中国 农业

从长计议国人饮食之变(摘要)

在自然资源已被过渡挖掘，以及中国的农业生产成本上升到其他主要农业国家的两倍的情况下，中国需要通过更多技术创新带来的产量增长，和加大进口来平衡未来的食品供需。我们认为中国农业领域投资前景颇具吸引力：近期非洲猪瘟、气候因素以及去库存结束有望带动价格周期上行，从长期来看价格呈现结构性上升趋势。更值得着重关注的是，在中国农业转型之际，供应整合、饮食结构升级、高效新技术/新产品加大渗透等因素将在行业内创造相对更为强劲的增长机会。

*全文翻译随后提供

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Table of Contents

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China Agriculture in numbers

DEMAND GROWTH IN CHINA

11%
CAGR for milk & milk product imports in the last few years

85%
of China beef consumption growth from 2018 to long term, 40% of which would need to come from imports

24%
higher daily consumption in grain equivalent terms, when China upgrades its animal protein consumption to the same level as Japan and Korea

+4%
growth in non-pork meat Chinese demand from China in 1Q19, while pork apparent demand declined by 5%, on the back of African Swine Fever (ASF)

SUPPLY CONSTRAINTS AND OPPORTUNITIES

45%
percentage of China pork output could decline from normal level, by end of 2020, assuming ASF comes under control in 2H19

3.5x
China's use of nitrogen-based fertilizer per hectare of land vs. global average

1.8x
higher yield in soybean in China vs. US

0-2.5%
negative climate impact on crop yield over a decade, reported by IPCC

30%
more potential yield gain can be achieved in theory for Longping's hybrid rice

150x
faster seeding operations using drone-based seeding versus traditional manual seeding in China

GLOBAL SUPPLY, TRADE, AND PRICES

7-42%
of the agriculture supply are traded globally today, and could grow by 12-51% due to increasing imports from China in the coming years

34-60%
gaps between global supply and China demand may emerge, without a yield revolution, if Chinese consumption upgrades are reached by 2030, while global land expansion is likely to remain disciplined

31%
of the Amazon maybe converted to agriculture use by 2050, from current 17%, if land expansion in Brazil grows at over 1% a year

100%
higher production costs for Chinese corn and soybean vs. US and Brazil

40%
of production in China is labour, which grew 4x in the past decade, vs. 3-5% labour costs in the US and Brazil

60-100%
price hikes in global soybean and corn prices in 2007-08 and 2011-12, when supply deficit was 2-8% due to drought

Source: FAO, USDA, NBS, Goldman Sachs Global Investment Research

10 THINGS THAT MAY SURPRISE YOU

1. **Chinese consumers** on average eat **half** a pig per year (37kgs), **8** chickens each year, and have **1** steak (200g/steak or equivalent beef) and **1** carton of milk every two weeks

2. **American consumers** on average eat **0.4** pig per year (30kgs), **30** chickens each year, and have **1** steak (200g/steak or equivalent beef) and **1.5** cartons of milk every two days

3. The average daily food consumption of Chinese consumers requires **680g** of grains to produce vs. **1700g** for average American consumers

4. While 1kg of beef has the same calorific value as 0.8kg of corn, it takes **8-10kg** of feed (corn and soybean meal) to produce 1kg of beef

5. 1kg of poultry consumes 2kg of grain and 3,000 litres of water over **35 days**, whereas 1kg of beef takes **365 days** to produce and consumes 4-10kg of grain and 16,000 litres of water

6. A broiler can grow to 4kg in **56 days**, and a piglet can grow to a 11kg hog in **6 months**

7. A US daily cow in 1985 could produce around **6,000kg** of milk per year and today can produce around **10,000kg** per year

8. Food waste from production to consumption account for **20%** of meat production in North Asia and **40%** of cereal

9. Total grain-equivalent imports into China in 2018 is equivalent to importing over **50mn hectare** or **40%** of arable land in China

10. Wastewater (COD) discharges due to small-scale pig farming could lead to **12mnt** of unreported pollutants, equivalent to 110% of the reported COD emissions in China

Source: FAO, USDA, NBS, Goldman Sachs Global Investment Research

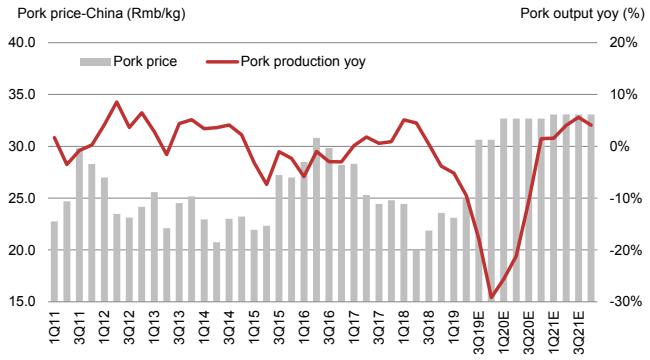
Story in charts

Exhibit 1: Daily food consumption pattern - China versus peers

Daily food consumption g/day/person ■ 2018 ■ LT	China	Japan	Korea	US	Brazil	China (LT)
Animal protein						
Pigmeat	102	62	109	83	36	91
Poultry Meat	38	62	55	149	128	62
Fish, Seafood	105	133	145	59	30	149
Milk	91	203	86	735	418	148
Beef	17	27	47	101	104	31
Total grain-equivalent (soybean/corn)	**680**	**724**	**943**	**1734**	**1340**	**842**
Cereal						
Rice	199	165	170	20	84	183
Wheat	176	123	125	214	151	159

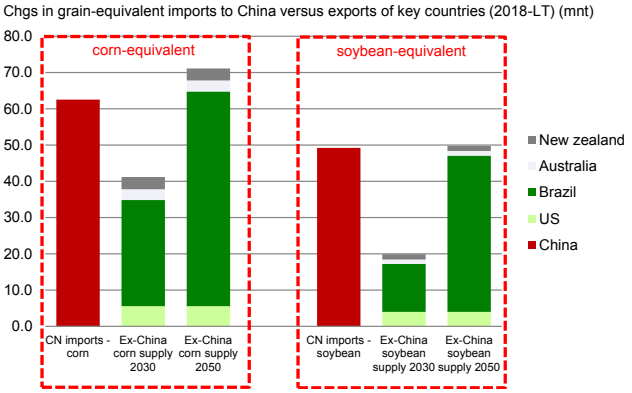
Source: FAO, Goldman Sachs Global Investment Research

Exhibit 2: China pork supply and pricing outlook
The impact of ASF on global supply is likely to be longer and deeper than expected, leading to a strong pricing and margin outlook



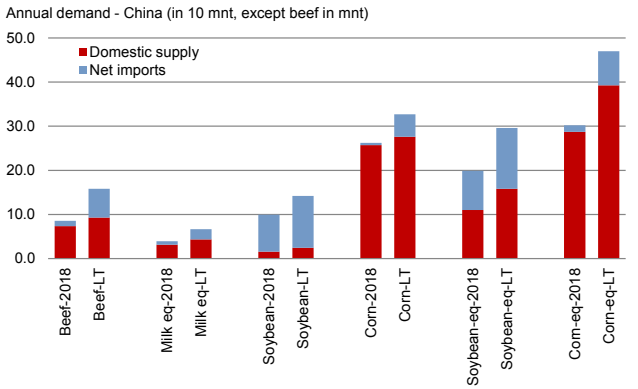
Source: CEIC, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 3: The import requirement of grain-equivalent crop demand from China, versus major global supply additions
Global deficit in meeting Chinese demand is likely to persist until 2050, based on land expansion projects by FAO



Source: Goldman Sachs Global Investment Research

Exhibit 4: China's food demand outlook - 2018 versus LT
Food balance to be addressed through both domestic supply and higher imports



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 5: Agriculture drones empower farmers for precision seeding - XAG, a private Chinese agriculture technology company
Precision farming may transform the productivity of the agriculture sector to a new level

Source: Company site

Investment summary

In the coming decades, a fundamental transformation will take place in China's agriculture sector. China's demand for major crops is set to continue its growth, as food structure shifts towards higher intake of animal protein. With resources fully stretched, and costs moving to nearly twice as high as peers, China is unlikely to address its future food balance on its own. Rather, a long-term solution has to be a combination of enhancements in innovation-driven yield gains internally, and higher imports from the global market, with the potential for long-term supply deficits and higher pricing.

We view China's agriculture sector as attractive in terms of near-term cyclical pricing on the back of African Swine Fever (ASF) and weather effects in the US as well as structurally higher pricing in the long run. What is more intriguing are the stronger growth opportunities within the sector, driven by supply consolidation, food upgrades, and the rising penetration of new technologies and products that deliver efficiency, as the sector transformation takes place.

We prefer companies with a strong intrinsic growth outlook, in addition to pricing, driven by: 1) market shares gains in the course of consolidation or rising penetration due to product upgrades; and/or 2) technology innovation that delivers attractive economics for rapid user adoption. While the availability of publicly traded companies may not cover the full spectrum of investment opportunities at this stage, we will continue to monitor the space.

ASF and global protein supply: Tighter and longer

As a result of ASF, we expect Chinese hog production to bottom between late 2020 to mid-2021, assuming ASF comes under control in 2H19

In the near term, the global impact of ASF is likely to be longer and deeper than expected. Since Aug 2018 when China reported the first case of ASF, we note that the total number of sow herd and hog herd has reduced by a quarter. Based on the life-cycle of pig farming, we expect Chinese hog production to continue to decline, and may reach bottom between late 2020 to mid 2021, at 30-45% below the normal level, under the assumption that the disease comes under control in 2H19. The depressed pork supply will likely also lead to higher demand for other animal proteins such as chicken and beef, subject to available supply response, yet is unlikely to fully offset the overall shortage in animal protein supply in the coming two years, in China and globally.

LT dietary pattern in transition: Not more, but better

We expect rising agriculture demand in China in the coming years, as continued income growth and urbanization drive a shift in China's food consumption patterns. The shift, is not about more food, but a change in food structure towards higher intake of animal protein, including more high-end protein such as beef and milk. The multiplier effect of basic crops required to produce animal protein, and the rising industrial feed penetration rate, will likely boost China's basic crop demand.

Benchmarking with North Asian peers, we estimate China's long-term dietary patterns would lead to grain-equivalent demand (in both direct and animal protein forms) in China to grow by 40-60% for soybeans (from 110mnt currently to 158-180mnt in the

Benchmarking the North Asian peers, we estimate the long-term dietary pattern of Chinese consumers would lead grain-equivalent demand to grow by 40-60% from current levels

long-term), depending on the penetration of industrial feed, and a similar growth rate for corn. The increase in the grain-equivalent demand would represent 5-7% of the global market (in the LT) by our estimates, and the higher import demand from China would potentially boost global trade volume by 12-51% on major agriculture commodities, assuming all else equal. Specifically, we expect rising beef and milk imports to China to boost global trade by 40-50% in the coming years, followed by an increase of over 20% from pork, soybeans, and corn.

Supply: Transformation needed

Structural demand trends will likely impose stress on domestic agriculture supply and tighten global agriculture resources and supply over the long term, in our view. Ongoing supply disruptions, including near-term events such as changing trade tariffs, epidemics such as African Swine Fever (ASF), as well as long-term factors of climate changes and the environment, combined with the perishable nature of agriculture products, adds further challenges to food supply and dislocation in food prices through the cycles. Calls for acceleration in non-input-based yield gains or fundamental transformations, such as new plant/seed breeding technology and precision farming practices for global and Chinese agriculture supply, will likely be more intensive than ever.

Rising demand imposes greater stress on food supply, with the climate and environment adding more challenges

Rising demand will impose greater stress on food supply, after all the "low-hanging fruit" (including land and input-based yield gains) has been taken perhaps to the detriment of resources and the environment. Challenges are also present in climate changes, and an environment that is struggling to withstand the continued use of an input-based approach to yield gains. The IPCC's (Intergovernmental Panel on Climate Change) work suggests a 0-2.5% negative climate impact on crop yields over a decade in the past, and for each Celsius degree increase in global mean temperature, the projected global production of corn and soybeans would be reduced by 7.4% and 3.1%, respectively. In China, despite the intensive use of fertilizer and pesticides, further yield improvements have been muted in recent years. Future supply growth will likely be more constrained as China steps up efforts to control deterioration in its soil and water — 2/3 of the ground water and 30% of surface water is of poor quality, and 19.4% of arable land does not meet national standards, due to the presence of major pollutants such as COD, ammonia nitrate, heavy metals, DDT and aromatic hydrocarbons, based on official reports from the MEE (Ministry of Ecology and Environment).

Calls for acceleration in non-input-based productivity gains will likely intensify

Calls for acceleration in non-input-based yield gains will likely intensify. Based on data from United Nations Food and Agriculture Organization (FAO), we estimate the contribution of non-input based yield gains or real productivity gains for the global market would need to accelerate by 40%, from the past average of 0.9% each year to 1.2% annually, to meet the future potential of 50% growth in global crop demand. Innovation-driven solutions are emerging, such as new plant/seeds technologies that focus on developing new seed traits within a given species through genetic engineering (FAO special report, "Innovation - feeding the world"), and precision farming practices may lead to a revolution in yields, potentially 70% yield gains based on our US team's estimates (Precision Farming: Cheating Malthus with Digital Agriculture), while reducing the use of fertilizer and water.

China faces the need for fundamental transformation in its agriculture sector, and will likely need to address its future food balance through internal improvements, and higher imports

The supply challenges ahead are more for China. In addition to its stretched resources, China's production costs for major crops and animal proteins have moved from on par to nearly twice the level of other major agriculture countries since 2007. As a result of China's rapid urbanization, land costs and unit-labor wages in farming have increased nearly 4x over the past decade, now accounting for over 40% of the production cost, versus 3-5% in US and Brazil. In the long run, it is unlikely that China can address its future food balance on its own. Rather, the long-term solution will likely be a combination of enhanced non-input based yield improvements from internal domestic supply, and higher imports from the global agriculture market.

The high level of supply stress in China provides more opportunities and incentivizes easier adoption for agriculture technology and innovation — for example, hybrid rice seeds, an ongoing 30-year development of Longping High Tech, have seen 35% yield improvements since the 1970's, with the potential to deliver 30% more. And according to XAG, a private Guangdong-based agriculture technology firm, the company is using drone-based technology and data to help over 4.7mn farmers grow crops smartly, sustainably, and effectively. According to XAG, its Granule Spreading System can project the demanded dosage of seeds and fertilizer uniformly into the required field, 150 times faster than manual seeding.

We see upside risk in LT pricing, given the potential deficit emerging, noting similar deficits in 2007-2008 and 2011-12 led to 60-100% rise in soybean and corn prices

On a global basis, we see certain potential sources of further supply growth in major agriculture supply countries, including the US, Brazil, Canada, Australia, and New Zealand. Yet supply additions are unlikely to meet demand without challenges. We estimate the aggregated grain-equivalent supply additions from major agriculture suppliers may reach 40-70mnt for corn and 20-50mnt for soybeans between 2030-2050E in China, or 5-19% of the current global market. Versus the grain-equivalent Chinese import requirement of 50-63mnt, global supply is likely to remain in a deficit between 2030-2050, depending on the pace of Chinese demand growth, land supply in Brazil, and any meaningful revolution in yields. We see upside risk for long-term pricing — we estimate the potential supply deficit could reach as deep as 34-60% below Chinese import demand, equivalent to 2-8% of the deficit in global supply, in a downside-case scenario assuming the current pace of China's consumption upgrade is maintained and Brazil land supply is disciplined. Similar deficits in 2007-2008 and 2011-12 led to surges in soybean and corn prices of 60-100% due to drought and growth in biofuel.

Given the unique nature of agriculture commodities, there are tangible and intangible barriers for global trade, including food safety (disease control) and political considerations (tariffs) as well as logistics. Nevertheless, trade and new parity prices would mostly find their way to bring supply to demand, in our view. Based on the higher import tariffs imposed in recent months, we estimate the current China CIF (Cost, Insurance, and Freight) price of imports remains attractive for soybeans, corn, and beef from South America, and for pork from the EU. Imports of beef from the US are on par with Chinese domestic prices, yet corn, soybeans, and pork are at higher prices versus domestic pricing at present.

Pricing and margin outlook: Strong margin outlook for animal proteins, best risk reward in corn

The agricultural commodities and animal proteins on which we are most positive are pork, beef, milk, and corn

Based on our analysis presented in this report, the agricultural commodities and animal proteins on which we are most positive are pork, beef, milk, and corn. For pork, we expect prices will likely be elevated for the coming three years on substantial supply shortages due to ASF and the difficulty and time required to add capacity. Beef and milk are the animal proteins for which we see the most upside in terms of consumption, and most of the growing demand would need to be filled by imports. We see the best risk/reward in corn prices in the coming years, given farmers' negative margin at present, a decelerating supply growth outlook, and the nearly three-year destocking in China is coming to an end.

We initiate coverage on China's agriculture sector with a positive view, and set our first price forecasts for China agriculture products including major crops (imported soybeans, domestic soybean meal, corn, and rice), and major animal proteins (hog, broilers, pork, chicken, and beef).

1) We expect higher-for-longer pork prices and margins due to a slow cyclical recovery from ASF, and estimate Chinese pork prices to move up 35% yoy in 2H19E, followed by a 20% increase yoy in 2020E, with prices to remain elevated at Rmb32.7/kg in 2021E, versus current levels of Rmb26.9/kg. We expect the live-hog to feed spread to expand by 50-100% over 2019-2020E to Rmb11/kg, versus the current level of Rmb7.7/kg and the mid-cycle of Rmb5.6/kg, and to remain high in 2021E.

2) In the broader animal protein space, we expect strong China pricing as well due to substitutions from pork given supply shortages, most prominently in beef and chicken. We forecast chicken prices to increase 8% in 2019E and 0% in 2020E, and beef prices to increase 7% in 2019E and remain high in 2020E Rmb70.6/kg.

3) We expect China domestic corn prices to improve 2% yoy in 2019E and 6% in 2020E. Domestic arable land allocation will decline by 0.8% in 2019E, based on (China National Oil and Grains Information Center (CNGOIC) forecast, while US harvest land may decline by 1.1% in 2019E, according to projections by the USDA. Corn inventory in China has also been destocked from nearly 600 days three years ago to 200 days in 2018.

4) We forecast imported soybean prices to soften by 9% yoy in 2019E and 4% in 2020E, due to lower demand from a contracting hog herd.

Investment and stock picks: China and global

We view investment in China's agriculture sector as attractive, in terms of near-term cyclical pricing on the back of ASF and weather effects in the US as well as structurally higher pricing in the long run. We also see stronger growth opportunities within the sector, driven by supply consolidation, food upgrades, and the rising penetration of new technologies and products that deliver efficiency, as the sector transformation takes place. Our long-term investment themes focus on companies with a strong intrinsic growth outlook, in addition to pricing, driven by: 1) market shares gains in the course of

consolidation or rising penetration due to product upgrades; and/or 2) technology innovation that delivers attractive economics for rapid user adoption.

We initiate coverage of five Chinese agriculture stocks: 1) Wens Foodstuff (300498.SZ) with Buy and a target price of Rmb58.8/sh; 2) Muyuan Foods (002714.SZ) with Buy and target price of Rmb83.3/sh; 3) Guangdong Haid Group (002311.SZ) with Buy and target price of Rmb36.4/sh; 4) Jinyu Bio-Technology (600201.SS) with Neutral and target price of Rmb15.9/sh; and 5) Longping High-Tech (000998.SZ) with Neutral and target price of Rmb12.0/sh.

Our top picks are the two hog producers Wens Foodstuff and Muyuan Foods, as key beneficiaries of higher for longer hog prices on the back of ASF. Risks are potential ASF infection, uncertainty in hog prices and cost inflation as well as uncertainty in sales volume.

On global basis, we also highlight positive views on major global protein players, including Tyson (TSN; Buy; 12-m TP of US$91.0), BRF (BRFS; Buy; 12-m TP of US$10.2), Tassal Group (TGR.AX; Buy; 12-m TP of A$5.5), and feed additive company DSM (DSMN.AS; Buy; 12-m TP of EUR 125/sh).

