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China's agricultural trade: A global comparative advantage perspective

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Introduction

The past two decades have witnessed rapid growth in agricultural production and consumption as well as a growing gap between food demand and supply in China. This makes the country one of the leading food importers on the global agricultural market. Between 1978 and 2018, China's agricultural output (in terms of real value-added measure) grew at the rate of 4.7 per cent per annum—far more than the population growth rate (1.0 per cent per annum)—helping to stabilise domestic food consumption prices (Huang and Rozelle 2018; NBS 2019). However, ongoing economic and population growth since then have driven food demand to outpace food supply, thus putting great pressure on domestic agricultural production, which was already constrained by the limited supply of land and water resources. To resolve the emerging conflict between domestic food demand and supply, imports of agricultural products from the international market have been increasing over time.

The increased food imports by China has aroused growing concerns over whether China's demand for food will impact global food security in the future. For instance, China's total food imports in 2018 accounted for less than 2 per cent of its food consumption, but this already represented more than 8 per cent of global tradable agricultural products. This made China one of the largest importers of agricultural products in the world by 2018—second only to the European Union (WTO 2019). Meanwhile, forecasts suggest China's food self-sufficiency ratio will decline from 98 per cent in 2020 to 93 per cent in 2035, even if agricultural total factor productivity (TFP)—an indicator of technological progress—is able to grow at a rate

of 2 per cent per annum (CAE 2020). This implies that the volume of agricultural products sourced by China from the international market will more than double by 2035. Should global food production and trade face more uncertainties caused by the outbreak of natural disasters, the impacts of climate change or deteriorating international relations, China's food demand would compete with demands from other developing countries, imposing greater pressures on the global food supply.

However, the above concerns could be redundant if global agricultural resources were properly exploited based on dynamic comparative advantage. There are more than 3.5 billion hectares of land suitable for agriculture throughout the world, but only around 1.5 billion hectares are being used effectively (FAO 2020). The majority of the spare arable land is in places such as the pan-Amazon region and major agricultural countries in Eastern Europe and Africa, and yields below the world average. If trade and investment relationships could be rearranged between China and the rest of the world based on their comparative competitiveness, the global food supply would significantly increase. For instance, the increased agricultural trade between China and African countries in recent years has provided economic incentives for both parties to increase their investment in agricultural production and facilitate the adoption of advanced agricultural technologies (Sheng et al. 2020). In this sense, rearranging agricultural trade between China and her trading partners could present a win-win strategy for China as well as for the world.

To demonstrate this point, this chapter utilises global agricultural trade data organised by commodity (obtained from FAOSTAT database) to systematically analyse agricultural trade between China and the rest of the world and its underlying determinants for the period 1978–2018. We first investigate China's agricultural trade patterns and characteristics, before going on to estimate the revealed comparative advantage (RCA) and relative trade advantage (RTA) indices for major agricultural commodities, which are categorised into 10 types of crops and seven types of livestock products. Then, we compare and analyse the complementarity between China and the rest of the world for each category of commodity, with the aim of sorting out the potential patterns of agricultural trade. Lastly, we discuss how agricultural trade between China and the rest of the world could be rearranged to enable better allocation of global resources based on countries' comparative advantage and competitiveness.

The results show that the existing pattern of agricultural trade between China and the rest of the world does not fully reflect these countries' dynamic comparative advantages. In particular, North America's comparative advantage in agricultural commodities has been declining over time compared with the rest of the world, although it currently accounts for a large proportion of China's imports. This, combined with the intensified trade friction between China and the United States, limits the potential for bilateral agricultural trade. With further increases in domestic demand, China is expected to diversify its agricultural imports by turning

to potential markets in the developing world—that is, Eastern Europe, South America and Africa. Countries in these regions have different advantages in different agricultural products, which may enable them to become alternative and reliable agricultural trading partners for China in the near future.

The rest of the chapter is organised as follows. Section two discusses the pattern of China's agricultural trade and its characteristics over the past 40 years. Section three provides a measure of the RCA index, the RTA index and overall bilateral complementarity (OBC). Section four analyses the comparative and competitive advantages of China's major agricultural products over the past 40 years compared with the rest of the world. Section five examines the complementarity by commodity between China's agricultural products and those of the world's major agricultural countries, thus identifying several potential future trade partners, while section six concludes.

China's agricultural trade from 1978 to 2018

China's agricultural trade pattern

China's agricultural trade started to increase in 1978 and has long been used as an important means to balance domestic agricultural production and consumption. Figure 3.1 depicts the changes in China's total agricultural imports, exports and net trade at current prices for the past 40 years. From 1978 to 2018, China's agricultural trade increased from US\$5.45 billion to US\$179.4 billion, with an average annual growth rate of 9.1 per cent, which was about twice the growth of output value (5.3 per cent per annum) for the same period (Huang and Rozelle 2018). Underlying the aggregated agricultural trade, agricultural imports increased from US\$3.1 billion in 1978 to US\$123.3 billion in 2018, with an average growth rate of 9.6 per cent per annum, exceeding that of agricultural exports (8.2 per cent per annum) over the same period (agricultural exports increased from US\$2.4 billion in 1978 to US\$56.1 billion in 2018).

