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Evolving Patterns of Agricultural Trade between Australia and China [1]

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Abstract

Agricultural trade between Australia and China has increased significantly in recent years and the momentum is likely to continue. However, concerns exist in both countries over the likely negative impacts of the increased agricultural trade on their domestic industries. This paper examines agricultural trade patterns between Australian and China and addresses the question as to whether agricultural trade between them is competitive or complementary. Our study shows that agricultural trade between the two countries is set to further increase and there is a high level of agricultural trade complementarity between the two countries. Increased agricultural trade is unlikely to generate much negative impacts on their agricultural sectors as a whole, although producers in some industries may be adversely affected to some extent. In general, both countries will benefit from the expansion of agricultural trade between them.

1. Introduction

Trade between Australia and China has been fast expanding in the recent decade and China has now become Australia's second-largest export market (DFAT 2005). In particular, Australia's agricultural exports to China have increased rapidly with total value almost trebling over the past decade to reach A$2.5 billion in 2004. This makes China Australia's third-largest agricultural export market. Driven by the effects of fast economic growth, higher incomes and rapid urbanisation, China's demand for agricultural products is expected to continue to rise, so is the demand for agricultural imports (Chen 2004, DFAT 2005, Wang and Zhou 2005, Zhou, et al. 2005).

China’s demand for increased agricultural imports presents enormous opportunities for Australian agricultural exports to this growing market. Following the conclusion of an Australia-China free trade agreement (FTA) feasibility study in March 2005, the two governments agreed in April 2005 to commence negotiations for an FTA. If signed, this proposed FTA would further facilitate Australia’s agricultural exports to China.

However, in both Australia and China, there are concerns over free agricultural trade between the two countries. In Australia, producers in some industries are worried about the imports of large amounts of cheaper Chinese agricultural products. In the mean time, Chinese farmers and more so the policy makers are concerned that under the proposed FTA, cheaper Australian agricultural products will injure China’s agricultural industries, particularly those industries which many Chinese farmers’ livelihood is still dependent upon. The inclusion of agriculture and the subsequent negotiation for agreement on agricultural trade has been one of the most difficult and challenging areas in the bilateral FTA negotiations.

Then, is the agricultural trade between Australia and China competitive or complementary? The primary objective of this paper is to ascertain this question. The paper will investigate the major trends of and changes in the bilateral agricultural trade between Australia and China; examine comparative advantages and trade complementarity associated with the two countries’ agricultural trade, and draw implications for promoting future agricultural trade and cooperation between Australia and China.

In the next section, we first highlight Australia-China agricultural trade dynamics. Section 3 analyses their agricultural trade complementarity. Section 4 addresses the likely prospects of agricultural trade between Australia and China. In the last section, conclusions and implications are drawn.

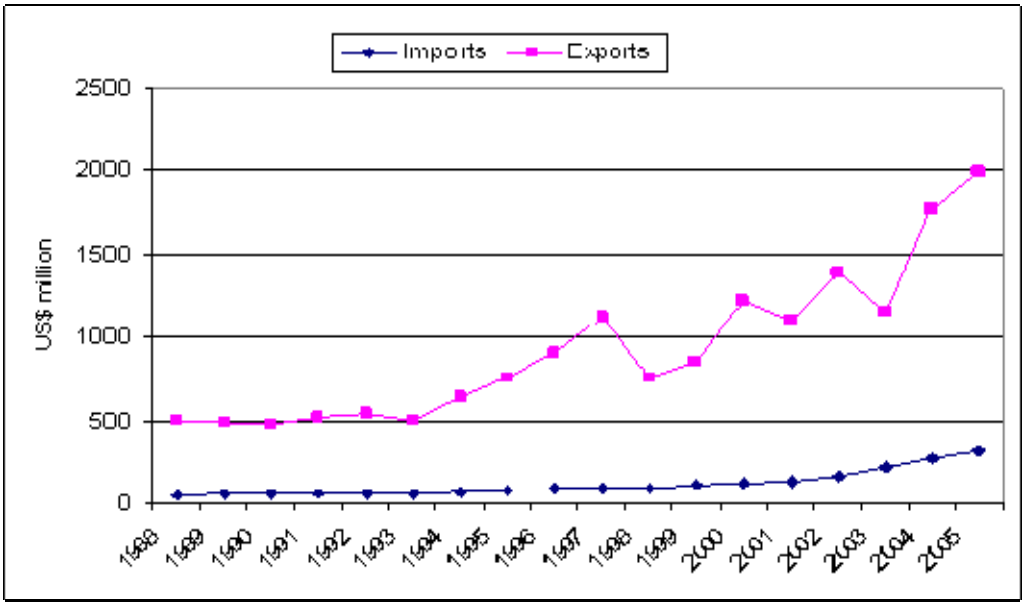
2. Australia-China Agricultural Trade Dynamics

There are different methods to classify agricultural products for trade statistics. One classification adopted in the United Nations Comtrade Database, i.e., the Standard International Commodity Classification (SITC revision 3), has been widely used in the literature.[2] According to SITC, traded agricultural products include “food” and “agricultural raw material”. “Food” includes SITC0 (Food and Live Animals), SITC1 (Beverages and Tobacco), SITC4 (Animal and Vegetable Oils, Fats and Waxes). The subgroup SITC22 (Oil Seeds and Oleaginous Fruits) of SITC2 (Crude Materials, Inedible, except Fuels) is also placed in “food”. “Agricultural raw material” includes several subgroups of SITC2 (Crude Materials, Inedible, except Fuels), i.e., SITC21 (Hides, Skins and Furskins, raw), SITC23 (Crude Rubber), SITC25 (Pulp and Waste Paper), SITC26 (Textile Fibres), and SITC29 (Crude Animal and Vegetable Materials). In this study, we make use of data from the United Nations Comtrade Database SITC Revision III and “agricultural products” include SITC0 (Food and Live Animal), SITC1 (Beverages and Tobacco), several subgroups of SITC2 (Crude Materials, Inedible, except Fuels), namely, SITC21(Hides, Skins and Furskins, raw), SITC22 (Oil Seeds and Oleaginous Fruits), SITC26 (Textile fibres), and SITC29 (Crude Animal and Vegetable Materials), and SITC4 (Animal and Vegetable Oils, Fats and Waxes). In this study, all the analyses of the bilateral trade and calculations of the indices are based on the values of Australia’s exports to China and Australia’s imports from China.