Pricing forecasts and key supply/demand balance

Exhibit 6: Soft commodity pricing forecasts for key products (Spot and YTD prices updated as of July 15, 2019)

Global futures prices		2011A	2012A	2013A	2014A	2015A	2016A	2017A	2018A	2019E	2020E	2021E	2022E	2023E	Spot	YTD
CBOT soybean	cent/bu	1,318	1,464	1,408	1,246	945	987	976	932	849	800	n/a	n/a	n/a	907	886
yoy	%	*22%*	*6%*	*-9%*	*-14%*	*-14%*	*-14%*	*0%*	*14%*	*-5%*	*-5%*	*n/a*	*n/a*	*n/a*	*9%*	*-10%*
FOB price	Rmb/t	*3,200*	*3,500*	*3,314*	*3,065*	*2,371*	*2,614*	*2,590*	*2,624*	*2,292*	*2,206*	*n/a*	*n/a*	*n/a*	*2,554*	*2,403*
CBOT corn	cent/bu	680	694	580	416	377	358	359	368	409	425	n/a	n/a	425	452	386
yoy	%	*59%*	*2%*	*-16%*	*-28%*	*-9%*	*-5%*	*0%*	*2%*	*11%*	*4%*	*n/a*	*n/a*	*n/a*	*32%*	*4%*
FOB price	Rmb/t	*1,908*	*1,911*	*1,635*	*1,249*	*1,097*	*1,141*	*1,114*	*1,385*	*1,266*	*1,322*	*n/a*	*n/a*	*n/a*	*1,423*	*1,217*
CME live cattle	cent/lb	115	123	126	152	146	119	118	115	121	120	n/a	n/a	n/a	108	120
yoy	%	*21%*	*7%*	*3%*	*20%*	*-3%*	*-19%*	*-1%*	*-3%*	*5%*	*-1%*	*n/a*	*n/a*	*n/a*	*1%*	*4%*
CME lean hog	cent/lb	90	85	89	106	69	66	70	65	76	91	n/a	n/a	n/a	71	73
yoy	%	*20%*	*-6%*	*5%*	*18%*	*-34%*	*-6%*	*7%*	*-7%*	*17%*	*20%*	*n/a*	*n/a*	*n/a*	*-11%*	*2%*
China prices - crop																
Imported soybean	Rmb/t	4,114	4,406	4,368	3,880	3,119	3,386	3,447	3,430	3,125	3,015	n/a	n/a	n/a	3,153	3,193
yoy	%	*9%*	*7%*	*-1%*	*-11%*	*-20%*	*9%*	*2%*	*0%*	*-9%*	*-4%*	*n/a*	*n/a*	*n/a*	*-8%*	*-6%*
Soybean meal	Rmb/t	3,202	3,710	4,135	3,720	2,863	3,083	3,024	3,211	2,742	2,714	n/a	n/a	n/a	2,886	2,791
yoy	%	*-1%*	*16%*	*11%*	*-10%*	*-23%*	*8%*	*-2%*	*6%*	*-15%*	*-1%*	*n/a*	*n/a*	*n/a*	*-7%*	*-10%*
Corn	Rmb/t	2,325	2,469	2,404	2,469	2,314	1,911	1,712	1,882	1,919	2,028	n/a	n/a	n/a	1,966	1,916
yoy	%	*16%*	*6%*	*-3%*	*3%*	*-6%*	*-17%*	*-10%*	*10%*	*2%*	*6%*	*n/a*	*n/a*	*n/a*	*7%*	*2%*
Rice	Rmb/t	2,553	2,732	2,734	2,811	2,854	2,807	2,808	2,630	2,424	2,400	n/a	n/a	n/a	2,415	2,445
yoy	%	*17%*	*7%*	*0%*	*3%*	*2%*	*-2%*	*0%*	*-6%*	*-8%*	*-1%*	*n/a*	*n/a*	*n/a*	*-4%*	*-10%*
China prices - animal protein																
Live hog	Rmb/kg	16.9	15.2	15.1	13.5	15.3	18.6	15.3	13.0	16.5	20.0	20.3	18.8	17.3	16.8	14.4
yoy	%	*48%*	*-10%*	*-1%*	*-11%*	*14%*	*22%*	*-17%*	*-15%*	*27%*	*22%*	*1%*	*-7%*	*-8%*	*46%*	*21%*
Broiler	Rmb/kg	10.1	8.9	8.6	8.8	7.3	7.7	6.7	8.5	9.4	9.2	9.1	8.6	8.4	8.0	9.5
yoy	%	*n/a*	*-11%*	*-4%*	*2%*	*-17%*	*6%*	*-13%*	*26%*	*10%*	*-2%*	*-1%*	*-5%*	*-2%*	*-4%*	*23%*
Pork	Rmb/kg	26.4	24.4	24.3	22.5	24.7	29.3	25.7	22.5	27.3	32.7	33.1	30.7	28.3	26.9	24.1
yoy	%	*42%*	*-8%*	*0%*	*-8%*	*10%*	*19%*	*-12%*	*-13%*	*22%*	*20%*	*1%*	*-7%*	*-8%*	*35%*	*9%*
Chicken	Rmb/kg	17.2	17.2	17.0	18.2	18.9	19.1	17.9	19.2	20.8	20.8	20.2	19.1	18.7	20.7	20.4
yoy	%	*15%*	*0%*	*-1%*	*7%*	*4%*	*1%*	*-6%*	*7%*	*8%*	*0%*	*-3%*	*-5%*	*-2%*	*12%*	*8%*
Beef	Rmb/kg	37.1	45.1	58.8	63.3	63.2	62.7	62.7	65.1	69.8	70.6	70.6	70.6	70.6	69.4	69.0
yoy	%	*10%*	*21%*	*30%*	*8%*	*0%*	*-1%*	*0%*	*4%*	*7%*	*1%*	*0%*	*0%*	*0%*	*9%*	*7%*
China margin and spread assumptions																
Hog - feed (spread)	Rmb/kg	8.1	5.7	5.1	3.4	5.6	9.4	6.3	3.9	7.6	11.0	11.0	9.5	8.0	7.7	5.4
yoy	%	*159%*	*-29%*	*-10%*	*-33%*	*64%*	*68%*	*-33%*	*-38%*	*96%*	*44%*	*0%*	*-14%*	*-16%*	*206%*	*89%*
Broiler - feed (spread)	Rmb/kg	3.9	2.4	1.8	1.9	0.7	1.5	0.6	2.3	3.3	3.0	2.7	2.2	2.0	1.7	3.3
yoy	%	*n/a*	*-38%*	*-25%*	*7%*	*-65%*	*120%*	*-61%*	*293%*	*46%*	*-9%*	*-10%*	*-19%*	*-9%*	*-18%*	*116%*
Corn margin	Rmb/t	557	564	323	324	(111)	(187)	(141)	(41)	59	159	259	259	259	31.4	(17.3)
yoy	%	*5%*	*1%*	*-43%*	*0%*	*-134%*	*68%*	*-24%*	*-71%*	*-243%*	*170%*	*63%*	*0%*	*0%*	*-135%*	*-63%*
Rice margin	Rmb/t	799	597	498	587	518	458	442	264	58	34	10	10	10	50.6	80.0
yoy	%	*-94%*	*-25%*	*-17%*	*18%*	*-12%*	*-12%*	*-4%*	*-40%*	*-78%*	*-42%*	*-71%*	*0%*	*0%*	*-68%*	*-77%*

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research , Bloomberg, Wind

Exhibit 7: Global agriculture sector - current and future changes from China demand, and new supplies

		Corn	Soybean	Pork	Beef	Chicken	Raw milk Equiv.
Global market-2018	**mn t**	**1100**	**367**	**113**	**63**	**96**	**606**
Top five producers							
United States	mn t	366	125	12	12	19	99
China	mn t	257	16	54	7	12	31
Brazil	mn t	95	121	4	10	14	
European Union	mn t	61		24	8	12	159
Argentina	mn t	46	56				
India	mn t		11		4	5	167
Russia	mn t			3			31
Global trade-2018	**mn t**	**167**	**155**	**9**	**11**	**11**	**45**
as % of production	**%**	**15%**	**42%**	**8%**	**17%**	**12%**	**7%**
Top five exporters							
United States	mn t	62.2	51.7	2.7	1.4	3.2	3.7
Argentina	mn t	29.0	8.0				
Brazil	mn t	29.0	77.0	0.7	2.1	3.7	
European Union	mn t			3.1		1.4	18.2
New Zealand	mn t				0.6		14.0
Australia	mn t				1.6		3.6
Chgs (2018E-LT)							
CN import demand	mnt	45.9	33.9	1.8	5.3	1.4	15.2
Global trade mkt	%	27%	22%	21%	51%	12%	34%
CN import-grain eqv	mnt	62.5	49.2	n/a	n/a	n/a	n/a
Global trade mkt	%	37%	32%	n/a	n/a	n/a	n/a
Global mkt	%	6%	13%	n/a	n/a	n/a	n/a
Ex-CN supplies 2030	mnt	41.2	19.9	n/a	n/a	n/a	n/a
Global mkt		4%	5%	n/a	n/a	n/a	n/a
Ex-CN supplies 2050	mnt	71.1	49.8	n/a	n/a	n/a	n/a
Global mkt		6%	14%	n/a	n/a	n/a	n/a

Source: FAO, USDS , Goldman Sachs Global Investment Research, Gao Hua Securities Research

Summary of key stocks

Exhibit 8: Coverage stock summary - China and Global
Pricing as of 2019/07/16

Ticker	Company name	Country	Rating	Mkt cap (US$bn)	Trading ccy	Target price	Share price	+/- to TP	Key investment summary
300498.SZ	Wens Foodstuff	China	Buy	31.0	CNY	58.8	40.2	46%	1. No.1 hog and chicken producer in China. 2. Potential to gain market share in China live hog industry; light-asset model to facilitate capacity expansion. Leading cost advantage, consistently making higher margin than industry peers; 3. Benefit from sustainable high hog price in 2019-2021 as well as higher chicken price
002714.SZ	Muyuan Foods	China	Buy	20.7	CNY	83.3	68.3	22%	1. No.2 hog producer in China. 2. Potential to gain market share through proactive capacity expansion; internal cultivation model with high quality control; Leading cost advantage, consistently making higher margin than industry peers; 3. Benefit from sustainable high hog price in 2019-2020
002311.SZ	Guangdong Haid	China	Buy	6.3	CNY	36.4	27.4	33%	1. Top3 aquafeed producer in China 2. Structural growth in aquafeed business, driven by faster growth in high end fish categories, and upgrade in product mix; 3. Full value chain service, from fish seed, feed to animal health to increase customer stickiness
600201.SS	Jinyu Bio-Tech	China	Neutral	2.5	CNY	15.9	15.0	6%	1. Leading animal health provider with clear leadership in FMD vaccine 2. benefit from growing demand on high quality vaccine from large scale hog producers. 3. Persistant spending in R&D to improve product quality and facilitate expansion into other animal vaccine categories.
000998.SZ	Longping Hi-Tech	China	Neutral	2.6	CNY	12.0	13.6	-12%	1. Largest hybrid rice seed producer in China 2. Clear leadership in hybrid rice seed and expanding into hybrid corn seed; Continue to spend in R&D to improve product quality; 3. Awaiting recovery in hybrid rice seed industry and better product offerings to drive earnings growth
0288.HK	WH Group	China	Buy	14.9	HKD	10.1	8.0	27%	1. Operates its pork business mainly in China, US and Europe 2. Benefit from higher profit in US hog production business, as US pork price is expected to remain lifted due to rising export 3. Plans for more ASP hikes and higher imports for China packaged meat business to mitigate rising input cost
TSN	Tyson Foods	US	Buy	29.0	USD	91.0	79.1	15%	1.The largest protein producer in the US, holding the #1 position in Chicken (vertically integrated), #1 in Beef, and #3 in Pork, with the company responsible for roughly 20% of all meat produced in the US 2. Provides exposure to protein industry inflation in the wake of African Swine Fever in China. Expect rising US exports of protein to drive inflation across US proteins.
BRFS3.SA	BRF	Brazil	Buy	7.1	BRL	40.0	32.7	22%	1. The largest chicken producer in Brazil, the second in the World and the largest global exporter. 2. We believe chicken is the most advantaged protein to benefit from growing demand and higher prices, in the backdrop of ASF in China. 3. We expect BRF's chicken business to benefit from higher export to China
JBSS3.SA	JBS	Brazil	Neutral	17.3	BRL	20.5	23.9	-14%	1. The largest protein company in the World by revenue 2. Neutral-rated as we believe current price already reflects stronger performance and improving outlook. 3. Could continue to benefit from accelerating momentum related to ASF
FNP.AX	Freedom Foods	Aus-tralia	Buy	0.8	AUD	6.2	4.9	27%	1. The largest player in the Health Food category in the Australian Supermarket channel. 2. Well placed to benefit from growing dairy demand in China and China's plans to encourage cross border collaboration 3. Ramp up of processing capacity to drive incremental group EBITDA
TGR.AX	Tassal	Aus-tralia	Buy	0.5	AUD	5.5	4.7	17%	1. Australia's largest Atlantic salmon producer based in Tasmania. 2. Benefit from growing demand on global atlantic salmon demand, expect earnings growth to be generated from the execution of mgmt's strategy in prawns and salmon 3. China exports are coming off a low base and could grow meaningfully over the medium to long term as consumers shift to this relatively healthier protein.
DSMN.AS	DSM	Nether-lands	Buy	22.5	EUR	125.0	115	9%	1. Feed additive producer, with c.75% of its EBITDA exposed to animal and human nutrition. 2. We like the stock as: (i) Underappreciated defensive earnings with limited downside; (ii) Best in-class balance sheet optionality; (iii) Continuing portfolio transformation story at a discount.

Source: Bloomberg, Goldman Sachs Global Investment Research, Gao Hua Securities Research

China's agriculture sector: A macro view, sustained growth ahead

We expect rising agriculture demand in China in the coming years, as continued income growth and urbanization drive a shift in the food consumption patterns of Chinese consumers. The change in food structure towards higher intake of animal protein, including more high-end protein such as beef and milk, would lead to a multiplier effect of basic crops required to produce animal protein. Combined with the rising industrial feed penetration rate (from 10-25% to 45-60%), we see sustained growth in China's basic crop demand as the country's food structure upgrades.

The structural trend in demand imposes challenges to domestic agriculture supply, from both a resource and productivity perspective, and will likely tighten global agriculture resources and supply in the long run. Ongoing supply disruptions, including near-term events such as changing trade tariffs as results of trade tensions, epidemics such as African Swine Fever (ASF), as well as long-term factors such as climate changes and the environment combined with the perishable nature of agriculture products, adds further challenges in food supply and dislocation in food prices through the cycles, in our view.

Our global supply work suggests an emerging supply deficit in the coming years in the global trade market due to higher China imports, implying a positive pricing outlook

Accounting for 25% of global cereal and 28% of animal protein demand, the fundamental tightening S/D balance in China's agriculture sector will likely lead to significant changes to global food supply and pricing — our global supply work suggests an emerging supply deficit in the coming years in the global trade market, implying a positive pricing outlook. The rise in food demand from China will likely translate into higher imports in both volume and contribution to the domestic market. We estimate the increase in grain-equivalent soybeans and corn in China would represent 6-13% of the global market, and Chinese imports may lead to a 12-51% expansion in the global trade of key agriculture products, all else equal. Import of soybean-equivalent as percentage of the domestic market would remain high at over 80% in the coming years, corn-equivalent import is likely to increase from 5% at present to 16% in the long run. The trend ahead may closely resemble the strong cycles in hard commodities over the past twenty years, albeit at a more moderate and sustained pace.

In the overall commodity complex, soft commodities are one of the few sub-segments in which China's demand is still lower than peers — as reflected in the 15-20% lower intake in the animal protein per capita in food structure versus developed Asian counties. Yet the path of growth of Chinese agriculture demand, has been more on track with peers than hard commodities, and has ample room to upgrade going forward, in our view, given the nature of the demand.

Higher demand, more imports

The animal protein intake of Chinese on average is 60% more today than 20 years ago, yet remains 20-60% lower than developed Asian countries such as Japan and Korea, a gap we expect to continue to close in the coming decades.

Today, the average intake of Chinese consumers is over 3,000 kCal of food per day, slightly above the world average, or 20% more than 20 years ago. On per day basis, Chinese consumers on average derive 22% of their energy from animal protein, including 102 grams of pork, 38 grams of poultry, 105 grams of fish and seafood, 91 grams of milk and 17 grams of beef. The total animal protein intake is 60% more today than 20 years ago, yet remains 15-20% lower than developed Asian countries such as Japan and Korea, a gap we expect to continue to close in the coming decades. With the assumption of per capita disposable income in China to grow from US$4.7k on average to US$8.8k by 2025E, and to over US$22k in the log run, we make estimates of Chinese agriculture demand, bench-marked to most developed Asian counties. Assuming total calorific value would not increase materially, an upgrade in animal proteins would lead to continued growth in agriculture demand due to its resource-intensive nature — for example, while 1kg of beef has the same calorific value as 0.8kg of corn, it takes 8-10kg of feed (corn and soybean meal) to produce one kg of beef.

The rise in food demand from China will translate into higher imports in both volume and contribution to the domestic market.

The rise in food demand from China will translate into higher imports in both volume and contribution to the domestic market...

We estimate the grain-equivalent Chinese demand for soybeans and corn (soft commodities used for animal feed) to expand by 17-20% from 2018A to 2025E and 37-44% in the longer run. Grain-equivalent imports of soybean, measured in both direct imports and animal proteins in equivalent feed, could reach 105mnt by 2025E and 138mnt in the long run, 18-55% higher than 2018A. China's soybean-equivalent imports as a percentage of grain-equivalent global trade, could also rise from 57% at present, to 70% in the long run. Similarly, grain-equivalent China imports of corn could triple in the long run to over 60mnt, or reaching 31% of grain-equivalent global trade (versus 9% at present). In terms of import contribution to domestic demand, we expect import of soybean-equivalent would remain high at over 80% in the coming years, corn-equivalent import is likely to increase to 5% at present to 16% in the long run.

...keeping imports of soybean-equivalent high, and leading corn-equivalent imports to increase from 5% at present to 16% in the long run.

We expect much of the food imports to China in the coming years to be more in direct animal protein form, rather than feed imports. We estimate Chinese consumption in major meat categories (beef, and chicken, and aqua products) has been growing at a 2.8-3.8% CAGR in the past decades (while feed crops in soybean and corn grew at 6.1-7.5% CAGR), and is likely to further increase at 3.5-6.0% CAGR, or up 27-48% from 2018A to 2025E, driving import growth of 3-8x over the period, and much higher over the long run. Specifically, we expect annual beef imports to nearly triple to 3.6mnt from the 1.2mnt in 2018A by 2025E and to 6.5mnt in the long run, an increase that could be over 60% of the current global beef trade market. Imports for pork will likely remain depressed in the long-run amid the near-term risk of a surge in imports given supply shortages. Consumption of milk and related products in China will also likely expand by 40% for 2018-2025E and likely see further expansion by 30% in the long run, driving imports to move up by 3-4x on top of the 8x growth in the past ten years from a low base. Imports of beef and milk as percentage of total demand would grow from the current 14-20% to 35-41% in the long-run.

Signs of China's rising appetite are starting to be reflected in the import data in different forms. While growth in soybean and corn imports has not been relatively aggressive, beef imports have surged since 2015, with an average growth rate of 30-40%, standing at annualized rate of 1.2mnt since 2H18. Milk imports, including raw milk, milk powder, and cheese products have also has been growing at an 11% CAGR in recent years.

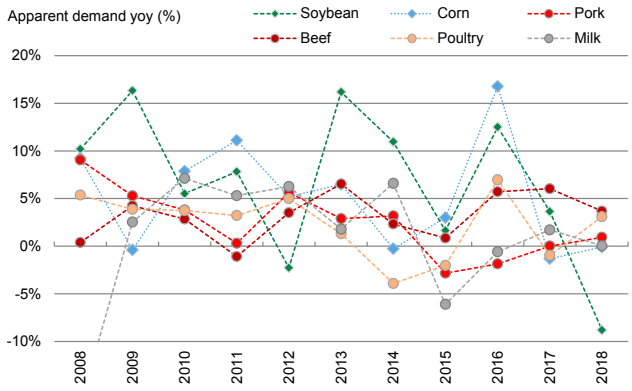
Exhibit 9: Animal protein consumption per person per day - China versus peers

Daily food consumption g/day/person ■ 2018 ■ LT	China	Japan	Korea	US	Brazil	China (LT)
Animal protein						
Pigmeat	102	62	109	83	36	91
Poultry Meat	38	62	55	149	128	62
Fish, Seafood	105	133	145	59	30	149
Milk	91	203	86	735	418	148
Beef	17	27	47	101	104	31
Total grain-equivalent (soybean/corn)	**680**	**724**	**943**	**1734**	**1340**	**842**
Cereal						
Rice	199	165	170	20	84	183
Wheat	176	123	125	214	151	159

Source: FAO, Data compiled by Goldman Sachs Global Investment Research

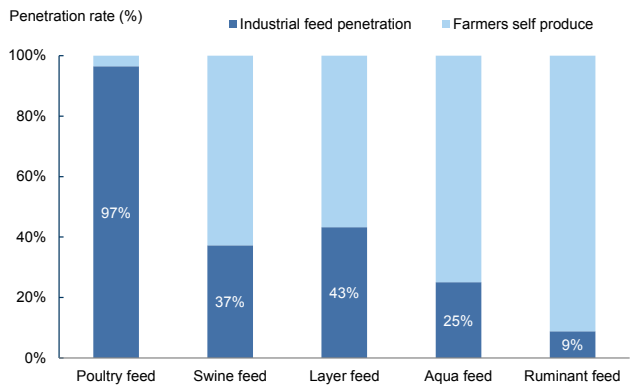
Exhibit 10: Apparent demand growth of key soft commodities - China

The average annual growth rate has been 1-7%



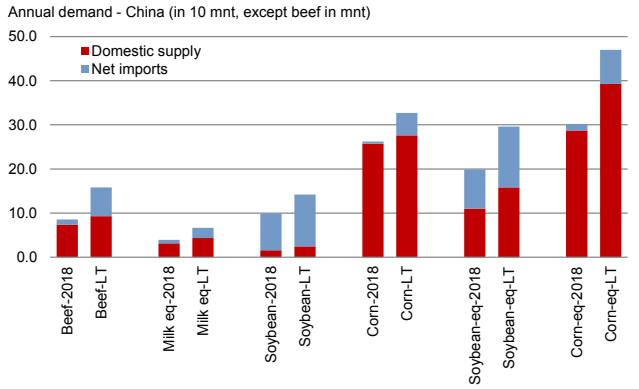
Source: Ministry of Agriculture, USDA, Goldman Sachs Global Investment Research

Exhibit 11: Industrial feed penetration rate - China



Source: China Industrial Feed Association, Goldman Sachs Global Investment Research

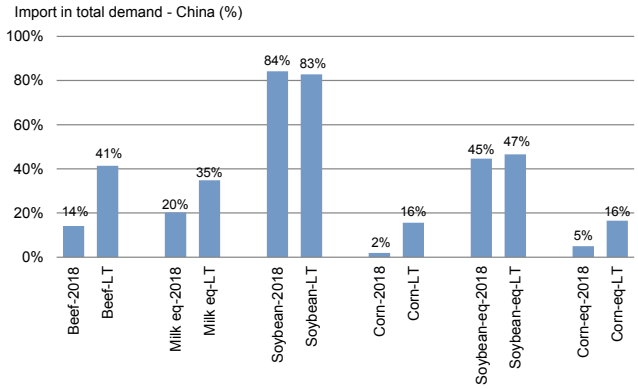
Exhibit 12: China food demand outlook - 2018 versus LT



Source: USDA

Exhibit 13: China imports as % of China demand

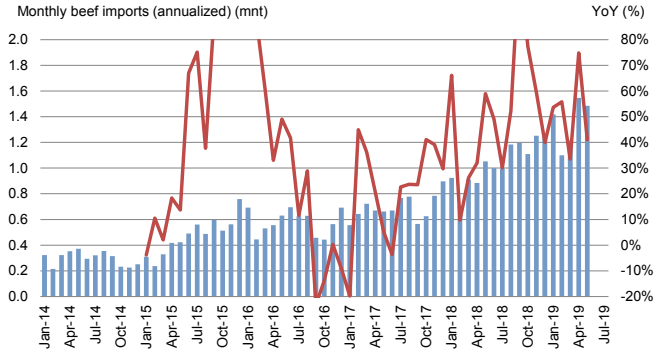
The weight of the imports is likely to raise over time



Source: FAO, USDA, Goldman Sachs Global Investment Research

Exhibit 14: Monthly beef imports - China

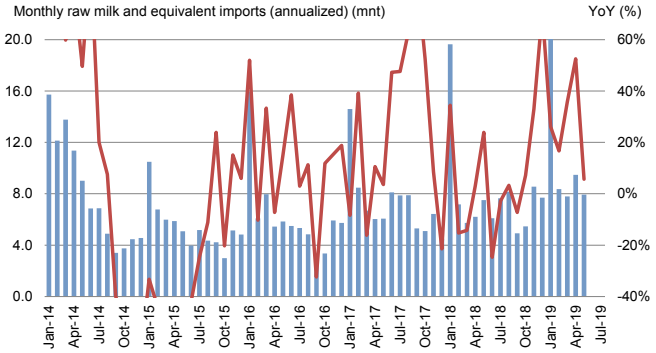
On a secular rise for a few years and have continued to surge in recent months



Source: Wind, Goldman Sachs Global Investment Research

Exhibit 15: Raw milk and milk equivalent (powder and cheese) imports

Milk imports have been on the rise



Source: Wind, Goldman Sachs Global Investment Research

China in the global agriculture sector

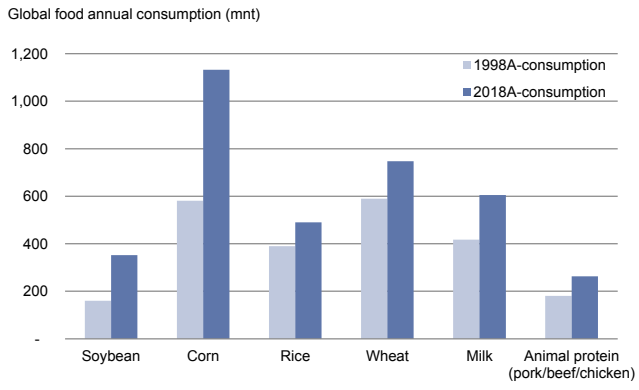
China is not the only place where food demand is rising. Its changing appetite is part of the global food demand trend, adding greater challenges to global food production in the coming years.