Agricultural imports have grown more quickly than exports, especially in recent years, showing China's growing dependence on the international market to feed its own population. While China's agricultural trade remained in surplus from 1984 to 2002, its trade deficit in agricultural commodities, which began in 2003, has been growing over the past two decades. By 2018, China's agricultural trade deficit reached US\$67.2 billion—45 times its agricultural trade deficit in 2003 (of US\$1.5 billion). In addition to the increased net food demand caused by rapid population and economic growth, the open-to-trade policy and the decline of China's

relative comparative advantage after its accession to the World Trade Organization (WTO) are also considered important drivers of the growing agricultural trade deficit (Huang and Rozelle 2018).

This rapid growth in net imports of agricultural products also led to China's improved status in global agricultural trade. Figure 3.2 shows the trend in China's share of total global agricultural exports and imports between 1978 and 2018. From 1978 to 2000, China's share increased with some fluctuation, with the average share of imports remaining close to that of exports. However, from 2000, China's share of total global agricultural imports increased sharply, from 2 per cent to 8 per cent, before gradually levelling off in recent years. This is in contrast with a more modest rise in its share of total global exports (from 3 per cent to about 4 per cent). Consequently, China had become the world's second-largest food importer by 2018 (WTO 2019).

Figure 3.1 China's agricultural trade, 1978–2018 (millions of US\$)

Source: FAOSTAT database.

Figure 3.2 China's share of global agricultural exports and imports, 1978–2018 (per cent)

Source: FAOSTAT database.

The increasing agricultural trade deficit triggered China to intensify support for domestic production and enact trade protection policies. Since the late 2000s, the average levels of producer support ratios and trade protectionism have been increasing in China, contrary to the earlier trend in the 2000s immediately before its WTO accession, as well as the trends in many developed and developing countries. Both Organisation for Economic Co-operation and Development (OECD) countries and non-OECD countries have significantly reduced their levels of producer support and agricultural protection over the recent decade and have gradually shifted their policies towards promoting marketisation and improving the competitiveness of their agricultural products. As is shown in Figures 3.3a and 3.3b, the average ratio of the producer support estimate (PSE) to agricultural output value among OECD countries has declined—attributable to the efforts of their governments to adjust the structure of domestic production and improve trade competitiveness. The increase in domestic support for agricultural production and trade protection in China has, to some extent, biased resource reallocation domestically, and could negatively affect efforts to improve agricultural comparative advantage and competitiveness.

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Figure 3.3 Production support and trade protection in China, OECD countries and non-OECD countries, 1995–2015

Source: OECD PSE database.

In sum, China's net imports of agricultural products have been rapidly increasing over the past two decades to supplement the shortfall in domestic agricultural production. In addition to the increased food demand caused by rapid population and economic growth, changes in the relative productivity and competitiveness of agricultural production and intensified trade protectionism could also be important drivers of China's agricultural trade deficit.

Changes in agricultural trade patterns by commodity and by region

In addition to the characteristics at the aggregate level, agricultural trade in China possesses some distinct features according to commodity and region. We attempt to summarise some of these characteristics from two perspectives.

First, the commodity structure of agricultural trade has changed substantially over the past 40 years. Figure 3.4 depicts the changes in the commodity structure of China's agricultural trade between 1978 and 2018. It is apparent that the increase in China's agricultural trade is concentrated in several types of commodities. For crop products, the growth comes mainly from China's increased exports of fruits and vegetables, while the rapid growth in total crop imports is caused mainly by the expansion of oil crop imports, including oilseeds and soybeans. For livestock products, exports of poultry meat have been growing rapidly since 2000, but China has become more dependent on the international market for the supply of dairy and other meat products, such as beef and mutton.

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Figure 3.4 Changes in the structure of China's agricultural trade, 1978–2018

Source: FAOSTAT database.

However, a closer look at the commodity-level trade data shows that almost all products were in deficit in recent years—even those that registered a strong export increase such as vegetables and fruits. Figure 3.5 shows the data by commodity for China's exports and imports of major crops and livestock products. On the one hand, China was a net exporter of several crop products before the twenty-first century, but it has lost its comparative advantage and come to increasingly rely on the international market over the past 20 years. On the other hand, for livestock products, China remained almost entirely self-sufficient over the first 30 years of the reform and opening-up period, before showing a growing dependence on international trade in the past 10 years. With further population and economic growth, it is foreseeable that Chinese domestic demand for pork, beef, lamb and dairy products will continue to grow in the future. By 2018, major agricultural products—with the exception of sugar beet, poultry and eggs—were all in trade deficit, and this trend is predicted to continue to increase. The rapid growth of imports and trade dependence not only reflects the widening gap between domestic production and demand, but also indicates that agricultural production is gradually losing its comparative advantage in China.

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Figure 3.5(a) Crops

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Figure 3.5(b) Livestock products

Figure 3.5 Value of China's imports and exports of major agricultural products, 1978–2018

Source: FAOSTAT database.

Second, the regional distribution of China's agricultural trade has diversified over recent years, but it remains unbalanced (Figure 3.6). China's agricultural exports were once concentrated in Asia, but exports to other continents have continued to increase over recent years. For instance, in 2018, more than 60 per cent of China's agricultural exports were concentrated in Asia, especially in Japan and South Korea, while its exports to non-Asian countries except the United States, although still relatively small, have displayed an increasing trend since 2010. In contrast, China's agricultural imports once originated primarily from developed countries; however, sources for imports have shown an inclination towards land-rich developing countries in recent years. For instance, previously more than half of China's agricultural imports originated from developed countries including the United States, Canada, Australia and New Zealand, but Brazil has grown to become the largest source of China's agricultural imports in recent years. Figure 3.7 reports China's imports of soybeans and beef in thousand metric tonnes by region including countries like Australia, the United States, Brazil and Argentina. Given that China has a growing demand for land-intensive products, it will show an increasing inclination towards land-rich developing countries in the future.

