Seller and Buyer Power
JEL code Q17; F6; L1

1. Introduction

Promoting trade liberalisation in agricultural and food markets remains high on the policy agenda worldwide though-due to the stasis in agreeing multilateral reform-the most common mechanism for promoting trade liberalisation over the last 20 or so years has been in the form of preferential trade agreements. This form of promoting access to countries' markets has also been the strategy of the UK government following the UK's departure from the EU. Yet, we have seen considerable opposition to these preferential agreements both in the UK (most recently by producers concerned with the impact of the UK-Australia trade agreement) and, more recently in the EU (in relation to the EU trade agreement with Mercosur). In this context, the assessment of the potential outcome from trade agreements is an important activity from researchers with direct relevance for policymakers.

There are two general challenges in addressing the potential impact of trade agreements. First, is the concern about market power and accommodating this issue in a framework that addresses the impact of trade agreements in member and non-member countries. In the formal literature on trade agreements with market power, the issue of seller power is considered; as such, the main benefits from joining a trade agreement arise with respect to the pro-competitive benefits it may bring and addresses the issue about whether a trade agreement involving a limited number of countries generates a pathway to global trade liberalisation. But-as it stands-the theoretical approaches do not consider the issue of buyer power, an issue that is of primary concern when addressing market power in agricultural supply chains. This leads to the second challenge: as they stand, approaches to addressing the impact of market power in determining the outcome of trade agreements are not directly relevant for addressing agricultural and food markets since they do not consider the possibility of two-sided market power i.e. the existence of both seller and buyer power in domestic and international markets. As such, the underlying assumptions of this extant literature on trade agreements side-steps issues that are pertinent to their application to agricultural and food trade policy issues: farmers' producer surplus does not enter the governments' welfare functions; with constant marginal costs, all countries in that become members of a trade agreement or outside it can be assumed to be segmented; since these models typically generate two-way trade in the same products, the benefits or otherwise of being a member or non-member relate only to the pro-competitive effects that may arise.

The framework we present below addresses these issues that makes our framework for addressing trade agreements more directly relevant to addressing agricultural and food trade issues. First, marginal costs are not constant. The principal consequence of this is that countries now cannot be assumed to be segmented since firms' decisions about changing supply to one country has an impact on costs of supplying all other countries. Thus, even if at the consumer end markets are segmented (consumers can only buy what

is sold in the domestic market), all countries are potentially connected by the characteristics of the supply function. Second, by allowing for non-constant marginal costs, we can accommodate the issue of buyer-as well as seller-power in supply chains. Consequently, even though the pro-competitive effects relating to reductions of mark-ups due to a trade agreement will still arise, the welfare outcome will also depend on the impact of changes in mark-downs on the buyer side. Moreover, by explicitly accommodating the agricultural sector in this framework, we can more appropriately characterise the distributional effects within each country that arise from membership or non-membership of a trade agreement.

Specifically, we present a framework where there is a network of countries that may or may not form trade agreements with each other. The base case is where all countries trade but all trade between each country is subject to a tariff. A trade agreement reduces these bilateral tariffs between a pair (or more generally, a subset) of these countries. We can account for multilateral free trade where all countries are members of a global agreement. In each country, there are a limited number of firms that can exert seller or buyer power. All firms sell domestically and can export but the domestic and export decisions are linked given the inverse supply function that intermediaries face relates to aggregate supply (i.e. domestic and export markets) such that decisions about how much to sell in each market are now connected. The framework we present is sufficiently flexible to account for different forms of trade (e.g. intra-industry trade between pairs of countries or countries which are export or import only) or some combination of these trade characteristics across the trade network. We can also allow for asymmetry in terms of country size as well as varying degrees of seller and buyer power in each country. In doing so, we can consider the impact on member countries and what factors likely drive this (for example, the importance of 'concession diversion') and the impact on on-member countries. Finally, in the assessment of preferential trade agreements, our framework also allows for differences in the current architecture of trade agreements i.e. for any two countries wishing to sign an agreement, the potential outcome will depend on current agreements between any combination of countries in the network.

More formally, the framework we apply here is an extension of the network formation model developed by Goyal and Joshi (2006) with the extension relating to the incorporation of buyer power. While in the context of the network model relating to the endogeneity of trade agreements issues associated with stability arise, we confine ourselves in this paper to a more direct question: to what extent does the existence of buyer power impact on the outcome of preferential trade agreements and, under what characterisations of the countries in the network, does buyer power matter more or less than seller power in determining the welfare impacts of these trade agreements in both member and non-member countries? Our results show that buyer power can be more important than seller power under different configurations of how we characterise the (a)symmetry between countries and the nature of trade between countries in the

network. Moreover, depending on these characterisations, farmers sometimes do have similar interests to intermediaries (i.e. they both gain or lose from a trade agreement) but in other cases, their interests' conflict. We also apply the theoretical framework to a case study of the UK-US agreement involving trade in cheese products between the two countries and highlight that the characterisation of the main countries in the network are impacted by this agreement and how assumptions about seller and buyer power impact on these outcomes.