Globally, we estimate total food supply will likely grow by another 50% or 1.4bnt in the coming 20-30 years

In the past 20 years, global food demand, quantified in aggregate supply of major crops including soybeans, corn, wheat, and rice, has increased by 950mnt or over 50%, driven by population growth (28% over the period) and higher food consumption as a result of urbanization. Based on projections from the United Nations Food and Agriculture Organization's (FAO), world population will continue to grow from 7.6 bn in 2018 to 9.1 bn in 2050, with around 70% of the world population living in cities or urban areas by 2050, up from 49% today. Based on our analysis on China and ex-China projections from the FAO, we estimate global food supply will likely grow by another 50% or 1.4bnt in the coming 20-30 years, including 25% growth in wheat and rice, and stronger growth of 80-130% in corn and soybeans driven by animal feed demand. Our long-term estimates are based on the growth rate implied from the FAO long-term forecasts, feed conversion ratios, and reported demand figures from 2018A (2330 mnt for cereal and 268mnt for major meat categories including pork, beef, and chicken, 3-7% above the FAO's earlier projection implied from the growth rate).

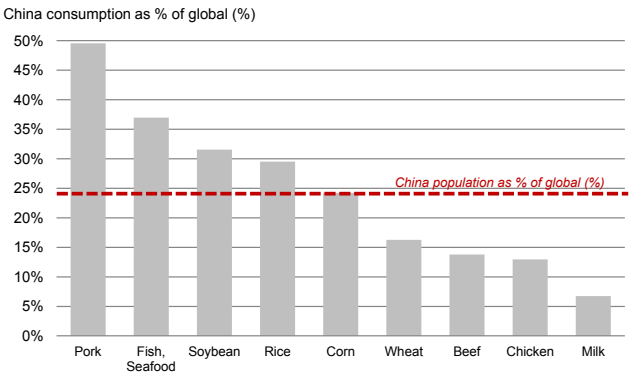
As of 2018A, China has consumed an outsized share of soft commodities such as pork, fish, soybeans, and corn — China (24% of total world population) accounts for nearly half of global pork consumption, over one third of global fish and seafood, one-third of soybean, a quarter of corn demand. However, China remains lean in the consumption of high-quality animal proteins such as beef, chicken, and milk. More importantly, China has been a major driver for global food consumption growth in the past ten years, accounting for 40-50% of global beef, pork, soybeans, and corn, and should continue to account for 10-27% of the future growth in our estimates.

Exhibit 16: Global agriculture market - 2018A and 1998A



Source: USDA, FAO, Goldman Sachs Global Investment Research

Exhibit 17: China's share in global food consumption (2017A)



Source: USDA, FAO, Goldman Sachs Global Investment Research

Exhibit 18: China soft commodity supply and demand outlook

	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019E	2020E	2021E	2022E	2023E	2024E	2025E	LT	Chgs 2008-18	Chgs 2018-LT	CAGR 2018-LT
Crops-China																							
Consumption	mnt	444	467	493	524	544	550	552	573	638	648	646	636	640	650	661	671	682	686	736	202	89	0.4%
Production	mnt	423	427	445	461	479	496	498	510	550	552	550	553	553	553	556	554	554	558	558	127	8	0.0%
Imports	mnt	40	52	53	67	67	83	89	93	104	104	93	75	78	89	104	109	116	114	154	53	61	1.6%
As % of global trade	%	12%	15%	15%	18%	18%	19%	20%	19%	21%	20%	18%	15%	15%	17%	19%	20%	21%	21%	26%	5.2%	8.5%	n/a
Soybean																							
Consumption	mnt	54	61	68	74	75	80	89	93	106	109	105	101	102	105	108	112	115	116	138	51	33	0.9%
Production	mnt	15	14	16	14	12	13	14	11	12	15	16	18	19	20	21	22	23	24	24	1	9	1.4%
Net imports	mnt	41	50	52	59	60	70	78	83	93	94	84	82	85	87	95	90	92	92	118	43	34	1.1%
As % of global trade	%	53%	58%	59%	63%	62%	63%	63%	62%	65%	61%	55%	55%	55%	56%	58%	57%	57%	57%	63%	2%	8%	n/a
Corn																							
Consumption	mnt	152	165	180	188	200	208	202	227	271	279	275	270	275	284	292	301	310	314	346	124	71	0.7%
Production	mnt	166	164	177	193	206	218	216	225	264	259	257	256	261	267	272	273	275	276	276	91	19	0.2%
Net imports	mnt	0	1	1	5	3	3	6	3	2	3	5	0	6	11	16	23	30	31	51	5	46	7.5%
As % of global trade	%	0%	1%	1%	5%	3%	3%	4%	2%	2%	2%	3%	0%	4%	7%	10%	13%	17%	17%	25%	3%	22%	n/a
Rice (milled equiv.)																							
Consumption	mnt	133	134	135	140	144	146	145	141	142	142	144	143	142	141	141	140	139	138	137	11	-7	-0.2%
Production	mnt	130	134	137	137	141	143	143	145	146	148	149	148	146	144	142	139	137	138	139	19	-10	-0.2%
Net imports	mnt	0	0	0	1	3	4	4	5	4	4	1	-4	-2	-1	0	2	0	-2	-4	1	-5	n/a
Wheat																							
Consumption	mnt	106	107	111	123	125	117	117	112	119	117	122	121	121	120	119	119	118	117	115	17	-7	-0.2%
Production	mnt	112	115	115	117	121	122	126	130	129	130	128	130	126	123	121	119	119	119	119	16	-9	-0.2%
Net imports	mnt	0	1	0	2	2	6	1	3	4	3	3	-3	-10	-8	-8	-6	-6	-7	-11	4	-14	n/a
Meat (pork, beef, chicken)- China																							
Consumption	mnt	69.0	72.1	74.8	75.6	79.5	81.7	82.9	81.1	82.1	82.2	83.4	83.4	82.7	84.9	87.1	90.4	91.9	93.4	99.9	14.4	16.5	0.6%
Production	mnt	68.3	71.9	74.5	74.9	78.7	80.6	81.8	79.5	78.9	79.6	80.7	74.1	69.8	72.2	75.2	78.1	80.9	83.7	88.7	12.4	8.0	0.3%
Imports	mnt	0.5	0.3	0.4	0.7	0.8	1.2	1.2	1.6	2.7	2.4	2.7	3.1	3.2	4.1	4.8	5.6	6.4	7.3	11.1	2.1	8.5	4.6%
As % of global trade	%	3%	2%	2%	3%	4%	5%	5%	7%	11%	10%	11%	12%	12%	15%	18%	20%	22%	24%	33%	7.9%	22.3%	n/a
Pork																							
Consumption	mnt	46.7	48.9	50.8	51.1	53.9	55.5	57.2	55.7	55.0	54.8	55.1	52.6	50.1	50.8	51.5	53.1	52.9	52.6	50.7	8.4	-4.5	-0.3%
Production	mnt	46.2	48.9	50.7	50.6	53.4	54.9	56.7	54.9	53.0	53.4	53.9	44.9	38.8	40.2	42.2	44.1	45.9	47.7	47.7	7.7	-6.2	-0.4%
Net imports	mnt	0.4	0.1	0.2	0.5	0.5	0.6	0.6	0.8	1.6	1.2	1.2	1.4	1.7	2.1	2.2	2.3	2.4	2.5	3.0	0.8	1.8	2.9%
Deficit	mnt	-0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.0	-0.4	-0.2	0.0	-6.3	-9.7	-8.5	-7.1	-6.8	-4.6	-2.4	0.0	n/a	n/a	n/a
as % of global trade	%	6%	2%	3%	7%	8%	9%	9%	12%	20%	15%	15%	17%	20%	23%	24%	25%	26%	27%	30%	8.7%	15.2%	n/a
Poultry																							
Consumption	mnt	16.2	16.8	17.5	18.0	18.9	19.2	18.4	18.1	19.3	19.1	19.7	21.8	23.0	24.0	25.0	26.0	27.1	28.2	33.4	3.5	13.7	1.7%
Production	mnt	16.0	16.6	17.2	17.8	18.7	18.9	18.2	17.9	18.9	18.9	19.4	21.7	23.3	24.0	24.7	25.5	26.2	27.0	31.7	3.4	12.3	1.5%
Net imports	mnt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.3	0.1	-0.3	0.0	0.2	0.5	0.8	1.1	1.6	0.1	1.4	5.6%
As % of global trade	%	3%	3%	3%	3%	3%	3%	3%	2%	4%	2%	3%	2%	-4%	-1%	2%	6%	8%	11%	16%	0.3%	13%	n/a
Beef																							
Consumption	mnt	6.1	6.3	6.5	6.4	6.7	7.1	7.3	7.3	7.8	8.2	8.5	9.0	9.6	10.1	10.7	11.3	12.0	12.7	15.8	2.4	7.3	1.9%
Production	mnt	6.1	6.4	6.5	6.5	6.6	6.7	6.9	6.7	7.0	7.3	7.3	7.5	7.8	8.0	8.2	8.5	8.7	9.0	9.3	1.2	2.0	0.7%
Net imports	mnt	0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.5	2.8	3.2	3.6	6.5	1.3	5.3	5.4%
As % of global trade	%	-1%	0%	0%	0%	1%	5%	5%	8%	10%	12%	14%	17%	20%	23%	25%	28%	31%	34%	48%	15%	33%	n/a
Aqua products																							
Consumption	mnt	49.1	51.3	53.9	56.2	55.0	57.4	60.0	62.0	64.0	64.7	64.9	67.3	69.8	72.3	74.8	77.4	80.0	82.6	94.2	15.8	29.3	1.2%
Production	mnt	49.0	51.2	53.7	56.0	54.8	57.2	59.8	61.8	63.8	64.5	64.7	66.9	69.1	71.3	73.6	76.0	78.5	81.1	83.8	15.7	19.1	0.8%
Net imports	mnt	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.6	0.9	1.2	1.4	1.5	1.5	10.4	0.1	10.2	13.1%
Egg																							
Consumption	mnt	26.9	27.4	27.7	28.2	28.8	29.0	29.2	30.4	31.5	30.9	31.2	31.7	32.2	32.3	32.4	32.5	32.6	32.7	32.8	4.3	1.6	0.2%
Production	mnt	27.0	27.5	27.8	28.3	28.9	29.1	29.3	30.5	31.6	31.0	31.3	31.6	31.9	32.1	32.2	32.4	32.6	32.7	32.9	4.3	1.6	0.2%
Net imports	mnt	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	0.3	0.2	0.2	0.1	0.0	0.0	-0.1	0.0	0.0	-1.8%
Milk																							
Consumption	mnt	30.9	31.7	34.0	35.8	38.3	39.1	41.6	39.3	39.2	40.1	40.2	41.8	44.3	46.4	48.7	50.9	53.3	55.8	66.4	9.3	26.1	1.6%
Production	mnt	30.0	29.6	30.5	32.0	33.1	31.5	33.1	33.3	32.2	31.9	31.3	31.1	32.3	33.6	35.0	36.4	37.8	39.4	43.3	1.3	12.0	1.0%
Net imports	mnt	0.9	2.1	3.4	3.8	4.9	7.2	8.1	5.4	6.3	7.3	7.9	9.6	12.0	12.8	13.7	14.6	15.5	16.4	23.1	7.0	15.2	3.4%
As % of global trade	%	7%	17%	27%	30%	38%	56%	62%	41%	47%	54%	59%	64%	69%	70%	72%	73%	74%	75%	81%	52%	22%	n/a
China grain-equivalent demand																							
Soybean	mnt	54	61	69	75	76	82	92	97	111	114	110	107	108	113	118	122	127	129	158	55.9	48.1	1.1%
Corn	mnt	154	166	182	191	204	214	208	234	282	289	287	284	291	302	314	325	336	344	393	78.6	105.5	1.0%
China grain-equivalent imports																							
Soybean	mnt	41	51	53	60	61	73	81	86	98	98	89	88	91	96	104	101	104	105	138	47.5	49.2	1.4%
Corn	mnt	1	1	3	4	9	9	10	12	14	13	15	19	16	25	32	40	50	60	77	5.3	62.5	5.3%
% of global grain-equivalent trade																							
Soybean	mnt	53%	58%	60%	64%	63%	64%	64%	64%	66%	63%	57%	57%	58%	59%	61%	61%	61%	62%	68%	4%	11%	n/a
Corn	mnt	1%	1%	4%	4%	9%	7%	8%	9%	9%	8%	9%	11%	9%	14%	17%	21%	24%	28%	31%	8%	22%	n/a
Grobal trade *(forecast trade only based on changes from China)*																					**Chgs**	**Chgs**	
Rice	mnt	27.2	28.1	32.9	35.6	36.5	38.4	41.1	38.3	41.3	47.4	45.2	40.8	42.2	43.5	44.7	45.9	44.3	42.7	40.7	12.4	-4.5	
Wheat	mnt	136.9	133.6	131.9	149.3	145.3	158.4	159.1	170.2	178.9	179.1	176.2	169.9	162.9	164.8	165.4	167.1	166.4	165.8	162.0	44.3	-14.2	
Soybean	mnt	77.4	86.8	88.7	93.5	95.9	111.9	124.4	133.3	144.4	153.7	152.3	150.6	153.1	155.9	163.5	158.7	161.0	160.3	186.2	63.5	33.9	
Corn	mnt	82.6	89.8	92.4	99.9	99.4	124.0	125.2	139.2	135.5	149.3	157.2	152.1	158.2	162.9	168.7	175.3	182.3	183.4	203.1	64.8	45.9	
Pork	mnt	6.2	5.5	5.8	6.6	6.9	6.6	6.3	6.7	8.0	7.9	8.1	8.3	8.6	9.0	9.1	9.2	9.3	9.4	9.9	2.3	1.8	
Beef	mnt	6.8	6.6	6.6	6.6	6.7	7.5	7.9	7.7	7.7	8.0	8.4	8.7	9.0	9.3	9.6	10.0	10.4	10.8	13.7	1.7	5.3	
Chicken	mnt	7.5	7.4	7.8	8.2	8.5	8.7	8.9	8.6	9.0	9.0	9.0	8.9	8.4	8.7	9.0	9.2	9.5	9.9	10.4	1.2	1.4	
Milk	mnt	12.4	12.4	12.5	12.6	12.8	12.9	13.1	13.2	13.4	13.4	13.4	15.0	17.4	18.3	19.1	20.0	20.9	21.8	28.5	0.9	15.2	
Global production and consumption																					**CAGR 10-18A**	**18-50E**	
Major crops	mnt	2141	2207	2193	2290	2267	2466	2542	2494	2719	2673	2697	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4132	2.6%	1.3%	
Soybean	mnt	212	261	264	240	269	283	320	314	349	339	368	n/a	n/a	n/a	n/a	n/a	n/a	n/a	672	4.2%	1.9%	
Corn	mnt	799	819	832	887	868	990	1016	972	1122	1076	1099	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1935	3.5%	1.8%	
Rice (milled equiv.)	mnt	448	443	449	467	472	478	479	473	491	495	496	n/a	n/a	n/a	n/a	n/a	n/a	n/a	592	1.2%	0.6%	
Wheat	mnt	682	684	647	697	659	715	728	735	757	763	735	n/a	n/a	n/a	n/a	n/a	n/a	n/a	932	1.6%	0.7%	
Major meat	mnt	229	232	240	244	250	254	258	259	260	263	268	n/a	n/a	n/a	n/a	n/a	n/a	n/a	398	1.4%	1.2%	
Pork	mnt	98	100	103	103	107	109	110	110	110	111	113	n/a	n/a	n/a	n/a	n/a	n/a	n/a	146	1.2%	0.8%	
Chicken	mnt	73	74	78	81	83	84	87	89	89	91	92	n/a	n/a	n/a	n/a	n/a	n/a	n/a	162	2.1%	1.8%	
Beef	mnt	58	59	59	59	60	61	61	60	60	62	63	n/a	n/a	n/a	n/a	n/a	n/a	n/a	90	0.7%	1.1%	
Milk	mnt	504	503	513	528	542	546	565	577	584	596	606	n/a	n/a	n/a	n/a	n/a	n/a	n/a	854	2.1%	1.1%	

For crops, 2018 refers to market year from Oct-18 to Sep-19. China as "percentage" of global trade is based on China's import changes, assuming else unchnaged.

Source: FAO, USDA, Goldman Sachs Global Investment Research, Gao Hua Securities Research

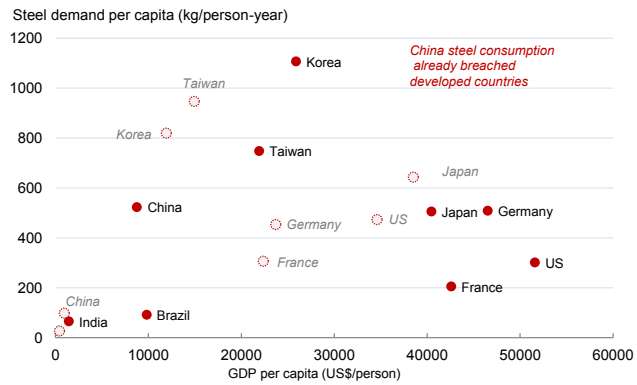
Soft versus hard commodities - persistent and paced growth

The trend ahead in China's agriculture sector resembles the path of the hard commodities cycle that began nearly 20 years ago. The incremental demand change due to China's domestic S/D balance appears remarkable in the global market in terms of its impact on pricing. The magnitude of Chinese demand growth in hard commodities over a relatively short period, supported by strong government policies, has served as a powerful driver to squeeze supply and thus increase pricing. As an example, from 2000 to 2018, as Chinese steel demand grew from 120mnt to over 800mnt per year, the country's demand accounted for over 30% of the global seaborne market for iron ore by 2018A, from 5% when the cycle started. As a result, the global iron ore price has moved from US$25/t in the early 2000s, to a peak of US$150/t in 2018, and remains higher than the historical average.

The growth path for Chinese agriculture demand has been more on track with peers than hard commodities and has ample room to upgrade going forward in our view, given the nature of the demand

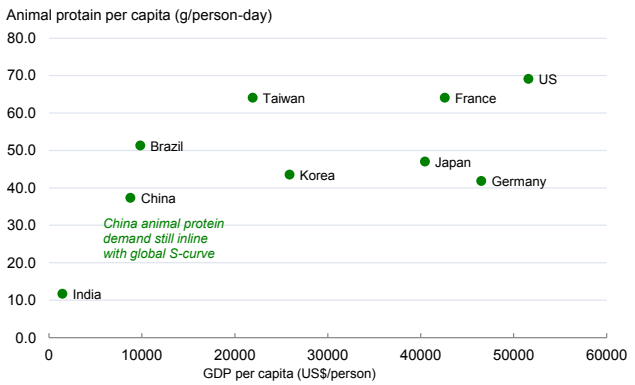
As of today, for most hard commodities, Chinese consumption per capita has reached or exceeded current and peak levels of developed countries. Chinese steel demand per capita is currently 520-570kg/person-year, similar to Japan, Germany, and well ahead of the US. Yet for agriculture demand, the path of growth has been more on track with peers and has ample room to upgrade going forward, given the nature of the demand. Animal protein consumption in China is 37.3g of protein per person per day, still lower than developed Asia by 15-20%, and 30-40% lower than developed western countries. For soft commodities, although Chinese demand may not be the robust force it was during hard commodity cycles (e.g., demand for steel and copper), the cumulative impact on the global agriculture sector will likely be as prevailing and certainly more persistent in the long run, in our view.

Exhibit 19: Steel demand per capita - China versus peers (2017A)
Red legend cycles are for 2017A and dotted cycle are for 2000A



Source: CEIC, Goldman Sachs Global Investment Research

Exhibit 20: Animal protein consumption per capita - China vs. peers (2017A)



Source: CEIC, USDA, Goldman Sachs Global Investment Research

Government policies - "The Number 1 Documents"

"Food security" sits high in priority for China's government

"Food security" sits high in priority for China's government, which is partly reflected in policies published in, " The Number 1 Documents" each year — the first policy published each year has always been on China's agriculture sector. In recent years, the Chinese government has reiterated the need for basic self-sufficiency in cereals and the absolute safety of food grains, yet in 2019, for the first time it stated, "Pro-actively increase imports of selected agriculture products with tight domestic supply."