Figure 3.6 Regional distribution of China's agricultural exports and imports, 2018

Source: MoFCOM (various years).

Figure 3.7(a) Soybeans

Figure 3.7(b) Beef and beef by-products

Figure 3.7 China's imports of soybeans and beef, by region (thousand metric tonnes)

Source: MoFCOM (various years).

In sum, China has significantly increased its agricultural imports over the past 20 years, partly because of its constrained resource endowments, increased production costs and the rapid growth of domestic demand. Such trends will continue to increase in the foreseeable future as population and income levels continue to grow. To meet China's growing demand while ensuring global food security, it is important to know what China will import and from where these increased imports should come. This will therefore require an in-depth analysis of the production and trade comparative and competitive advantages of each major agricultural product in China (which will determine the trade) compared with the rest of the world.

Methodology

According to international trade theory, comparative advantage is the fundamental determinant of agricultural trade patterns throughout the world. As one of the world's largest producers and consumers of agricultural products, China should rearrange its agricultural trade to reflect its comparative advantages compared with the rest of the world, as global agricultural production and consumption change over time. To predict China's future agricultural trade, it is essential to use standard approaches to measure and analyse the changes in the comparative advantage and international competitiveness of China's major agricultural products.

The RCA and RTA indices

In the literature, the most commonly used measures of a country's trade competitiveness are the trade competitiveness index, world market share (WMS), the RCA index and the RTA index. Although different indices have different advantages, their results are generally mutually consistent when providing a measure of revealed comparative and competitive advantages at the commodity level. Based on both the availability of data and project length, we chose to use the RCA index and the RTA index in this study.

Most previous studies have focused on the competitiveness of either a single agricultural product or agricultural products as a whole, while neglecting competitiveness analysis according to product between major agricultural countries. In this study, we propose to use the RCA and RTA indices to measure and compare the changing comparative and competitive advantages for 17 major agricultural products in China and its major trading partners. Detailed information on these 16 agricultural products/product groups are presented in Appendix Table 3.1.

A standard RCA index takes the form of Equation 3.1, and the corresponding relation between the RCA index and the level of trade comparative advantage is given in Table 3.1.

Equation 3.1

$$RCA_{ij} = \frac{X_{ij} / X_{it}}{X_{wj} / X_{wt}}$$

In Equation 3.1, X_{ij} is the export value of agricultural product j in country i ; X_{it} is the total value of agricultural exports from country i ; X_{wj} is the export value of agricultural product j in world trade; and X_{wt} is the total value of global agricultural exports.

Table 3.1 RCA and the corresponding level of trade comparative advantage

RCA	Level of trade comparative advantage
$RCA > 2.5$	Extremely strong
$1.25 \leq RCA \leq 2.5$	Relatively strong
$0.8 \leq RCA < 1.25$	Medium
$RCA < 0.8$	Relatively weak

While the RCA index provides a good measure of comparative advantage for a country based on its exports, the structure of its import demand should also be included. To deal with this problem, the RTA index is also introduced. Unlike the RCA index, the RTA index fully represents comparative advantage based on the use of all resources. In practice, a standard RTA index is defined as in Equation 3.2.

Equation 3.2

$$RTA_{ij} = \frac{X_{ij} / X_{io}}{X_{wj} / X_{wo}} - \frac{M_{ij} / M_{io}}{M_{wj} / M_{wo}}$$

In Equation 3.2, X_{ij} (M_{ij}) is the export (import) value of agricultural product j in country i ; X_{io} (M_{io}) is the total export (import) value of all other agricultural products except j in country i ; X_{wj} (M_{wj}) is the export (import) value of agricultural product j in world trade; and X_{wo} (M_{wo}) is the total export (import) value of all other agricultural products except j in world trade. A positive RTA indicates that agricultural product j of country i has a comparative advantage over other countries, while a negative RTA indicates no comparative advantage.

The overall bilateral complementarity index

An analysis of the comparative advantage of China's agricultural trade over the past 40 years can indicate which products China will import. However, it will not tell us from where the newly created agricultural trade will come. In particular, if the current trading partner cannot fully meet China's growing demand, it will be important to know whether there will be alternative trading partners that could help to fill the gap.

In theory, the relationship and cooperation potential between two countries (or regions) in the trade of a certain product can be measured by constructing a bilateral trade index. One of the most commonly used measures is overall bilateral complementarity (OBC), which is mainly used to analyse the competitive or complementary relationship between two countries (or regions) in the trade of a certain commodity. OBC is defined as Equation 3.3.

