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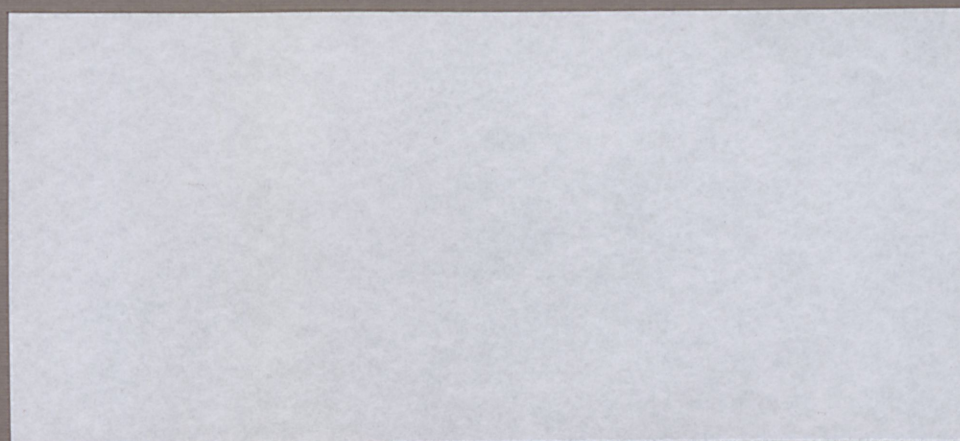
OCCASIONAL PAPER SERIES

INTRA-INDUSTRY TRADE AND SPECIALISATION IN PROCESSED AGRICULTURAL PRODUCTS: THE CASE OF THE US AND EC

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ABSTRACT

The literature on intra-industry trade emphasises imperfect competition as a determinant of such trade, and most of the empirical work has focussed on manufactured goods. However, given the growth in trade in processed agricultural products, particularly between developed countries, and given the structure of the food processing industries, then trade in processed products may also be intra-industry in nature. This paper, therefore, examines trade in high-value products for the US and EC using measures of intra-industry trade and specialisation. The results show intra-industry specialisation to be generally more important for the EC than the US.

INTRODUCTION

A considerable part of the growth in world trade, particularly between developed countries, is of an intra-industry nature, i.e. the simultaneous export and import of products which are very close substitutes for each other in terms of factor inputs and consumption (Tharakan). Since neoclassical trade theory cannot easily rationalise such a phenomenon, a substantial literature has emerged in recent years that attempts to explain such trade. These theoretical developments have emphasised the existence of imperfect competition in industrial markets, particularly the role of economies of scale and product differentiation. Perhaps the best-known models are those based on monopolistic competition by Krugman (1980), Lancaster and Helpman and those based on duopoly by Brander and Brander and Krugman[1].

Most of the empirical work on intra-industry trade has focussed on industrial products. However, given the nature of market structures in food processing and the extent of product differentiation, one may expect intra-industry trade to be a feature of trade in high value-added food and related products. This paper, therefore, applies measures of intra-industry trade and specialisation to establish the importance of such trade in a sample of processed agricultural products for the US and the European Community (EC). In addition, the nature of trade specialisation between developed country markets is assessed.

The paper is organised as follows. Section 1 gives a brief overview of world trade in processed agricultural products and Section 2 outlines the measures of intra-industry trade and specialisation used. The results are presented in Section 3 and Section 4 concludes with a short discussion of the direction of future research in this area.

1. World Trade in Processed Agricultural Commodities

In terms of quantity, bulk commodities such as wheat and soyabeans dominate world agricultural trade though, as one might expect, the value of trade is dominated by high-value products. For example, in 1988, world trade in high-value products amounted to $150 billion whilst bulk commodities were valued at $60 billion (FAO). Moreover, the value of world trade in processed products has been growing at a faster rate than bulk commodities since the mid-1970s.