China's agriculture sector, like those in many other countries, does not amount to a large contribution to GDP or investment — we estimate the fixed asset investment in primary industries represents 3.5% of the total China FAI. Based on NBS data, employment in agriculture-related sectors is 209mn, or 27% of the total work force. Nevertheless, investment growth in the sector has been above the average growth of FAI since 2004, when the Chinese government started to put more effort into the sector, triggered by raising income disparity between urban and rural regions. The policy support seen in the past several years has ranged from subsidies to government funding of projects and is partly reflected in the sector's rising contribution of FAI in total, from 1.1% in 2004A to 3.5% in 2018A.

However, income levels of farmers remain more depressed than reflected in our estimates - imposing a key challenge to increasing supply for the long run

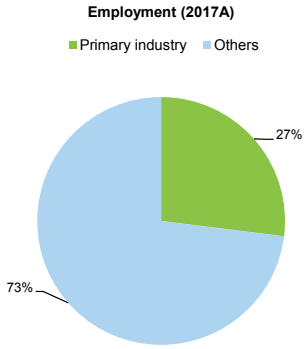
However, despite policy positioning, challenges remain. The income levels of farmers remain more depressed than reflected in our estimates imposing a key challenge to increasing supply for the long run. Reported rural incomes have been rising at an average growth rate of 11.2% over the past several decades, slightly ahead of urban income growth. However, adjusting for the reported non-farming income of migrant workers, we estimate farming income per person could have been depressed by as much as Rmb700-2000 per year in 2007-2010A, with further deterioration of Rmb200-700 per year in 2017-2018A. Key soft commodity prices in China have underperformed versus reported income changes in China during the period. For example, over 2009-2018, disposable incomes for China's urban and migrant workers increased by 120-190% versus price changes in rice, soybeans, and pork of flat to 30% (except for beef which increased 100%). With nearly 40-50% of the soft commodity prices in China being composed of logistics and distribution costs in wholesale and retail (based on a 2014 study from the NBS), we think cost inflation in non-farming costs has eroded the income of farmers.

Exhibit 21: State minimum purchases and subsidy - China

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
State minimum purchase price														
Corn	Rmb/t	n.a.	1,480	1,480	1,780	1,960	2,100	2,220	2,220	2,000	n.a.	n.a.	n.a.	n.a.
Soybean	Rmb/t	n.a.	3,700	3,740	3,860	4,000	4,600	4,600	4,800	4,800	4,800	n.a.	n.a.	n.a.
Wheat	Rmb/t	1,400	1,440	1,700	1,747	1,880	2,040	2,240	2,360	2,360	2,360	2,360	2,300	2,240
Rice	Rmb/t	1,447	1,587	1,847	1,967	2,247	2,567	2,780	2,853	2,853	2,840	2,773	2,507	2,507
Producer subsidy														
Corn-avg	Rmb/mu	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	162	168	60	83
Soybean--avg	Rmb/mu	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	135	119	220	335	283

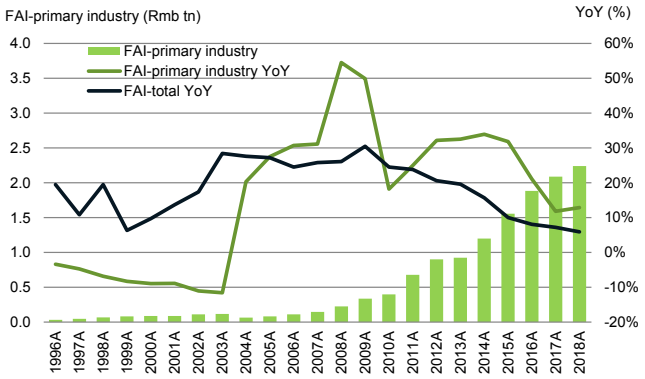
Source: NDRC, Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 22: Employment in the agriculture sector - China
With 209mn farmers, agriculture (primary industry) accounted for 27% of the total employment in China



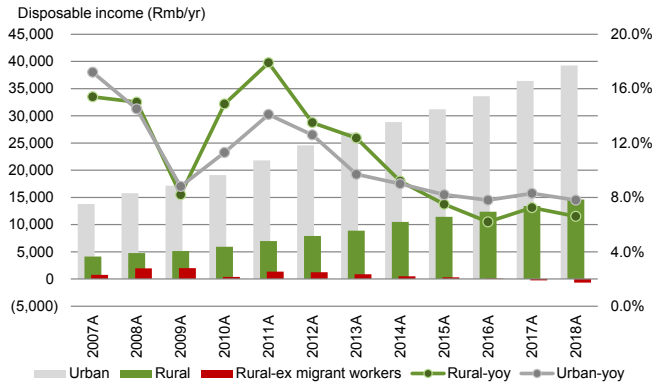
Source: CEIC, Goldman Sachs Global Investment Research

Exhibit 23: FAI - China agriculture sector



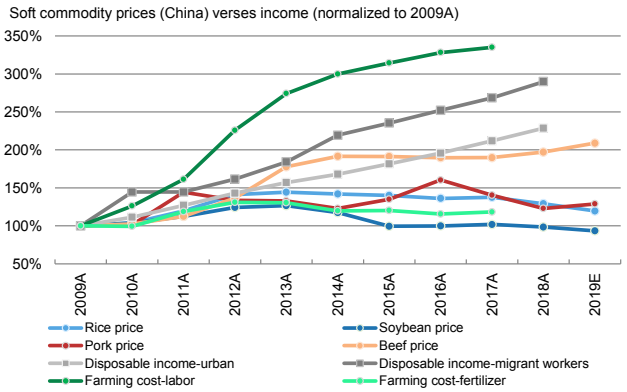
Source: CEIC, Goldman Sachs Global Investment Research

Exhibit 24: Disposable income - China rural and adjusted rural



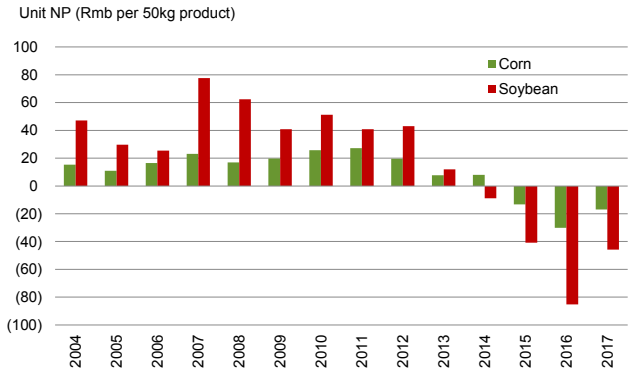
Source: CEIC, Goldman Sachs Global Investment Research

Exhibit 25: Relative performance of soft commodity prices versus income - China



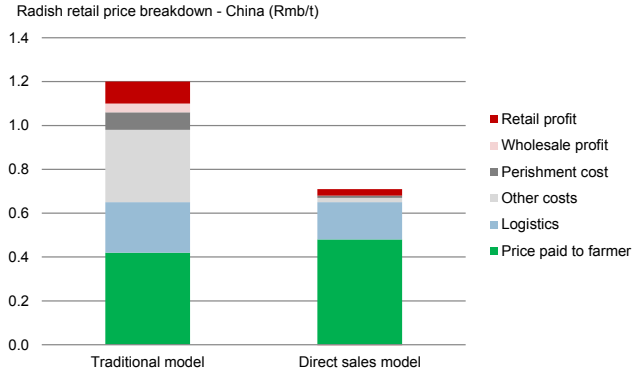
Source: CEIC, Goldman Sachs Global Investment Research

Exhibit 26: Reported unit NP of soybean and corn - China (excl. subsidies)
Corn and soybean farming in China has been loss making since 2014



Source: NDRC, Goldman Sachs Global Investment Research

Exhibit 27: Direct distribution model could help reduce costs in the distribution channel



Source: NBS, Data compiled by Goldman Sachs Global Investment Research

Historical "No.1 policies" each year have covered a wide range of topics, from the well-being of farmers, to the supply of major agriculture products, and the development

of rural areas. Below we highlight a few key policies that resulted in a significant impact on the supply dynamics of agriculture products:

- *Minimum purchase price and temporary storage policy*: The policy was initially launched in 2004, with the purpose of encouraging farmers to plant major crops and protecting their interests. In such practice the state storage house would purchase crops from farmers at a predetermined price and resell to the market when needed. From 2008-2014, the state purchase price was gradually raised, and inventory at state storage was piling up. As of 2014, the inventory of rice/wheat/corn was 57/76/166 mnt, accounting for 40%/65%/80% of annual consumption. The government started to unwind the policy from 2014, replacing state purchases with subsidies to producers. In 2016, "agriculture supply side reform" was mentioned in the No.1 document. From 2017, the government adjusted down the planted area of corn and encouraged the planting crops like soybeans. The minimum purchase price policy for rice and wheat was maintained but purchase prices have been reduced every year since 2017.
- *Agriculture subsidy*: From 2004, in order to improve farmer incomes and encourage agriculture production, the government started to implement subsidy policies to farmers, which included direct subsidies for grain producers, subsidies for high-quality seed purchase, comprehensive agriculture input subsidies, and agriculture machine purchase subsidies. The funds for the subsidies come from both the central government and regional governments. Subsidies vary by region and crop, and are in the range of Rmb100/mu in total. In 2016, the direct subsidies for grain producers, subsidies for high-quality seed purchases, and comprehensive agriculture input subsidies were combined as the "agriculture support and protection subsidy." In addition, the state minimum purchase price policy for soybeans and corn were replaced with "producer subsidies", based on planted area, which ranged from Rmb200-300/mu. From 2017, in order to encourage the planting of soybeans, the producer subsidy for soybeans was raised while subsidies for corn were reduced.
- *Rural land transfer policy*: From the 1950s to 1978, rural land was collectively owned by the People's Commune and local production brigades. Farmers had no right to sell or transfer the land to any third party. Since the establishment of the household contract responsibility system in 1978, farmers have contracted management rights on their land, while ownership still remains with the local government. As cities became greater sources of opportunities for work, there was growing demand for farmers to transfer the operation of their land. Gradually more policies have been established regarding how farmers can transfer the "operating rights" of their land to other persons or companies. In 2008, the government promoted the building of the land transfer market in the No.1 document, facilitating rural land transfers. From 2008-2017, rural land transfers increased from 7.3mn hectares to 34mn hectares, accounting for 25% of total arable land in China. With more land transferred, farm sizes in China could grow larger, facilitating industrial farming, the use of large tractors, and the reduction of labor costs. We estimate that the average farm size in China grew 7% from 2006-2015, based on data from the National Agriculture Census.

Exhibit 28: Key highlights of historical "No.1 Document"

Year	Title	Key policy highlights related to supply (CN)	Key policy highlights related to supply
2004-07		*从2004年开始，国家将全面放开粮食收购和销售市场，实行购销多渠道经营 *坚持和完善重点粮食品种最低收购价政策 *加强主产区粮食生产能力建设，增加对粮食主产区的投入，减免农业税、取消除烟叶以外的农业特产税，对种粮农民实行直接补贴，对部分地区农民实行良种补贴和农机具购置补贴	*Liberalize the purchase and distribution of grains from 2004 *Set minimum price for state purchase of rice, wheat, corn, soybean, etc., to encourage farmers to plant these crops. *Give direct subsidy to farmer planting grains, issue subsidy to high quality seed and ag machine purchase
2008	中共中央国务院关于切实加强农业基础建设进一步促进农业发展农民增收的若干意见	*高度重视发展粮食生产。切实稳定粮食播种面积，优化品种结构，提高单产水平，确保粮食生产稳定发展。积极发展稻谷生产，扩大专用小麦播种面积，合理引导玉米消费。 *按照依法自愿有偿原则，健全土地承包经营权流转市场。农村土地承包合同管理部门要加强土地流转中介服务，完善土地流转合同、登记、备案等制度，在有条件的地方培育发展多种形式适度规模经营的市场环境	*Ensure stable planted area for grains, improve yield. Develop rice, wheat production *Establish rural land transfer policy, build and improve rural land transfer markets, allow farmers to transfer their land use rights to third party. Foster reasonable scale operation of farming in suitable areas
2009	中共中央国务院关于2009年促进农业稳定发展农民持续增收的若干意见	*千方百计保证国家粮食安全和主要农产品有效供给，千方百计促进农民收入持续增长 *较大幅度增加农业补贴。2009年要进一步增加补贴资金。增加对种粮农民直接补贴。加大良种补贴力度，提高补贴标准，实现水稻、小麦、玉米、棉花全覆盖，扩大油菜和大豆良种补贴范围。大规模增加农机具购置补贴,逐步加大对专业大户、家庭农场种粮补贴力度。 *保持农产品价格合理水平。2009年继续提高粮食最低收购价。扩大国家粮食、棉花、食用植物油、猪肉储备，2009年地方粮油储备要按规定规模全部落实到位，适时启动主要农产品临时收储，鼓励企业增加商业收储。防止部分品种过度进口冲击国内市场。	*Ensure national safety of grains and effective supply of major agriculture products, improve the sustainable growth of farmers' income *Significantly increase agriculture subsidies. Increase direct subsidy, high quality seed subsidy, ag machine subsidy. Increase subsidy scale to large scale professional farms and family farms who plant grains *Keep agriculture product pricing at reasonable level. Continue to raise minimum state purchase price. Increase state storage fo grains, cotton, vege oil and pork. Start temporary state purchase and storage for major crops at suitable time, protect impacts from over-import for some categories
2010	中共中央国务院关于加大统筹城乡发展力度进一步夯实农业农村发展基础的若干意见	*坚持对种粮农民实行直接补贴。增加良种补贴，进一步增加农机具购置补贴 *在稳定粮食播种面积基础上，大力优化品种结构，着力提高粮食单产和品质。全面实施全国新增千亿斤粮食生产能力规划，尽快形成生产能力。加快建立健全粮食主产区利益补偿制度，增加产粮大县奖励补助资金，提高产粮大县人均财力水平。有关扶持政策要向商品粮调出量大、对国家粮食安全贡献突出的产粮大县（农场）倾斜	*Continue direct subsidy, high quality seed subsidy and ag machine subsidy *Optimize product structure on the basis on stabilizing planted area, improve yield and quality. Establish profit reimbursement to major grain production areas, increase subsidy to large grain production counties/farms
2011	中共中央 国务院关于加快水利改革发展的决定	到2020年，基本完成大型灌区、重点中型灌区续建配套和节水改造任务，在水土资源条件具备的地区，新建一批灌区，增加农田有效灌溉面积	Accelerate the reforms and development of water resource systems. By 2020 complete infrasture and water conservation projects. Build a batch of irrigated areas where water and soil resources permit.
2012	中共中央、国务院印发《关于加快推进农业科技创新持续增强农产品供给保障能力的若干意见》	*发挥政府在农业科技投入中的主导作用，保证财政农业科技投入增幅明显高于财政经常性收入增幅，逐步提高农业研发投入占农业增加值的比重 *继续加大农业补贴强度，新增补贴向主产区、种养大户、农民专业合作社倾斜。提高对种粮农民的直接补贴水平 *努力提高农户集约经营水平。按照规模化、专业化、标准化发展要求，引导农户采用先进适用技术和现代生产要素，采取奖励补助等多种办法，扶持联户经营、专业大户、家庭农场	*Gradually increase the contribution of R&D to agriculture value added *Continue to increase subsidy, favor major production areas, large scale operators of farming and livestock cultivation, professional farmer cooperatives. *Improve scale operation of farmers, introduce industrialized and technical production factors, promote joint-operation, large scale farms and family farms
2013	中共中央国务院关于加快发展现代农业进一步增强农村发展活力的若干意见	充分发挥价格对农业生产和农民增收的激励作用，按照生产成本加合理利润的原则，继续提高小麦、稻谷最低收购价，适时启动玉米、大豆、油菜籽、棉花、食糖等农产品临时收储。优化粮食等大宗农产品储备品种结构和区域布局，完善粮棉油糖进口转储制度	*Continue to increase minimum state purchase price of wheat and rice. At suitable time start temporary state purchase and storage for corn/soybean/oilseeds/cotton/sugar etc.
2014	《关于全面深化农村改革加快推进农业现代化的若干意见》	完善粮食等重要农产品价格形成机制。继续坚持市场定价原则，探索推进农产品价格形成机制与政府补贴脱钩的改革，逐步建立农产品目标价格制度	Improve the price determination system for agriculture products. Gradually establish target price system for agriculture products.
2015	中共中央国务院关于加大改革创新力度加快农业现代化建设的若干意见	*深入推进农业结构调整，加快发展草牧业，加大对生猪、奶牛、肉牛、肉羊标准化规模养殖场（小区）建设支持力度，实施畜禽良种工程，加快推进规模化、集约化、标准化畜禽养殖，增强畜牧业竞争力 *逐步扩大"绿箱"支持政策实施规模和范围，调整改进"黄箱"支持政策 *继续执行稻谷、小麦最低收购价政策，完善重要农产品临时收储政策	*Accelerate the development of grassland husbandry, increase supports to standard large scale livestock farms of hog/dairy cattle/beef cattle etc. Start high quality livestock breeding project. Improve scale and concentration of livestock cultivation. *Gradually increase the scale of "Green Box Measures", adjust and improve "Amber Box Measures" *Maintain minumum purchase price policy for wheat and rice, improve temporary state purchase and storage policy for major agriculture products
2016	中共中央国务院关于落实发展新理念加快农业现代化实现全面小康目标的若干意见	*大规模推进高标准农田建设，到2020年确保建成8亿亩、力争建成10亿亩集中连片、旱涝保收、稳产高产、生态友好的高标准农田 *推进农业供给侧结构性改革。启动实施种植业结构调整规划，稳定水稻和小麦生产，适当调减非优势区玉米种植 *继续执行并完善稻谷、小麦最低收购价政策。深入推进新疆棉花、东北地区大豆目标价格改革试点。按照市场定价、价补分离的原则，积极稳妥推进玉米收储制度改革。建立玉米生产者补贴制度	*By 2020 ensure the build of 800mn mu concentrated, high yield, climate resilient, and environmental friendly agriculture land *Initiate agriculture supply side reform, optimize the structure of agriculture sectors, production of wheat and rice remain stable; properly adjust down corn planted area in non-advantageous areas *Maintain minimum purchase price for wheat and rice. Enhance target price trials for cotton in Xinjiang and soybean in Northeast region. Carry out reforms in state purchase policy in corn based on market determined price, establish corn producer subsidy policy.
2017	中共中央国务院关于深入推进农业供给侧结构性改革加快培育农业农村发展新动能的若干意见	*统筹调整粮经饲种植结构，重点发展优质稻米和强筋弱筋小麦，继续调减非优势区籽粒玉米，增加优质食用大豆、薯类、杂粮杂豆等 *发展规模高效养殖业，稳定生猪生产，大力发展牛羊等草食畜牧业。全面振兴奶业，重点支持适度规模的家庭牧场 *坚持并完善稻谷、小麦最低收购价政策，合理调整最低收购价水平，形成合理比价关系。坚定推进玉米市场定价、价补分离改革，健全生产者补贴制度，多渠道拓展消费需求，加快消化玉米等库存	*Adjust crop plant structure. Develop high quality rice and wheat; adjust down corn planted area in non-advantageous areas, increase high-quality food-use soybean *Develop high efficiency livestock industry, stabilize hog production, develop grassland husbandry. Promote dairy industry, support reasonable scale family rangeland *Maintain and improve minimum state purchase price policy for rice and wheat, reasonably adjust minimum state purchase price. Firmly promote market pricing of corn, separate subsidy from price, improve production subsidy policy, accelerate de-stocking of corn.
2018	中共中央国务院关于实施乡村振兴战略的意见	探索开展稻谷、小麦、玉米三大粮食作物完全成本保险和收入保险试点，加快建立多层次农业保险体系。稳步扩大"保险+期货"试点，探索"订单农业+保险+期货（权）"试点	Explore experiments of total cost insurance and revenue insurance for rice/wheat/corn, explore experiments of "insurance + futures" system.
2019	中共中央国务院关于坚持农业农村优先发展做好"三农"工作的若干意见	*稳定粮食产量:确保粮食播种面积稳定在16.5亿亩,严守18亿亩耕地红线，确保永久基本农田保持在15.46亿亩以上 *实施大豆振兴计划，多途径扩大种植面积 *实施重要农产品保障战略。将稻谷、小麦作为必保品种，稳定玉米生产，确保谷物基本自给、口粮绝对安全。巩固棉花、油料、糖料、天然橡胶生产能力。加快推进并支持农业走出去，加强"一带一路"农业国际合作，主动扩大国内紧缺农产品进口	*Ensure 1.65bn mu planted area of grains and 1.8bn mu of farmland. Ensure 1.55bn mu of permanent basic farmland. *Promote soybean production and increase planted area; *Ensure basic self-sufficiency for cereals and absolute safety of food grains. Pro-actively increase imports of selected agriculture products with tight domestic supply.

Source: Ministry of Agriculture

ASF and global protein: tighter for longer

African Swine Fever (ASF) is a highly contagious viral disease found in domestic and wild pigs, with a nearly 100% of mortality rate, based on the description of the World Organization for Animal Health (OIE). China reported the first case of African Swine Fever in the northern city Shenyang in Aug. 2018. Since then, the country has witnessed a rapid spread of the disease, covering nearly every province in China.

We believe the impact of ASF on the global pork and overall animal protein market is likely to be deeper and longer than expected.

We believe the impact of ASF on the global pork and overall animal protein market is likely to be deeper and longer than expected. An international trader we spoke with called the impact of ASF as "devastating" for the industry.