Equation 3.3

$$OBC_{ij}^p = - \frac{Cov(RTA_{ip}, RTA_{jp})}{\sqrt{Var(RTA_{ip}) \times Var(RTA_{jp})}}$$

In Equation 3.3, RTA_{ip} and RTA_{jp} represent the RTA indices of product p in country (or region) i and j , respectively. A positive OBC index indicates that the covariance between the RTA indices of two countries (or regions), i and j , in the trade of product p is negative, and that these two countries (or regions) are complementary in the trade of product p , with one country at a comparative advantage and the other at a comparative disadvantage. On the other hand, a negative OBC means that the covariance of RTA indices is positive, which indicates that these two countries (or regions) are in a competitive situation in which both have a comparative advantage in the international trade of product p . It should be noted that, if one country's comparative disadvantage is worsening while the other is losing its comparative advantage, although the signs of the two countries' RTA indices are not the same (that is, the former is negative, while the latter is positive), the two countries are on the same trend—that is, the covariance is positive. In this case, although the OBC is negative, the two countries are not in a competitive situation, as one of them does not have a comparative advantage and the other is losing its competitiveness.

Unlike the RCA and RTA indices, which only calculate the trade advantage at a certain point, the OBC reflects the trade of two countries or regions over time. Although the changes in comparative advantage over a certain period can be represented by the RCA and RTA indices and their changes, the OBC can reflect the bilateral trade relations and cooperation potential between two countries or regions in a better and more intuitive way.

Estimation strategy

Based on the proposed approaches, our estimation process consists of three steps. First, we used the RCA and RTA indices to measure the changes in the comparative and competitive advantages of crops and livestock products at the aggregate level and by commodity in China for the past four decades. Second, we identified the major producers of each agricultural product in the world, using the criteria that their share of global production should total more than 1 per cent, before calculating their RTA and RCA indices for the past 20 years (1998–2018). By comparing the RTA and RCA indices in China with the indices of the selected countries, we determined China's comparative advantage in international trade. Third, to identify China's potential trade partners, we selected several countries and regions with comparative advantage in different agricultural products and used the OBC to check their complementarity with China.

The comparative and competitive advantages of China's agricultural trade and changes over time

Changes in comparative and competitive advantages in China's agricultural trade

Using the data on the imports and exports of major crops and livestock products in China over the period 1978–2018, we calculate the RCA and RTA indices for 17 types of agricultural commodities and analyse the comparative and competitive advantages of each commodity and their changes over the past 40 years. The estimated RCA and RTA indices for the crops and livestock products at the aggregate level and by commodity are shown in Figures 3.8 and 3.9, respectively.

China had a comparative advantage in producing major crops during the early reform period, but this gradually declined after the mid-2000s. As is shown in Figure 3.8a, the RCA indices for rice, corn and cotton used to be above 2.5 over a certain period before 1991, suggesting there was a strong revealed comparative advantage for the production of these three products. For other crop products such as oilseeds, soybeans, sugar/sugar beet, vegetables and fruits, the average RCA indices were also above 1.25, which implies they held a relative comparative advantage. However, the comparative advantages of major crops have gradually declined since the late 2000s. As shown in Figure 3.8a, the average RCA indices of nine out of 10 commodity groups (with the exception of vegetables and fruits) are significantly below 0.8, which suggests the comparative advantage for most crops—in particular, land-intensive products—has been disappearing.

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Figure 3.8(a) Crops

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Figure 3.8(b) Livestock products

Figure 3.8 The RCA index of major agricultural products in China, 1978–2018

Source: Authors' estimates by using FAOSTAT database.

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Figure 3.9(a) Crops

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Figure 3.9(b) Livestock products

Figure 3.9 RTA indices of China's major agricultural products, 1978–2018

Source: Authors' estimates by using FAOSTAT database.

A similar trend change has also been seen in livestock products. As shown in Figure 3.8b, China once had a strong comparative advantage in the production of pork and eggs (the RCA indices used to be more than 2.5), a moderate comparative advantage in poultry meat (the RCA indices were between 1.25 and 2.5) but no advantage in beef, lamb and dairy (the RCA index was below 1). However, the comparative advantage of the majority of livestock products has been in decline over the past 10 years. Apart from poultry and eggs, whose RCA indices are still above 1, the RCA indices of other livestock products are significantly below 1.

Figure 3.9 further shows the change in the competitive advantage for China's major agricultural products between 1978 and 2018 using the RTA index. Consistent with the comparative advantage analysis, we show that China used to have a competitive advantage in trade for almost all agricultural products except wheat, cotton and dairy. However, the competitive advantages of major agricultural products have gradually declined over time. In the past 10 years, China has had only a relatively modest competitive advantage in the trade of sugar beet, fruits, vegetables, poultry and eggs, the production of which has been rapidly scaled up and industrialised.

In sum, China had comparative and competitive advantages in many crop and livestock products during the early reform era, going back to the 1980s and the 1990s. However, its comparative and competitive advantages for most agricultural products in the global market have gradually declined over time. For the moment, except for sugar beet, vegetables, fruits, poultry and eggs, for most agricultural products (in particular, land and resource-intensive products such as coarse grains and oilseeds), China has almost no comparative or competitive advantage compared with the rest of the world. This, to some extent, reflects the fact that the growth of domestic agricultural output (due either to the limited improvement in production efficiency or constrained resource supply) has not been able to meet the growth in domestic demand caused by rapid population and economic growth. Thus, imports of these agricultural products are being used to fill the gap between production and consumption.

Comparing the comparative and competitive advantages of major agricultural products across countries

How are the comparative and competitive advantages of major agricultural products changing in the rest of the world? Are they also falling over time? To answer this question, we further calculate the RCA and RTA indices for major crops and livestock products at the aggregate level and by commodity in their major producing regions. The purpose of this is to understand which countries or regions have the potential to supply the international market with each commodity.

