

China's agriculture: drivers of change and implications for China and the rest of world

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Abstract

The overall goal of this article is to identify major changes in China's agriculture/food economy and their implications for both China itself and, more importantly, to the rest of world. China has become one of the fastest-growing economies in the world since late 1970s. GDP grew at about 10% annually in the past 30 years. China's experience shows the importance of both domestic and external policies in achieving sustainable growth. The results from this study provide significant policy implications to many countries that are currently China's major trade partners or those seeking greater economic and trade relations with China. The main conclusions on the implications of China's rapid economic growth are that China's growth will provide more opportunities than challenges to the rest of the world, on average. Overall, the rest of the world will gain from China's economic expansion though this general conclusion may not hold for some countries.

JEL classifications: O13, Q18

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1. Introduction

Rapid economic growth has been accompanied by significant structural changes in the economy. Rising income together with urbanization and other dynamics of the economy have resulted in large changes in demand and consumption patterns (Fan et al., 1995; Huang and Bouis, 1996). These changes have in turn formed part of the driving force that stimulated structural changes in the economy. The share of agriculture in GDP declined from about 40% in 1970 to 11% in 2007 (NSBC, 1995–2009). The share of services has

risen over time. Within the agricultural sector, considerable structural adjustments have also been observed as a result of changes in the pattern of food consumption.

While past changes in China have been wrenching for both China and the rest of world, changes are expected to continue in the future—and in some cases the pace of the change will accelerate. Continued growth, continued urbanization, and continued dynamism in China's economy will affect all segments of the economy and all regions of the nation. And, because of China's size, continued growth, urbanization, and marketization will likely have profound impacts on the rest of the world.

The overall goal of this article is to identify major changes in China's agriculture/food economy and their implications for both China itself and, more importantly, to the rest of world. In order to achieve these goals, the rest of this article is organized as

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follows. The next two sections first discuss the major drivers of demand and then identify and analyze the major drivers of agricultural supply. The article's next two sections then describe a framework that we use to predict changes in supply and demand and trade and measure the implications—first—to China, and—second—to the rest of world. The final section concludes.

2. Consumption changes and its major drivers

Despite the global economic crisis, China's GDP growth is projected to maintain an 8% growth rate in 2009. Moreover, most analysts believe that China will continue to grow at a rate that ranges between 5% and 7% annually between 2010 and 2030. If this happens, the economy of China will grow by four to five times or more over the coming two decades.

During this time, it is expected the urbanization trends will continue. Over the 25-year period (between 1980 and 2005) there have been increasingly more people moving to the cities. By 2005, nearly 45% of China's population was living in the cities. China is expected to reach a level in which half of the population is living in cities within the next five or so years. By 2025, between 60% and 70% of the population is expected to be living in urban areas.

Income rises and the shift of the nation's population from countryside to city have resulted in significant changes in China's consumption patterns and these changes will continue as income growth and urbanization continues. Specifically, rising incomes and urban expansion have boosted the demand for meats, fruits, and other nonstaple foods and have had a defining effect on the agricultural economy as producers have shifted their production to meet demand. For example, the share of livestock output value rose 2.5 times from 14% to 35% between 1970 and 2005. One of the most significant signs of structural changes in the agricultural sector is that the share of crops in total agricultural output fell from 82% in 1970 to less than half of agricultural GDP in 2008.

Within the crop sector, the importance of the three major crops—rice, wheat, and maize—have begun to wax. Since 1990, the share of these three major grains has gradually declined (from 57% in 1990 to 50.2%

in 2005). Most of the fall has been due to the fall of the area sown to rice and wheat. In contrast, the share of maize area grew by more than 56% between 1970 and 2005. The rise in maize area, China's main feed grain, is correlated in no small way with the rapid expansion of the nation's livestock production during the same period. In addition to maize, cash crops, such as vegetables and fruit, edible oil, sugar, and tobacco, have expanded in area.

Interestingly, although the size of China's population is what makes China (in part) such an important player internationally, population growth will play an increasingly lesser role in demand changes. The main reason for this is that population growth rates are falling so fast. In recent years, the rate of growth of the population fell to about half of 1%. Throughout the coming years, it is expected to fall further and approach zero around 2030.