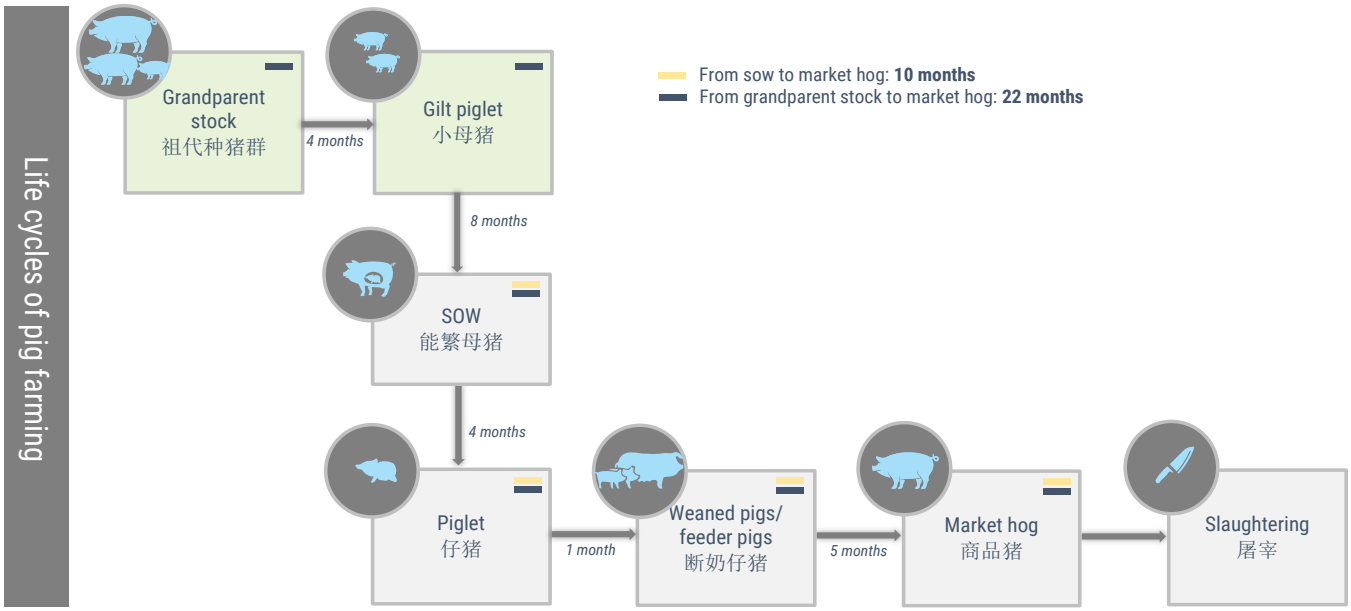
With nearly a quarter of China's sow herd and hog herd reduced since 4Q18, we expect Chinese hog production to continue to decline, potentially reaching bottom between late 2020 to mid 2021, at 30-45% below the normal level, under our assumption that the disease comes under control in 2H19 based on the extra investments producers are making on ASF disease control. The recovery of the sow herd is likely to be a slow and lengthy process as it can only be driven by marginal improvement in productivity at the grandparent level, and we estimate a full recovery could take four to five years from the time when the sow herd bottoms. While the depressed supply of pork would likely lead to higher demand for chicken and beef, subject to available supply response, this would unlikely fully offset the overall shortage in animal protein supply in the coming two years, for both China and the global market.

Question 1: When will Chinese hog production reach the bottom?

With nearly a quarter of China's sow herd and hog herd reduced since 4Q18, we expect Chinese hog production to continue to decline, potentially reaching bottom between late 2020 to mid-2021, at 30-45% below the normal level, under our assumption that the disease comes under control in 2H19

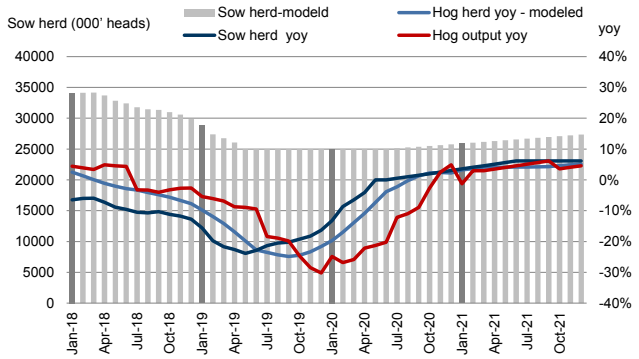
While the short estimate is between 4Q20 to 4Q21, much of the answer is subject to the trend in sow herd, and we estimate hog output to bottom 22 months after the bottom of the sow herd in theory, or 12 months after if we consider sow productivity would also improve once the disease is under control. As of May 2019, the reported sow herd in China is still declining by 3-4% MoM sequentially, and there are signs the trend could persist in the coming months, even though the rate of decline maybe decelerating. Between a more optimistic scenario in which the sow herd stabilizes at present, and a more bearish scenario where a further 20% decline takes place until the end of 2019, we expect Chinese hog production to continue to decline, and may reach bottom between late 2020 to mid 2021, at 10-20% below current levels and 30-45% below normal levels. Once a bottom is reached, the sow herd recovery is likely to be a slow and lengthy process, and full recovery could take four to five years by our estimates, assuming the disease comes under control. There is a possibility for the process to be accelerated by the practices of turning market hogs into sows, in which case the productivity of sows would be lower, and/or an increase in the grandparent generation sow herd (although this would only affect the recovery 34 months from the implementation of the practice).

Exhibit 29: Life cycles of pig farming - China
It takes 22 months to increase market hog supply, by the recovery of sow herds through grandparent stock



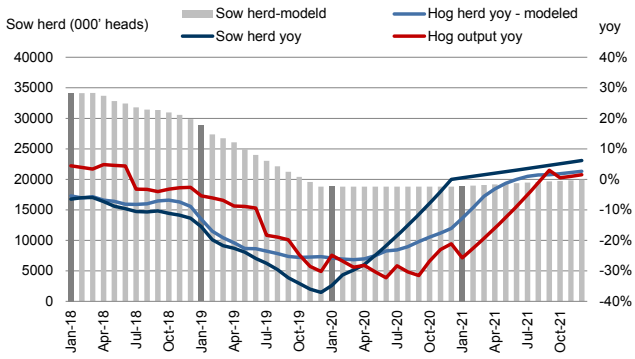
Source: Goldman Sachs Global Investment Research

Exhibit 30: Recovery of Chinese hog production from ASF - optimistic case
Optimistic case: Sows stabilize as of mid-2019, and start to recover in late 2020 while the bottom for hog production is reached in 4Q20, at ~30% lower than normal levels and ~10% lower than current levels.



Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 31: Recovery of Chinese hog production - bear case
Bear case: Sows further decline to end of 2019 until bottoming while the bottom for hog production is reached in 4Q21, at ~45% lower than normal levels and ~20% lower than current levels.



Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

The sow herd in China has contracted by over 20% from Oct. 2018 levels, 25.0mn as of May 2019, or 4.1% lower MoM. With no clear signs of disease under control, we do not see incentives for suppliers to start rebuilding the sow herd.

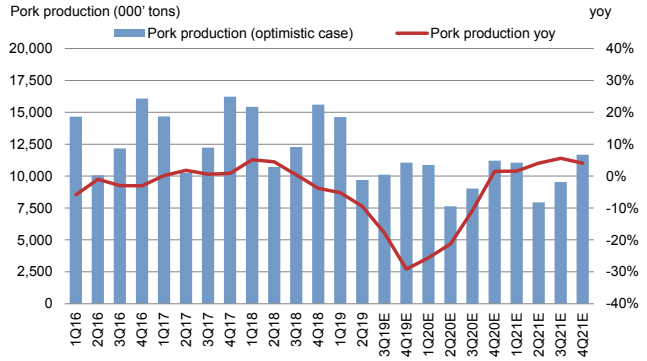
Due to spreading ASF affecting hog and sow herds, and a reluctance among farmers to restock due to fears of further infection, China's hog and sow herd sow is now in an unprecedented decline — since the start of ASF in 4Q18, the sow herd in China has contracted by over 20% from Oct. 2018 levels. In May 2019, the reported sow herd was 25.0mn, or 4.1% lower MoM. This is followed by another 5% decline MoM in June 2019, taking the sow herd 27% below the level a year ago. With no clear signs of the disease coming under control, we do not see incentives for suppliers to start rebuilding the sow herd, and the trend is likely to continue.

Given the time lag between hog/sow herd declines and pork supply, we think the tightest pork supply would be in 2H19 and 1H20. For illustrative purposes, we lay out an

optimistic case and a bear case below to gauge the potential shortage of pork supply. In the optimistic case, where we assume the sow herd bottoms out from 3Q19, we estimate that pork supply would be down 17% and 14% in 2019E and 2020E. In the bear case, we expect 17% and 27% pork supply reduction in 2019E and 2020E. Our main assumptions are below:

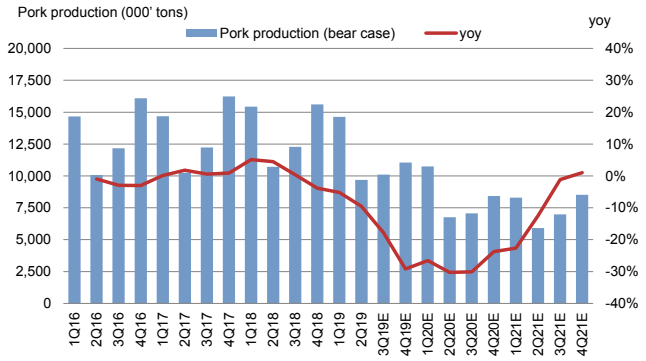
- Sow herd: Sow herd is the core assumption in our forecast for future hog and pork supply. In the optimistic case, we expect the spread of ASF to stop worsening in 3Q19 and the sow herd to stop declining. But as it takes typically 12 months to raise a piglet to a sow, we would not expect the sow herd to show a material increase until 3Q20. However, given the current hog and sow herds still show no signs of recovery, and the coming summer may facilitate the spread of disease, things could potentially get worse from here. In our bear case, we assume ASF to continue to get worse and the sow herd to decline 3-4% MoM until the end of 2019, resulting in another 20% decline from Jun-19 to Dec-19 in the sow herd from June 2019.
- Piglet production per sow: In both the optimistic and bear cases, we assume ASF comes largely under control in Jan. 2020 and piglet production per sow recovers to normal levels, presenting a 3-5% increase over 2019 levels.
- Hog output and pork production: As there is typically a 6-month lag from the birth of piglet to the output of a full-weight market hog, and a 10-month lag from farrowing to market hog output, sharp declines in the hog and sow herds would result in steep declines in pork production from 3Q19, and the decline would likely persist until 4Q20.

Exhibit 32: Chinese pork production - an optimistic case
A more optimistic case forecast: Sow herd bottoms out in Jun-19. YoY hog production changes move out of negative in 4Q20



Source: MOA, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 33: A more bearish case - sow herd further declines by another 20% until end-2019
A more bearish case: Sow herd further declines by another 20% until end-2019. YoY hog production changes move out of negative in 4Q21



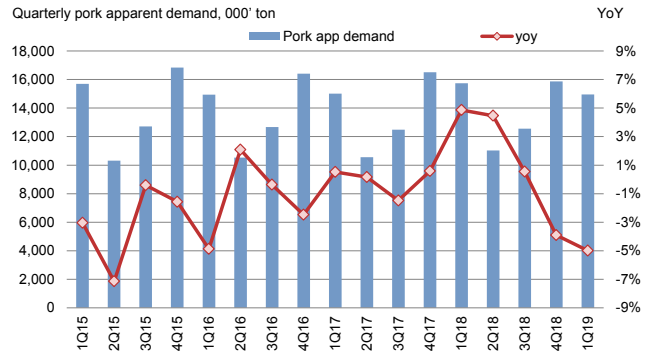
Source: MOA, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Question 2: Will demand substitutions lead to higher beef and chicken demand?

Chinese pork demand has partially shifted to substitutes in other animal proteins such as chicken and beef. According to data from the Ministry of Agriculture and Ministry of Customs, we estimate the apparent demand of pork in China declined 5% yoy in 1Q19, while the apparent demand of non-pork meat (beef, mutton, and poultry) is up 4% yoy. This includes the increase in the import of beef and chicken at 50-70% yoy. On the other hand, domestic prices of beef and chicken have risen by 8-13% yoy at current prices. We have not observed much material substitution in eggs and fish, given stagnant prices and limited production increases (MOA chicken egg production volume index up 3% on average YTD).

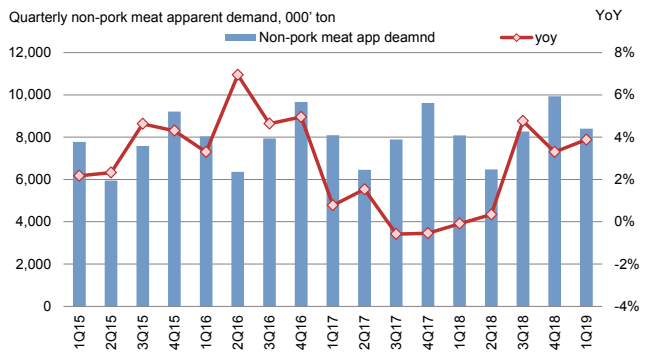
We understand major domestic chicken producers are planning to increase production in 2019 by 10-20%, and we therefor estimate that domestic chickens could see a c.15% increase in 2019 vs. 2018, partially offsetting the shortage in pork supply. Evidence: (1) Leading domestic yellow feather chicken producers such as Wens Foodstuff has indicated plans to increase chicken production by 10% in 2019. (2) Introduction of the grandparent generation of white feather broilers increased by 30% yoy in 2018 (taking about 1 year to reflect in market broiler production). For beef, while there are signs of supply response, we see limited supply changes in 2019 and 2020 given the longer time required to raise beef cattle (> 2 years).

Exhibit 34: Pork apparent demand - China
Pork apparent demand declined 5% in 1Q19



Source: Ministry of Agriculture, Ministry of Customs

Exhibit 35: Non-pork meat apparent demand - China
... while non-pork apparent demand increased 4% yoy



Source: Ministry of Agriculture, Ministry of Customs, Goldman Sachs Global Investment Research

Exhibit 36: Animal protein price - China
Chicken and beef prices started to increase in 1Q19

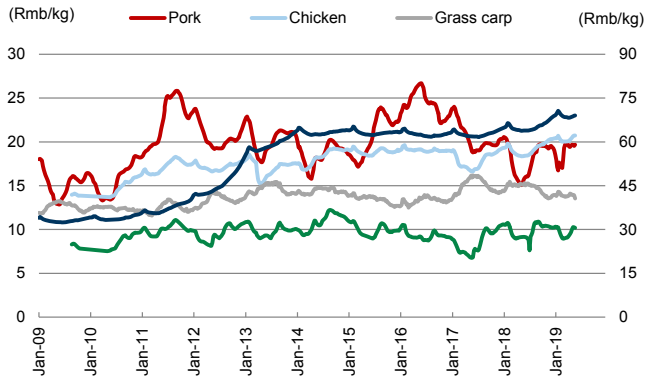
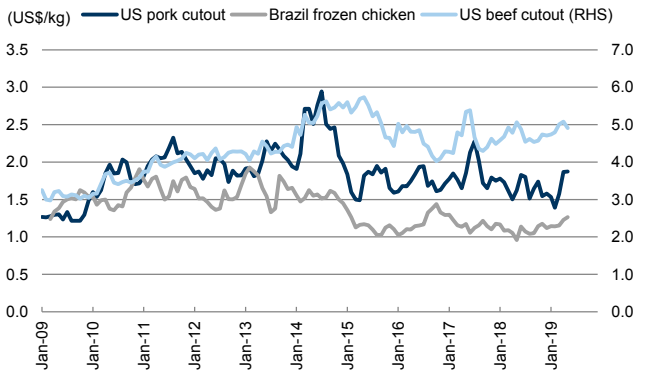


Exhibit 37: Global animal protein price - US and Brazil
Prices improved by 10-30% QoQ for most meat



Source: Ministry of Agriculture

Question 3: How much will the net shortage be?

We estimate that supply shortages of animal meat in China in 2019-2021E would be 11-19% in an optimistic case (no further deterioration from current levels), or over 30% if disease control takes effect towards end of 2019E.

We expect the further decline in Chinese pork production, partly offset by protein substitution, and extended supply shortages in pork and global animal proteins. In an optimistic case where the sow herd stabilizes at present, we estimate that supply shortages of animal meat in China would be about 7.3mnt in 2019E, and 12.3mnt in 2020E, followed by 9.8mnt in 2021E, or 11%, 19%, and 15% of the domestic market, respectively. Should the sow herd further decline for another half a year (bear case), we would expect the supply deficit to reach 11%, 31%, and 36% of the domestic market, in 2019E-2021E, respectively. This would be equal to 3-5% of the global market in the optimistic case, or 3-8% in the bear case.

From a global supply perspective, the major countries for animal protein would be the US, Brazil, and the EU, in addition to China. The average growth rates in the past 10 years were 0.9-1.4% for pork, 2-3% for chicken, and 0-1% for beef. We expect limited supply responses from ex-China supplies in pork and beef in 2019 given the time it takes to effectively increase supply (10 months for pork and >2 years for beef). Feedback from our US team suggests a limited response on chicken given poor profitability, but potentially a larger supply response in chicken production in Brazil (please see African Swine Fever upending protein markets).

Exhibit 38: GS ASF net shortage scenario analysis
China animal meat shortage could account for 3-5% of global supply if the disease is contained as of mid 2019, or 3-8% in a bear case with a further 20% decline in Sows until end-2019

Assumption on sow herd			Optimistic case Stabilizes in mid 2019			Bear case Further decline 20% to end 2019		
		2018A	2019E	2020E	2021E	2019E	2020E	2021E
Chinese demand								
Intrinsic pork demand	mnt	55.0	55.0	55.0	55.0	55.0	55.0	55.0
Demand pork ex. substitutes	mnt		52.8	51.0	50.0	52.8	51.0	50.0
Non-pork meat subsititutions (subject to supply increase)								
Chg vs. 2018 - Chicken	mnt		2.1	3.5	4.4	2.1	3.5	4.4
Chg vs. 2018 - Beef	mnt		0.2	0.4	0.7	0.2	0.4	0.7
Chinese supply								
Pork production	mnt	54.0	45.5	38.8	40.2	45.5	33.0	29.7
yoy	mnt		(8.6)	(6.7)	1.4	(8.6)	(12.5)	(3.3)
yoy	%		-16%	-15%	4%	-16%	-27%	-10%
Global production*	mnt	271.4	267.2	264.5	268.8	267.0	258.5	258.1
Pork	mnt	113.0	105.1	98.8	100.6	104.9	92.8	89.9
Beef	mnt	62.9	63.4	63.8	63.9	63.4	63.8	63.9
Chicken	mnt	95.6	98.7	101.9	104.3	98.7	101.9	104.3
China production	mnt	75.2	68.9	63.9	66.4	68.9	58.1	55.9
Pork	mnt	54.0	45.5	38.8	40.2	45.5	33.0	29.7
Beef	mnt	7.3	7.5	7.8	8.0	7.5	7.8	8.0
Chicken	mnt	13.8	15.9	17.3	18.2	15.9	17.3	18.2
Ex-China production*	mnt	196.3	198.4	200.7	202.4	198.1	200.4	202.2
yoy	%		1.1%	1.2%	0.9%	1.0%	1.2%	0.9%
Pork	mnt	58.9	59.7	60.1	60.4	59.4	59.9	60.2
Beef	mnt	55.6	55.9	56.0	55.9	47.5	46.5	45.8
Chicken	mnt	81.8	82.8	84.6	86.1	82.8	84.6	86.1
Supply deficit-China	mnt		(7.3)	(12.3)	(9.8)	(7.3)	(18.1)	(20.3)
As % of total China meat supply	%		-10.6%	-19.2%	-14.8%	-10.6%	-31.1%	-36.3%
Supply deficit-global	mnt		(5.2)	(10.0)	(8.0)	(5.4)	(16.0)	(18.7)
As % of total global meat supply	%		-2.7%	-4.6%	-3.6%	-2.7%	-7.0%	-7.9%

**1-3% production growth in US chicken and beef assumed for 2019-21E based on USDA projection. 6-10% production growth in Brazil chicken assumed for 2019-21E based on past high growth period, and EU based on CAGR from past 10 years*

Source: NBS, USDA, Goldman Sachs Global Investment Research, Gao Hua Securities Research

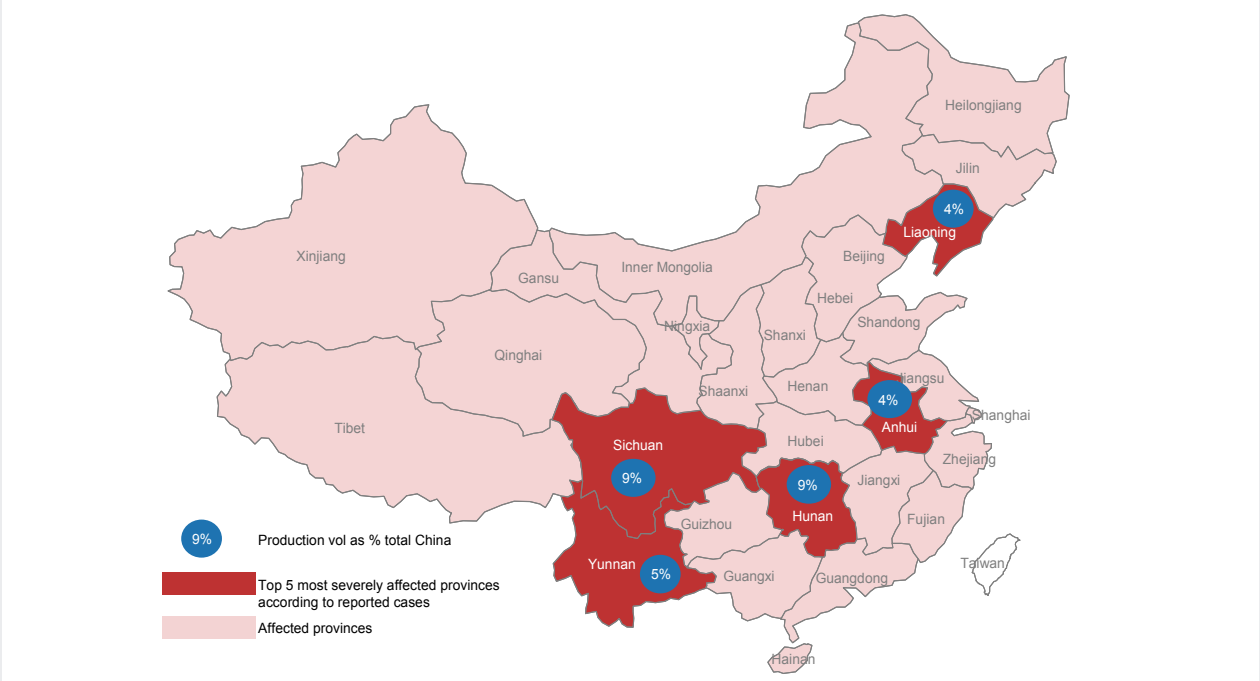
ASF Background

According to World Organization for Animal Health (OIE), African swine fever (ASF) is a highly contagious haemorrhagic viral disease of domestic and wild pigs, which is responsible for serious economic and production losses. It is caused by a large DNA virus of the Asfarviridae family, which also infects ticks of the genus Ornithodoros. Disease transmission can be through direct contact with infected domestic or wild pigs; indirect contact, through ingestion of contaminated material (e.g. food waste, feed, or garbage); contaminated fomites, or biological vectors (soft ticks of the genus Ornithodoros). Acute forms of ASF are high fever, depression, anorexia and loss of appetite, haemorrhages in the skin, abortion in pregnant sows, cyanosis, vomiting, diarrhoea and death within 6-13 days (or up to 20 days). Mortality rates may be as high as 100%. According to OIE, ASF is not a risk to human health. Currently there is no approved vaccine for ASF, based on OIE. However, ASF can be reasonably contained if pig production can be strictly segregated from external contact, with strict sterilization of feed and personnel, based on OIE.