Figure 1   World Trade in Processed Agricultural Commodities

U.S. Dollars (Billion)   Source: FAO

Bulk Products (Excluding Tropical)   Intermediate Stage HVP   Consumer-Oriented HVP (incl. EC intro)
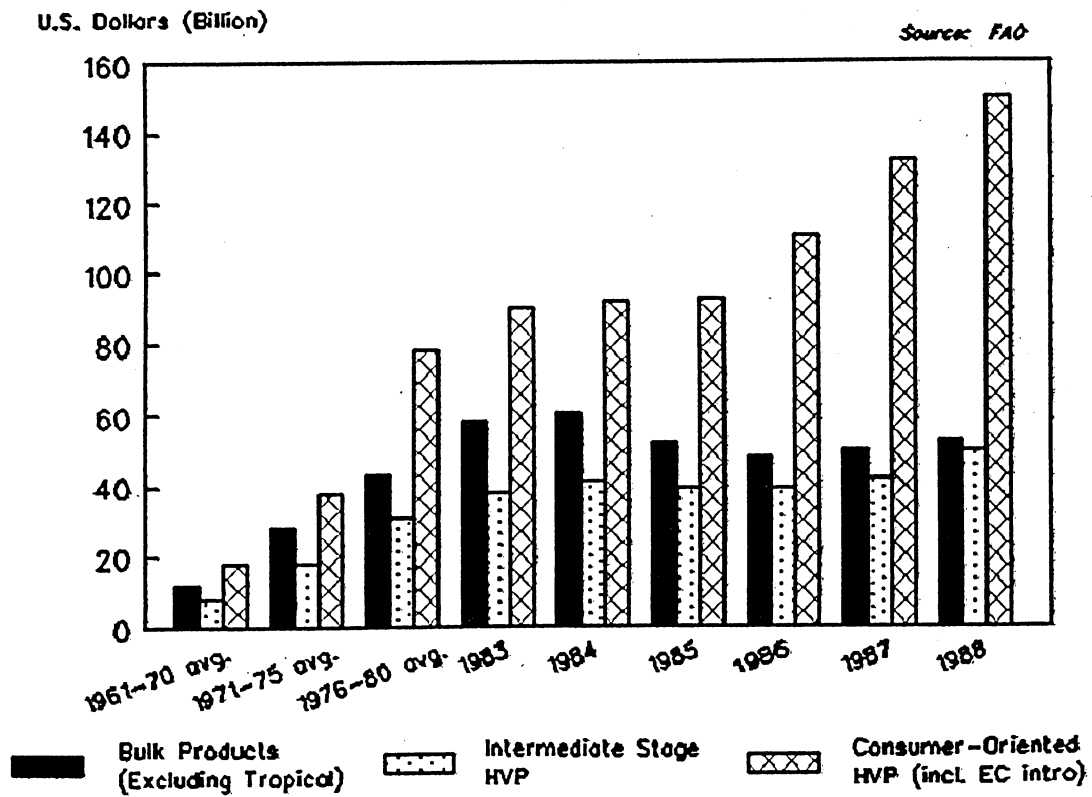
As Figure 1 shows, in the 1960s, bulk and processed commodities accounted for roughly equal shares of agricultural trade. However, by the end of the 1970s, processed products accounted for approximately half of world agricultural trade with bulk commodities accounting for around 30 per cent. High-value unprocessed commodities (such as eggs, fresh fruit and vegetables) constituted the remainder. Over the 1980s, world trade in processed products has continued to increase whilst the value of trade in bulk and intermediate products has stagnated or even diminished. For example, in 1988, processed products accounted for almost 60 per cent of world agricultural trade with bulk and intermediate products accounting for equal shares of the remainder.

Clearly, trade in processed products is the most dynamic sector of world agricultural trade. However, despite the importance of the US in world agricultural trade, trade in processed products is dominated by the European Community (EC). For example, as Table 1 shows, in 1988, US agricultural exports amounted to $40 billion with $12 billion being in processed products. High-value unprocessed and bulk products accounted for the remainder. However, processed products take a substantial share of EC countries' agricultural exports. For example, total agricultural exports for the Netherlands in 1988 totalled $25 billion with $21 billion of this being in processed products. For France, processed product exports were $15 billion out of total agricultural exports of $27 billion. For W. Germany and the UK, agricultural exports were largely in the form of processed products.