2.1 General trends

The volume of Australia's agricultural trade with China was relatively small before 1994 but it has shown a strong increasing trend since then. The increase in the most recent years has been very remarkable, with imports and exports enjoying average annual growth rates of 16.5% and 15.0%, respectively, during 1994-2005 (see Figure 1).[3] In addition, Australia's exports to China have been far greater than its imports from China, resulting in a large trade surplus in favour of Australia. This highlights the importance of China as a market for Australian agricultural products.

Figure 1. Australia's Agricultural Trade with China

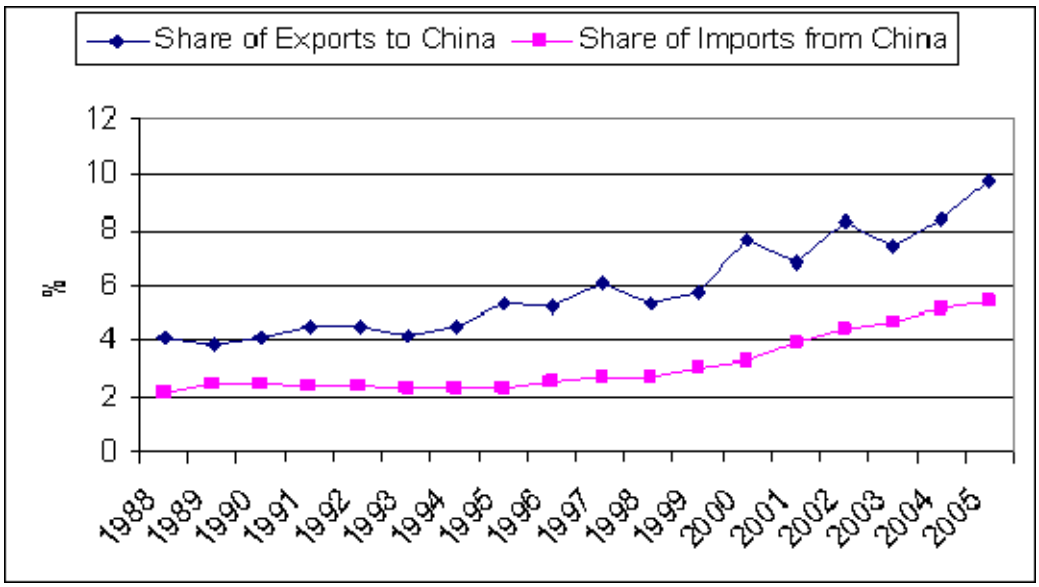


Source: Based on data extracted from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

In terms of the share of Australia's agricultural imports from China out of its total agricultural imports, it has been increasing steadily, reaching 5.4% in 2005. Its share of agricultural exports to China out of its total agricultural exports has also been increasing and reached 9.8% but it tends to fluctuate (Figure 2). Unstable production level of Australia's agricultural products due to changes in weather and other conditions and China's adjustments in production and trade policies are likely responsible for such fluctuations.

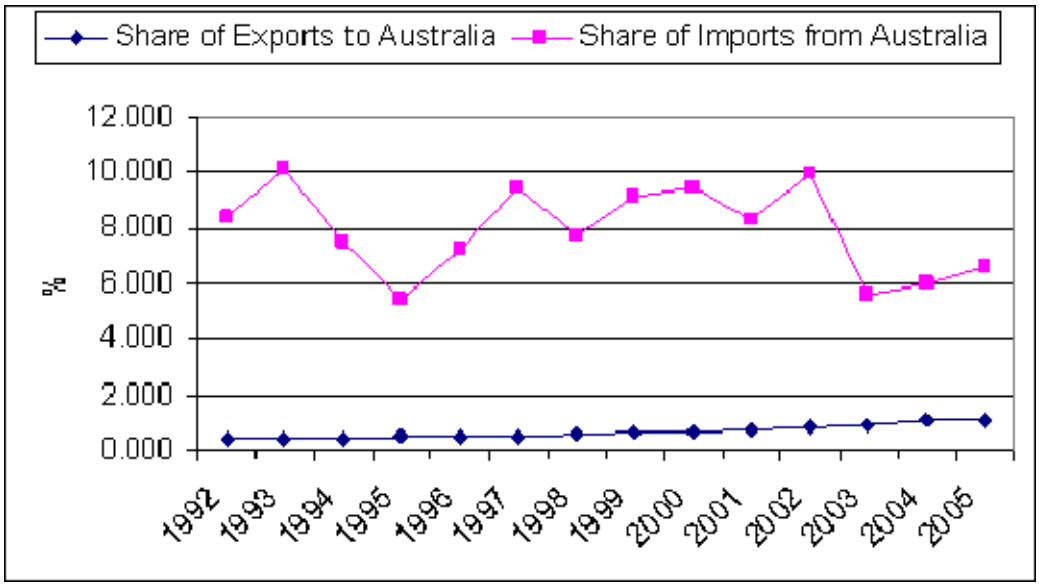
The share of China's exports to Australia out of its total agricultural exports has been increasing steadily. This share has been, however, very small, being only 1.1% in 2005, suggesting Australia is not China's major agricultural export market. On the other hand, its share of agricultural imports from Australia out of its total agricultural imports did not register an increase; instead, it has dropped from a peak of 10.1% in 1993 to 6.6% in 2005. This share has also fluctuated, and sometimes greatly, over the years (Figure 3). The recent decline in shares of imports from Australia might be due to even faster increase in China's imports from Southeast Asian countries and the US. For example, China offered 'early harvest deal' to major ASEAN countries such as Thailand, the Philippines and Malaysia (Ministry of Commerce).

Figure 2. Share of Australian Agricultural Exports to and Imports from China out of its Total Agricultural Exports/Imports



Source: Based on data extracted from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

Figure 3. Share of Chinese Agricultural Exports to and Imports from Australia out of its Total Agricultural Exports/Imports



Source: Based on data extracted from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006.

At the disaggregate level, Australia's major agricultural imports from China are food and live animals (SITC0). The share of Australia's food and live animals imports from China out of its total agricultural

imports from China was as high as 83% in 2005, increased from 71% in 1990 (see Table 1). Under SITC0, major commodity items imported include fish, crustaceans and molluscs (SITC03, 5.8% in 1990 and 22.3% in 2005), vegetables and fruits (SITC05, 38.5% in 1990 and 29.5% in 2005). The share of vegetable imports has increased while that of fruit imports has declined. Australia's imports of sugar confectionary from China have increased from 0.6% in 1990 to 7.3% in 2005. Beverages and tobacco imports from China have also increased.