The paper is organised as follows. In section 2, we relate the framework we present here to various strands in the literature on trade agreements and research on the potential impact of market power. In Section 3, given space constraints, we present the basic features of the framework and highlight with some simulations, the role of seller and buyer power in determining outcomes. We present a case study as an example of the application of our framework in Section 4. In Section 5, we highlight current directions of research relating to the development and application of this framework.

2. Literature Review

Given constraints, we only briefly touch upon the literature to which our paper relates. There are three strands to this. First, as highlighted by Barrett *et al*. (2022), research on the role of intermediaries in food supply chains is a priority this being especially true when intermediaries can exert market power and where the existence of market power (both buyer and seller) can influence policy outcomes. In an open economy setting, research on how market power can influence the outcomes of trade and trade and domestic policy issues is even more sparse with some exceptions; for example, Sexton *et al*. (2007) deal with the distributional impact of policy reforms with both seller and buyer power and McCorriston and MacLaren (2007, 2008) also accommodate the potential for oligopoly and oligopsony power while Zavala (2022), Méndez-Chacón and Van Patten (2022) and Rubens (2023) provide more recent accounts for the role of monopsony power in commodity value chains. However, these analyses are confined to single country scenarios whereas in the case of trade agreements that we explore here, the emphasis is on trade agreements in a network of countries and where market power plays a role.

In the mainstream trade literature, the issue of two-sided market power has-until more recently-been largely ignored. As Antràs (2024) has noted, the primary way in which competition has been included in standard trade models has been via a monopolistic competition model which in essence rules out any changes in mark-ups and therefore the distributional effects arising from changes in trade policy. Yet, the monopolistic model contrasts with the empirical observation that trade is dominated by a relatively small number of firms including those involved in food and agricultural trade. But while seller power has played some role in the trade policy literature and, as Head and Spencer (2017) point out should have stronger emphasis, research that incorporates

intermediaries that can exert buyer power remains nascent. Some recent exceptions to this include Morlacco (2019) and Alviarez *et al*. (2023) while there has been some acknowledgment of oligopsony power when the focus is on labour market linkages.

More directly on the analysis of trade agreements which is the focus of this paper, a strand of this literature has accounted for oligopoly in determining the desirability of trade agreements. Notable in this case are Yi (1996), Krishna (1998), Freund (2000) and Ornelas (2005) among others. Closest to the set-up we employ is Goyal and Joshi (2006) and Furusawa and Konishi (2007) and Chen and Joshi (2010) that place the issue of trade agreements in the context of a network of countries and explore the endogeneity of trade agreements. However, the common assumption of this strand of models that account for imperfect competition in the context of trade agreements are that countries are segmented and that firms face constant marginal costs. These assumptions become redundant with the incorporation of buyer power: although consumers can only purchase what is sold in the domestic market, with the potential for market power in procurement and with the marginal outlay curve not being fixed, countries now become linked through the firms' supply functions which makes the assumption of market segmentation redundant. While in the context of our network trade model issues of the stability of agreements become relevant (as in Goyal and Joshi, 2006 and Furusawa and Konishi, 2007), we confine our analysis here to a more direct question: does the potential for market power in procurement influence the distributional and net welfare effects of trade agreements? In doing so, our aim is to present a network framework that allows for different characterisations of trade (i.e. intra-industry trade between countries, or export-import only trade) and allow for asymmetry in country size.

3. Theoretical Framework

Given constraints on space, we confine ourselves to the reporting the basic structure of the network trade model and some simulations to highlight the role of seller and market power in determining the outcome of trade agreements. For present purposes, we sidestep issues associated with stability in networks that are common in network formation games; this would involve a more direct comparison with the model of Goyal and Joshi (2006) but here the discussion focuses on how two-sided market power is accommodated and lays the basis for the calibrated example that follows in Section 4.

We assume that there are 4 countries (nodes) in the trade network labelled i, j, k and l. In each country, there a n firms and each of these firms supplies the domestic market and exports to some combination of the other countries in the network. For example, firms in country i will sell in country i but can potentially export to countries j, k and l. They can supply all 3 other countries or, reflecting the geography of trade, a limited number of these countries. Common in the theoretical models of trade agreements, firms in countries j, k and l also serve their own domestic markets and export to all other countries. In this case, all trade between the four countries would be intra-industry in

nature. If firms in any of the four countries serve only their domestic market, these countries are importers only; if firms in any of the four countries serve only the domestic market and export but do not import, we have inter-industry trade. Combinations of intra and inter-industry trade can co-exist across the four countries in the network.