According to OIE, ASF cases have been reported in Asia, Europe and Africa. Since 2016, 2.53mn hogs have been lost, of which 68% were in Asia.

China reported the first case of African Swine Fever in Shenyang in Aug. 2018. Since then, the country witnessed a rapid spread of the disease with more than 100 cases reported, covering almost every province in China. Among the reported case, 20% are located in larger hog farm, and 80% are smaller sized farm. There are also indications the reported cases each month are decelerating in recent months, yet based on our recent industry checks there is conflicting information on the ground on how well controlled ASF is currently in China.

Exhibit 39: Top 5 most severely affected provinces are large hog producers - China



Source: Ministry of Agriculture

Policy responses

Transportation ban: To cope with the situation, China's Ministry of Agriculture implemented "transportation ban policies," to suspend the export of live hog and pork products out of provinces with ASF cases. However, due to regional disparities in hog production and consumption, the transportation ban policy resulted in oversupply in net export provinces and shortages in net import provinces, and widened price difference among regions. Since Dec. 2018, the MOA has lift the local quarantine. However, the duration of low prices in northern provinces and concerns among farmers of future ASF outbreaks have resulted in a sharp decline in hog and sow inventory.

ASF disease control and subsidy policies: In response to the declining sow/hog herd and potential shortage of pork supply, in June 2019, Ministry of Agriculture issued policies aimed at stabilizing hog production. The policy encourages provincial agriculture loan guarantee companies to provide loan guarantees to breeding farms as well as hog farms with > 5000 heads annual output; and provincial government could provide up to 2% interest rate discount to the short term loans of these hog producers. We view the subsidy remains modest, and is unlikely to lead to meaning restoring the sow herd, without addressing the financial risk of ASF to hog farms.

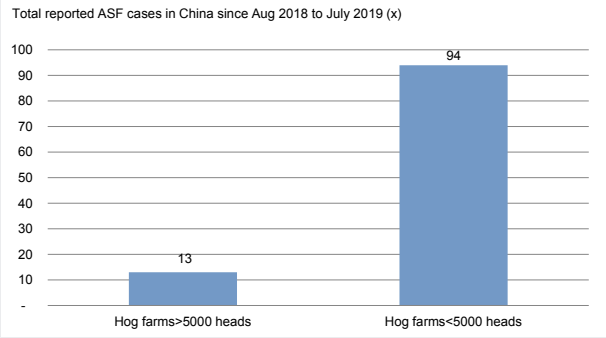
Exhibit 40: Policies regarding live hog transport and sow farm supports - China

Policies	Content
Aug-18, restrict live hog and pork product transportation	*For a province/city/county that have reported a case of ASF, suspend transportation of live hog and pork product out of the province/city/county *For Provinces with more than 2 cases, suspend transportation of live hog and pork product out of all cities in the province
Dec-18, Permission on transportation of feeder pigs, sows	*Feeder pigs, sows and boars that are negative on ASFV and meet quarantine standards, can be transported out of the province
Dec-18, Point-to-point transportation	*Hog producers and slaughter houses in different provinces can directly transport live hogs on a point-to-point basis, subject to certain requirements, including license, scale, animal healthcare conditions, negative on ASFV, etc.
Jun -19, Policies regarding loans and interest support for sow farms and large scale farms	*Provincial agriculture loan guarantee companies should provide loan guarantee service for breeding farms as well as hog farms with > 5000 heads annual output. *Provincial government could give short term loan interest subsidy to breeding farms as well as hog farms with > 5000 heads annual output, mainly for purchasing feed, sows and feeder pigs. Loan interest discount rate should not exceed 2%

Source: Ministry of Agriculture

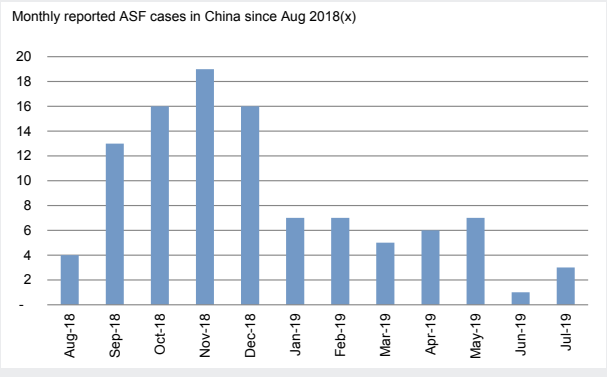
Exhibit 41: Total reported ASF cases in China since August 2018 - by farm sizes

Small sized farms are 6x more likely to be affected



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 42: Monthly reported ASF cases - China



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Question 4: Why has the China pork price been slow to respond?

We believe the hog selloff and the delayed output impact from a lower sow herd were the reasons behind the slower-than-expected pork price increase

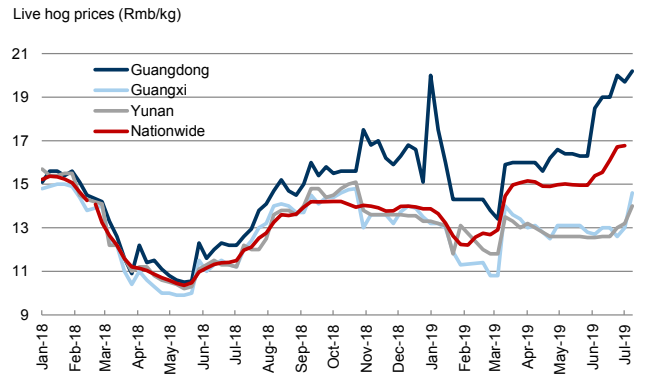
Live hog and pork prices have already increased 50% and 25% yoy, respectively, over their trough prices in June 2018, but the absolute level have just surpassed mid-cycle, showing a disconnect with the impact of ASF. We believe the hog selloff and the delayed output impact from a lower sow herd were the reasons behind the slower-than-expected pork price increase.

(1) The hog and sow herd decline will likely take time to reflect in pork supply. According to the Ministry of Agriculture, pork production volume was down 5% yoy in 1Q19. Sharp declines in hog and sow inventory started in Jan. 2019. As a result, we think the sharp decline in hog and pork supply is likely to be reflected in 2H19, with the most severe shortages in 4Q19, when demand is high due to preparations of pork related products prior to Chinese New Year.

(2) The southern China hog selloff adds to near-term supply. As analyzed below, the hog selloff in southern China due to spreading disease could lead to about 5% increase in nationwide hog supply in 1H19, alleviating the potential shortage and suppressing hog prices. However, the front loading of supply also means that the shortage would be more severe in the second half of this year.

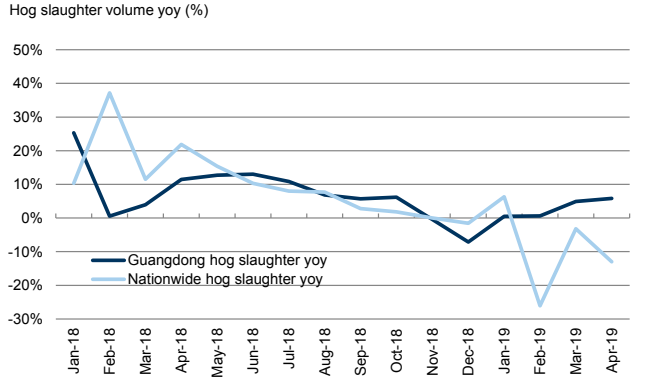
According to channel checks with Qingsong Agriculture and Husbandry Consulting, Bobai county in Guangxi Province has been most severely hit by outbreaks of ASF. In Bobai, hog farms are selling off hogs at Rmb10/kg, in some extreme cases, Rmb2-2.5/kg for prematured hogs at 60-80kg (mature weight 110kg). The price was competitive in eastern and northern China, versus local price at Rmb15-16/kg, and transport costs of Rmb1-1.5/kg. As a result, local Bohai hog herd declined 60% yoy and overall Guangxi may have declined by 30-40%, based on Qingsong. A 30% reduction in hog herds due to prematured sales in Guangxi, Guangdong, and Yunnan would imply 18mn head hog supply, or 1.35mnt pork supply (0.075 tonne pork supply/head), 5% of total China pork demand in 1H19 (54mnt of pork demand per year). After the selloff comes to an end, live hog prices in Guangdong responded the most rapidly (reaching Rmb20/kg in Jul 2019). Prices in Guangxi and Yunnan also rebounded to Rmb15/kg, though still lower than nationwide average (Rmb17/kg).

Exhibit 43: Live hog price - China by regions
Guangxi / Yunnan live hog price stagnant in 2Q19 due to sell-off



Source: Wind

Exhibit 44: Monthly hog slaughter volume - China
Guangdong hog slaughter volume started to increase in 1H19



Source: Ministry of Agriculture, Ministry of Commerce

Question 5: What would be the impact on feed?

Due to a reduced hog herd, we expect a proportionate decline in hog feed demand to have a negative impact on soybean and corn demand, partly offset by increasing demand from poultry feed, and potentially cattle feed. We expect in our optimistic case, soybean feed use (crushing use) would decline by 6% in 2020E, and corn feed use would fall by 5% over the period, all else equal. In the bear case scenario, the decline would be 5-8% lower for soybeans and corn.

Exhibit 45: ASF impact on feed and crop demand under two scenarios

ASF impact on feed	Unit	Optimistic case			Bear case		
		2019E	2020E	2021E	2019E	2020E	2021E
YoY chg in swine feed	mnt	(24.2)	(24.6)	5.1	(24.2)	(47.1)	(13.2)
yoy	%	-12%	-14%	3%	-12%	-27%	-10%
YoY chg in poultry feed	mnt	7.7	5.9	2.5	7.7	5.9	2.5
yoy	%	6%	4%	2%	6%	4%	2%
Net change	mnt	(16.5)	(18.7)	7.6	(16.5)	(41.3)	(10.7)
		2018/19E	2019/20E	2020/21E	2018/19E	2019/20E	2020/21E
YoY chg in soybean feed use	mnt	(5.1)	(4.9)	0.9	(5.1)	(9.0)	(4.2)
% impact on soybean feed use	%	-5%	-6%	1%	-5%	-10%	-5%
YoY chg in corn feed use	mnt	(8.1)	(9.4)	0.1	(8.1)	(17.8)	(10.9)
% impact on corn feed use	%	-4%	-5%	0%	-4%	-10%	-7%

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

In our optimistic case for the ASF impact, we expect in the 2018/19 market year (from Oct-2018 to Sep-2019) soybean feed use to fall by 5mnt yoy (5%), followed by 5mnt in year 2019/20 (6%), with a recovery of 1mnt (1%) in year 2020/21. For corn, we estimate feed use of corn to decline by 8mnt in year 2018/19, and 9.4mnt in 2019/20E, impacting corn feed use by 4% and 5% respectively.

In the bear case, due to a sharper decline of pork production in 2020E in our forecast, the impact on crop demand would be higher. Soybean feed use demand would fall 5mnt yoy (5%) and 9mnt yoy (10%) in 2018/19 and 2019/20. Corn feed use would fall 8mnt yoy (4%) and 17.8mnt (10%) in 2018/19 and 2019/20.

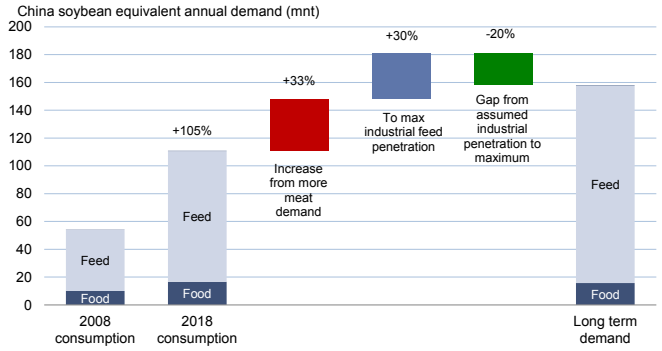
The prices of soybeans and soybean meal have started to reflect the muted demand. The average imported soybean price YTD is Rmb3200/t, down 6% yoy. The soybean meal price is Rmb2780/t, down 11% yoy. The impact on corn prices is smaller as explained above, and domestic corn was in an effective deficit on an annual S/D basis, due to reduced subsidies and planted acreage. YTD corn price is Rmb1916/t, up 2% yoy.

LT dietary pattern in transition: Not more, but better

Benchmarking the animal protein consumption level of Japan and Korea, we expect Chinese grain-equivalent soybean demand to grow by 50-70mnt or 43-63%, and 37-59% for corn, in the coming years

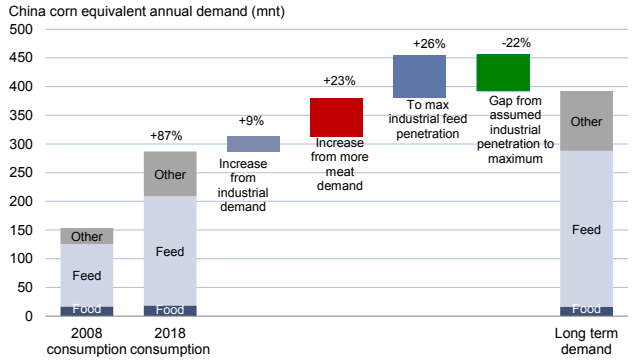
In the coming decades, Chinese food demand growth is set to continue, driven by: 1) the structural change in higher animal protein in the Chinese dietary pattern; and 2) the intrinsic nature of the low energy/protein conversion ratio for animal proteins serving as multiplier. The potential acceleration in more expensive animal proteins such as beef and milk will likely also exaggerate the trend, due to their lower energy/protein conversion ratio. Benchmarking the animal protein consumption level of Japan and Korea, we expect Chinese grain-equivalent soybean demand to grow from 110mnt at present, to 158-180mnt in the long-term, up by 50-70mnt or 43-63%, depending on assumptions for the penetration of industrial feed, despite a small set back in the near term due to ASF. Similarly, we expect China's grain-equivalent corn demand will likely grow from 287mnt at present to 393-455mnt, up by 106-168mnt or 37-59% over the period. The increase in grain-equivalent soybeans and corn would represent 5-10% of the global market and 25-50% of the global trade by our estimates.

Exhibit 46: Chinese grain-equivalent demand outlook - soybeans
Depending on industrial feed penetration, Chinese soybean demand would rise by 50-70mnt from current levels



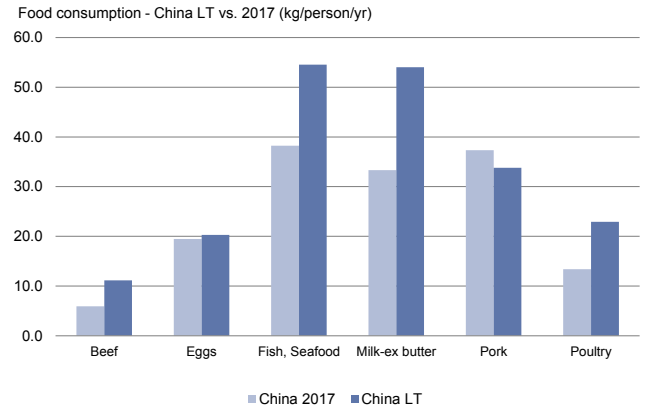
Source: Goldman Sachs Global Investment Research, USDA, NBS

Exhibit 47: Chinese grain-equivalent demand outlook - corn
Depending on industrial feed penetration, Chinese corn demand will likely rise by 105-168mnt from current levels



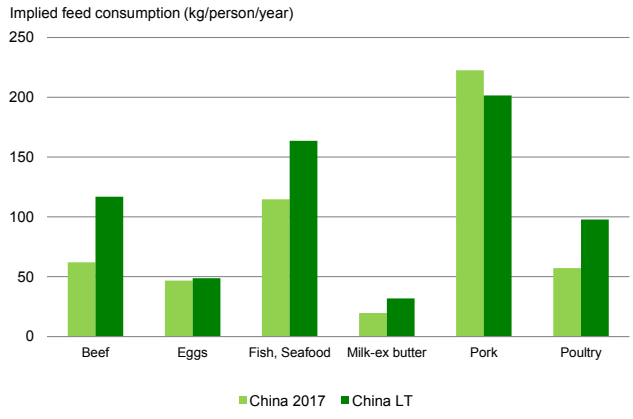
Source: Goldman Sachs Global Investment Research,Gao Hua Securities Research USDA, NBS

Exhibit 48: Food consumption patterns - China



Source: NBS, Goldman Sachs Global Investment Research

Exhibit 49: Food consumption pattern - implied feed requirement



Source: NBS, Goldman Sachs Global Investment Research

Global context

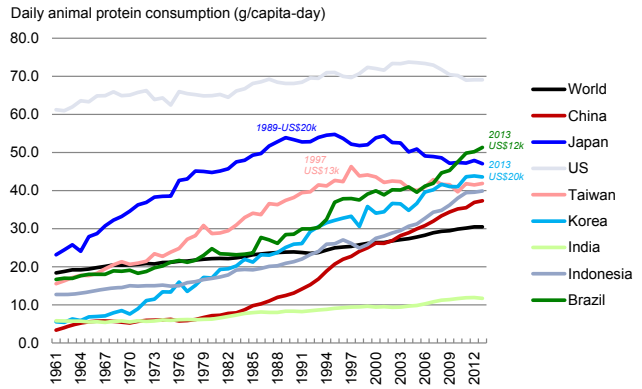
In the past 50 years, daily calorie intake per Chinese has more than doubled to 3,100Kcal/day, from 34% below the global average to 8% above

In the past 50 years, daily calorie intake per Chinese has more than doubled to 3,100Kcal/day, from 34% below the global average to 8% above, and now ranks at the higher end of Asian countries, between Japan (2,726kCal) and Korea (3,334 kCal), and much higher than India (2,459 kCal) and SEA countries such as Indonesia (2,777 kCal). In the coming decades, we think food consumption for Chinese will be not about more, but better. Based on historical food consumption patterns of peer countries, consumption of total animal protein rises with GDP per capita and disposable income per capita, mostly in the period before disposable income reaches US$20k per person. Within the mix of animal protein, the weight of more expensive proteins such as beef and milk tends to pick up when disposable income reaches the US$5k-10k range, and China is in the midst of this transition range.

We expect average Chinese animal protein consumption to move from 160 kg/capita-yr in 2018A, to 188 kg by 2025E, and to 210 kg in the longer run (versus 197-172kg in Japan and Korea today)

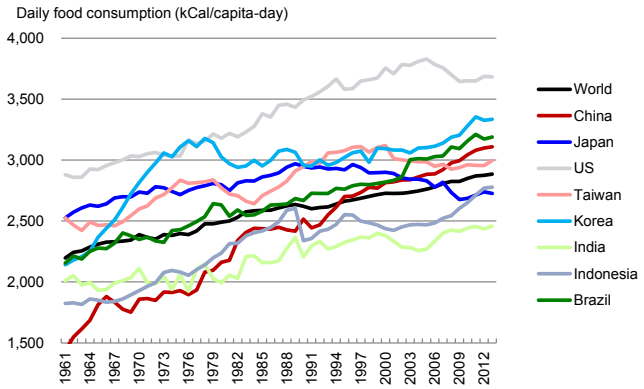
As of 2018, the reported disposable income for China averages at US$4.7k, including urban at US$6.4k and rural at US$2.3k per person. We estimate disposable income should reach over US$10k for urban in the coming 5-10 years, and nearly US$5k for rural, and China's continued urbanization will likely move 10% more people to the cities. As a result, we expect average Chinese animal protein consumption (simple aggregate of all animal protein) to move from 152 kg/capita-yr in 2018A, to 182 kg by 2025E, and to 201 kg in the longer run (versus 197-172kg in Japan and Korea today), as higher beef, milk, and poultry consumption is partly offset by lower pork.