Table 1. Share of Australia's Agricultural Commodity Imports from China out of its Total Agricultural Imports from China (%)

Code	Item	1990	1995	2000	2004	2005
0	Food and live animals	70.82	74.74	73.35	84.49	83.15
03	Fish, crustaceans, mollusc	5.84	12.11	9.30	21.16	22.27
036	Crustaceans, molluscs etc	2.69	6.55	3.84	15.37	15.65
04	Cereals and cereal preparations	3.38	4.57	10.35	10.63	9.51
048	Cereal preparations	3.13	4.47	9.76	9.21	8.98
05	Vegetables and fruit	38.54	37.10	34.97	29.98	29.53
054	Vegetables	2.73	4.45	5.95	5.35	5.41
057	Fruit, nuts ecl. oil nuts	10.97	8.42	4.77	4.21	3.82
06	Sugars, sugar preparations and honey	1.07	1.67	4.92	8.82	9.24
062	Sugars, sugar preparations and honey	0.57	1.05	4.18	7.14	7.31
09	Miscellaneous edible products and preparations	7.17	12.63	10.06	9.10	7.77
098	Edible prod. preprtns, nes	7.15	12.63	10.06	9.09	7.77
1	Beverages and tobacco	0.79	2.90	9.07	5.77	6.75
12	Beverages	0.27	2.64	8.79	4.38	5.76
29	Crude animal and vegetable materials	7.81	12.81	9.22	4.86	4.22

Source: Based on data extracted from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

Table 2 presents the share of Australia's agricultural commodity exports to China out of its total agricultural exports to China. This share for some export items have fluctuated between years and sometimes, dramatically. Textile fibres (SITC26) are the major exports to China accounting for 65% of Australia's total agricultural exports to China in 2005. Textile fibre exports are chiefly composed of cotton (SITC263, increased from 5.6% in 1990 to 14.3% in 2005) and wool (SITC268, increased from 22.8% in 1990 to 50.7% in 2005). The share of food and live animal exports fluctuated and has declined over time. It was 67.3% in 1990 but drooped to 20.2% in 2005. Under food and live animals, major commodity items exported include fish, crustaceans and molluscs (SITC03, 0.2% in 1990 and 4.6% in 2005), and barley (SITC043, 22.2% in 1990 and 6.1% in 2005). The share of barley exports was very unstable. Other major commodity exports include hides, skins and furskins (SITC21) and animal and vegetable oils, fats and waxes (SITC4).

The analysis in this section suggests that Australia chiefly exports land-intensive commodities to China while China mainly exports labour-intensive products to Australia. China is increasingly becoming Australia's major agricultural export market but Australia is not China's major export market. The

importance of the Chinese market to Australian exports is increasing. China's unstable pattern of imports from Australia may have some ramifications on Australia's export efforts. The likely signing up of a free trade agreement is expected to further promote agricultural trade between Australia and China.

Table 2. Share of Australia's Agricultural Commodity Exports to China out of its Total Agricultural Exports to China

Code	Item	1990	1995	2000	2004	2005
0	Food and live animals	67.33	6.61	20.03	22.60	20.21
00	Live animals	0.24	0.02	0.56	5.78	2.33
01	Meat and meat preparations	0.58	2.22	1.88	2.94	2.63
02	Dairy products and birds' eggs	0.44	0.65	1.86	2.61	2.01
03	Fish, crustaceans, mollusc	0.20	0.98	1.58	3.16	4.60
04	Cereals and cereal preparations	65.54	0.36	12.56	6.37	6.86
043	Barley	22.19	0.00	12.49	5.95	6.10
21	Hides, skins and furskins, raw	0.27	4.67	6.47	7.91	6.50
26	Textile fibres	28.38	81.28	53.48	60.14	65.03
263	Cotton	5.61	3.72	0.97	8.71	14.29
268	Wool and other animal hair	22.75	77.36	52.41	51.43	50.74
29	Crude animal and vegetable materials	1.86	1.70	1.74	2.85	2.70
4	Animal and vegetable oils, fats and waxes	2.14	5.65	3.62	6.07	4.29

Source: Based on data extracted from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

2.2 Trade intensity

While the preceding section examined the general trend of agricultural trade between Australia and China, this issue is to be further investigated by using popular analytical techniques. To start, this section looks at trade intensity between the two countries. Trade intensity is a useful statistical tool measuring trade between two nations. It is often reported in index format, i.e., the trade intensity index (TII) (Brown 1949, Kojima 1964). TII appears in two forms: the export intensity index (XII) and import intensity index (MII). They can be defined as follows:

$$XII_1 = \frac{x_{ij} / X_{iw}}{M_{jw} / (M_w - M_{iw})} \quad (1)$$

and

$$MII_1 = \frac{m_{ij} / M_{iw}}{X_{jw} / (X_w - X_{iw})} \quad (2)$$

where:

XII_i = Country i's export intensity index

MII_i = Country i's import intensity index

x_{ij} = Country i's exports to country j

X_{iw} = Country i's total exports to the world

M_{jw} = Country j's total imports from the world

M_w = World total imports

M_{iw} = Country i's total imports from the world

m_{ij} = Country i's imports from country j

X_{jw} = Country j's total exports to the world

X_w = World total exports

i, j = Australia and China

Export and import intensity indices reflect the ratio of the share of country i's trade with country j relative to the share of world trade destined for country j. An index of greater (less) than unity has been interpreted as an indication of larger (smaller) than expected trade flow between two parties concerned. Table 3 demonstrates that most export and import intensity indices are greater than unity, implying that Australia and China are trading greater than expected. Most importantly, the trade in SITCs 0 and 4 is "intensifying" in recent years. The trade in SITC 1 is smaller than expected in most cases, which tends to suggest that neither of the two countries is good at producing them. Nonetheless, for Chinese exports to Australia and Australian imports from China, the trade in SITC 1 has increased over the years and has become greater than expected in recent years. Table 3 also shows substantial increases in the bilateral agricultural trade between Australia and China in the past few years and China imported relatively more from Australia. China's increased imports reflect, to a great extent, changes in domestic agricultural demand and supply situations (e.g., sharp increase in wheat from Australia) and may also reflect the increased demand for diverse products by wealthier consumers. China's WTO accession may have also improved the access of foreign products to China but the role is likely to be small as noted earlier.

At the SITC 2 and 3 digit level, trade intensity indices do not always show a clear pattern of increasing or decreasing. In most cases, they tend to change between years. Some commodities have a TII greater than (and in some cases far greater than) unity. They tend to be those commodities that a country has a comparative advantage to produce. Full details of TII at the 2 and 3 digit levels can be obtained from the authors.