From a consumption point of view, countries are segmented; consumers can buy only what is sold in the domestic market. However, by relaxing the assumption of constant marginal costs, the costs to intermediaries' change depending on the supply decisions on domestic sales and exports. As such, any increase in sales to any one market drives up marginal costs to all other markets the intermediary serves. Intermediary decisions on how much to sell in each country are now inter-connected with the sales in every other country it serves. With a limited number of n firms in each country in the network, there is the potential for seller power; with an upward sloping supply function, the limited number of firms can also benefit from a mark-down in terms of the prices they pay farmers. The consequences of these assumptions are two-fold: first, depending on the characterization of trade, there are potential pro-competitive effects arising from sales in each country in the network which increases consumer surplus but dissipates the extent of firms' mark-ups; second, as changing supply to each country is impacted by trade (or changes in trade policies), this has an impact on firms' costs across all countries as determined by the slope of the perceived (aggregate) marginal outlay curve.

In the baseline case, tariffs are given exogenously but they are not so high that countries in the network are autarchic. In exporting to each country, the intermediaries face tariffs that can vary by country of destination. When countries sign a trade agreement, the tariffs between each country are zero (or, at least, reduced). We assume that the trade agreements are free trade areas such that remaining bilateral tariffs are unchanged (given the assumption of exogeneity) and that the reduction in the bilateral agreements between countries are not replaced by a common external tariff (though this could easily be accommodated). In this context, a trade agreement could involve two counties in the network, or more than two countries in the network. If all countries sign the trade agreement and all tariffs are reduced or set to zero, we have a multilateral trade agreement. Variations to the baseline case involve the pre-existence of trade agreements between any of the countries. This would change the benchmark against which the outcomes of a new agreement will be assessed. With four countries in the trade network, this results in 64 combinations of trade agreements from no trade agreement through to global free trade (or, in the terminology of the network approach, an empty network through to a complete network).

More formally, consider the welfare function for country i in the network. Welfare is a composite of domestic consumer surplus, profits from intermediaries' sales in the domestic market, profits from intermediaries' sales in export markets, j, k and l (or any

combination thereof), tariff revenue from imports from *j*, *k* and *l* (or any combination thereof) plus producer surplus for farmers based in country *i*. This is given by:

$$W_i = CS_i + \pi_i + \sum_{j,k,l} \pi_{j,k,l} + \sum_{j,k,l} TR_{j,k,l} + PS_i$$

with similar representations of welfare for each of the other countries *j*, *k* and *l* in the network. Note that, in contrast to theoretical models on trade agreements (c.f. Goyal and Joshi, 2006, and Ornelas, 2005), producer surplus is not an argument in the welfare functions and the role of imperfect competition that impacts on profits arises solely from seller power.

Consider next, the profits for a representative firm (subscripted 1) in country *i* as given by:

$$\begin{aligned}\pi_{1i} &= \pi_{1i}^{i} + \pi_{1i}^{j} + \pi_{1i}^{k} + \pi_{1i}^{l} \\ &= \left(P_i - P_i^f\right)q_{1i}^{i} + \left(P_j - P_i^f - t_i^j - c_{ij}\right)q_{1i}^{j} + \left(P_k - P_i^f - t_i^k - c_{ik}\right)q_{1i}^{k} \\ &\quad + \left(P_l - P_i^f - t_i^l - c_{il}\right)q_{1i}^{l}\end{aligned}$$

where π_{1i}^{i} is profits from sales in the domestic market, and $\pi_{1i}^{j} + \pi_{1i}^{k} + \pi_{1i}^{l}$ are profits from sales in each of the other countries in the network. c_{ij}, c_{ik} and c_{il} are costs of trading with countries j, k and l say through transportation costs. Tariffs that apply on country *i*'s exports to j, k and l are t_i^j, t_i^k and t_i^l; these can differ across each of the three countries. Similarly, for countries exporting to country *i* the tariffs they will face are given by: $t_j^i, t_k^i \; and \; t_l^i$. For countries joining a trade agreement, these tariffs are reduced; for example, if country *i* signs a trade agreement with country *j*, then t_i^j=t_i^j=0 or we can have any permutation of tariff reductions across the four countries depending on who signs an agreement. For non-member countries, we assume that bilateral tariffs still apply and that, consistent with the structure of free trade area agreements, the tariffs between *i* and *j* are not replaced by a common external tariff. For multilateral free trade, all tariffs are reduced to zero.