Cereal crops

Although China's wheat production never held a comparative or competitive advantage during the past four decades, rice and corn production did once possess a comparative and competitive advantage, before being gradually lost over the past decade. To understand how the world market has changed over time, we measured the comparative and competitive advantages of cereal crops in their major producing countries throughout the world. Figure 3.10 presents the changes in the RCA and RTA indices for other major producing countries and regions from 1998 to 2018, compared with China.

The RCA and RTA indices for rice in China are at a lower level relative to other major producing countries, and have been declining over recent years, indicating that rice production in China is losing its comparative and competitive advantages. Since the domestic demand for rice has decreased and shifted towards high-value/high-quality products, such a change in the comparative advantage is more likely to be caused by production-side factors. There are two possible reasons: one is related to increasing production costs, given the dominance of smallholder farms in the industry and the rise of labour and land costs in recent years. The other is the lack of technological innovation in the rice-processing industry. There are few large domestic processing enterprises in China. Indeed, 95 per cent of processors are small or medium-sized, and they are suffering from the impact of massive imports of cheap rice from neighbouring countries.

In contrast to the changing trend in China, the comparative and competitive advantages of rice production are rising or have continued to be maintained at a relatively high level in some other developing countries in South and Southeast Asia, including Myanmar, Cambodia, Thailand, Vietnam, India and Pakistan. Most of these countries have a tropical or subtropical monsoon climate and conditions amenable to intensive rice cultivation, as well as low economic development and an abundant supply of cheap labour. The comparison of the RCA and RTA indices of China with those of rice-producing countries/regions shows that South and Southeast Asia—especially Cambodia and Pakistan—may possess great potential to provide additional supplies of rice to the international market in the near future.

Although wheat production is gradually increasing in China, it remains an industry at a competitive disadvantage compared with the rest of the world. Throughout the past two decades, net wheat imports remain at a high level. While the wheat price on the international market has been falling due to the recent increase in supply, China's domestic wheat price has continued to increase due to increasing production costs. This has exacerbated China's comparative and competitive disadvantages in the international wheat market.

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Figure 3.10(a) RCA index

Figure 3.10(b) RTA index

Figure 3.10 RCA and RTA indices of cereal crops for China and other major producers, 1998–2018

Source: Authors' estimates by using FAOSTAT database.

In addition to China, for the moment, Central Asia, North America, Eastern Europe and Australia are the world's four-largest wheat producing/exporting regions. Among these regions, the RCA and RTA indices of Kazakhstan and Russia are significantly higher than those of the other major producers. With greater potential for productivity improvement and the development of spare land, the comparative and competitive advantages of wheat production for those countries/regions will continue to increase, and they are expected to provide a greater supply of wheat to the international market.

As one of the most important feed crops, corn has surpassed rice to become the largest cereal crop in China, yet its comparative advantage has diminished in recent years. With increasing domestic demand and declining comparative and competitive advantages, China is expected to increase its imports of corn in the near future due to the rapid expansion of its livestock industry (and its use of corn for feed). Based on our estimates of the RCA and RTA indices, South Africa, North America, South America and Eastern Europe now possess strong market competitiveness in corn production, and South America and Eastern Europe have displayed significant growth in their advantages in recent years. In particular, Ukraine, Romania, Brazil and Argentina have relatively large advantages in corn trade, which have been on the rise in the past 20 years. Therefore, these countries and regions should have great potential to increase corn supply to the international market in the future.

Economic crops

In contrast to cereal crops, economic crops have a relatively higher market value since they have a wider range of industrial usages. From the early 1980s, marketisation reform gradually changed the enterprise structure of agricultural production in rural China, and the proportion of economic crops in total crop output significantly increased. However, similar to cereal crops, many economic crops are losing their comparative and competitive advantages in the international market.

Figure 3.11 presents the changes for China in the RCA and RTA indices of six types of economic crop, compared with the major producing countries in the rest of the world, between 1978 and 2018.

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Figure 3.11(a) RCA I

Figure 3.11(b) RCA II

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Figure 3.11(d) RTA II

Figure 3.11 RCA and RTA indices of economic crops for China and other major producers, 1998–2018

Source: Authors' estimates by using FAOSTAT database.

Although China used to be one of the largest cotton producers in the world, it has lost its comparative advantage in recent decades compared with other major producing countries. In the 1980s and the 1990s, China's demand for cotton increased along with the development of its domestic textile industry, providing strong incentives for farmers to produce cotton. However, this trend has changed since 2000. Our measures of the RCA and RTA indices show that China used to have a comparative advantage in cotton production in the past but has shifted to increasing imports gradually. As potential suppliers to China, Uzbekistan has a far greater comparative advantage, while Kazakhstan, India and Egypt are also important cotton producers. With the development of China's Belt and Road Initiative, there exists great potential for future cooperation between China and these countries in the cotton trade.¹

Oilseeds and soybeans are not only important oil crops, but also can be processed to make feedstuff. The production of these two crops in China is falling far short of the increasing domestic demand, causing a heavy reliance on the international market to make up for the shortfall. As an example, soybean production in China has continued to decline in recent years, with more than 80 per cent of domestic demand being met by the international market (mainly imports from North America). Throughout the world, South and North America still dominate the production and supply of these two crops. In particular, Brazil, Argentina, Paraguay, Uruguay, the United States and Canada have significant comparative and competitive advantages in the international market. Since China–US trade frictions have increased uncertainties around future economic cooperation, more attention is being placed on diversifying the import markets in South America to cultivate more stable and reliable supplies of oil crops.