Table 3. Intensity of Agricultural Trade between Australia and China, 1995-2004

Code	0	1	4
	Food and Live Animals	Beverages and Tobacco	Animal and Vegetable Oils, Fats and Waxes
Export intensity: Australia to China			
1995	0.289	0.196	2.087
1996	0.836	0.324	2.746
1997	1.372	1.110	2.198
1998	1.786	0.645	2.088
1999	1.824	0.335	2.985
2000	1.601	0.129	5.058
2001	1.423	0.165	7.155
2002	2.208	0.185	4.079
2003	2.001	0.295	3.133
2004	1.370	0.406	3.353
Export intensity: China to Australia			
1995	0.840	0.187	0.236
1996	0.943	0.320	0.510
1997	0.867	0.708	0.528
1998	0.882	1.298	1.736
1999	0.994	1.533	3.003
2000	0.926	1.524	1.667
2001	1.153	1.349	2.247
2002	1.180	1.490	1.901
2003	1.215	1.884	2.320
2004	1.444	1.381	2.166
Import intensity: Australia from China			
1995	0.819	0.222	0.283
1996	0.899	0.377	0.561
1997	0.844	0.790	0.611
1998	0.838	1.368	1.899
1999	0.921	1.582	3.188
2000	0.860	1.557	1.670
2001	1.077	1.334	2.225
2002	1.092	1.445	2.086
2003	1.159	1.844	2.554
2004	1.388	1.346	2.485
Import intensity: China from Australia			
1995	0.278	0.229	2.227
1996	0.795	0.375	2.804
1997	1.336	1.231	2.344
1998	1.685	0.680	2.164
1999	1.682	0.348	3.019
2000	1.472	0.132	4.878
2001	1.313	0.164	6.878
2002	2.011	0.181	4.217
2003	1.866	0.293	3.147
2004	1.291	0.402	3.427

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

2.3 Intra-industry trade

It should also be interesting to examine whether and to what extent intra-industry trade (IIT) in agricultural commodities is taking place between Australia and China. To provide an assessment, the following conventional IIT index proposed by Grubel and Lloyd (1975) is computed

$$IIT_{ic} = \frac{x_{ic} + m_{ic} - |x_{ic} - m_{ic}|}{x_{ic} + m_{ic}} \quad (3)$$

where:

IIT_{ic} = index of intra-industry trade in commodity group c for country i

x_{ic} = value of exports of commodity group c by country i to its partner country

m_{ic} = value of imports of commodity group c by country i from its partner country

IIT index defined in Equation (3) has a value range between zero and one or zero and 100 in percentage form.[4] A large value implies greater trade between firms in the same industry. In this study, we calculated intra-industry trade indices for all agricultural commodity groups traded between Australia and China from 1 to 4 digit levels. Table 4 presents IIT index for selected commodity groups. For many other commodity groups, the IIT indices are not reported because they are generally very low, or there is no intra-industry trade at all. [5]

Table 4. Index of Intra-Industry Trade of Agricultural Commodities between Australia and China

Code	Item	1990	1995	2000	2003	2004	2005
0	Food and live animals	0.212	0.963	0.514	0.724	0.724	0.789
03	Fish, crustaceans, mollusc	0.460	0.920	0.715	0.997	0.993	0.868
034	Fish, fresh, chilled, frozen	0.926	0.641	0.973	0.883	0.829	0.675
0341	Fish, fresh, chilled, whole	0.000	0.293	0.370	0.691	0.510	0.438
061	Sugars, molasses, honey	0.000	0.063	0.743	0.446	0.544	0.477
0612	Other beet, cane sugar	0.000	0.018	0.438	0.768	0.206	0.587
07	Coffee, tea, cocoa, spices	0.192	0.896	0.740	0.957	0.776	0.423
0819	Food waste, animal feeds		0.429	0.775	0.695	0.525	0.456
1	Beverages and tobacco	0.247	0.517	0.160	0.343	0.586	0.723
29	Crude animal, veg. materl.	0.642	0.837	0.666	0.657	0.411	0.397
4	Animal, veg. oils, fats, wax	0.113	0.044	0.079	0.066	0.052	0.082
42	Fixed veg. fats and oils	0.000	0.036	0.217	0.591	0.622	0.272

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

It is not unexpected that intra-industry agricultural trade between Australia and China is not extensive. On the one hand, Australia is a major agricultural exporter and over 60% of its many agricultural

commodities have to be exported. On the other hand, China's agricultural production is primarily for domestic consumption, except in a few cases where labour-intensive products are purposely produced for exporting, e.g., some fruits and vegetables, Chinese tea, and some aquatic products. In addition, due to tastes and preference differences, some products, such as animal offal and chicken feet, were exported to China from Australia but it is generally not expected that Australia will import such foods from China. Furthermore, there is generally less product differentiation in agriculture than in manufacturing. Thus, IIT in agricultural products may be less important than that in manufacturing sectors.

Nonetheless, Table 4 does show that IIT has taken place among some commodity groups. Although the IIT indices for some groups were generally not small in the early 1990s, they have increased over the years. Based on Table 4, overall, IIT between Australia and China has been on the increase. This is clearly reflected by SITCs 0 and 1. IIT for SITC 4 has been very weak. Should an FTA be signed, a higher level of IIT between the two countries may be expected for their agricultural products. It is likely that China may be able to export more varieties of foods to Australia to cater for the needs of Asian migrants should China be able to meet the health and quality standards of Australia. Due to very severe environment pollutions in China, in the foreseeable future, it is unlikely that China will be able to produce many fresh vegetables and fruits that can meet the standards of developed countries. China's exports of fresh agricultural produce to its neighbouring countries such as Japan have frequently met difficulties in recent years.

3. Analysis of Agricultural Trade Complementarity

In this section, we focus on examining agricultural trade complementarity between Australia and China. We first employ the Revealed Comparative Advantage (*RCA*) index to assess export potential of each of the two countries. We then calculate trade complementarity index (TCI) to measure how well the structures of Australia/China's exports match the structures of China/Australia's imports.

3.1 Comparative Advantage

To compare export potential and competitiveness of each country in trade of a particular commodity group, the Revealed Comparative Advantage (*RCA*) index is often computed, using the following formula:

$$RCA_{ic} = \frac{x_{ic} / X_{iw}}{x_{cw} / X_{w}} \qquad (4)$$

where:

RCA_{ic} = revealed comparative advantage index of commodity group c for country i

x_{ic} = value of exports of commodity group c by country i

X_{iw} = value of total exports by country i

x_{cw} = value of world exports of commodity group c

X_{w} = value of total world exports

Country i has a comparative advantage in exporting commodity group c when RCA_{ic} has a value greater than unity, that is, when country i's export share of commodity group c is large than the world export share of the same commodity group.[6] On the contrary, if RCA_{ic} is less than unity, country i has a comparative disadvantage.