Taking the first order condition for profit maximisation for firm *i* in country *i* and aggregating over all firms in country *i*, we have:

$$\frac{\partial \pi_{1i}}{\partial q_{1i}^i} = \frac{\partial \pi_{1i}^i}{\partial q_{1i}^i} + \frac{\partial \pi_{1i}^j}{\partial q_{1i}^i} + \frac{\partial \pi_{1i}^k}{\partial q_{1i}^i} + \frac{\partial \pi_{1i}^l}{\partial q_{1i}^i}$$

$$= P_i - P_i^f - Q_i^i \frac{p_i'}{n_i}\left(1 + \frac{\partial Q^i_{i-\{q_{1i}^i\}}}{\partial q_{1i}^i} + \frac{\partial Q_j^i}{\partial q_{1i}^i} + \frac{\partial Q_k^i}{\partial q_{1i}^i} + \frac{\partial Q_l^i}{\partial q_{1i}^i}\right)$$

$$- Q_i^i \frac{p_i^{f\prime}}{n_i}\left(1 + \frac{\partial Q^i_{i-\{q_{1i}^i\}}}{\partial q_{1i}^i} + \frac{\partial Q^j_{i-\{q_{1i}^j\}}}{\partial q_{1i}^i} + \frac{\partial Q^k_{i-\{q_{1i}^k\}}}{\partial q_{1i}^i} + \frac{\partial Q^l_{i-\{q_{1i}^l\}}}{\partial q_{1i}^i}\right)$$

$$- \frac{\theta_i}{n_i}\left(Q_i^j + Q_i^k + Q_i^l\right)$$

$$= P_i - P_i^f - Q_i^i V_{ii}^B - Q_i^i V_{ii}^S - \frac{\theta_i}{n_i}\left(Q_i^j + Q_i^k + Q_i^l\right)$$

and by extension for similar expressions for the first-order condition for export sales to each other countries in the network, *j*, *k* and *l*. Note that, even though firms choose how much to sell in each market separately, because of the upward sloping supply function, sales in country *i* also impact on profits earned in each of the other countries in the network. This spillover effect across countries is absent in standard models of trade agreements because of the assumption of constant marginal costs.

Seller power is captured by the aggregate conjectural variations parameter, V_{ii}^S and given by:

$$V_{ii}^S = \frac{p_i'}{n_i}\left(1 + \frac{\partial Q^i_{i-\{q_{1i}^i\}}}{\partial q_{1i}^i} + \frac{\partial Q_j^i}{\partial q_{1i}^i} + \frac{\partial Q_k^i}{\partial q_{1i}^i} + \frac{\partial Q_l^i}{\partial q_{1i}^i}\right)$$

where the partial derivatives in the parenthesis relate to expectations on how competitors in the domestic market and from each of the other countries exporting to country I will respond and where p_i' is the slope of the inverse demand function. Buyer power (V_{ii}^B) is given by:

$$V_{ii}^B = \frac{p_i^{f\prime}}{n_i}\left(1 + \frac{\partial Q^i_{i-\{q_{1i}^i\}}}{\partial q_{1i}^i} + \frac{\partial Q^j_{i-\{q_{1i}^j\}}}{\partial q_{1i}^i} + \frac{\partial Q^k_{i-\{q_{1i}^k\}}}{\partial q_{1i}^i} + \frac{\partial Q^l_{i-\{q_{1i}^l\}}}{\partial q_{1i}^i}\right)$$

where the partial derivatives in the parenthesis relates to conjectures in the procurement market relating to competitors changes in procurement from domestic farmers in terms of sales to the domestic market and export markets. In essence, these aggregate conjectural variations parameters contingent on the number of firms capture the perceived marginal revenue and marginal outlay functions associated with the intensity of competition in each of the four countries in the network.

Notice from this representation of welfare and the decision of the firms in country *i* that we can characterize the trade network in alternative ways. For example, if country *j* does not export to country *i*, then Q_j^i and $\frac{\partial Q_j^i}{\partial q_{1i}^i}$ equal zero and vice versa for *i* not selling to country *j* (i.e. Q_i^j and $\frac{\partial Q^j_{i-\{q_{1i}^j\}}}{\partial q_{1i}^i}$ equal zero).

