Assessing the impact of dual production systems on Agri-food trade and trade policy

1. Introduction

Agri-food exporters, and exporters in general, often have to meet different standards depending on the target market (domestic or export). Sometimes they will employ 'dual production systems', with separate production systems depending on whether the product is for export or domestic consumption. In recent years, there has been growth in the number of dual production systems seen around the world. We live in a globalised economy, but often with localised setting of standards, so exporters are having to address whether and how they should produce for different markets. For example, there is evidence of a dual production system in Thailand's broiler industry: major integrated suppliers segregate export production farms from domestic farms and some processors are set up to satisfy specific requirements (Bowles et al., 2005).

However, there is little analysis of these dual production systems, and their impacts on Agri-food trade and linked trade policy. The approach suggested here is to use the latest GTAP model version 7, which allows for multiproduction[1]. By allowing for multiproduction in agricultural sectors, we can create competition between two commodities, produced by the same industry, which may have cost, and therefore price, differences. Therefore, any reduction in the prices of either commodity may see a shift in intermediate use by industries such as food processing and hospitality.

The analysis here will focus on meat treated with growth promoters. In 1981, the EU banned the use of growth hormones in farm animals (Council Directive 81/602/EEC)[2] to protect consumers from possibly harmful substances, so any country wishing to export to the EU is required to meet these restrictions. This had led to some countries using dual production systems, such as in Australia. Australian farmers have set up a dedicated cattle herd segregation and processing system for producing hormone-free beef for European markets (Meat & Livestock Australia).

These is just one example and similar dual production systems could become more widespread as consumer choices increasingly reflect a desire for certain production methods. For example, US pork producers stopped using Ractopamine (a growth promoting feed additive) because exporting to China, where it is banned, became so attractive. Similarly, animal-friendly products are increasingly considered healthier, safer, tastier, more hygienic and environmentally friendly (Alonso, González-Montaña & Lomillos, 2020). The link between consumer concerns and the policy response is also strong (Cook and Bowles, 2010) and there is some support in the literature for restrictions, aimed at protecting animal welfare, being justified under Article XX(a) of the GATT (Offor and Walter, 2017).

Dual production systems are likely to apply to numerous industries and countries so understanding the implications of these systems is important for trade policy and trade policy analysis. This paper explores the data requirements, and the possibilities for extra insights offered by this capability. The paper continues as follows. First there is a short literature review, followed

[1] Where an industry produces two or more commodities, or one commodity is made by several industries.

[2] Council Directive 81/602/EEC of 31 July 1981 concerning the prohibition of certain substances having a hormonal action and of any substances having a thyrostatic action.

by the proposed methodology. Then a scenario will be presented, alongside some initial results and the conclusions drawn from this.

2. Literature Review

GTAP model version 7 allows for some valuable new features, including the option to have multiproduction, but similar approaches have been used in the literature. Taheripour et al. (2010) introduce biofuel by-products into their CGE model and Selva (2018) uses a model that allows for both multi-input and multi-output production to analyse some of the key macroeconomic aspects of Nicaragua's energy plan. However, as yet, it doesn't seem to have been used to look at dual production systems in livestock markets, as this paper attempts to do.

Work ongoing.

3. Method

There are potentially a few approaches to this problem, as set out in Table 1 below. In this paper, we focus on two: two industries, two commodities; and one industry, two commodities which we feel are most appropriate to this work. The two industry, two commodity approach is an extension of the standard model, with the industry/commodity of interest being split out into more detail. The one industry, two commodity approach takes advantage of the new GTAP model version 7, which allows for multiproduction.

Table 1. A summary of the different approaches available.

Industry/ commodity	**One Industry**	**Two Industries**
One Commodity	Standard model.	Two industries producing the same commodity: This assumes that the two industries are separate but the commodity they produce is identical (not what we want here).
Two Commodities	One industry producing different commodities: the two outputs are different but compete for the same inputs.	Two completely separate industries producing different commodities. Extension of the standard model.