At the highly aggregate level (SITC 1 digit), China has shown comparative advantage mainly in food and live animals. Australia also has comparative advantage in food and live animals but Australia's RCA indices are close to unity over the years (see Table 5). Both countries do not show any comparative advantage in SITC 1 and 4. Clearly, RCAs based on highly aggregate data reveal limited information. In this study, we also calculated RCAs at the more disaggregate levels (SITC 2 and 3 digit levels). At the 2 digit level, RCAs are more realistically "revealed" and more so at the 3 digit level (see Tables 6 and 7).

Table 5. Revealed Comparative Advantage, Australia and China (at 1-digit level)

	SITC0 Food and Live Animals		SITC1 Beverages and Tobacco		SITC4 Animal and Vegetable Oils, Fats and Waxes	
	Australia	China	Australia	China	Australia	China
1995	0.970	0.979	0.268	0.836	0.247	0.578
1996	1.016	1.005	0.285	0.792	0.229	0.552
1997	0.997	1.041	0.309	0.590	0.212	0.825
1998	0.960	1.081	0.440	0.596	0.301	0.386
1999	0.973	1.066	0.498	0.456	0.277	0.187
2000	0.969	1.088	0.536	0.391	0.266	0.176
2001	0.952	1.106	0.583	0.456	0.249	0.175
2002	0.975	1.136	0.709	0.449	0.206	0.107
2003	0.964	1.159	0.942	0.410	0.256	0.101
2004	1.000	1.146	0.883	0.450	0.228	0.115

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

According to Table 6, at the 2 digit level, Australia shows much greater comparative advantage in the production of several groups of commodities (e.g., 00: live animals; 01: meat and meat preparations; 02: dairy products and bird eggs; 04: cereal and cereal preparations; 11: beverages; 21: hides, skins and furskins; 26: textile fibres; and 41: animal oils and fats). China has relatively fewer groups of commodities that have comparative advantages (03: fish, crustaceans, mollusc; 05: vegetables and fruit; 26: textile fibres; and 29: crude animal and vegetable material) and in some cases the comparative advantage has in fact declined (e.g., 00: live animals; 01: meat and meat preparations; and 12: tobacco and tobacco manufactures).

Table 6. Revealed Comparative Advantage, Australia and China (at 2-digit level)

Code	Item		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
00	Live animals	A	1.480	1.592	1.775	1.382	1.554	1.441	1.791	2.044	2.560	1.899
		C	1.711	1.790	1.845	1.731	1.424	1.203	1.162	1.015	0.968	0.937
01	Meat, meat preparations	A	2.037	1.463	1.622	2.012	1.963	1.897	2.074	2.023	2.375	2.410
		C	1.047	1.111	1.004	0.948	0.836	0.818	0.944	0.792	0.714	0.738
02	Dairy products, bird eggs	A	1.275	1.399	1.366	1.640	1.597	1.680	1.570	1.635	1.455	1.383
		C	0.070	0.091	0.106	0.096	0.091	0.092	0.080	0.097	0.084	0.103
03	Fish, crustaceans, mollusc	A	0.565	0.456	0.475	0.495	0.520	0.503	0.455	0.457	0.516	0.401
		C	1.843	1.896	1.878	1.784	1.845	1.885	2.076	2.117	2.242	2.674
04	Cereals, cereal preprtns	A	1.336	2.195	2.328	2.111	1.960	1.826	1.742	1.779	1.465	2.113
		C	0.188	0.305	0.938	1.113	0.852	1.064	0.718	0.943	1.290	0.461
05	Vegetables and fruit	A	0.319	0.323	0.319	0.320	0.309	0.327	0.319	0.324	0.312	0.271
		C	1.532	1.418	1.375	1.355	1.340	1.284	1.416	1.406	1.468	1.594
06	Sugar, sugr. preprtns, honey	A	2.918	1.959	1.990	0.192	0.207	0.238	0.193	0.219	0.223	0.223
		C	0.781	0.864	0.604	0.636	0.542	0.629	0.539	0.610	0.550	0.612
07	Coffee, tea, cocoa, spices	A	0.138	0.135	0.115	0.108	0.135	0.146	0.143	0.157	0.192	0.170
		C	0.523	0.582	0.592	0.585	0.589	0.550	0.639	0.576	0.543	0.715
08	Animal feed stuff	A	0.499	0.466	0.462	0.511	0.637	0.753	0.607	0.646	0.742	0.694
		C	0.564	0.522	0.416	0.339	0.405	0.405	0.427	0.489	0.436	0.465
09	Misc. edible products etc	A	0.351	0.331	0.349	0.352	0.361	0.366	0.318	0.322	0.443	0.353
		C	0.609	0.677	0.802	0.974	0.949	0.943	0.974	0.945	0.905	0.936
11	Beverages	A	0.489	0.515	0.546	0.714	0.794	0.851	0.890	1.041	1.361	1.243
		C	0.444	0.426	0.415	0.420	0.427	0.381	0.401	0.384	0.317	0.379
12	Tobacco, tobacco manufact	A	0.057	0.071	0.055	0.074	0.057	0.047	0.052	0.075	0.105	0.099
		C	1.831	1.675	1.021	0.980	0.558	0.444	0.552	0.552	0.590	0.597
21	Hides, skins, furskins, raw	A	1.881	1.572	1.558	1.875	1.414	1.563	1.762	1.525	2.107	1.985
		C	0.260	0.160	0.197	0.149	0.088	0.052	0.046	0.052	0.036	0.035
22	Oil seed, toleaginus fruit	A	0.250	0.330	0.313	0.653	1.207	0.844	0.727	0.774	0.424	0.649
		C	1.434	1.108	0.559	0.666	0.963	0.845	0.891	0.796	0.736	0.746
26	Textile fibres	A	4.383	4.045	4.426	4.822	4.578	4.065	4.533	4.158	3.821	3.229
		C	0.994	1.025	1.107	1.046	1.878	1.567	1.191	1.290	1.160	1.050
29	Crude animal veg. materl	A	0.316	0.281	0.263	0.302	0.287	0.259	0.257	0.250	0.259	0.245
		C	2.492	2.392	2.397	2.191	1.995	1.992	1.852	1.614	1.496	1.710
41	Animal oils and fats	A	2.407	2.083	1.961	2.782	2.510	2.199	2.063	1.876	2.715	2.194
		C	0.024	0.019	0.036	0.048	0.039	0.155	0.097	0.109	0.096	0.174
42	Fixed veg. fats and oils	A	0.005	0.015	0.033	0.071	0.055	0.045	0.043	0.045	0.037	0.048
		C	0.800	0.679	1.070	0.450	0.203	0.181	0.190	0.114	0.096	0.097
43	Animal, veg. fats, oils, nes	A	0.244	0.253	0.306	0.341	0.318	0.280	0.257	0.285	0.315	0.322
		C	0.115	0.278	0.346	0.312	0.195	0.117	0.090	0.086	0.138	0.213