3. Agricultural production growth and its major drivers

Although agricultural growth has been lower than the growth in the rest of economy, its performance has been impressive since late 1970s. After 1978, decollectivization, price increases, and the relaxation of domestic trade restrictions on most agricultural products accompanied the take off of China's food economy and allowed China's producers to meet the shifts in consumer demand (discussed in the section above). Between 1978 and 1984, grain production increased by 4.7% per year; the output of fruit rose by 7.2% (Table 1). The highest annual growth rates (between 1978 and 1984) came in cotton, edible oils, livestock, and aquatic commodity sectors, sectors that expanded in real value terms from 8% to 19%.

Agricultural growth remained remarkable for all agricultural products except for grain and cotton during the period 1985–2005. Fishery production experienced the fastest growth between 1985 and 1995 (13.7% annual growth, Table 1). Although its annual growth rate fell in the following period, it still recorded 10.2% growth between 1996 and 2000. Over the same period, meat production, vegetable sown area, and fruit orchard output expanded at 7% to 9% annually. Other cash crops, such as edible oil crops, also grew at rates much higher than population growth.

Table 1
The annual growth rates (%) of agricultural economy, 1970–2005

	Pre-reform 1970–1978	Reform period			
		1979–1984	1985–1995	1996–2000	2001–2005
Agricultural GDP	2.7	7.1	4.0	3.4	3.9
Production:					
Grain	2.8	4.7	1.7	−0.7	1.1
Cotton	−0.4	19.3	−0.3	−1.9	5.3
Soybean	−2.3	5.2	2.8	2.6	1.4
Oil crops	2.1	14.9	4.4	5.6	0.8
Fruits	6.6	7.2	12.7	8.6	21.0
Meats	4.4	9.1	8.8	6.5	4.9
Fishery	5.0	7.9	13.7	10.2	3.6
Planted area:					
Vegetables	2.4	5.4	6.8	6.8	3.1
Orchards (fruits)	8.1	4.5	10.4	1.5	2.4

Note: Growth rates are computed using regression method. Growth rates of individual and groups of commodities are based on production data. Sources: NSBC (1982–2008).

Overall growth of agriculture sector kept at an average of nearly 4% of annual growth rate in 2001–2005 (row 1, Table 1). Comparing the growth rates of individual commodities between the early and late reform periods, it appears that production growth of some individual commodities (measured in quantity terms) fell. One explanation is that China's agricultural production system has been shifting from one that emphasizes total aggregate production to one that is more concerned with creating value-added and quality. During the three-year period, 2005–2007, China's agricultural GDP in real terms grew at an annual rate of more than 5%.

3.1. Investments

Past studies have already demonstrated that there are a number of factors that have simultaneously contributed to agricultural production growth during the reform period. The earliest empirical efforts focused on measuring the contribution of the implementation of the household responsibility system (HRS), a policy that gave individual farmers control and income rights in agriculture. These studies concluded that most of the rise in productivity in the early reform years was a result of institutional innovations, particularly the HRS (Fan, 1991; Lin, 1992).

More recent studies show that since the HRS was completed in 1984, technological change has been

the primary engine of the agricultural growth (Fan, 1997; Fan and Pardey, 1997; Huang and Rozelle, 1996; Jin et al., 2002). Improvements in technology have by far contributed the largest share of crop production growth even during the early reform period. When examining the sources of the technology shifts, Jin et al. (2002) empirically demonstrate the cross-province differences in investment into R&D by the government have had the largest effects on technological improvements. Between 1990 and 2005, investment in R&D nearly tripled. China is one of the only countries in the world in which agricultural R&D expenditures as a share of Agricultural gross domestic product (AgGDP) is rising.

Moreover, China is investing in far more than conventional agricultural technology. Since the late 1990s, China has greatly expanded its investment into plant biotechnology. By the mid 2000s, China's public investment into plant biotechnology was the largest in the world. China's agricultural leaders believe that past gains in no small part are from government-supported technologies; they believe their current investments in agricultural R&D will play an important role in driving agricultural output in the future.

Transportation and market infrastructure have also improved remarkably since the early 1990s—which serve to raise the return to farmers at the farmgate. Huang and Rozelle (2006) show that China's food markets have become highly integrated since the late

1990s. Not only do integration measures show that prices in one region are highly linked to prices in other regions, our work also suggests that the efficiency of moving commodities across the nation is improving. In fact, when measuring efficiency in terms of the percentage change in price for every 1,000 km of distance from port (between 4% to 7%), in efficiency terms, China's agricultural marketing is comparable with that in the United States.