Table 1 Major Exporters of Agricultural Products - 1988
        ($ - billion)

Country	Total Exports	Processed Products	Intermediate Products	Bulk Products
US	40.0	11.9	7.7	20.3
France	27.1	15.4	4.8	6.0
Netherlands	24.9	20.7	3.6	0.6
W. Germany	16.6	12.5	3.3	0.9
UK	10.0	7.6	1.7	0.8
Australia	9.9	3.1	4.8	1.9
Canada	8.9	2.6	1.4	4.9

Source: FAO Trade Yearbooks

The increasing importance of trade in processed products has, in recent years, received attention in US trade policy debates (see Choices). In particular, it has been argued by many observers that export subsidies should be directed at processed products. There are two related reasons for targeting export subsidies: first, given the strong position of the EC, the US should use subsidies on processed products to counter the export restitutions offered to European exporters; second, targeting export subsidies would increase domestic economic activity in the US since the income multipliers for high-value products are estimated to be 50 percent higher than those for bulk exports due to the extra employment and other activity generated by food processing (Henderson).

This paper focusses on patterns of trade and specialisation in processed products with the emphasis being on the US and the EC. In particular, the aim is to ascertain the importance of intra-industry trade and specialisation in these products. The emphasis on intra-industry trade is important for two broad reasons. First, most empirical work on intra-

industry trade has focussed almost entirely on manufactured goods with agricultural commodities, if highlighted at all, being confined to high levels of aggregation. Hence, part of the purpose here is to analyse the structure and patterns of trade at a more disaggregated level. *A priori*, it is expected that intra-industry trade will be important since, in both the US and EC, these industries have imperfectly competitive market structures, characterised by high seller concentration, some degree of plant level economies of scale and product differentiation[2].

Second, intra-industry trade gives rise to potentially important policy implications. It has been suggested that if trade is of an intra-industry nature then industrial adjustment to competitive forces will be easier than if it were inter-industry in nature (see Greenaway and Milner for a discussion). Although there have been few studies to support this contention, the basis for it is that, if industries are characterised by product differentiation, then it is easier to adjust product lines than it is to undertake industrial restructuring implied by inter-industry trade. Furthermore, given the role of imperfect competition as an important determinant of intra-industry trade, rent-shifting arguments that advocate a role for government intervention through the use of export subsidies or import tariffs may become applicable to the agricultural processing sector[3].

The processed products discussed in this paper follow the definition of Elleson. The products include processed meat, cheese, cereal preparations, processed fruit, processed vegetables, non-chocolate sugar preparations, chocolate and cocoa-based products and manufactured tobacco products[4]. As Table 2 shows, EC exports are substantially larger than those of the US in all of these categories. However, it should be noted that a

considerable proportion of EC trade occurs within the Community. The following sections outline the measures of intra-industry trade and estimate the importance of such trade in these products.

Table 2 Share of World Trade in Processed Products: US and EC (%)

| | United States | | EC-9 | | | |
Product	1977	1986	1977	of which intra-EC trade	1986	of which intra-EC trade
Processed Meat	3	2	92	65	92	66
Cheese Products	1	1	78	60	82	62
Cereal Preparations	11	5	74	39	80	49
Processed Fruit	21	16	45	38	76	59
Processed Vegetables	10	4	58	46	79	53
Sugar Products	6	3	77	44	79	42
Chocolate Products	3	3	83	63	78	57
Tobacco Products	35	35	54	36	61	46

Source: OECD

2. Measuring Intra-Industry Trade and Specialisation

The measurement of intra-industry trade has been dominated by the measures suggested by Balassa and Grubel and Lloyd. In this paper, the Grubel and Lloyd index is used which, adjusted for imbalance in aggregate trade, is shown in (1):

(1)

$$IIT_{jki} = 1 - \frac{\dfrac{X_{jki}}{X_{jk}} - \dfrac{M_{jki}}{M_{jk}}}{\dfrac{X_{jki}}{X_{jk}} + \dfrac{M_{jki}}{M_{jk}}}$$

where X_{jki} and M_{jki} stand for exports and imports of industry i in trade between countries j and k. The index tends towards one in the case of intra-industry trade and zero for inter-industry trade.