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

Table 7. Revealed Comparative Advantage, Australia and China (at 3-digit level)

Code	Item		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
011	Bovine meat	A	4.602	3.701	3.832	4.640	4.361	4.238	5.398	5.364	5.492	5.339
		C	0.075	0.140	0.135	0.190	0.062	0.048	0.076	0.042	0.025	0.044
022	Milk and cream	A	1.566	1.857	1.700	1.925	1.806	1.872	1.833	2.073	1.714	1.657
		C	0.065	0.079	0.110	0.103	0.118	0.109	0.084	0.120	0.091	0.109
025	Eggs, birds, yolks, albumin	A	0.096	0.092	0.050	0.076	0.091	0.035	0.030	0.032	0.031	0.053
		C	0.863	0.954	0.935	0.845	0.674	0.710	0.742	0.738	0.774	0.949
034	Fish, fresh, chilled, frozen	A	0.177	0.141	0.183	0.229	0.299	0.286	0.285	0.310	0.326	0.203
		C	1.367	1.294	1.463	1.485	1.557	1.528	1.836	1.787	1.874	2.168
036	Crustaceans, molluscs etc	A	1.238	1.058	1.025	1.060	1.044	0.953	0.899	0.912	1.001	0.880
		C	1.891	1.590	1.496	1.364	1.384	1.283	1.375	1.483	1.546	1.780
041	Wheat, meslin, unmilled	A	2.857	4.701	5.056	4.985	4.590	4.334	4.297	4.166	3.510	5.015
		C	0.003	0.000	0.000	0.003	0.001	0.000	0.091	0.119	0.432	0.166
042	Rice	A	1.308	1.015	1.284	0.964	1.098	1.090	0.962	0.453	0.346	0.144
		C	0.103	0.555	1.455	3.983	2.868	2.691	1.727	1.829	2.102	1.075
043	Barley, unmilled	A	2.357	5.503	6.324	6.150	5.460	3.850	3.062	6.240	4.724	10.850
		C	0.003	0.003	0.027	0.034	0.015	0.001	0.001	0.001	0.007	0.005
044	Maize, unmilled	A	0.006	0.012	0.008	0.012	0.022	0.024	0.022	0.022	0.016	0.011
		C	0.041	0.087	2.831	1.970	1.683	3.257	1.957	3.068	4.125	0.712
046	Meal, flour of wheat, msln	A	0.446	0.588	0.720	1.290	1.338	1.043	1.202	1.314	1.303	1.473
		C	1.330	3.099	2.465	1.939	1.313	1.081	1.450	1.503	1.212	1.363
054	Vegetables	A	0.379	0.470	0.498	0.448	0.454	0.533	0.517	0.479	0.354	0.359
		C	2.059	2.113	2.045	1.939	1.959	1.742	1.899	1.846	1.879	1.964
057	Fruit,nuts excl.oil nuts	A	0.320	0.308	0.288	0.305	0.292	0.297	0.286	0.323	0.340	0.279
		C	0.502	0.452	0.433	0.401	0.355	0.327	0.328	0.372	0.410	0.475
061	Sugars, molasses, honey	A	3.586	2.326	2.422	0.138	0.150	0.177	0.122	0.146	0.172	0.191
		C	0.750	0.844	0.498	0.555	0.443	0.483	0.368	0.397	0.322	0.335
071	Coffee, coffee substitute	A	0.045	0.053	0.037	0.037	0.053	0.059	0.065	0.071	0.087	0.072
		C	0.016	0.016	0.054	0.062	0.069	0.039	0.070	0.080	0.096	0.102
222	Oilseed (sft. fix veg. oil)	A	0.214	0.318	0.313	0.621	1.134	0.791	0.683	0.757	0.406	0.566
		C	1.315	1.069	0.550	0.651	0.890	0.772	0.764	0.738	0.676	0.627
211	Hides, skins (ex. furs), raw	A	2.040	1.904	1.977	2.446	1.838	2.036	2.261	2.072	2.947	2.934
		C	0.263	0.165	0.168	0.123	0.083	0.038	0.037	0.045	0.026	0.010
263	Cotton	A	1.773	1.802	2.478	3.795	4.180	3.351	3.800	3.344	2.600	1.959
		C	0.149	0.046	0.017	0.230	1.364	1.163	0.305	0.773	0.430	0.044
268	Wool, other animal hair	A	12.703	12.131	12.411	12.552	11.768	11.128	11.532	12.745	12.778	11.498
		C	1.322	1.815	1.868	1.561	2.820	2.226	2.006	2.015	2.199	2.453
292	Crude veg. materials, nes	A	0.190	0.176	0.160	0.188	0.194	0.169	0.172	0.166	0.163	0.149
		C	1.438	1.272	1.245	1.020	0.940	0.864	0.878	0.820	0.748	0.773
411	Animal oils and fats	A	2.407	2.083	1.961	2.782	2.510	2.199	2.063	1.876	2.715	2.194
		C	0.024	0.019	0.036	0.048	0.039	0.155	0.097	0.109	0.096	0.174

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

The RCA indices based on 3-digit data provide even clearer information at the commodity level. Table 7 shows that Australia has strong comparative advantage in the production and supply of the following commodities:

- Bovine meat (011)
- Milk and cream (022)
- Wheat, meslin, unmilled (041)
- Barley, unmilled (043)
- Meal, flour of wheat, meslin (046)

- Hides, skins (ex. Furs), raw (211)
- Cotton (263)
- Wool and other animal hair (268)
- Animal oils and fats (411)

China has comparative advantage in the production and supply of the following commodities:

- Fish, fresh, chilled and frozen (034)
- Crustaceans, molluscs etc. (036)
- Rice (042)
- Meal, flour of wheat, meslin (046)
- Vegetables (054)
- Wool and other animal hair (268)

The comparative advantage for some commodities has shown a declining trend. These include crustaceans, molluscs etc. (036) and rice (042) in Australia and oilseeds (222) and crude vegetable materials, nes (292) in China. The change in the RCA indices for unmilled maize (044) was related to China's temporary large amounts of exports. The RCA index for Australia's sugar has declined dramatically and this is a puzzle to us as one would have thought Australia has a great comparative advantage in producing sugar. Further investigation is needed to understand the decline in the RCAs for Australia's sugar.