To obtain closed form solutions for sales from firms in each country across the network, we have to assume specific functional forms for the inverse demand and supply functions. Given the combination of tariffs and potential trade agreements involving the four countries, the 4-country network we outline here gives rise to 64 combinations of trade agreements between the countries ranging from no agreements in place and only currently applied tariffs between all country pairs through to a global trade agreement where all bilateral agreements are zero or are at least reduced. To provide some insights, we therefore simulate some examples of alternative trade agreements and differences in the network architecture with a view to answering a specific question: to what extent does seller and buyer power impact on the effects of trade agreements both between countries that are party to the agreement and those that are not? An example of the simulations is reported in the tables below and here we summarize the main insights:

There are several important insights from the network trade model that we have developed. These are as follows:

- Our headline result is that, in the context of trade reform, buyer power in the agricultural sector can have a significant impact on the outcome of trade agreements and be more important than the impact of seller power.
- When countries are identical in market size, in the absence of buyer power, a trade agreement results in a net increase in the new partner countries' welfare arising from the pro-competitive effects that are associated with trade reform.
- When countries are similar in market size, when there is buyer power, a trade agreement causes some countries to increase welfare and others lose. The distributional effects can also vary as intermediaries can lose but farmers gain from trade agreements.
- When countries differ in market size, relatively large countries do not have an incentive to sign a trade agreement with relatively small countries.
- In the presence of buyer power, the welfare impacts of a 'new' trade agreement will depend on the network of trade agreements already in existence.
- Buyer power can limit the gains from global trade reform and countries may prefer limited preferential trade agreements between countries rather than free trade between all countries.

Alternative Combinations of Network Architecture and Welfare Effects with Seller and Buyer Power (in the asymmetrical case, countries *i* and *l* have larger domestic markets).

Welfare simulations for bilateral agreements

Table 1. Welfare under seller power when countries are symmetrical.

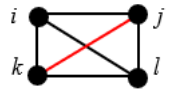
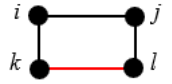
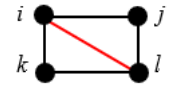
Network structure	Country	W (VS=0.1) %	W (VS=0.3) %	W (VS=0.7) %	W (VS=1) %
	*i*	-0.6728	-0.5892	-0.4961	-0.4455
	j	0.6991	0.6412	0.5893	0.5625
	k	0.6991	0.6412	0.5893	0.5625
	l	-0.6728	-0.5892	-0.4961	-0.44559
	*i*	-0.5851	-0.5601	-0.4839	-0.4371
	j	-0.5851	-0.5601	-0.4839	-0.43711
	k	0.6113	0.6134	0.5786	0.5556
	l	0.6113	0.6134	0.5786	0.5556
	*i*	0.6944	0.6375	0.5863	0.5599
	j	-0.6774	-0.5929	-0.4990	-0.4479
	k	-0.6774	-0.5929	-0.4990	-0.4479
	l	0.6944	0.6374	0.5863	0.5599
	*i*	-0.4972	-0.5310	-0.4718	-0.4288
	j	0.5236	0.5856	0.5679	0.5487
	k	-0.4972	-0.5310	-0.4718	-0.4288
	l	0.5236	0.5856	0.5679	0.5487

Table 2. Welfare under seller power when countries are asymmetrical.

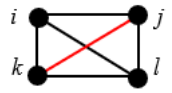
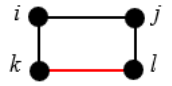
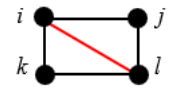
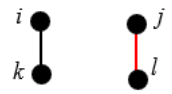
Network Transition	Country	W (VS=0.1) %	W (VS=0.3) %	W (VS=0.7) %	W (VS=1) %
	*i*	-0.2847	-0.2456	-0.1974	-0.1723
	j	0.6262	0.5239	0.4249	0.3837
	k	0.6262	0.5239	0.4249	0.3837
	l	-0.2847	-0.2456	-0.1974	-0.1723
	*i*	-0.3338	-0.2997	-0.2437	-0.2133
	j	-0.6874	-0.5484	-0.3847	-0.3140
	k	1.0492	0.9201	0.7677	0.7021
	l	0.2052	0.1985	0.1815	0.1718
	*i*	0.4456	0.4240	0.4006	0.3888
	j	-0.8772	-0.6763	-0.4691	-0.3818
	k	-0.8772	-0.6763	-0.4691	-0.3818
	l	0.4456	0.4240	0.4006	0.3888
	*i*	-0.3132	-0.2924	-0.2403	-0.2110
	j	1.0119	0.9118	0.7665	0.7022
	k	-0.6483	-0.5376	-0.3811	-0.3118
	l	0.1855	0.1921	0.1788	0.1700

Table 3. Welfare under buyer power when countries are symmetrical.