As it stands, this index gives an indication of the structure of trade in any given year but does not allow tests of statistical significance for changes in trade patterns over time. In order to deal with this, an adjustment to the Glejser, Goosens and Vanden Eede measure is presented. This is an index of either export or import specialisation which measures the changes in an individual country's trade relative to changes in total trade of a group of countries[5]. For example, if a country's exports increase at a rate equal or less than that for the group, this represents intra-industry specialisation. However, if exports change at a faster rate than that of the group, this is inter-industry specialisation.

In order to measure intra-industry specialisation for a single product, an adjustment to the Glejser *et al* measure can be made. Focussing on exports, the following coefficient can be calculated:

(2)

$$\xi^f = \frac{1}{m} \sum_{k=1}^{m} \log \left[\frac{X_{kj}^f / X_{kj}}{X_g^f / X_g} \right] - \frac{1}{m} \sum_{k=1}^{m} \xi_{kj}^f$$

where ξ^f = total intra-industry specialisation of product f

m = number of countries

X_{kj}^f = exports of product f from country k to any other country j

X_{kj} = total exports of all products from country k to any other country j

X_g^f = total intra-group exports of product f

X_g = total intra-group exports of all products

If intra-industry specialisation within the area is a predominant feature of trade in product f, the above ratios will be close to 1 (close to zero after taking logs). Further, if intra-industry specialisation in product f is important for any particular country with the rest of the group, we would expect the variance to be small as given below:

(3)

$$\frac{1}{m} \sum_{k=1}^{m} (\xi_k^f - \xi^f)^2 = S^2_{\xi_k^f}$$

where ξ_k^f equals $\Sigma \xi_{kj}^f$, i.e. the sum of exports of f from k to all other j.

This can be used to ascertain whether intra-industry specialisation in product f for country k to all j has increased significantly over time, i.e. the variances should be significantly smaller (using an F-test). This is given by:

(4)

$$S^2_{\xi_k^{ft}} / S^2_{\xi_k^{ft'}} = p \ where \ t \neq t'$$

This measure can also be adjusted to allow for a test of whether intra-industry specialisation for country k differs between countries for product f. Disaggregating overall trade patterns may be important since the nature of specialisation may vary between any group of countries. Therefore, in order to test whether US and EC trade in product f exhibits differing patterns of specialisation between countries, the following variance is calculated:

(5)

$$\frac{1}{m} \sum_{k=1} (\xi_{kj}^f - \xi^f)^2 = S^2_{\xi_{kj}^f}$$

To compare growth in intra-industry specialisation from k to any particular j for product f over time, the following test is appropriate:

(6)
$$S^2_{\xi^{ft}_{kj}} / S^2_{\xi^{ft'}_{kj}} = r \ where \ t \neq t'$$

where the null hypothesis is that no specific patterns of changes in intra-industry specialisation should emerge over time.

3. Results

Using the Grubel and Lloyd measure shown in (1), the nature of trade with the world for the US, the EC and the remainder of the OECD in processed agricultural products was calculated for 1986.

Table 3 Intra-Industry Trade in Processed Agricultural Products[1]: 1986

Product	US	EC-9	Rest of OECD
Processed Meat	0.25	0.97	0.64
Cheese Products	0.21	0.97	0.92
Cereal Preparations	0.94	0.85	0.76
Processed Fruit	0.73	0.79	0.26
Processed Vegetables	0.53	0.95	0.79
Sugar Products	0.36	0.82	0.81
Chocolate Products	0.54	0.93	0.88
Tobacco Products	0.06	0.85	0.50

[1]As value tends to 1, this indicates intra-industry trade.