Sugar production in China has never had any comparative advantages compared with other major global producers, especially as the planting area for sugar crops in China has continued to decline due to rising production costs and declining international prices over recent years. In contrast, many developing countries—including Pakistan, Egypt, Thailand and Cuba—have increased their comparative advantage in sugar production over the past decade. Given their price advantage in the international market, there will be a continuing increase in the sugar supply from these countries.

1 It is noteworthy that, although China's cotton market has been faced with short supply, cotton imports have dropped significantly in recent years. This is partly because the domestic textile industry has shifted in recent years to Southeast Asian countries in response to increased labour and material costs. If this trend continues, China's trade dependence on cotton imports will decline in the future.

Vegetables and fruits are among the few agricultural products in China that still hold a moderate comparative advantage, even though their trade has been in deficit for the past decade. Over the past 40 years, driven by increasing per capita incomes, vegetables and fruits have become indispensable products in the national diet. Meanwhile, China's total and per capita outputs of fruits and vegetables have been growing rapidly, with total imports and exports also expanding. The production of vegetables and fruits is evenly distributed throughout the world, while the diversity of fruits and vegetables in each country due to differences in climate and environment is an important factor contributing to the active international trade in these products. With the uptick in domestic consumption and the enhancement of national awareness about nutrition and health, demand for vegetables and fruits in China will inevitably continue to expand, meaning foreign imports will also continue to increase and diversify.

Livestock products

Figure 3.12 depicts the changes in the comparative and competitive advantages of livestock products in China and the world's major producers between 1998 and 2018. At the aggregate level, the comparative and competitive advantages of livestock products have declined in China for the past two decades, but the country maintains a comparative advantage for some products, such as poultry and eggs.

Pork is the most important livestock product in China, accounting for around 60 per cent of total meat consumption, yet it has become a disadvantaged industry in recent years compared with other producing countries. Although domestic total and per capita pork production have been growing, there is still a widening gap between domestic production and demand due to the increase in domestic consumption and the impact of factors such as breeding costs and food safety. Consequently, Chinese pork imports have increased since 2010. In the rest of the world, pork production is concentrated mainly in the Americas, including Brazil, Chile, Mexico, the United States and Canada, and Europe, in Denmark, Germany, the Netherlands, Poland and Spain. Among these regions, the comparative and competitive advantages of Latin American countries have increased rapidly, alongside Western and Eastern Europe's traditional hold on relatively high comparative and competitive advantages in this industry.

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Figure 3.12(a) RCA I

Figure 3.12(b) RCA II

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Figure 3.12(c) RTA I

Figure 3.12(d) RTA II

Figure 3.12 RCA and RTA indices of livestock products for China and other major producers, 1998–2018

Source: Authors' estimates by using FAOSTAT database.

Similar to pork, the production of beef and lamb in China has no comparative or competitive advantage compared with the rest of the world. Since 2010, China's beef and lamb imports have entered a stage of explosive growth in recent years. Because of constrained domestic production due to high land prices and farming costs, the increased demand for beef and lamb in China is expected to depend on the international market for supply. The major beef producers in the world are Australasia, South Asia, South America and Europe, among which Australia, New Zealand, India, Brazil and Argentina have a relatively large comparative advantage. For the moment, in China's imported beef market, the medium and high-end products come mainly from Australia and New Zealand, while the medium and low-end products are supplied mainly by South America. Constrained by the farming conditions and production technologies in different countries, this pattern is not expected to change much in the near future. As for lamb, China's total imports grew rapidly from 2000. Globally, Australia, New Zealand and the United Kingdom have a strong comparative advantage in trade among the world's major producers, making them suitable lamb suppliers for the international market in the future.

In China's national dietary structure, poultry meat is second only to pork among major meat products and there is a high degree of substitution between the two. Among major livestock products, poultry and eggs are the only ones for which China still possesses some comparative and competitive advantages and also maintains a trade surplus. Although the comparative advantage of poultry and eggs in China has also declined over the past two decades, that advantage is still greater than for most of the world's major producers. Apart from China, other net exporters of poultry and eggs to the international market include Brazil, Thailand, Poland and the Netherlands for poultry, and Turkey and European countries such as Poland and the Netherlands for egg products.

China's dairy production has been at a disadvantage in international trade, and this continues to worsen. China lags far behind the major producers in terms of both quantity and quality. With the growth of domestic demand for dairy products, the deficit has begun to accumulate, and China's domestic market has become more and more dependent on international imports. For the moment, the main suppliers of dairy products are Australia, New Zealand and several European countries, including France, Germany, Italy, Poland and the United Kingdom, all of which have regional advantages and high technological supports; therefore, these countries and regions will remain major sources of China's dairy imports in the future.

In sum, the comparative and competitive advantages of most agricultural products in China have been in decline for the past 20 years compared with the rest of the world. As well as the United States and European countries, many developing countries in Asia, Africa and Latin America have been able to gradually increase their comparative and competitive advantages in the production of particular

agricultural products. This will increase the potential supply of agricultural products to the international market and offer alternative regions for China to source its future demand.