Irrigation has played a critical role in establishing the highly productive agronomic systems in China (Wang, 2000). The proportion of cultivated area under irrigation increased from 18% in 1952 to a level at which about half of all cultivated land had been irrigated after the early 1990s (NSBC, 1995–2009). However, rising demand for domestic and industrial water uses poses a serious constraint to irrigated agriculture and increasing water scarcity has come to be seen as a major challenge to the future food security and well-being of people especially in the northern region.

3.2. Subsidies

In 2004, China launched its new path of development. Instead of taxing farmers and charging them fees to provide basic services in their rural homes, the government has taken decisive action to eliminate almost all taxes and fees. In addition, since 2004, the government has begun to subsidize farmers. Since 2004, subsidies have grown fast. In 2004, the government gave out 14.52 billion yuan. In 2008, the amount had climbed to 94.97 billion yuan. While the government initially launched the subsidy program (at least nominally) to increase grain production and enhance food security, as it turns out, the implementation has made the program nondistortive. According to a recent study by Huang et al. (2009), changes over time in a farmer's grain subsidy have no impact on grain production. Similarly, so-called input subsidies have no effect on the level of input investment by farmers. As a result, in recent years the government really has begun to rely on the program for an alternative policy target: increasing the welfare of rural households. Because of this neutral effect in terms of affecting agricultural production, we do not include subsidies in our empirical analysis of the effect of policy on the agricultural supply, demand, or trade of China or the rest of the world.

4. China's agriculture and food economy and sustainable economic growth

Based on the above discussions, this subsection provides our prospects of China's economic growth in the first two decades of the 21st century. While our prospects are focused on the most likely growth scenario (baseline—7.2% in 2010–2015 and 6.3% in 2016–2020), we also formulate an alternative higher-growth scenario (or high-growth scenario—or we assume the annual GDP growth rate will be increased by 10% compared to that under the baseline scenario) because one of the objectives of this study is to examine the global implications of China's rapid economic growth. The details of both baseline growth scenario and high-growth scenario for China in 2006–2020 are summarized in Table 2.

The results of analyses presented in this section are based on the Global Trade Analysis Project (GTAP). A brief introduction to the model, improvements on data and parameters of current GTAP model, and assumptions on macro-economic development (e.g., GDP and population growths by country or region, total factor productivity changes, and factor endowments) are provided in Huang et al. (2006). The implications of China's rapid economic growth on domestic agriculture and food economy as well as sustainable economic growth are examined through several key indicators (e.g., self-sufficiency, imports, exports, net exports, and relative trade shares in China and world economy).

4.1. Major results from the baseline scenario

Baseline projections show that self-sufficiency of all land-intensive crops except for rice will fall, but the fall will be very moderate for most commodities in the future. This is what we should expect as many land-intensive crops in China have a less comparative advantage in the world markets.

Under the baseline scenario, the most significant increase in import will be oilseeds. By 2020, oilseed self-sufficiency will further fall from 70% in 2001 to 45%. Increasing import of oilseeds is mainly because of the rising domestic demand for both edible oils and feed. This should not be surprising given China's experience in soybean import in the past decade. After China liberalized soybean trade by eliminating nearly

Table 2
Projections of annual growth rate (%) of China's economy, 2001 to 2020

	1985–1995	1996–2000	2001–2005	2006–2010	2011–2015	2016–2020
<i>Baseline</i>						
GDP	9.7	8.2	8.9	8.0	7.2	6.3
Per capita GDP	8.3	7.2	8.2	7.4	6.7	5.9
<i>High growth</i>						
GDP	9.7	8.2	8.9	8.6	7.6	6.7
Per capita GDP	8.3	7.2	8.2	8.2	7.4	7.5

all its trade distortions (both tariff and nontariff measures), annual import of soybean surged from virtually zero in the late 1990s to more than 30 million metric tons in 2007.

The production of cotton and other plant-based fiber is projected to expand over time, mainly through their productivity growth, but it will also fall behind domestic demand. Similar to many other crops, fiber imports will rise with gradually falling self-sufficiency levels. Increasing imported fibers are required to meet demand from China's rapidly expanding textile and apparel sector, which has created and will continue to generate employment for millions of rural people.