The results, shown in Table 3, indicate that EC trade in all processed products tended to be of an intra-industry nature. In the case of the US, however, trade tended to be mainly of an inter-industry nature with the notable exceptions of cereal preparations and processed fruit. For the rest of the OECD, intra-industry trade was the dominant feature, though trade in processed fruit was inter-industry in nature. Two points arise from these results. First, the lower levels of intra-industry trade for the US relative to the EC in processed products accords with overall patterns of intra-industry trade for the US in all products (see Grimwade). Second, where the results indicate intra-industry trade, they are of a similar order of magnitude to other industrial goods and higher than values recorded for agricultural products[6]. These results emphasise the importance of choosing suitably disaggregated data when measuring intra-industry trade since aggregated product groups such as "Food and Live Animals" may hide the importance of intra-industry trade at a more disaggregated level of product definition.

As pointed out in the previous section, the Grubel and Lloyd measure cannot be used to assess whether there have been statistically significant changes in trade patterns over a given period of time. Therefore, using (2) and (3) to carry out the test suggested in (4), the extent to which trade patterns with the rest of the world for the US, EC and the rest of the OECD have changed over the period 1977 to 1986 is measured. The results are shown in Table 4[7]. The predominant feature of specialisation in processed agricultural products appears to be inter-industry in nature. Of the twenty-four entries in the table, only eight indicate intra-industry specialisation with four of these being statistically significant. Sixteen of the entries indicate inter-industry specialisation with three of these being statistically

significant. Two additional features of Table 4 are notable. First, along product lines, trade in chocolate products indicates intra-industry specialisation with one of these being statistically significant whilst two statistically significant changes in intra-industry specialisation are indicated for processed vegetables. Second, most of the statistically significant changes in trade specialisation (inter- or intra- in nature) originate from the rest of the OECD grouping. It is notable that specialisation for the EC is predominantly inter-industry in nature.

Table 4 Trends in Industry Specialisation in Processed Products: 1977-1986

Product	US	EC-9	Rest of OECD
Processed Meat	Inter	Inter	Inter
Cheese Products	Intra	Inter	Intra
Cereal Preparations	Inter	Inter	Intra*
Processed Fruit	Inter	Inter	Inter
Processed Vegetables	Intra*	Inter*	Intra*
Sugar Products	Inter	Inter	Inter*
Chocolate Products	Intra	Intra	Intra*
Tobacco Products	Inter	Inter	Inter*

* Significant at the 5 per cent level

The results appear to refute the hypothesis that intra-industry specialisation in processed agricultural products would have increased over time. However, it may be the case that even though inter-industry specialisation has been recorded as the predominant feature of overall trade in these products, the geographical pattern of trade may exhibit intra-industry specialisation over time. In particular, the growth of trade between countries

of similar income levels with low barriers to trade and/or with common borders may be expected to tend towards intra-industry specialisation. Therefore, using (5) to carry out the test suggested in (6), the geographical distribution of exports of each product by the US and the EC to other developed countries was estimated over the period 1977 to 1986. The results are shown in Tables 5 and 6 for the US and EC respectively.

Table 5 Trends in Industry Specialisation in Processed Products: 1977-1986 - United States

Product	US Exports to:			
	Oceania[1]	Canada	EC-9	Other Europe[2]
Processed Meat	Inter	Intra*	Inter	Inter*
Cheese Products	Intra*	Intra*	Inter	Inter
Cereal Preparations	Intra	Intra*	Intra	Inter
Processed Fruit	Inter*	Intra*	Intra	Inter
Processed Vegetables	Inter	Intra*	Intra*	Inter
Sugar Products	Inter	Inter	Inter	Inter*
Chocolate Products	Inter	Inter	Inter*	Intra
Tobacco Products	Inter*	Intra*	Inter*	Inter