Exhibit 50: Animal protein consumption per capita - China versus peers
Animal protein consumption tends to move up before disposable income reaches US$20k in peer countries



Source: FAO, Goldman Sachs Global Investment Research

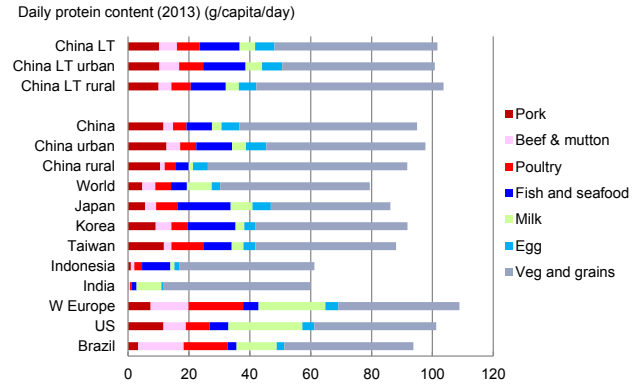
Exhibit 51: Daily calorie intake per capita - China versus peers
China calorie intake per capita is higher than the world average and lower than a few developed countries



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 52: Daily protein content intake breakdown - China vs. peers

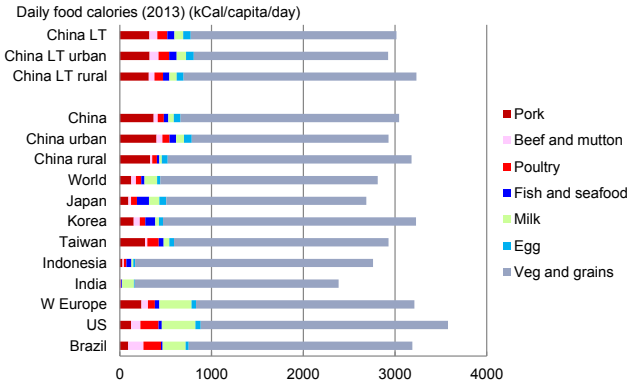
We expect higher China protein demand in the long term, getting close to developed country levels



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 53: Daily food calorie intake per capita breakdown -China vs. peers

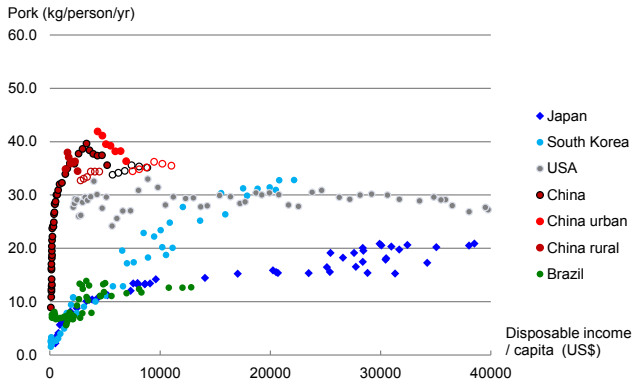
We expect China's long-term calorie intake per capita to remain similar vs. current levels



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 54: Per-capita consumption versus disposable income - pork

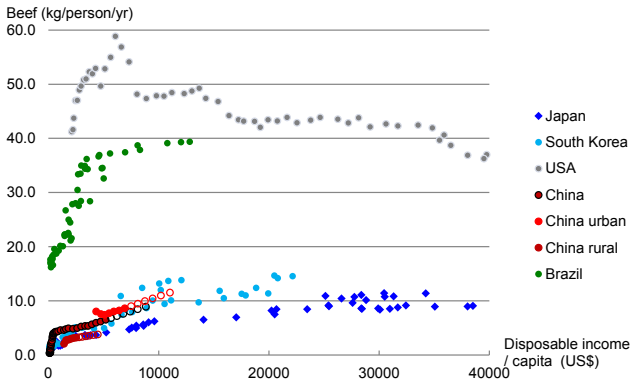
China pork consumption is already very high



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 55: Per-capita consumption versus disposable income - beef

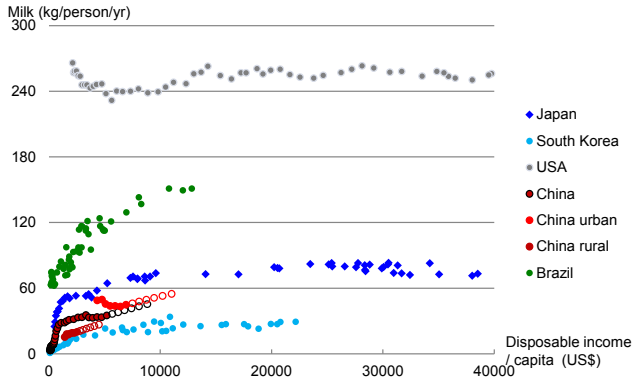
Still at low levels, but China is tracking the path of North Asian peers at respective income levels



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 56: Per-capita consumption versus disposable income - milk

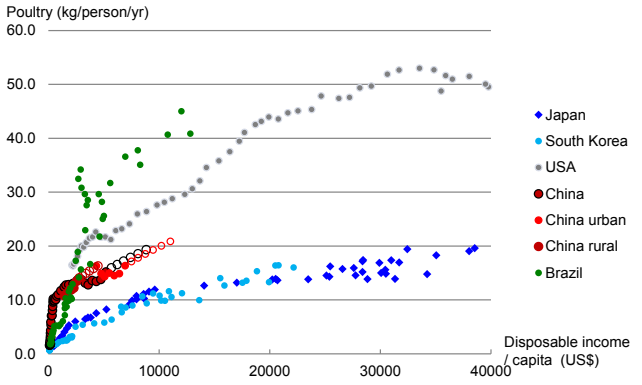
Still at low levels, but China is tracking the path of North Asia peers at respective income levels



Source: FAO, Goldman Sachs Global Investment Research

Exhibit 57: Per-capita consumption versus disposable income - poultry

China consumes more than Asian peers but less than Western



Source: FAO, Goldman Sachs Global Investment Research

China demand model

In our China agriculture supply/demand model, we estimate the demand and supply of major crops and livestock over the next five to ten years. The model starts with per capita demand of animal meat and grains, projected animal feed demand based on meat production growth, and thus the crop demand for making feed. On the supply side, we estimate the domestic supply potential for animal meat and crops, with the deficit filled by import requirements.

In the coming years, we expect more consumption of beef, poultry, milk, and aquatic products, where China remains low compared with developed countries. These are also considered 'healthier' animal proteins, especially fish and poultry. We also noticed a material per capita consumption gap between urban and rural residents in these categories of animal protein, suggesting ample room for improvement in the rural area.

Historical dietary pattern shifts come with economic growth and usually accelerate when GDP/capita is around US$10,000-20,000/person, or when disposable income reaches US$5,000-10,000/person level, based on data from developed countries such as Japan, Korea, and the United States. For example, per capita beef consumption more than doubled from 5.8kg per person each year to 13.2kg for South Korea in 1990-2000, when its disposable income grew from $5,700 to $10,000 in the same period. The key assumptions for the China demand outlook are:

- Beef: Per capita beef consumption in China grew from 4.6kg/capita in 2008 to 6.1kg/capita in 2018, up 33%. We expect faster growth in the next stage: Urban beef consumption per capita to reach 11.5kg/yr in 2025E, compared with 9.2/14.5kg for Japan and Korea in 2013, and rural beef consumption to reach 8.0kg/yr in the long term, reaching the urban per capita consumption level in 2017.
- Poultry meat: Per capital poultry meat consumption growth was rather muted in 2010-18, at 1.3% CAGR to 14.4kg/capita. Yet poultry meat is the category seeing sustainable growth in developed countries like the US/Japan/Korea, due to its healthiness compared with pork/beef. We expect China urban/rural poultry meat consumption per capita to reach 21/17 kg/yr in 2025E, compared with 21/33kg for Japan and Korea in 2013.
- Aquatic products: Per capita aquatic product consumption per capita in China grew to 38kg/capita, at 2% CAGR from 2010-18 (per FAO data, which is different in scale from NBS data). Given the healthiness of fish as a source of protein, we expect urban/rural consumption of aquatic products to grow to 54/35 kg/capita in 2025E, compared with 49/53 for Japan/Korea in 2013.
- Milk: Per capita milk consumption in China increased to 27kg/capita in 2018, growing at 1% CAGR. We expect faster growth in the next stage: Urban/rural milk consumption per capita to reach 45/22 kg/yr in 2025E, compared with 72/29kg for Japan and Korea in 2013.
- Pork: China's per capita consumption of pork was 39.5kg/capita in 2018, already higher than Japan and Korea in 2013 (21/33 kg/yr). We expect a slight decline of pork consumption per capita in China, 35.5kg/yr in 2025E, as consumers switch to other animal proteins.

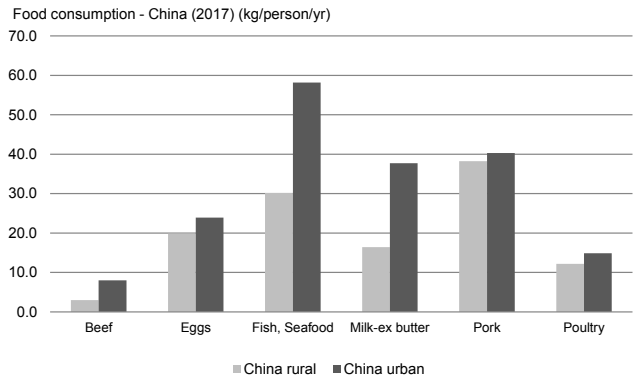
Exhibit 58: China per capita food consumption model

China	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019E	2020E	2021E	2022E	2023E	2024E	2025E	LT	2008-18	2018-LT
Population																						
China total	mn	1328	1335	1341	1347	1354	1361	1368	1375	1383	1390	1396	1400	1405	1409	1412	1415	1417	1419	1419	0.5%	0.2%
Urban	mn	624	645	670	691	712	731	749	771	793	813	831	848	864	881	897	913	929	944	993	2.7%	1.8%
Rural	mn	704	689	671	657	642	630	619	603	590	577	565	553	541	528	515	502	489	475	426	-2.1%	-2.5%
Urbanization rate	%	47%	48%	50%	51%	53%	54%	55%	56%	57%	59%	60%	61%	62%	63%	64%	65%	66%	67%	70%		
Disposable income																						
China average	US$	1423	1597	1833	2241	2619	2981	3331	3603	3951	4331	4744	5203	5686	6213	6787	7412	8092	8833	21788	12.6%	9.2%
Urban	US$	2271	2514	2823	3375	3892	4351	4783	5105	5513	5954	6431	6945	7501	8101	8749	9449	10205	11021	26000	10.8%	8.0%
Rural	US$	685	754	874	1080	1254	1436	1610	1730	1903	2093	2302	2533	2786	3064	3371	3708	4079	4487	11960	12.9%	10.0%
Food consumption per capita - China average																						
Soybeans	kg/yr	7.5	7.6	7.8	7.9	7.9	8.2	8.8	9.3	10.2	10.9	11.9	11.7	11.6	11.6	11.5	11.5	11.4	11.4	11.1	5.5%	-0.4%
Maize and products	kg/yr	12.7	12.8	12.9	12.9	13.0	13.1	13.1	13.2	13.2	13.4	13.3	13.0	12.8	12.6	12.4	12.1	11.9	11.7	11.5	0.4%	-1.7%
Rice	kg/yr	79.7	80.0	80.4	82.3	80.8	80.6	78.6	75.6	75.8	75.9	76.6	75.8	75.0	74.2	73.4	72.6	71.9	71.1	70.3	-0.6%	-1.1%
Wheat and products	kg/yr	73.4	72.7	72.7	73.1	73.9	73.9	73.5	73.8	73.8	74.5	75.2	74.4	73.6	72.8	72.1	71.3	70.6	69.8	68.1	0.4%	-1.1%
Pigmeat	kg/yr	35.2	36.7	37.9	37.9	39.8	40.8	41.8	40.5	39.8	39.4	39.5	37.5	35.7	36.1	36.4	37.6	37.3	37.1	35.7	0.5%	-0.2%
Beef	kg/yr	4.6	4.8	4.9	4.8	4.9	5.2	5.3	5.3	5.6	5.9	6.1	6.4	6.8	7.2	7.6	8.0	8.4	8.9	11.2	2.9%	5.6%
Mutton & Goat Meat	kg/yr	3.1	3.2	3.2	3.2	3.2	3.2	3.3	3.4	3.5	3.6	3.6	3.8	3.9	4.0	4.1	4.3	4.4	4.6	4.6	1.5%	3.4%
Poultry Meat	kg/yr	12.2	12.6	13.0	13.4	14.0	14.1	13.5	13.1	14.0	13.8	14.1	15.6	16.4	17.0	17.7	18.4	19.1	19.8	23.5	1.0%	4.1%
Fish, seafood	kg/yr	37.0	38.5	40.2	41.7	40.6	42.2	43.8	45.1	46.3	46.5	46.5	48.1	49.7	51.3	53.0	54.7	56.4	58.2	66.4	1.8%	3.2%
Eggs	kg/yr	20.3	20.6	20.6	20.9	21.2	21.3	21.4	22.1	22.8	22.2	22.3	22.6	22.9	22.9	22.9	23.0	23.0	23.0	23.1	1.0%	0.3%
Milk	kg/yr	23.3	23.8	25.3	26.5	28.3	28.7	30.4	28.6	28.4	28.9	28.8	30.2	31.5	33.0	34.5	36.0	37.6	39.3	46.8	1.6%	4.5%
Food consumption per capita - China urban																						
Soybeans	kg/yr						6.5	7.2	7.6	8.4	9.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.8		0.0%
Maize and products	kg/yr						10.4	10.9	11.1	11.2	11.4	11.4	11.3	11.2	11.0	10.9	10.8	10.7	10.6	10.5		-1.0%
Rice	kg/yr						67.4	64.9	63.2	64.2	64.6	65.7	65.3	65.0	64.7	64.3	64.0	63.7	63.4	63.4		-0.5%
Wheat and products	kg/yr						61.7	60.7	61.8	62.5	63.3	64.5	64.1	63.8	63.5	63.2	62.9	62.5	62.2	61.6		-0.5%
Pigmeat	kg/yr						44.2	43.4	41.7	41.4	40.3	40.3	38.3	36.4	36.8	37.1	38.2	37.9	37.5	36.0		-0.4%
Beef	kg/yr						8.0	7.5	7.4	7.7	8.0	8.2	8.6	9.0	9.5	9.9	10.4	11.0	11.5	12.5		5.0%
Mutton & Goat Meat	kg/yr						4.1	4.0	4.1	4.1	4.1	4.2	4.3	4.4	4.6	4.7	4.8	5.0	5.1	5.1		3.0%
Poultry Meat	kg/yr						16.7	15.2	14.7	15.4	14.9	15.2	16.8	17.6	18.3	19.0	19.8	20.6	21.4	25.0		4.2%
Fish, seafood	kg/yr						59.4	57.4	57.9	58.2	58.2	57.6	58.8	60.0	61.2	62.4	63.6	64.9	66.2	70.0		2.0%
Eggs	kg/yr						24.3	24.2	24.2	24.8	23.9	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0		0.0%
Milk	kg/yr						42.2	42.8	39.3	37.8	37.7	37.3	38.6	40.0	41.4	42.8	44.3	45.8	47.5	50.0		3.5%
Food consumption per capita - China rural																						
Soybeans	kg/yr						10.2	10.7	11.3	12.3	13.2	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.2		0.0%
Maize and products	kg/yr						16.2	15.9	16.0	16.0	16.2	16.1	15.8	15.5	15.1	14.8	14.5	14.3	14.0	13.7		-2.0%
Rice	kg/yr						96.0	95.2	91.3	91.4	91.9	92.8	91.9	90.9	90.0	89.1	88.2	87.4	86.5	86.5		-1.0%
Wheat and products	kg/yr						87.9	89.0	89.2	88.9	90.1	91.1	90.2	89.3	88.4	87.5	86.6	85.8	84.9	83.2		-1.0%
Pigmeat	kg/yr						36.8	40.1	39.1	37.9	38.2	38.3	36.4	34.6	34.9	35.2	36.3	36.3	36.3	35.0		0.0%
Beef	kg/yr						2.0	2.7	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	8.0		3.0%
Mutton & Goat Meat	kg/yr						2.1	2.5	2.5	2.6	2.8	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.5		3.0%
Poultry Meat	kg/yr						11.0	11.4	11.2	12.1	12.2	12.5	13.8	14.4	14.9	15.3	15.8	16.3	16.7	20.1		3.3%
Fish, seafood	kg/yr						22.2	27.4	28.9	30.3	30.1	30.1	31.6	33.2	34.9	36.6	38.4	40.4	42.4	57.9		5.0%
Eggs	kg/yr						17.7	17.9	19.4	20.0	19.8	19.9	20.5	21.2	21.2	21.2	21.2	21.2	21.2	21.2		0.5%
Milk	kg/yr						13.1	15.5	15.0	15.7	16.4	16.4	17.2	18.1	19.0	19.9	20.9	22.0	23.1	39.3		5.0%

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

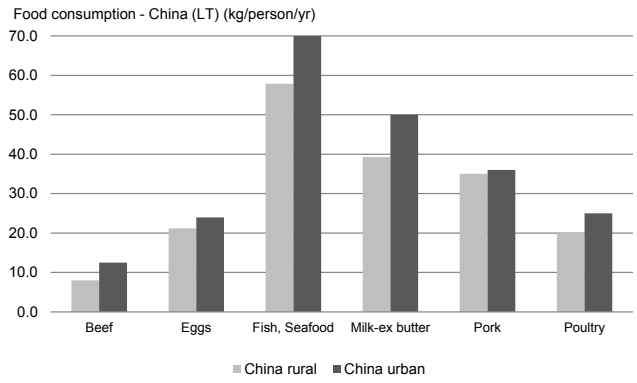
Exhibit 59: Food consumption per capita urban vs. rural

There is still a gap between China urban/rural food consumption



Source: NBS, Goldman Sachs Global Investment Research

Exhibit 60: Long-term food consumption per capita



Source: NBS, Goldman Sachs Global Investment Research

Carnivore versus vegans: Animal protein versus plant-based protein

Foods derived from plants and animals can both provide protein, one of the essential macro-nutrients needed in a balanced diet, but there are some differences. Proteins are made up of amino acids. A person's body needs a balance of all 22 types of amino acids to function correctly.

Essential amino acids are required for human health, but cannot be produced by human bodies, and must be obtained from food, while non-essential amino acids can be produced by human bodies. Complete protein sources are foods that contain all the essential amino acids in adequate amounts. According to the FDA, animal foods and soy are complete protein sources, while most plant proteins (such as beans and peas, grains, nuts and seeds, and vegetables) are incomplete proteins, meaning they are missing or do not have enough of the amino acids that are essential to human beings.

There are also differences among animal proteins, in terms of energy provided, protein content, minerals and lipids especially amino acid. Beef probably could rank as the higher quality animal protein, with a good combination of high protein content, highest in most minerals, yet ranked as the most expensive source of protein, along with milk, versus others. Pork has relatively higher calorific value and lower protein content, and is highest in saturated fat. Chicken and fish are considered lower priced protein sources, and are also low in saturated fat.

Exhibit 61: Comparison among animal and plant-based protein

(Value per 100g meat)		Pork	Beef	Chicken	Egg	Carp	Tilapia	Salmon	Milk	Tofu	Rice
Nutrient											
Water	g	49.8	57.3	66.3	76.2	76.3	78.1	72.5	87.7	80.6	68.4
Energy	kcal	376.0	291.0	213.0	143.0	127.0	96.0	131.0	64.0	94.0	130.0
Protein	g	13.9	17.3	18.3	12.6	17.8	20.1	22.3	3.3	9.4	2.7
Total lipid (fat)	g	35.1	24.1	14.8	9.5	5.6	1.7	4.7	3.7	5.3	0.3
Minerals											
Calcium, Ca	mg	19	8	11	56	41	10	9	119	176	10
Iron, Fe	mg	0.69	1.83	1.31	1.75	1.24	0.56	0.43	0.05	1.7	1.2
Phosphorus, P	mg	155	154	149	198	415	170	257	93	NA	43
Sodium, Na	mg	42	59	70	142	49	52	78	49	12	1
Zinc, Zn	mg	1.59	3.57	1.48	1.29	1.48	0.33	0.46	0.38	NA	0.5
Vitamin B-12	□g	0.61	2.67	1.11	1.53	1.53	1.58	4.69	0.36	NA	0.0
Lipids											
Fatty acids, total saturated	g	12.4	9.8	4.2	3.1	1.1	0.6	0.8	2.3	0.6	0.1
Cholesterol	mg	74	74	90	372	66	50	51	14	0.0	0.0
Types of amino Acids	x	20	20	20	20	20	20	20	20	20	15
Unit prices per kg in China											
Prices per kg of Food	Rmb/kg	22.5	65.1	19.2	9.9	9.0	20.0	92.5	11.5	4.8	6.5
Price per kg of protein	Rmb/kg	162	376	105	79	50	100	416	351	51	242

Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Pricing sensitivity in demand

In 2019YTD, given the deeper impact on pork supply, apparent demand declined by 5% yoy, while non-pork, including chicken and beef, increased by 4%

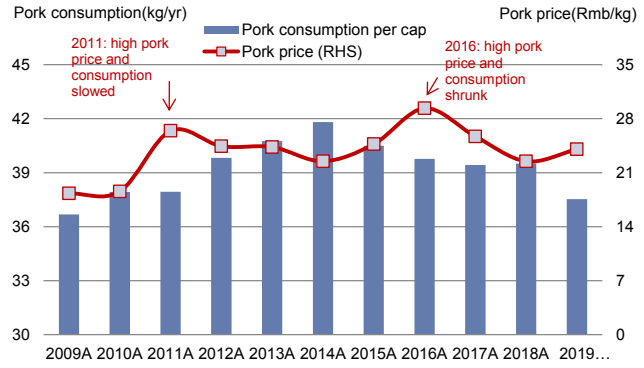
We noticed animal protein consumption sensitivity to price and substitution among animal proteins in China, mostly between chicken and pork. In 2011, when pork prices increased by 40%+ to Rmb28/kg, due to supply disruptions from diseases like FMD (Foot and Mouth Disease) and PRRS (Porcine Reproductive and Respiratory Syndrome), the consumption of pork decelerated to 1%, from its growth trajectory of 3-4% per annum. Over the same period, broiler prices also increased by 15% to Rmb10/kg, without signs of changing supply, suggesting a mild demand switch from pork to chicken. In 2018, when ASF hit the pork industry, we estimate that a nearly 1% of pork demand shifted to chicken, partly reflected in the 26% increase in broiler wholesale prices to Rmb8.5/kg. In 2019YTD, given the deeper impact on pork supply, apparent

demand declined by 5% yoy, while non-pork, including chicken and beef, increased by 4%. Pork prices increased by 20% over 2018 troughing to Rmb25/kg, yet broiler and beef prices increased by 25%/7% to Rmb9.7/kg and Rmb69/kg, respectively.