Among cereals, most of the imports are for feed grain (Panel A, Fig. 1). By 2020, China will import nearly 20% coarse grains, mainly maize, to meet increasing demand from the expansion of domestic livestock sector. Wheat import will be minimal because per capita demand for wheat is projected to fall in the near future. Rice is the only cereal that will expand its export and maintain a net export commodity in 2001–2020. But rice export is projected to be only moderate.

On the other hand, China will export most relatively labor-intensive products such as vegetables, fruits, fish, and processed foods. The largest export will be recorded in processed foods (Panel B, Fig. 1). While China may import large value of horticultural products, the exports will exceed the imports.

In sum, China's economic growth and trade liberalization will facilitate domestic agricultural structural changes. China's agriculture will be gradually shifting from land-intensive sectors with less comparative advantage to labor-intensive sectors with more comparative advantage. While self-sufficiency levels of many commodities will fall with economic growth under a more liberalized trade environment, food grain (excluding feed grain) and overall food self-sufficiency will remain high.

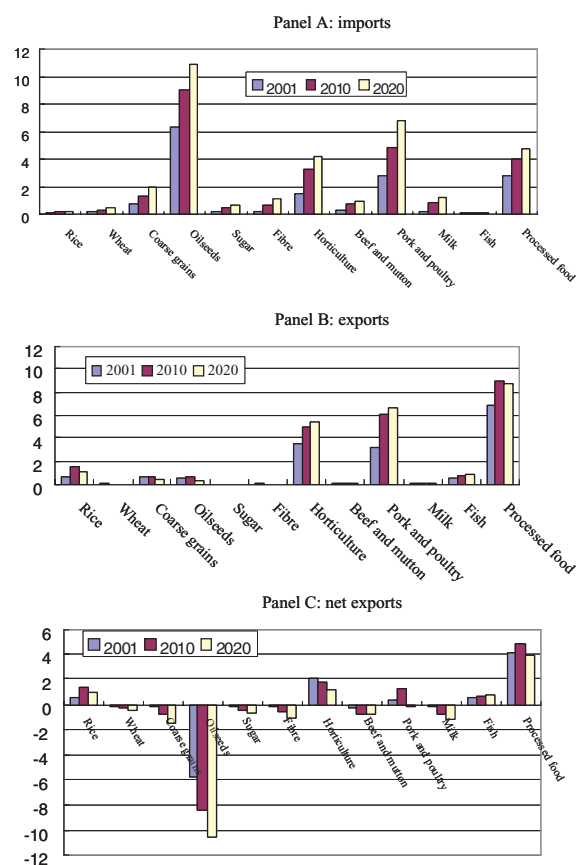


Fig. 1. Agriculture and food trade (US\$ billion) under baseline in 2001–2020.

4.2. Major results from China's high GDP growth scenario

The simulations show that the higher growth of China's economy will not have significant impacts on overall food and agricultural economy in China. Although a higher growth of China's economy is

Table 3
Self-sufficient level (%) in different scenarios in 2020

	Baseline	High GDP
Rice	103	102
Wheat	95	92
Coarse grains	86	84
Oilseeds	45	43
Sugar	72	71
Fiber	93	92
Horticulture	102	100
Beef and mutton	94	93
Pork and poultry	100	99
Milk	81	80
Fish	102	101
Processed food	101	100

associated with a lower rate of self-sufficiency of nearly all agricultural and food commodities, the changes will not be significant (Table 3). Rising domestic demand resulting from additional income growth in the future will be less than what occurred in the past. Food income elasticities have been falling and will continue to fall with the rapid growth of China's economy. After 2010, all cereal grains will have negative income elasticities. Increases in income will lead to decline in cereal consumption. Table 3 shows that, comparing the columns 1 and 2, the rates of self-sufficiency decline only 1% or 2% for nearly all agricultural and foods commodities.

With higher GDP growth, China would further restructure its agricultural and food economy in favor of the commodities with a greater comparative advantage. For example, the export shares of land-intensive

food and feed crops sectors in the world trade will decline and their import shares will rise (Table 4). The high GDP growth scenario reduces the export share of animal products (6.1% in high GDP growth scenario, comparing to 5.5% in the baseline) because of their positive income elasticities. As a whole, the net export (or net import) of food and feed will decline (increase) by about US\$4 billion comparing to the baseline in 2020.