[1]Defined as Japan, New Zealand and Australia
[2]Excludes Eastern Europe

* Significant at the 5 per cent level

With reference to the results for the US, Table 5 indicates that whilst intra-industry specialisation is apparent between the US and other developed countries, inter-industry specialisation is still the predominant feature of US trade in processed products. Twenty of the thirty-two entries indicate inter-industry specialisation with six of these being

statistically significant whilst twelve entries show intra-industry specialisation with eight being statistically significant. However, a particularly notable feature of Table 5 is that most of the statistically significant changes in intra-industry specialisation for the US were accounted for by trade between the US and Canada. Trade between the US and Europe indicated inter-industry specialisation for most of the processed products considered.

Table 6   Trends in Industry Specialisation in Processed Products: 1977-1986 - EC-9

| Product | EC-9 Exports to: | | | | |
	Oceania[1]	US	Canada	EC-9	Other Europe[2]
Processed Meat	Inter*	Intra*	Inter	Intra*	Intra
Cheese Products	Intra	Inter*	Intra*	Inter	Intra*
Cereal Preparations	Inter	Intra*	Intra	Inter*	Intra*
Processed Fruit	Intra	Intra	Inter	Intra	Intra*
Processed Vegetables	Intra*	Inter	Intra*	Intra*	Inter*
Sugar Products	Intra*	Intra	Intra*	Intra*	Intra
Chocolate Products	Intra	Intra*	Intra	Intra	Inter*
Tobacco Products	Intra*	Intra*	Inter*	Inter	Intra

[1]Defined as Japan, New Zealand and Australia
[2]Excludes Eastern Europe

* Significant at the 5 per cent level

In contrast with the US, intra-industry specialisation is more apparent for the EC. Of the forty entries recorded in Table 6, twenty-seven of these were intra-industry in nature with sixteen of these being statistically significant. With reference to the thirteen entries indicating inter-industry specialisation, six of these were statistically significant. In the case

of intra-industry specialisation, six of the statistically significant changes occur with European countries (both EC and other Europe), the remainder being divided almost equally between the US, Canada and Oceania respectively. In terms of specific processed products, no pattern of specialisation emerged, although six of the sixteen statistically significant changes of an intra-industry nature occurred in processed vegetables and non-chocolate sugar products categories.

In summary, for the processed agricultural products reviewed, the Grubel and Lloyd measure indicates that in 1986 the structure of trade with the world for the EC was of an intra-industry nature whilst that for the US was inter-industry in nature. However, in focussing on the changes in trade between 1977 and 1986, total trade with the world tended to be inter-industry specialisation for both the US and EC. Given that trade in processed products between developed countries may differ from the general pattern characteristics of world trade, the measure was used to focus on geographical patterns of trade for the US and EC. The results indicate different general patterns of specialisation for the US and EC. Specifically, for all processed products, EC specialisation was largely intra-industry in nature whilst for the US it was predominantly inter-industry in nature. A principal exception to the latter case is trade between the US and Canada which indicated intra-industry specialisation.

Whilst the aim of this paper is only to ascertain the importance of intra-industry trade and specialisation in processed commodities for the US and the EC, it is nevertheless interesting to identify some possible reasons for the differences in specialisation observed for the two countries. Econometric studies of intra-industry trade have identified certain factors that largely explain the growth and levels of intra-industry trade. These are listed

in Table 7. However, given that market structures for processed agricultural commodities will be broadly similar for the US and EC, a large number of the factors listed in Table 7 would not appear to be relevant in explaining the different patterns of trade observed in this paper.

Table 7 Factors Affecting the Level of Intra-Industry Trade

1. Taste Similarity
2. Product Differentiation
3. Scale Economies
4. Number of Firms in Differentiated Goods Markets
5. Oligopolistic Interdependence in Homogeneous Goods Markets
6. Technological Factors, Vertical Differentiation
7. Proximity to Markets
8. Extent of Tariff and Non-Tariff Barriers to Trade
9. Extent of Foreign Direct Investment

Source: Greenaway and Milner

However, three factors from Table 7 would appear to be relatively important. The first two relate to the role of distance from foreign markets and access to markets. Specifically, for the EC, economic integration, proximity to Community and other European markets as well as economic ties with ex-colonial countries are likely to influence the extent of intra-industry trade. Proximity to markets is likely to be the main explanation for intra-industry specialisation observed between the US and Canada.