Tables 6 and 7 clearly show that there are few areas where there is an overlap in the two countries' comparative advantage. The two exceptions are meal, flour of wheat, meslin (046) and wool and other animal hair (268). In the case of wool, China's demand is so high (for processing and re-exporting) and there is a strong need to import from Australia. Hence, the two countries do not compete with each other in agricultural trade and indeed, the two countries' trade in agricultural products is very complementary.

3.2 Complementarity in agricultural trade

To provide an assessment, trade complementarity index (TCI) can be computed. TCI correlates nation i's export specialisation pattern with nation j's import specialisation pattern across the spectrum of all traded products. TCI is a trade-weighted measure for sector s of the degree to which the relative-export-share structure of nation i's exports (RXS_i) corresponds with the relative-import-share structure of nation j's imports (RMS_j) across all k commodities within the s sector (Vollrath and Johnston 2001). The formula is:

$$TCI_{ij}^{s} = \sum_{k \in s} \left[\sigma^{k} \cdot RXS_{i}^{k} \cdot RMS_{j}^{k} \right] \qquad (5)$$

where:

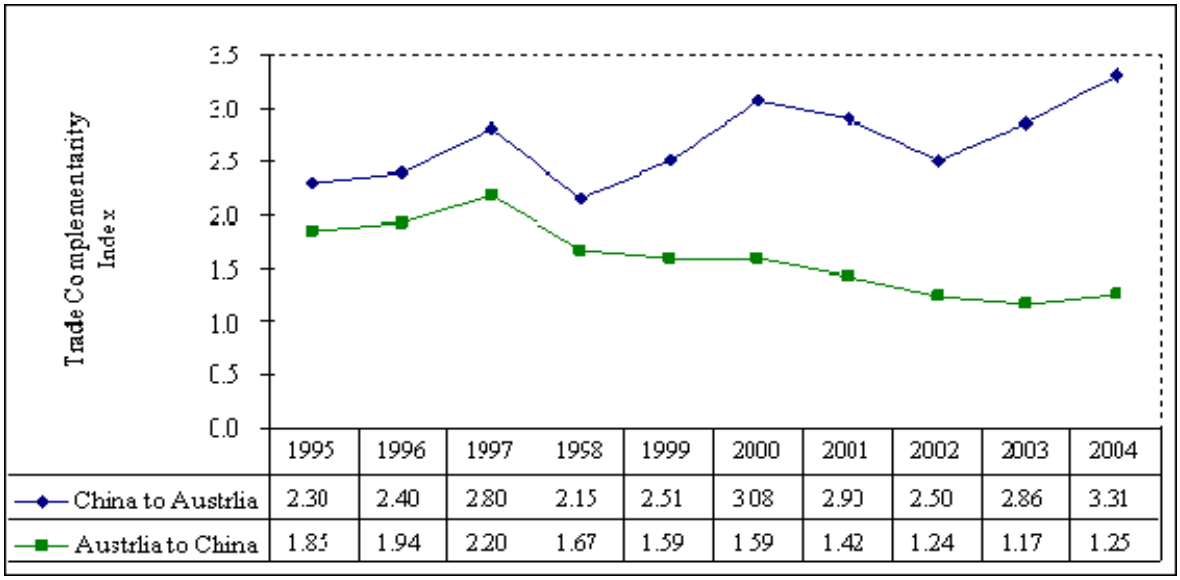
$$RXS_{i}^{k} = \frac{X_{iw}^{k} / X_{iw}^{t}}{X_{nw}^{k} / X_{nw}^{t}} = \frac{\text{share of k in country i's exports of s goods}}{\text{share of k in the world's exports of s goods}};$$

$$RMS_{j}^{k} = \frac{M_{jw}^{k} / M_{jw}^{t}}{M_{nw}^{k} / M_{nw}^{t}} = \frac{\text{share of k in country j's imports of s goods}}{\text{share of k in the world's imports of s goods}};$$

$$\theta^k = \frac{X^k_{iw}}{X^t_{iw}} = \text{share of k in global exports of s goods.}$$

RXS_i^k is Balassa's revealed comparative advantage. RMS_j^k has the same structure, except that import rather than export data are used. In other words, the index can be interpreted as being a trade-weighted measure for sector s of the degree to which exporter i's profile of "comparative advantages" corresponds with the profile of "comparative disadvantages" for importer j. In other words, this index depicts how specialisation in the commodity composition of nation i's exports to the global market meshes with the specialisation in the commodity composition of nation j's imports from the international market. There is always some degree of complementarity in bilateral specialisation patterns, provided i exports some goods that j imports within the same sector. TCI with a value of unity represents a threshold, with a value greater (less) than one showing a greater (lesser) level of complementarity in the composition of what nation i exports and what nation j imports than it occurs between the average pair of countries. Figure 4 presents complementarity indices of Australia export to China and China export to Australia. They are calculated at the 2-digit level, across all agricultural commodities according to SITC from 1995 to 2004.

Figure 4. Agricultural Trade Complementarity between Australia and China



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
China to Austrlia	2.30	2.40	2.80	2.15	2.51	3.08	2.90	2.50	2.86	3.31
Austrlia to China	1.83	1.94	2.20	1.67	1.59	1.59	1.42	1.24	1.17	1.25

Source: Authors' own estimates using data from United Nations Comtrade Database SITC Revision III (unstats.un.org/unsd/comtrade, accessed June 2006).

The TCIs in Figure 4 further confirm that agricultural trade between Australia and China are very complementary. The TCIs for China's exports and Australia's imports are greater than those for Australian exports and Chinese imports. This is likely due to the fact that (1) some agricultural products that Australian imports from China cannot be produced locally (e.g., some special products largely demanded by migrants and some of them have been processed), and (2) China chiefly imports Australia's wool, meat and barley to meet some demand for higher quality. Such products are also produced in China and the imports only account for a small portion of total consumption. Further, it is noted that before 1998, the TCIs for China's exports to Australia are greater than those for Australia's exports to China and they moved in a similar pattern. However, after 1998 their movements started to divert. While the TCIs for China's exports to Australia generally increased, the TCIs for Australia's exports to China have continuously declined. This seems to suggest that the complementarity for China

to export agricultural products to Australia is increasing while that for Australia to export to China is declining. China seems to be enjoying more opportunities to export to the Australian market. Australia needs to make more efforts to tap into the Chinese market and export more to China.