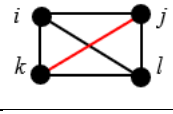
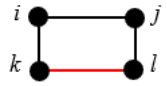
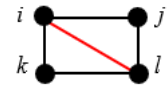
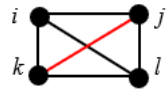
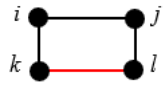
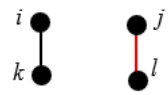
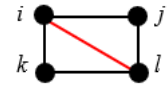
Network Transition	Country	W (VS=0.1) %	W (VS=0.3) %	W (VS=0.7) %	W (VS=1) %
	*i*	-0.3587	-0.3306	-0.3329	-0.3014
	j	0.4802	0.4606	0.4789	0.4573
	k	0.4802	0.4606	0.4789	0.4573
	l	-0.3587	-0.3306	-0.3329	-0.3014
	*i*	-0.3782	-0.3677	-0.2991	-0.2887
	j	-0.3782	-0.3677	-0.2991	-0.2887
	k	0.5016	0.4999	0.4461	0.4459
	l	0.5016	0.4999	0.4461	0.4459
	*i*	0.4772	0.4580	0.4764	0.4551
	j	-0.3617	-0.3332	-0.3354	-0.3035
	k	-0.3617	-0.3332	-0.3354	-0.3035
	l	0.4772	0.4580	0.4764	0.4551
	*i*	-0.3977	-0.4048	-0.2652	-0.2760
	j	0.5231	0.5392	0.4132	0.4344
	k	-0.3977	-0.4048	-0.2652	-0.2760
	l	0.5231	0.5392	0.4132	0.4344

Table 4. Welfare under buyer power when countries are asymmetrical.

Network Transition	Country	W (VB=0.1) %	W (VB=0.3) %	W (VB=0.7) %	W (VB=1) %
	*i*	-0.0361	-0.0413	-0.0606	-0.0592
	j	0.3562	0.2893	0.2474	0.2185
	k	0.3562	0.2893	0.2474	0.2185
	l	-0.0361	-0.0413	-0.0606	-0.0592
	*i*	-0.2909	-0.2591	-0.1992	-0.1775
	j	-0.2413	-0.2238	-0.1700	-0.1573
	k	1.5427	1.3413	1.0745	0.9678
	l	-0.1492	-0.1396	-0.1343	-0.1179
	*i*	-0.2973	-0.2713	-0.1885	-0.1736
	j	1.5812	1.3836	1.0680	0.9712
	k	-0.2608	-0.2517	-0.1548	-0.1534
	l	-0.1404	-0.1253	-0.1435	-0.1205
	*i*	0.3864	0.3787	0.3808	0.3711
	j	-0.7493	-0.5888	-0.4326	-0.3497
	k	-0.7493	-0.5888	-0.4326	-0.3497
	l	0.3864	0.3787	0.3808	0.3711

4. Applying the Network Trade Model: Trade Agreements Across Main Countries in the Global Cheese Trade

Given space constraints, we only briefly describe and report on the application. Specifically, we apply the model to a five-country network involving countries where there are: (i) a significant amount of trade (both exports and imports) between countries in the network; (ii) we have data on wholesale and farm-gate prices in each country as well as data on trade and domestic production and sales in each country; (iii) tariff data on

imports from each country that applies to this commodity; (iv) where there have been concerns about market power in the food chains in each of these countries; and (v) where there have been recent trade agreements between some of the countries (e.g. the UK and Australia) and where there is current discussion on future trade agreements that would involve this sector i.e. between the UK and EU or the UK and the US. In the analysis, we confine ourselves to the latter. We allow for product differentiation between home produced and imported commodities at the wholesale level. Domestic consumption is assumed to be segmented from other countries but domestic procurement is contingent on both the procurement for the domestic market and for exports to other countries in the network. For each country, we use 'typical' estimates relating to the demand and supply elasticities. In Table 5, we report the data for each country that characterises the network and in Table 6, we summarise the trade agreements that exist between country pairs in the network.

Table 5. Data used in the network analysis (average between 2018 and 2020).

	UK	New Zealand	EU	US	Australia
Total production (tonnes)	477059	361667	9076550	5961433	367779
Total imports (tonnes)	510864	11621	210575	173849	97677
Total exports (tonnes)	195121	327921	1342803	356028	161696
Exports by the UK (tonnes)	NA	98	158307	7588	1321
Exports by New Zealand (tonnes)	134	NA	825	1758	46191.33333
Exports by the EU (tonnes)	493779	4273	NA	125150	25706.66667
Exports by the US (tonnes)	188	2957	1028	NA	23422
Exports by Australia (tonnes)	433	3750	308	2163	NA
Retail price ($/tonne)	5827	10846	7882	9597	8974
Wholesale price (£/tonne)	2899	2971	2721	2955	2971
Ad valorem tariff	40%	0%	40%	32%	22%

Source: AHDB

Table 6. Summary of existing trade agreements between country pairs in the network (period of reference: 2018-2020).