Further, some industry characteristics may be important. As Balassa and Bauwens have shown, foreign direct investment tends to act as a substitute for international trade. Related to this point, Norman and Dunning argue that intra-industry foreign direct

investment[8] may also be a substitute for intra-industry trade and report high values for this phenomena for the US in a range of processed food products[9]. Therefore, the role of multinationals may in part explain the predominance of inter-industry specialisation for the US since a number of leading US food processors have plants overseas. Moreover, as Handy and MacDonald have pointed out, the focus of US foreign direct investment in food processing activity has been increasingly towards Europe. The role of foreign direct investment may also account for the US's relatively lower share of trade in processed products discussed in Section 2.

4. Summary and Conclusion

Most studies of intra-industry trade have focussed on manufactured goods, trade in agricultural commodities being identified as (or assumed to be) inter-industry in nature. This paper has focussed on trade in processed agricultural products, production and competition in this category of agricultural commodities being characterised by imperfect competition, a principal determinant of intra-industry trade. In general, analysis of trade for the US and EC to other developed countries highlighted an important difference in the patterns of specialisation. Specifically, trade in processed agricultural products for the US was predominantly characterised by inter-industry specialisation (with the exception of exports to Canada) whilst EC trade was characterised by intra-industry specialisation. Proximity to markets, economic integration and the role of foreign direct investment by US processors were suggested as the main reasons for explaining these trade patterns.