4. Prospects of Agricultural Trade between Australia and China

The preceding analysis suggests that, in terms of both trade compositions and factor endowments, there is strong complementarity in the trade of agricultural products between Australia and China. Currently, the volume of trade between the two countries is still small. Yet the scope of commodities traded is relatively extensive. Further trade expansion between the two countries will render huge benefits to both partners. It is noted, however, given the size of the Chinese market, increased Australian exports to China will lead to trade diversion in some commodities (e.g., wool and wheat), unless Australia can significantly increase its output level of such commodities.

Further expansion in agricultural trade between Australia and China is desirable by both parties. Given that over 60% of Australia's agricultural products have to be exported, Australia has a strong need to export. China offers a potentially huge market for Australian products. China's demand for agricultural products will continue to rise. This is driven by several important factors such as (1) limited land and other natural resources, (2) increased demand as a result of rising income, and to some extent, by population increase, and (3) the increasing demand for higher quality and diverse products as consumer tastes and preferences change. Australia's reputation in producing good quality products is advantageous to increase its exports to China. If the proposed FTA is signed, Australia will be in a much better position to secure a larger share in the growing Chinese market.

China's competitiveness will be in the production of labour-intensive agricultural products and processed goods. However, constrained by limited land and other important natural resources, there is limited chance for China to export such products in large volume to Australia. Currently, it is difficult for many Chinese products to meet Australian standards and exporting to Australia is not easy. If an FTA is signed and if Chinese producers can manage to meet Australian standards, China's agricultural exports to Australia will increase but unlikely to a great extent.

Australia's competitiveness lies in the production of land-intensive products. Australia's land-intensive products such as grains (e.g., barley, wheat, and oats), animal products (wool, meats, dairy products) and cotton have great potential for exporting to China. As Chinese consumers' income further increases, the demand for higher quality and diverse products will increase. This will create enormous opportunities for Australia to export to China in the medium and longer term. However, in the near future, China's import of wheat from Australia is unlikely in a large quantity because current domestic production basically meets the consumption needs and any imports would be primarily for some special quality needs. The import of meats and dairy products is unlikely large either in the near term. However, China may continue to import barley at a large quantity.

It is expected that total trade volume between the two countries will further increase. While Australia's exports to China are expected to grow, so are the imports from China. However, Australia will continue to export more to China than it imports from China. Increased exports from Australia to China are unlikely to generate too much a shock to China's domestic production. This is mainly due to the fact that imports from Australia are chiefly for some niche market. Australian products, because of their higher quality or products that China does not produce, are not competing at the same level with those of locally produced low-cost products.

The increase in the volume of China's future exports to Australia is likely to be small. China chiefly exports some special products to the Australian market that are not generally demanded by the majority of the population but for catering the tastes and preferences of some Asian migrants. Products that China can export in a large quantity are unlikely to be accepted by Australia due to their inability to meet the Australian standards. Therefore, likewise, increased imports from China will not generate much negative impacts on Australian agricultural sector as a whole. However, producers in some industries, e.g., horticultural sector, fishing industry and food processing, may be adversely affected to some extent.

The high level of agricultural trade complementarity between Australia and China provides strong support, at least from agricultural sector's point of view, for an FTA between the two countries. If an FTA is signed, bilateral agricultural trade will increase further and both countries will benefit from the expansion. In passing, opposite agricultural production seasons in Australia and China represents another important complementarity, attractive to traders in both markets to import and export products based on seasonal differences.

5. Concluding Comments

The volume of Australia's agricultural trade with China has increased remarkably since 1994, particularly in the last few years. Australia's exports to China have been far greater than its imports from China. This pattern of agricultural trade between Australia and China is expected to continue.

Australia chiefly exports land-intensive and often bulky commodities to China such as wheat, barley, wool and meats. China mainly exports labour-intensive products to Australia; particularly those processed and small-quantity packaged speciality foods catering Asian migrants. Although China has also started to export some fresh vegetables and fruits to Australia, the amount at present is minimal.

China is becoming an increasingly important market for Australia's agricultural exports but Australia is not a major market for China's exports. In addition, China's imports from Australia tend to fluctuate between years and sometimes to a great extent. China's unstable pattern of imports will have some ramifications on Australia's export efforts.

A large portion of agricultural trade between Australia and China is inter-industry trade. Intra-industry agricultural trade between the two countries is not extensive. Australia and China are trading greater than expected and the trade is "intensifying" in recent years. This study shows that there are few areas where there is an overlap in the two countries' comparative advantage and thus the two countries do not compete with each other in agricultural trade and indeed, their trade is very complementary.

The high level of agricultural trade complementarity between Australia and China provides strong support, at least from agricultural sector's point of view, for an FTA between the two countries. If an FTA is signed, bilateral agricultural trade will increase further and both countries will benefit from the expansion of trade.

Because agricultural trade between the two countries are not directly competitive, Australia and China may consider promoting not only trade, but also more general agricultural cooperation between them. Cooperation in areas of agricultural technology and management is likely to benefit China more than Australia in the short run. However, in the longer term, Australia will benefit from China's increased needs to import, resulting from greater rural affluence and the subsequent increased demand for imports from Australia and the rest of the world.

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[2] The other system to classify traded goods is the Harmonised Commodity Description and Coding System, or in short, Harmonised System (HS). The HS data have also become frequently used in trade analyses. China only started to adopt HS in 1992 but our analysis covers years before 1992. As a result, the SITC data are used in this study.

[3] It is worth noting that since 2001, when China joined the WTO late that year, the volume of agricultural trade between Australia and China has increased rapidly. Some may wonder whether China's accession to the WTO has led to a significant increase in China's imports and exports. To some extent, the accession may have played a role leading to increased trade between China and the rest of the world. However, several years is relatively a short time and to what extent China's increased trade can be attributed to WTO accession requires further research. In a separate paper where we explore China's implementation and management of its grain TRQs, we suggest that China's increased grain trade after WTO accession is to a greater extent dependent upon China's domestic demand and supply situations but to a lesser extent influenced by WTO accession (Zhou and Kang 2007). Discussions with researchers and government officials in China also confirm this.

[4] It is noted that alternative forms of *IIT* index have been proposed by Hamilton and Kniest (1991), Greenaway et al. (1994) and Brulhart (1994).

[5] Full details of the IIT indices for these commodity groups can be obtained from the authors.

[6] It should be pointed out that this *RCA* index is asymmetric in the sense that it ranges from one to infinity for products in which a country has comparative advantage but only from zero to one for the case of comparative disadvantage. To correct this skewed distribution, several symmetric *RCA* indices have been proposed (e.g. Dulum et al. 1998 and Laursen 1998).