Two industries, two commodities

The approach taken in this paper is to split the cattle meat (CMT) sector into lamb and hormone and hormone-free beef. This approach is essentially an extension of the standard GTAP model, by disaggregating the standard 'cmt' or cattle meat sector into three more detailed sectors. The industry and commodity are split using SplitCom (Horridge, 2005). SplitCom can be supplied with comprehensive data on splitting GTAP flows. For this analysis, the data collection requires two steps. First, data is collected to split the old sector and commodities e.g. red meat, into the disaggregated sectors and commodities e.g. into beef and lamb. The data required for this step is as follows:

i. Bilateral trade data to split the GTAP trade flows. Trade data comes from the BACI[3] database (CEPII, http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=37, see Gaulier & Zignago, 2010) which uses UN COMTRADE data and provides bilateral trade flows for more than 5000 products and 200 countries.
ii. Production data to split the GTAP input flows. The assumption here is that each $ worth of the new commodities uses the same inputs[4], the exception being that each new commodity is only used as an intermediate input by itself so, for example all beef (new) used by cattle meat (old) is used by beef (new), and none of it is used by lamb (new). Production data comes from FAOSTAT.
iii. Consumption data to split the uses of the GTAP commodity. This assumes that the split proportion is the same for each use e.g. household consumption and intermediate use. Consumption data is more complex. Using data from the GTAP database, we apportion production, imports and exports using the shares from the above trade and production data. We then calculate *consumption = production – exports + imports.*

Step two is to split the new data for beef into hormone and hormone-free. This involves apportioning the previously collected data between compliant/non-compliant sectors. Preliminary data used for trade, input use, and consumption is available in the appendix. The final data is used in SplitCom to carry out the split. We now have new sectors including hormone and hormone-free beef, which together with lamb are three entirely new sectors with three separate industries producing three separate commodities. This can then be used to perform scenarios.

One industry, two commodities

SplitCom is designed to work with the 'classic' data format used by Version 6 of the GTAP model. It assumes that industries are single-output, and each commodity is made by just one industry, so no MAKE (Multiproduction) matrix is needed. The newer Version 7 of the GTAP model uses a different data format which allows for multiproduction and for the industry and commodity sets to differ. Where activities are producing multiple outputs, changes in the supply of a certain output depends on the overall level of output, as well as any shift in the mix of the commodities supplied by that sector.

Using programs included with GTAPAGG2 we convert data produced by Splitcom to the V7 format. Now, one industry can produce multiple commodities (the cattle meat industry can produce both hormone treated meat and hormone-free meat) which compete for the same inputs. The hormone/hormone-free industries are combined back into one industry, which is then used to run the GTAP model version 7.

[3] French acronym of "Base pour l'Analyse du Commerce International": Database for International Trade Analysis.
[4] This is a strong assumption, but necessary due to data and resource constraints.

4. Scenarios/Results

This section will offer a demonstration scenario, and results.

Two industries, two commodities

The scenario used is to combine a negative productivity shock, which is used to simulate the higher cost of production for hormone free beef – only where hormone beef is produced, with a multilateral reduction in beef tariffs. The shock used is a 25% tariff reduction on beef (both hormone & hormone free) for all regions. The impact on real exports from this scenario are presented in the tables below.

% change in real exports of hormone beef

*qxs[BeefHGP**]*	*Australia*	*New Zealand*	*USA*	*UK*	*EU_27*	*Rest of World*
Australia	0	0	-**4.958**	0	0	1.729
New Zealand	0	0	0	0	0	0
USA	**2.598**	0	0	0	0	-0.278
UK	0	0	0	0	0	0
EU_27	0	0	0	0	0	0
Rest of World	25.31	0	22.283	0	0	9.972

% change in real exports of hormone free beef

*qxs[BeefHGPfree**]*	*Australia*	*New Zealand*	*USA*	*UK*	*EU_27*	*Rest of World*
Australia	0	-11.287	-**8.092**	**30.686**	**28.271**	18.397
New Zealand	17.186	0	30.938	**72.09**	**78.919**	33.737
USA	-**13.461**	-12.008	0	**19.712**	**23.193**	9.482
UK	22.734	24.748	29.138	0	-1.706	38.133
EU_27	22.634	24.647	29.033	-2.897	0	54.109