5. Implications of China's rapid economic growth in the rest of the world

The Chinese economy has been increasingly integrated into the world economy since its economic reform. The integration has occurred in both commodity trade and FDI between China and rest of the world. In this section, we examine the impact and implications of China's economic growth on the rest of the world in the future. We will first discuss the implications of China's rapid growth upon the rest of the world from our baseline analysis. Then further implications from higher GDP growth scenarios will follow.

Main conclusions on the implications of China's rapid economic growth from our baseline analysis are that China's growth will provide more opportunities than challenges to the rest of the world, and overall the world will gain from China's economic expansion. As regards food and agriculture, China's economic growth under a more liberalized global economy will help countries with a comparative advantage in land-intensive agricultural products to expand their

Table 4
China's trade shares (%) in the world under different scenarios in 2020

	Export share		Import share		Net export share	
	Baseline	High GDP	Baseline	High GDP	Baseline	High GDP
Food + feed crops	3.9	3.7	9.8	10.3	-5.9	-6.6
Processed food	4.9	5	2.7	2.7	2.2	2.3
Animal products	6.1	5.5	6.7	7.5	-0.6	-1.9
Fiber	0.1	0.1	9.2	11.4	-9.1	-11.3
Energy	0.2	0.2	7.1	9.0	-6.9	-8.8
Mineral	2	1.6	23.4	29.4	-21.4	-27.8
Textile/apparel	34.3	37	7.5	7.4	26.8	29.6
Manufacture	8.9	9.5	6.9	7.4	2.1	2.1
Service	2	2.2	6.2	6.2	-4.2	-4
Total	8.5	9	6.9	7.4	1.5	1.6

Table 5

Percentage output changes in different regions in 2020 due to China's higher economic growth: high GDP growth comparing to baseline

	HK + TW	India	SE Asia	Japan + Korea	Other Asia	AusNzl	NAFTA	SAM	Enlarged EU	Russia	ROW
Food + feed crops	0.4	0.1	0.4	0.3	0.1	0.5	0.4	0.5	0.3	0.5	0.3
Processed food	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.2
Animal products	0.4	0.0	0.6	0.4	0.2	0.6	0.4	0.3	0.3	0.6	0.4
Fiber	-2.0	-0.9	-0.8	0.4	-1.1	-0.5	0.0	-0.5	4.4	-0.7	0.0
Forestry	1.1	0.5	4.0	0.9	1.4	6.6	1.6	1.3	4.8	17.1	5.0
Energy	3.1	2.7	3.3	4.0	3.9	2.9	2.7	2.7	3.0	3.0	3.1
Mineral	1.3	9.1	2.2	1.4	6.7	8.8	1.2	6.8	1.5	1.0	2.8
Textile & apparel	-3.6	-1.0	-3.3	-2.5	-2.0	-3.5	-1.6	-1.6	-2.6	-2.6	-2.6
Manufacture	0.6	0.1	0.2	0.3	0.2	-0.6	0.0	-0.1	0.2	-1.1	-0.4
Service	0.1	-0.2	0.1	0.2	-0.2	0.5	0.0	0.1	0.1	0.8	0.2
Total	0.12	-0.09	0.09	0.17	-0.16	0.49	0.05	0.13	0.10	0.77	0.20

production and export additional agricultural products to the Chinese markets. China's economic growth will not affect the world's food security.

Under the high GDP growth scenario, China will generate more trade and nearly all countries or regions will gain from the faster growth of China's economy. The signs and sizes of gains for each region from additional growth in China depend on the nature of its economic structure. Those countries that are largely complementary to China's economy will gain more from China's growth. Otherwise, when a country has a similar economic structure as that of China, adverse consequence could occur. Detailed comparisons of impacts on output, trade, and corresponding welfares due to China's higher economic growth (compared to the baseline) are presented in Table 5.

Table 5 shows that all regions will gain in terms of food and feed production from China's faster growth. A 10% increase in the annual growth rate of GDP (e.g., from 8% to 8.8%) and holding all other factors constant, China's food and feed net imports (exports) will increase (decline) by about US\$3 billion in 2020. The rising imports in China will push the world price upward and increase production of food and feed in all countries, particularly exporting countries (Table 5).