China's potential trading partners: Complementarity analysis

As China's population and per capita income continue to grow, the coming decade will witness further increases in domestic food demand. In addition to increasing domestic agricultural productivity, it is inevitable that China will source more of its domestic supply from the international market. As has been illustrated in the previous sections, both China and the rest of the world will stand to benefit from the expansion of China's agricultural trade if these increases are based on the respective countries' comparative advantage and competitiveness. Thus, in this section, we first provide a forecast of food demand by commodity in the near future, and then use the OBC index to list potential source countries.

China's future net demand for agricultural products

While the comparative advantage of major agricultural products in China has declined over the past 20 years, it is still important for China to maintain a relatively high level of self-sufficiency in its food supply. There is a belief that, given China's huge population and continuing growth trends, it will be hard for the world to meet such a dramatic increase in China's demand for food imports. As previously noted, China currently imports less than 2 per cent of its total food, which accounts for more than 8 per cent of global tradable food.

Based on forecasts made by the China Center for Agricultural Policy (CCAP), China will continue to maintain a high food self-sufficiency ratio over the next decade or two through improvements in agricultural productivity. However, with China's population continuing to grow until 2035, its food self-sufficiency ratio may drop from 98 per cent in 2020 to 92–95 per cent in 2035. This implies that more than twice the current domestic food demand will need to be sourced from the international market in the next two decades.

Table 3.2 compares the self-sufficiency ratio of major agricultural products for 2025, 2035 and 2050. Although production of and demand for the main cereal crops will be roughly balanced domestically, there will be a widening gap between domestic demand and supply of most economic crops and livestock products. This, to some extent, reflects the shift in domestic food consumption towards high-value and high-quality products driven by increasing per capita income. In addition, this will be a good way for China to improve the efficiency of resource reallocation by importing more agricultural products in which it has relatively low comparative and competitive advantages.

Table 3.2 Self-sufficiency ratio of China's major agricultural products in 2025, 2035 and 2050

Commodities	Self-sufficiency ratio (%)		
	In 2025	In 2035	In 2050
Rice	98	98	98
Wheat	98	98	98
Maize (corn)	92	82	81
Cotton	74	67	55
Oilseed	87	87	90
Sugar	58	40	22
Vegetables	100	100	100
Fruits	100	100	100
Pork	99	98	98
Beef	85	77	65
Lamb	91	85	75
Poultry	100	99	98
Eggs	100	100	100
Dairy	72	68	60

Source: CCAP forecast based on the ChinaAgro Model.

Based on our estimates of the RCA and RTA indices, China's major cereal crops, including rice, wheat and corn, are gradually losing their comparative advantage. However, the self-sufficiency ratios of rice and wheat are predicted to remain above 98 per cent, as they are top priorities for national development.² This implies that domestic food grain production will be able to roughly meet domestic consumption demand, despite the shortage of land resources and rising production costs. In contrast, there will be increasing demand for feed grain (in particular, corn), which will need to be sourced from elsewhere as the demand for livestock products increases over time. Given that US–China trade frictions have cast doubts on the future stability of international cooperation, it is clear that China will seek to broaden its import channels to ensure diversified sources of future imports.

Compared with cereal grains, economic crops including cotton, oilseed and sugar have more comparative disadvantages. By 2025, about 13 per cent of oilseed, 26 per cent of cotton and 42 per cent of sugar demand for the domestic market had to be met through imports. Along with the decrease in the self-sufficiency ratios for these agricultural products over the coming decade or two, their imports will increase substantially due to their relatively lower comparative advantage in China compared

² The issue of grain supply is a fundamental and critical issue affecting the national economy and people's livelihood. Since the 18th National Congress of the Communist Party of China (CPC), China has established a national grain security strategy of 'giving priority to China, relying on domestic resources, ensuring production capacity, with moderate imports and technological supports.'

with other crop products in China and the rest of the world. This does not include soybeans, of which more than 90 per cent are already coming from the international market. Nowadays, most of these products are imported from new continental countries, such as North and South America and Australia. Yet, the question remains whether these regions and countries will continue to increase their supply.

As for livestock products, China's total imports have soared since 2010, caused largely by increased domestic production costs. With the exception of poultry and eggs, the production of most livestock products in China is still based on the household production system and/or small-scale businesses, which are sensitive to land resources, labour prices and feed costs. As a consequence, domestic livestock production in China is at a price disadvantage and has lost its competitiveness. By 2020, 9 per cent of beef, 10 per cent of lamb and 25 per cent of dairy products were coming from the international market, though pork production roughly met domestic demand. With increased consumption demand and competition from the rest of the world, a greater proportion of feed grain, as well as beef and lamb, is expected to come from imports, even if self-sufficiency in pork is maintained.

Predictions of China's future agricultural trading partners

Given its forecast future food demand structure, China will need to increase its imports of high-value and land- and water-intensive agricultural products to free up more resources for the production of agricultural products for which China possesses a relative comparative advantage. This arrangement can only be achieved when other countries are able to supply enough to meet China's demand. China's existing trading partners are more or less constrained by their potential supply capacity (because of limitations in their natural endowment supplies or difficulties in the bilateral relationship). Thus, it is necessary for China to identify new trading partners, according to their potential (rather than real) complementarity in agricultural production with China.³

In this sense, we are most interested in analysing the trade potential between China and land-abundant developing countries. This is because these countries have great potential to increase agricultural output due to the availability of spare land and other agricultural resources, although they are yet to use them effectively due to a lack of economic investment and technological support. Therefore, if the comparative advantage of these countries in agricultural products complements China's future imports, the potential of increased agricultural exports to China will bring economic incentives to scale up and industrialise their agricultural production, thus increasing global agricultural output and contributing to global food security.