Rest of World	-12.726	-11.189	-7.251	-2.281	5.581	1.543

% change in real export of beef (no hormone/hormone free split)

*qxs[Beef**]*	*Australia*	*New Zealand*	*USA*	*UK*	*EU_27*	*Rest of World*
Australia	0	-0.97	**-3.29**	**67.26**	**63.79**	17.46
New Zealand	1.26	0	5.36	**68.44**	**74.46**	1.45
USA	**1.93**	2.33	0	**60.6**	**63.46**	12.87
UK	2.52	2.92	0.5	0	-7.3	1.34
EU_27	2.54	2.93	0.51	-7.99		13.17
Rest of World	2.48	2.87	0.91	29.2	38.99	3.7

The key results are highlighted in bold. Trade between Australia and the USA. Australia, New Zealand and USA exports to the UK and EU.

Work in progress: To be completed.

5. Conclusions

This section will conclude the paper, highlighting key findings/issues. *Work in progress: To be completed.*

References:

Alonso, M.E., González-Montaña, J.R., & Lomillos, J.M., 2020. “Consumers' Concerns and Perceptions of Farm Animal Welfare”. *Animals : an open access journal from MDPI*, *10*(3), 385.

Bowles, D., Paskin, R., Gutiérrez, M., & Kasterine, A., 2005. “Animal welfare and developing countries: opportunities for trade in high-welfare products from developing countries.” *Revue scientifique et technique, 24 2*, 783-90.

Cook, K. and Bowles, D., 2010. “Growing pains: The developing relationship of animal welfare standards and the world trade rules.” *Review of European Community & International Environmental Law*, *19*(2), 227-238.

Gaulier, G and Zignago, S, 2010. “BACI: International Trade Database at the Product-Level. The 1994-2007 Version,” CEPII Working Paper 2010- 23, October 2010, CEPII.

Offor, I.I.H and Walter, J, 2017. “GATT Article XX(a) Permits Otherwise Trade-Restrictive Animal Welfare Measures”, 12, Global Trade and Customs Journal, Issue 4, 158-166.

Selva, A.C., 2018. The Economic Case for Renewable Energy: a Recursive Dynamic Model Analysis for the Nicaraguan Economy.

Taheripour, F., T.W. Hertel, W.E. Tyner, J.F. Beckman, and D.K. Birur. 2010. “Biofuels and their by-products: Global economic and environmental implications.” *Biomass and Bioenergy,* Volume 34, Issue 3, 278-289.

Appendix – tables to be added with data for split

Beef

How are the inputs split between hormone/hormone-free beef? It is estimated that the cost increase from not using growth hormones is 7-8%.

Region	**UK**	**EU27**	**USA**	**Australia**	**New Zealand**	**RoW**
% of production that is hormone treated	0%	0%	66%	40%	0.01%	10%
Source	*European Commission (2019)*	*European Commission (2019)*	*Congressional Research Service (2015)*	*Food Standards Australia (2011)*	*New Zealand Food Safety (2015-16)*	*Various*

Bilateral trade – what % of current trade flows are hormone treated? Set total exports of hormone beef equal to the hormone beef production shares, then set exports to the UK and EU equal to zero, and split exports among the remaining four countries according to their consumption shares.

Exporter (row) / importer (column)	**UK**	**EU27**	**USA**	**Australia**	**New Zealand**	**RoW**
UK	-	0%	0%	0%	0%	0%
EU27	0%	0%	0%	0%	0%	0%
USA	0%	0%	-	82%	0.01%	69%
Australia	0%	0%	77%	-	0.01%	26%

New Zealand	0%	0%	0.02%	0.01%	-	0.01%
RoW	0%	0%	18%	12%	0.01%	10%

How are the old uses split between the new sectors?

Region	**UK**	**EU27**	**USA**	**Australia**	**New Zealand**	**RoW**
% of consumption that is hormone treated	0%	0%	66%	40%	0.01%	10%