While higher economic growth in China will generate more domestic demand for final consumer goods, it will also result in both higher exports and imports of manufactures and textile and apparel products. The world prices of these commodities are projected to fall accordingly. The consumers in large importing countries or regions (i.e., NAFTA, EU, Japan and Korea, China's Hong Kong, and Taiwan) will gain from the

lower world prices. For those countries or regions that export manufacturing products to China (e.g., Japan and Korea, Southeast Asia), their production will rise (Table 5). However, countries with the same export structures as China may be hurt by lower prices. This may explain why India and some other Asian countries will incur slightly negative effects from China's higher economic growth.

Our simulations also show that the production structure in other countries will adjust accordingly as China's economic growth accelerates. This is reflected in the differences of production changes across sectors in each region (Table 5). Whether a country or region can reap gains from China's economic expansion as those presented in this section will depend on how flexible and efficient their economies are in responding to world market changes triggered by China's economic growth.

To have a better understanding of the overall impact of China's rapid economic growth on the rest of the world, welfare analysis is applied. Table 6 shows that global welfare will increase by about US\$241 billion in 2020 under China's high-growth scenario (comparing to the baseline), of which about US\$226 billion (93.7%) occurred in China and nearly US\$15 billion in the rest of world (6.3%). In terms of GDP, the rest of world (whole world excluding China) will have additional annual growth of 0.12% in 2020 (comparing with the baseline). Therefore, rapid economic growth in China is an important engine of the world economic development.

Table 6 also shows that nearly all regions could gain from China's economic expansion. The changes

Table 6
Welfare change in different regions in 2020 due to China's higher economic growth: high GDP growth comparing to baseline

	Aggregate welfare effect (EV) US\$ billion	Change in welfare (%)
China	226.2	10.6
The rest of world	14.8	0.09
China: HK + TW	1.3	0.22
India	-1.4	-0.15
Japan + Korea	1.4	0.07
SE Asia	0.4	0.07
Other Asia	-0.2	-0.06
AusNzl	1.3	0.51
NAFTA	1.4	0.03
SAM	1.1	0.10
EU15	0.8	0.03
CEEC	-0.2	-0.05
Russia	2.7	0.82
ROW	6.2	0.44
TOTAL	241.0	1.31

of welfare indicate that regions that are complementary to China will gain more from China's higher economic growth (Table 6). For example, the Russian Federation, Australia, South America, and the Middle East (including in "rest of world" [ROW] group) will gain more than many other countries because China will significantly increase its imports of energy and minerals as well as many agricultural products from these regions compared to other regions. The exporting countries gain from increases in both price and volume associated with China's commodities. This will further expand welfare gains by raising the return of endowments, enhancing efficiency of allocation, etc. India and other South Asian nations are exceptions. These countries are also major exporters of textiles and apparels in the world. Moreover, manufacturing products exported from India and some other Asian countries have a high degree of substitutability with those from China. Therefore, these countries would encounter increasing competition from China in the world markets in the coming decades.

6. Concluding remarks

China has become one of the fastest-growing economies in the world since the late 1970s. GDP grew at about 10% annually in the past 30 years. Over the course of the reform period, both rural and ur-

ban incomes have increased noticeably. The rising income has also associated with substantial reduction of poverty and significant improvement of food security.

China's experience shows the importance of both domestic and external policies in achieving sustainable growth. China's rapid growth would not have been possible without its domestic economic reforms and its "open-door" policy. China's experience also shows that institutional innovation (particularly land tenure), technological changes, and market reform and infrastructure development are critical to the improvement of the nation's food security.

The results from this study provide significant policy implications to many countries that are currently China's major trade partners or those seeking greater economic and trade relations with China. The main conclusions on the implications of China's rapid economic growth are that China's growth will provide more opportunities than challenges to the rest of the world. Overall, the rest of the world will gain from China's economic expansion though this general conclusion may not hold for some countries. As China is set to play an increasing role in international trade, which should benefit both developed and developing countries.

For those countries whose economic structures are complementary to China, there will be emerging opportunities offered by China's increasing imports due to its rapid growth and integration into the world economy, while countries that have similar export structures to that of China and are competing for the same export markets, will have to put extra efforts to restructure their economies and invest more in domestic infrastructure to lower production and marketing costs.

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