	UK	New Zealand	EU	US	Australia
UK	---	No	Yes	No	No
New Zealand	No	---	No	No	Yes
EU	Yes	No	---	No	No
US	No	No	No	---	Yes
Australia	No	Yes	No	Yes	---

We contain the results to three cases, where the scenario relates to the current applied tariffs on cheese imports involving trade between the US and the UK being reduced to zero. In Case 1, we assume the combination of both seller and buyer power in each country; in Case 2, there is only seller power; in Case 3, buyer power only. The impact on

welfare across the five countries in this network (i.e. for both the countries involved in the trade agreement and those not involved) are reported in Table 7.

Table 7. Simulations for the UK-US deal (percentage changes).

Case 1: Seller and buyer power in each country					
Variable	**UK**	**NZ**	**EU**	**US**	**AU**
National Welfare (%)	1.3742	-0.0236	-0.0371	-0.0730	-0.0137
Consumer Surplus (%)	-0.7409	0.0008	0.0024	0.1644	-0.0032
Intermediaries' Profits (%)	6.7423	-0.0426	-0.0831	-0.1403	-0.0348
Producer Surplus (%)	1.5899	-0.0624	-0.0233	-0.1073	-0.0209
Tariff Revenue (%)	-24.7508	0.0000	0.9616	-13.0520	-0.1077
Case 2: Seller power only in each country					
Variable	**UK**	**NZ**	**EU**	**US**	**AU**
National Welfare (%)	0.4686	-0.0071	-0.0060	-0.0318	-0.0022
Consumer Surplus (%)	0.0107	0.0000	0.0000	0.0338	0.0000
Intermediaries' Profits (%)	1.0662	-0.0128	-0.0092	-0.0286	-0.0072
Producer Surplus (%)	0.0000	0.0000	0.0000	0.0000	0.0000
Tariff Revenue (%)	-24.6209	0.0000	0.0000	-5.8568	0.0000
Case 3: Buyer power only in each country					
Variable	**UK**	**NZ**	**EU**	**US**	**AU**
National Welfare (%)	1.0841	-0.0133	-0.0254	-0.0635	-0.0108
Consumer Surplus (%)	-0.5075	0.0001	-0.0046	0.1282	-0.0036
Intermediaries' Profits (%)	4.5171	-0.0229	-0.0514	-0.1119	-0.0240
Producer Surplus (%)	1.5558	-0.0368	-0.0135	-0.0978	-0.0135
Tariff Revenue (%)	-27.6387	0.0000	0.9081	-11.2341	-0.1058

The results show that when buyer power is absent (Case 2), the agreement between the UK and the US positively affects consumer surplus in both countries due to its pro-competitive effect. In the case of the UK, on the other hand, intermediaries' profits increase due to the increased exports to the US causing a positive impact on national welfare. However, total profit in the US decreases because the additional export profits are not large enough to compensate for the loss of domestic profits, due to the pro-competitive effect in the domestic market. This negative effect on profits plus the decrease in tariff revenue after the agreement, explains why national welfare in the US is reduced after the agreement. Regarding third countries, they are affected only by the impact of the pro-competitive effect on the profit made by the intermediaries of these countries in the UK and the US under non-prohibitive tariffs. From the point of view of consumers, all the countries in the network are segmented as they can buy only what is sold in the domestic market. Moreover, domestic markets are not affected by an agreement signed by third countries, and this explains why consumer surplus remains fixed in the EU, New Zealand, and Australia.

When seller power is absent (Case 3), all markets in the network become interconnected. This happens because in this case, the marginal cost faced by the intermediaries, i.e. the price paid to the farming sector, changes depending on the supply decisions on domestic sales and exports. This means that increasing sales to the US by the UK raises the marginal cost in the latter country, and this raises the costs to all other markets the intermediary in the UK serves (the same happens in the US). The intermediaries in the UK and the US adjust in response to the increased marginal cost by reducing sales in the domestic and foreign third markets to release pressure on the prices paid to farmers. This, in turn, affects profits made by the intermediaries of third countries and their farming sector. In the UK, net profit increases because the loss of profits caused by the decrease in sales in some markets is compensated by the additional export profit in the US. This is accompanied by a net increase in the output demanded from the farming sector which is why the latter obtains gains in producer surplus. In the US the situation is different: the decrease in sales in some markets (to reduce pressure on the price paid to farmers) is not compensated by the additional export profits. This is why the intermediary of this country faces a net decrease in profits, and farmers a decrease in producer surplus. The other countries are also affected which is reflected as a decrease in national welfare caused by the effects of the changing marginal cost after the agreement.