Analysis of processed food markets, the most dynamic sector of agricultural trade, is an important topic for future research. Two broad areas would appear to be important. First, in the context of this paper, more empirical work on the level and determinants of intra-industry trade in processed agricultural commodities is necessary. Although some possible reasons have been suggested for the trade patterns observed, this is no substitute for formal econometric analysis. Second, given that such intra-industry trade is characterised by imperfect competition, the role of government policy when such factors are relevant is clearly important. Most of the work carried out on agricultural trade issues has largely focussed on bulk commodities and has assumed perfectly competitive market structures. However, given that processed agricultural products and imperfect competition are increasingly important in agricultural trade, greater attention needs to be given to policy concerns in this area.
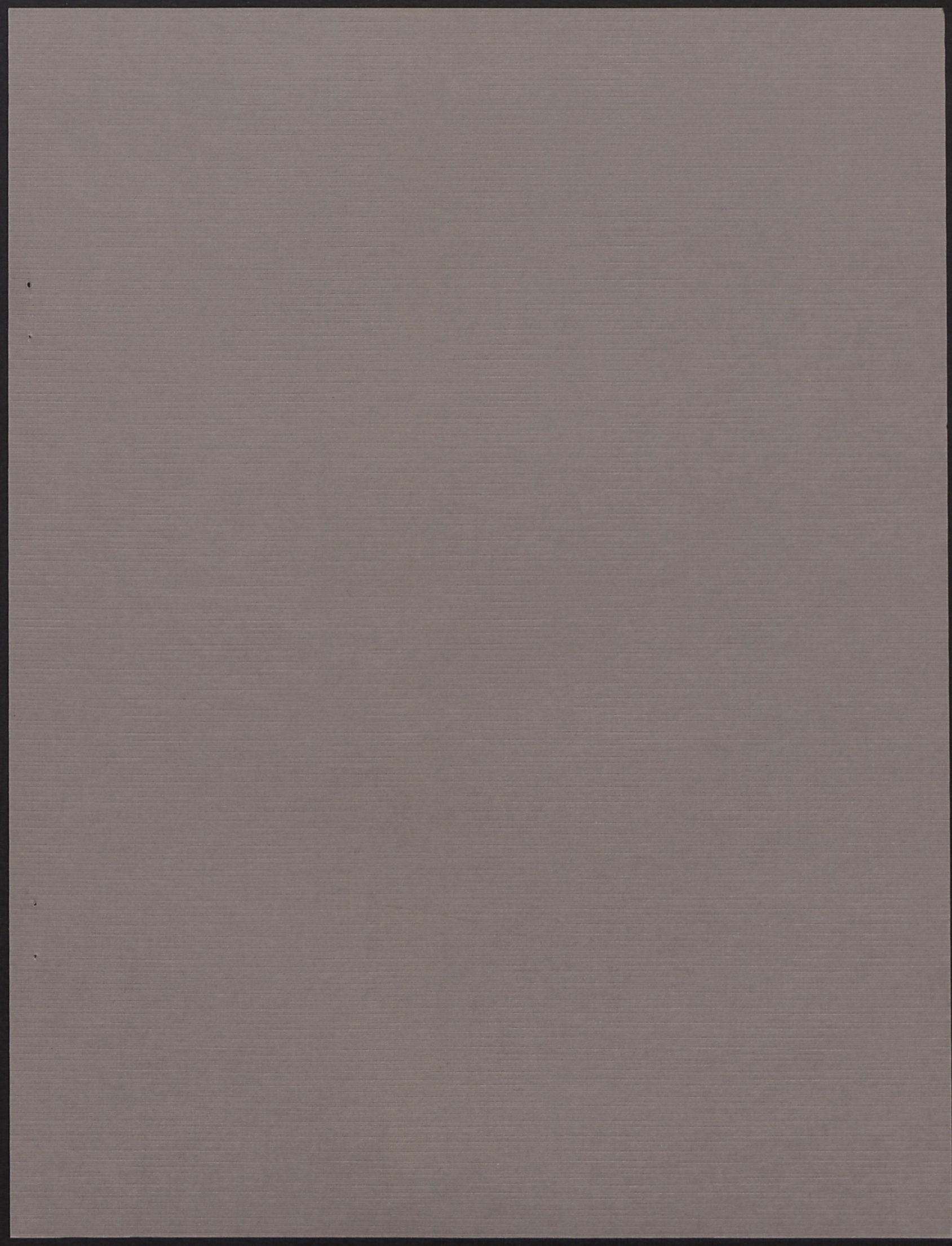
NOTES

1. The common theme to the theories of intra-industry trade is the relationship between the structure of trade and the nature of competition. For example, with a market structure of monopolistic competition, the existence of economies of scale and free entry will limit the extent of product differentiation in a given product market under autarchy. However, trade between two countries expands the market and hence the range of products, and because some are produced in one country and some in another, the structure of trade is intra-industry in nature (see Sheldon for further discussion).

2. See Connor *et al.* for an overview of the US food industries and OECD for details of the European food processing sector.

3. See Krugman (1986) for a review and discussion of the literature relating to strategic trade policy.

4. The product groups are defined according to SITC categories: Processed meat - 012 + 013, cheese products - 024, cereal preparations - 048, processed fruit - 058, processed vegetables - 056, non-chocolate sugar preparations - 062, chocolate and cocoa-based products - 073, manufactured tobacco products - 122.

5. See Kol and Mennes for a discussion of the properties of this measure.

6. For example, Greenaway and Milner report values of 0.35 for agriculture and 0.69 for manufactured goods for the UK in 1977.

7. The data used and the estimated variances are available from the authors on request.

8. Intra-industry foreign direct investment (FDI) can be defined as two-way FDI by multinational enterprises based in different countries, in each other's home market, to produce goods and services that are close substitutes in either consumption or production (Erdilek).

9. Using the Grubel and Lloyd index, intra-industry FDI for the US in the early 1970s for selected food products were reported as: dairy products - 0.70; canned foods - 0.77; grain mill products - 0.35; confectionary products - 0.29; beverages - 0.64; tobacco - 0.66.

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