³ The potential complementarity between two countries was interpreted based on their OBC coefficient as well as their RTA changing trends.

Figure 3.13(a) shows the complementarity between China and major producing countries and regions for the three major cereal crops. As for the maize market, the OBC index for corn between South America, Eastern Europe and China was enhanced between 2012 and 2018, as their comparative advantage in corn production increased. In particular, Argentina and Russia have shown great potential for providing additional supplies of maize to China, beyond China's existing trading partners.

Figure 3.13(a) Cereal crops

Figure 3.13(b) Economic crops

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Figure 3.13(c) Livestock products

Figure 3.13 OBC coefficients for agricultural commodities between China and the world's major producers, 2012–18

Source: Authors' estimates by using FAOSTAT database.

Compared with food crops, the self-sufficiency rate for economic crops in China is much lower. Imports of cotton, oilseeds and sugar crops have been rising sharply over the past decade, due to high domestic production costs and international competition. In the foreseeable future, trade dependence on these three products will continue to rise.

Figure 3.13(b) shows the complementarity for economic crops between China and other trade-advantaged countries and regions for the period 2012–18. First, among the world's major cotton exporters, the comparative advantages of South America, North America and Central Asia in the cotton trade have increased significantly. In particular, developing countries such as Brazil and Kazakhstan are alternatives for China's cotton product imports. Second, for soybeans, the OBC coefficient between China and South America is positive. This suggests the comparative advantage of oil crops in South America may have more complementarity in agricultural trade with China. Third, sugar imports for China, which are influenced heavily by domestic policies, have increased with some cyclical fluctuation over time. Among

major exporters, Thailand shows high complementarity with China. Thus, if the sugar trade is dominated by market behaviour in the future, Thailand could be a promising alternative to Cuba.

As for trade in livestock products, China's imports (in particular, of beef, lamb and dairy products) currently come primarily from Australia, Europe and North America. However, our estimates of the OBC coefficients for these three products show that some developing countries in South Asia, North America, South America and Europe also have strong capacity to supply those products (Figure 3.13[c]). In particular, as the comparative advantage of the United States has decreased in recent years, the comparative advantage of countries in South Asia, South America, Africa and Australia has been increasing. Therefore, these countries could become new sources for China of livestock products, especially given the current trade tensions between China and the United States. Specifically, while medium-range to high-end meat and dairy products will come mainly from traditional trading partners including developed countries like Australia, New Zealand, the United Kingdom and Germany, developing countries in South Asia, South America and Africa, including India, Brazil and Argentina, will be able to supply China with low-end to medium-range products. With growing export advantages, these countries will be suitable future sources of livestock imports for China.

Conclusions

Using global commodity-level agricultural trade data for the period 1978–2018, this chapter systematically examines the comparative and competitive advantages of crop and livestock products at the aggregate level and by commodity in China and changes over time. In addition, we investigate the potential production complementarities that exist between China and its potential suppliers of each product. The results indicate that the comparative and competitive advantages of major agricultural products in China have declined rapidly in recent years, making China (with its increasing demand) an important food importer on the international market. In addition to relying on existing trading partners, China needs to explore the potential supply of particular agricultural products from developing countries with increased comparative advantages. Based on relative comparative advantages, this newly created agricultural trade will help not only to improve the welfare of China and its trading partners, but also to ensure global food security by boosting global food production.

At the commodity level, we show that many developing and developed countries have high levels of complementarity with China in the bilateral trade of feed grains, oil crops and other agricultural products, including developing countries in Eastern Europe, South America and Africa. These countries have different advantages in agricultural production, holding the potential to become alternative and reliable agricultural trading partners for China in the future. Properly increasing China's agricultural trade with the rest of the world, based on comparative advantage and competitiveness, will not only help to alleviate domestic pressure on relatively scarce agricultural and ecological resources, but also provide the world with economic incentives to increase its agricultural production, and thus contribute to global food security.

Appendix Table 3.1 Trade and production data of agricultural commodities

Commodities	Code	
	Trade data	Production data
Cereals	1944	1717
Rice	1946	27
Wheat	15	15
Maize (corn)	56	56
Cotton	767	1753
Oilseeds	1899	339
Soybeans	236	236
Sugar	164	/
Sugarcane	/	156
Sugar beet	157	157
Vegetables	1889	1735
Fruits		1738
Meat	2077	1770
Pork	2027	1055
Beef	1924	867
Lamb	1925	1012
Poultry	2074	1808
Eggs	1942	1783
Dairy	2030	1780
Total agricultural products	1882	/

/ = no data about certain commodities in original database

Source: FAOSTAT database.

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This text is taken from *China's Challenges in Moving towards a High-income Economy*, edited by Ligang Song and Yixiao Zhou, published 2021 by ANU Press,
The Australian National University, Canberra, Australia.

doi.org/10.22459/CCMTHE.2021.03