Finally, in Case 1 when seller and buyer power are both present, rates are more closely related to Case 3 suggesting that the impact of buyer power on the trade outcome is stronger. This is also inferred from the fact that rates are significantly higher under buyer power than under seller power.

5. Summary and Conclusions

Drawing on theoretical approaches to trade agreements and specifically the model of network formation associated with Goyal and Joshi (2006), we have detailed an extension to these theoretical approaches that will apply more readily to trade agreements relating to agricultural and food settings. Specifically, we have extended the welfare function to allow for farmers' welfare to be considered and extended the issue to allow for buyer as well as seller power, an issue that is of concern to policymakers across many countries. This is also consistent with the general trade literature which is now extending to consider buyer power issues given that only a small number of firms typically account for most of the exports from any country. We have shown that buyer power is an important determinant of the net welfare and distributional impacts of trade agreements across countries though the impact of buyer power is contingent on the nature of asymmetry between countries, how many countries are involved in a trade agreement and the architecture of current trade agreements. As we have shown, we can apply this framework to specific cases.

There are several obvious extensions of this approach. First and most obviously, given that trade agreements have been the main form of trade liberalization in recent years, there are many settings in which the framework can be applied. In this context, although the motivation here has tied with the literature on trade agreements, the framework can also be applied to consider the impact of changes in unilateral tariffs given the changes in the trade policy environment that may emerge with President Trump. Second, the framework here has assumed exogenous tariffs (a common assumption with this literature); but addressing the issue of endogenous tariffs would also be of interest as it addresses the wider issue of whether trade agreements between a limited number of countries fosters a path to global free trade. Third, and related to this, is the more formal treatment of stability in the network. In the Goyal and Joshi (2006) model, global free trade was a stable outcome; but with buyer power impacting on the benefits of trade agreements at least for some countries, stability of the network may involve a characterization of trade agreements that is a significant deviation from the global free trade outcome that is typically the desired outcome of trade economists.

References

Alviarez, V., Fioretti, K.K Kikkawa and M. Morlacco (2023) 'Two-Sided Market Power in Firm-to-Firm Trade' NBER Working Paper 31253

Antràs, P. (2024) The Uncharted Waters of International Trade. Mimeo, Harvard University

Barrett, C.B. T. Reardon, J. Swinnen and D. Zilberman (2022) "Agri-food Value Chain Revolutions in Low-and Middle-Income Countries," *Journal of Economic Literature*, 60: 1316-1377

Chen, M.X. and S. Joshi (2010) 'Third Country Effects on the Formation of Free trade Agreements' *Journal of International Economics,* 82: 238-248

Freund, C. (2000) 'Different Paths to Free Trade: The Gains from Regionalism' *Quarterly Journal of Economics*, 115: 1317-1341

Furusawa, Tand H. Konishi (2007) 'Free Trade Networks' *Journal of International Economics*, 72: 310-335

Goyal, S. and S. Joshi (2006) 'Bilateralism and Free Trade' *International Economic Review*, 47: 749-778

Head, K. and B. Spencer (2017) 'Oligopoly in International Trade: Rise, Fall and Resurgence' *Canadian Journal of Economics*, 50: 1414-1444

McCorriston, S. and D. MacLaren (2005) "The Trade-Distorting Impact of State Trading Enterprises in Importing Countries" *European Economic Review,* 49: 1693-1715.

McCorriston, S. and D. MacLaren (2007) 'Do State Trading Exporters Distort Trade?' *European Economic Review,* 51: 225-246.

Méndez-Chacón, E. and D. Van Patten (2022) 'Multinationals, Monopsony and Local Development: Evidence from the United Fruit Company' *Econometrica*, 90: 2685-2721

Morlacco, M. (2019) 'Market Power in Input Markets: Theory and Evidence from French Manufacturing' Mimeo.

Ornelas, E. (2005) 'Trade Creating Free Trade Areas and the Undermining of Multilateralism' *European Economic Review*, 49: 1717-1735

Rubens, M. (2023) 'Market Structure, Oligopsony Power and Productivity' *American Economic Review*,113: 2382-2410

Sexton, R., I.M. Sheldon, S. McCorriston and H. Wang (2007) 'Agricultural Trade Liberalisation and Economic Development: The Role of Downstream Market Power' *Agricultural Economics,* 36: 253-270

Yi, S. 'Endogenous Formation of Customs Unions Under Imperfect Competition: Open Regionalism is Good' *Journal of International Economics*, 41: 153-177

Zavala, L. (2022) 'Unfair Trade? Monopsony Power in Agricultural Value Chains' Mimeo.