...beef and aqua product consumption in China appears to be less price sensitive

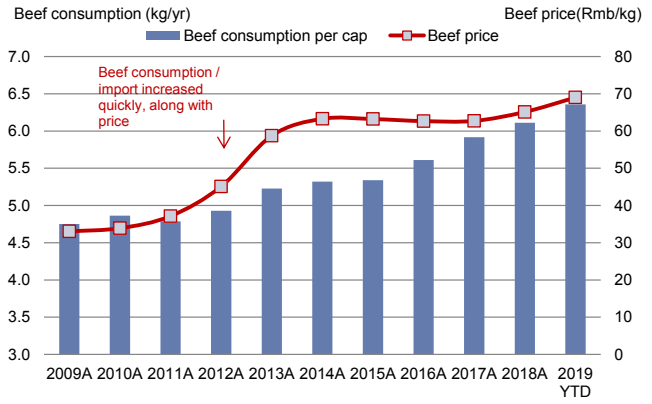
In the longer run, beef and aqua product consumption in China appears to be less price sensitive, as demand tracks structural growth in both volume and pricing — similar to luxury products. We find that beef consumption has increased by 3% CAGR over the past ten years, including imports of beef grew from 0 in 2011 to 40k tons in 2013, while pricing continued to pick up from Rmb37/kg to Rmb59/kg. For aquatic products, the structural growth of consumption remains intact, though pricing was disrupted by its own supply cycles. In addition, aquatic products may have seen some mild substitution from pork in years like 2011 and 2016, but due to the relatively large size of the aquatic product market, the impact on pricing was not prominent.

Exhibit 62: Pork consumption and price - China



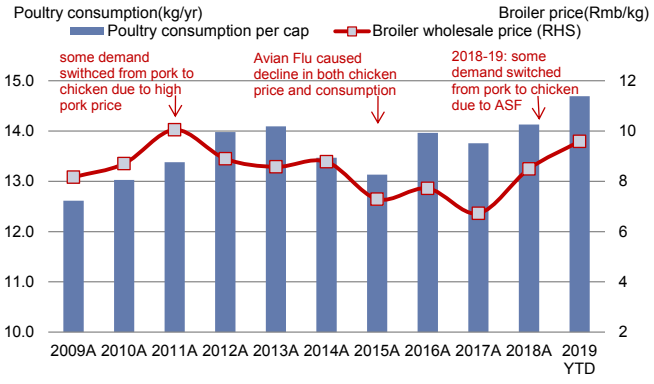
Source: Ministry of Agriculture, Goldman Sachs Global Investment Research

Exhibit 63: Beef consumption and pricing - China



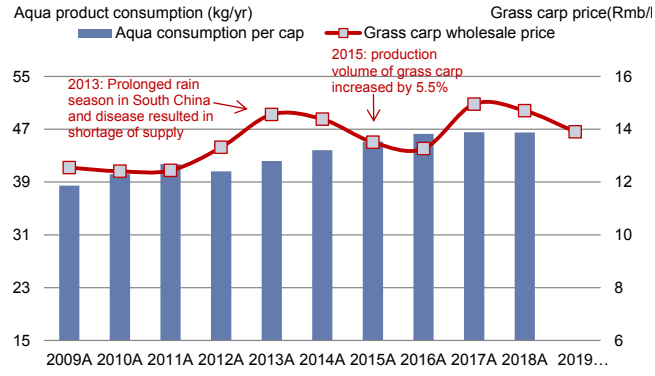
Source: USDA, Ministry of Agriculture, Goldman Sachs Global Investment Research

Exhibit 64: Chicken consumption and price - China



Source: Wind, USDA, Goldman Sachs Global Investment Research

Exhibit 65: Aquatic product consumption and pricing - China



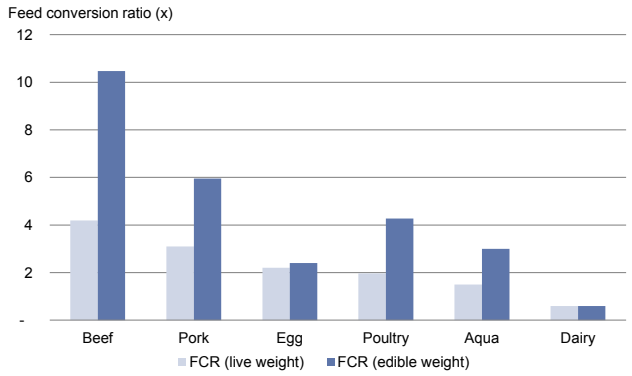
Source: Ministry of Agriculture, Wind, Goldman Sachs Global Investment Research

Grain-equivalent agriculture demand: How animal proteins translate into feed

We expect the grain-equivalent demand of soybeans to increase from 110mnt in 2018 to 158mnt in the long term, and grain-equivalent corn demand to grow from 287mnt to 393mnt in the same period, driven by an upgrade in the diets of Chinese consumers and higher industrial feed penetration:

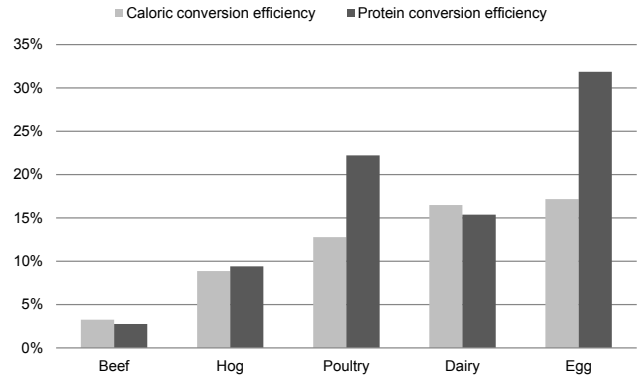
- **Feed conversion ratio (FCR):** Feed conversion ratio refers to the quantity of animal feed required to produce one kilogram of meat, egg, or milk product. FCR reflects the conversion efficiency to produce animal meat and could differ across different categories. For example, beef has the highest FCR among animal meat (8-10x compared with less than 5 for other animal meat), meaning it requires a higher amount of feed to produce the same amount of beef than other animal proteins. Due to the amount of energy consumed in the process of weight gain, beef also has the lowest calorie/protein conversion efficiency among animal proteins, less than 5% vs. 15-30% for poultry, milk and egg. While we expect most of the growth in beef demand to be filled by imports, this demand would contribute 51mnt of feed demand if translated into grain-equivalent demand.
- **Industrial feed penetration:** Refers to the amount of industrial feed reported as a percentage of theoretical feed demand. Industrial feeds are mostly used by larger scale livestock producers, while farmers and small operations have a higher tendency to use self-produced feed, or forage/kitchen waste. Take hog production as an example. In 2009, we estimate industrial feed penetration for swine feed is only at 30%. Apart from this, another 25% of the hogs produced are fed with concentrated feed and self-procured corn, which is not reported in industrial feed production volume but still constitutes actual consumption of soybean meal and corn. About 40-50% of hogs produced are fed with forage or kitchen waste, and do not consume soybean meal or corn. As the agriculture industry in China industrializes and consolidates, total feed penetration for swine (industrial + self-supply) has increased from 60% to 85%, partly driven by a 115% increase in soybean meal usage, and an 85% increase in feed usage of corn in 2008-2018. Looking ahead, the penetration in aquatic and ruminant animal production still has much room to grow from a low base, likely in the range of 10-30% as of 2018, according to our estimates, compared with 50%+ in developed countries. Hence, we expect industrial feed penetration for existing aquatic / ruminant production to increase from c. 30%/10% in 2018 to 45%/30% in long term, bringing 15-20mnt increase in feed demand (for new demand, we assume 100% industrial penetration).
- **Crop demand from animal feed use:** Soybean meal (by-product of soybean crushing) and corn are two major crop inputs for animal feed. We generally assume 20%/60% input of soybean/corn in animal feed. With rising demand from animal meat, and higher industrial penetration in aquatic and ruminant feed (we assume from 10-30% currently to 30-45% in the long run), the increased feed assumption would lead to a 46mnt increase in the feed use of corn and a 33mnt increase in the feed use of soybean from 2018 to long term, accounting for 17% and 34% of 2018 consumption respectively. In the optimistic case, if we assume 100% maximum industrial penetration for all feeds, soybean/corn demand could reach 180mnt and 450mnt in the long term, 20%-22% higher than our base case forecast.

Exhibit 66: Average feed conversion ratio by animal protein



Source: Goldman Sachs Global Investment Research, USDA

Exhibit 67: Calorie/protein conversion efficiency



Source: A Shepon et al. 2016

Chinese supply: Transformation needed

Base on data from FAO, in the past 50 years, global food production (using cereal as an example) grew by 240% or 2.2% each year, through the combination of the addition of new arable land (18% of the supply growth), crop intensity, as well as productivity or yield gains including irrigation, input-based productivity (such as use of fertilizer and pesticides), and non-input based productivity (such as technology or efficiency management). Over the same period, China managed to deliver higher-than-average food supply growth at a 3.1% CAGR growth in food supply by maintaining its arable land per capita and stretching input-based productivity.

We estimate the contribution of non-input based productivity gains for the global market would need to accelerate from the past average of 0.9% each year to 1.2%, to meet the future demand growth

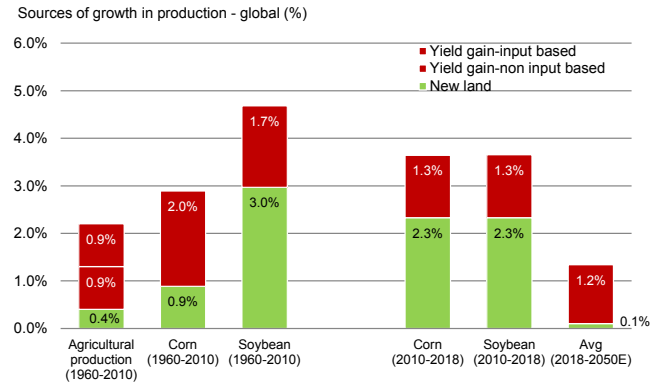
In the coming decades, rising demand is likely to impose more stress on food supply, in our view, after all the "low-hanging fruit" (including land and input-based gain) taken at the expense of intensive consumption of resources and the environment. Calls will intensify for the acceleration of non-input-based yield gains such as new plant/seed technologies that focus non-developing new seed traits within a given species through genetic engineering (World Agriculture towards 2030/2050, FAO) and precision farming practices that may lead to a revolution in yields while reducing the use of fertilizer and water. Based on data from the FAO, we estimate the contribution of non-input based yield gains for the global market would need to accelerate by 40%, from the past average of 0.9% each year to 1.2%, to meet the future demand growth. Climate changes and the potential negative impact on yields over the long run also add further challenges. In studies summarized by the IPCC on climate impact in the past, most have pointed to a 0-2.5% negative climate impact on crop yields over a decade. For each Celsius degree increase in global mean temperatures, the projected global production of corn and soybeans would be reduced by 7.4% and 3.1%, respectively.

The supply challenge ahead is more for China. However, we believe the highest level of supply stress provides a greater opportunity and incentivizes easier adoption for agriculture technology and innovation in the future

The supply challenge ahead is more for China. In the coming decades, China will likely face the need for fundamental transformation in its agriculture sector. To maintain its food balance, China has stretched much of its input-based resources, as seen in its intensive use of fertilizer and pesticides accompanied by water and soil quality deterioration. As a result, there have been nearly muted productivity gains in recent years for major crops such as corn and soybeans. China's production cost for major crops and animal proteins is already nearly twice the level of other major agriculture counties, driven by higher labor and land costs, a result of its rapid urbanization, in our view. Nevertheless, we believe the highest level of supply stress provides greater opportunity and incentivizes easier adoption for agriculture technology and innovation in the future — for example, hybrid rice seeds, an ongoing 30-year development of Longping High Tech, have seen 35% yield improvements since the 1970's, with the potential to deliver 30% more. And according to XAG, a private Guangdong-based agriculture technology firm, the company is using drone-based technology and data to help over 4.7mn farmers grow crops smartly and sustainably while effectively managing farmlands with less chemical use.

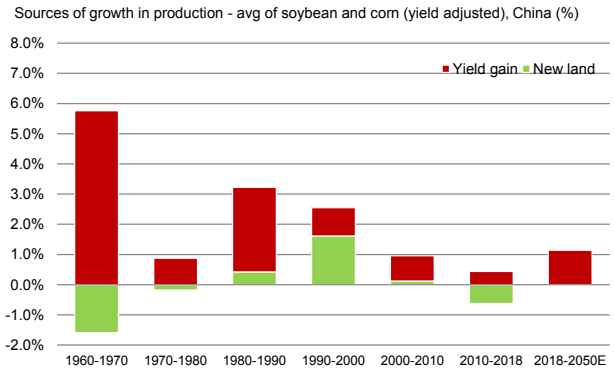
In the long run, China needs to address its future food balance through a combination of enhanced non-input or innovation-driven yield improvements from domestic supply, as well as higher imports from the global market.

Exhibit 68: Sources of growth in agriculture production - Global
Calls for acceleration in non-input based yield improvement will likely intensify



Source: FAO, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 69: Sources of production growth - China
Despite strong growth in corn supply in recent years, the net impact of key feed inputs (core and soybeans) has been muted, putting more pressure on the productivity gains needed to meet food demand

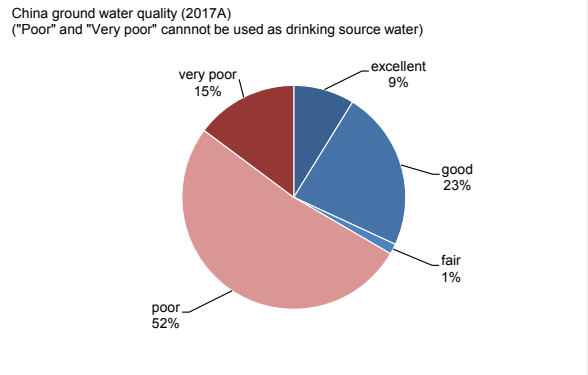


Source: FAO, Goldman Sachs Global Investment Research, Gao Hua Securities Research

How stressed is China's input-based agriculture supply?

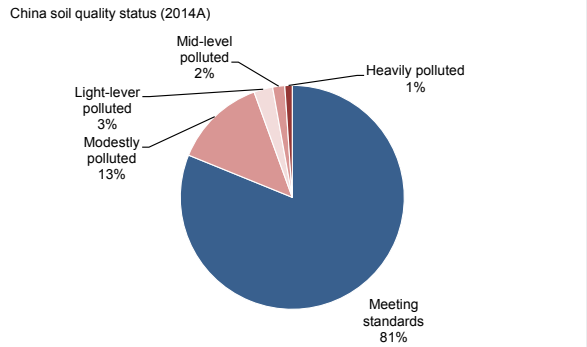
- China holds 8.4% of global arable land, and has nearly a quarter of the global population. Arable land per person is 0.10 hectare, half of the global-ex China average, or less than 20% of the US level.
- China consumes 82 mnt of fertilizer each year, three times the US level.
- China applies 3.5 times the nitrogen-based fertilizer per hectare of land versus the world average, and five times more pesticides
- COD discharges due to small-scale pig-farming could lead to 12mnt of unreported pollutant discharge, equivalent to 110% of reported COD emissions
- There is a profound impact on yields from soil degradation such as acidification, displacement of high-yield by less fertile land in the course of urbanization, as well as water and soil pollution.
- Based on an MEE annual report, 2/3 of ground water and 30% of surface water is of poor quality, not suited for drinking sources. Major pollutants are COD, ammonia nitrate, and heavy metals.
- Based on a 2014 national soil status report issued by the MEE, 19.4% of arable land does not meet national standards, given the presence of major pollutants as cadmium, nickel, copper, arsenic, mercury, lead, DDT and aromatic hydrocarbons.

Exhibit 70: China ground water quality (2017A)
67% of the ground water is of poor or very poor quality



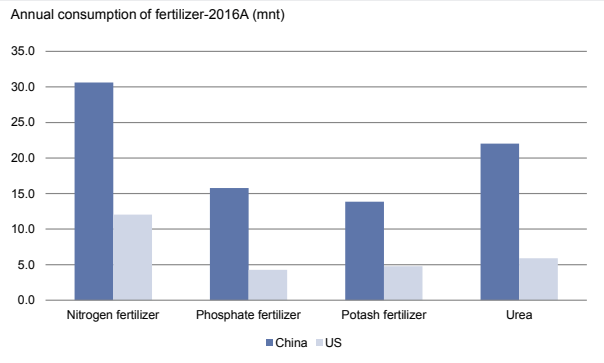
Source: MEE, Goldman Sachs Global Investment Research

Exhibit 71: China soil quality status (2014A)
19% of arable land does not meet national standards



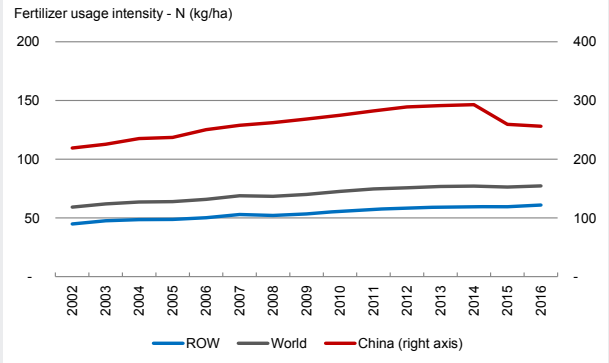
Source: MEE, Goldman Sachs Global Investment Research

Exhibit 72: Annual fertilizer consumption - China versus US
China applies 82mnt of fertilizer per year, vs. 27mnt in US



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 73: Fertilizer usage intensity
China's fertilizer intensity is 3.5x the ex-China average



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Land and inputs: Most stretched

In the past 50 years, China has added 30% more arable land, with total arable land standing at 135.6mn hectares, versus its "red line" of 120 mn hectares. Over this period, China has maintained the world's most stable arable land per capita level. Nevertheless, the absolute level of arable land per capita remains low at 0.10 hectares, far below the world average of 0.19 hectares (0.21 hectares for ex-China). On a global basis, new arable land additions, 15% for the past 50 years, have been unable to offset population growth — as a result, global average arable land per person has shrunk from 0.36 hectares in 1970, to 0.19 hectares in 2017, and will likely further decline by 21% in 2050E, based on FAO projections of decelerating annual growth of 0.1% in the coming decades, versus an average annual expansion of 0.4% per year from 1960-2010.

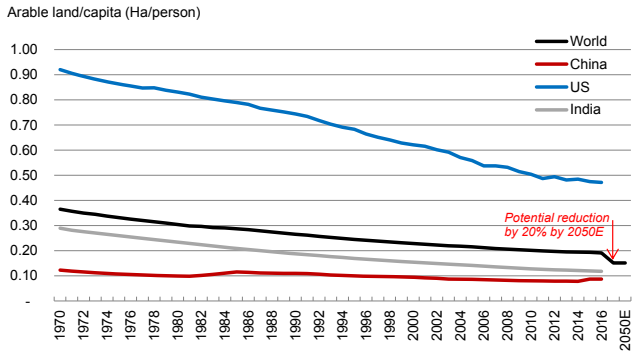
While overall land size maybe limited in China, there is some flexibility in terms of the allocation of land for crops

While overall land size maybe limited in China, there is some flexibility in terms of the allocation of land for crops. For example, China has been aggressive in pushing the production growth of corn, partly at the expense of soybeans — driven by a focus of self-sufficiency in cereal in the context of food security. For each hectare of land, China can produce 6.1t of corn a year, 3.4x of yield versus soybeans. As a result, corn production grew 73% in 2006-2016A, with 46% coming from land expansions, while soybean output declined 25%. The trend is beginning to reverse in 2018-19, with planned arable land for soybeans increasing by 9%. According to the "soybean promotion plan" set in 2019's No.1 document, soybean acreage in China is targeted to increase by 11% to 140mn mu (9.33mn hectares), and production volume is targeted to increase to by 12% to 19mnt in 2020 vs. 2019. And in the meantime, land for corn would be cut by 0.4mn hectares or 1% , land for rice by 0.1mnt (0.5%) and wheat down 0.3mn hectare (1%)

In addition to the absolute limitation on land area, soil degradation has also been severe. Degraded land typically includes soil with reduced fertility, erosion, changes in acidity, and damage from climate change and pollutants. According to Xinhua reports and China Daily (2014), more than 40% of China's arable land is suffering from degradation, including the thinning of the rich black soil in northeastern Heilongjiang province while farmland in southern China is suffering from acidification, based on Agriculture Ministry statistics. The intensive use of fertilizers and pesticides is likely a factor in soil degradation.

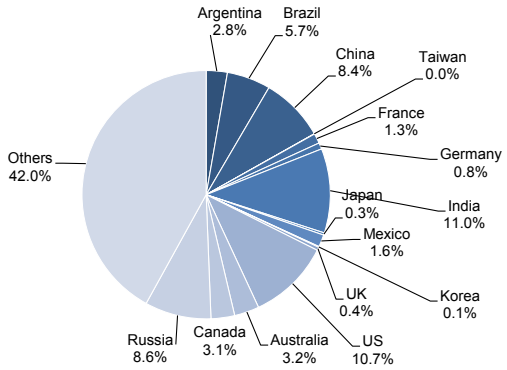
Nevertheless, much of the crop yield is also determined by local climate conditions, which would be rather unique for each crop. Despite the intensive push on yields, Chinese soybean yields remain lower than peers, at 1800kg/hectare versus 3300-3400kg/hectare in US and Brazil. Corn yields currently stand at c. 6000kg/hectare, versus US and Brazil 11,000/5,600 kg/hectare. There are also issues of lower oil yields for domestic soybeans compared with imported soybeans, making domestic soybeans less suitable for crushing.

Exhibit 74: Arable land per capita- China vs. world



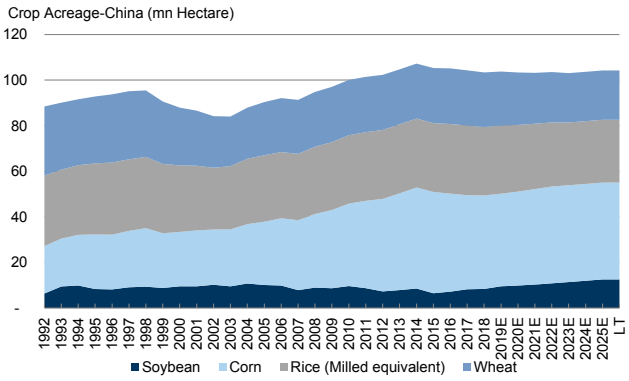
Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 75: Arable land by country



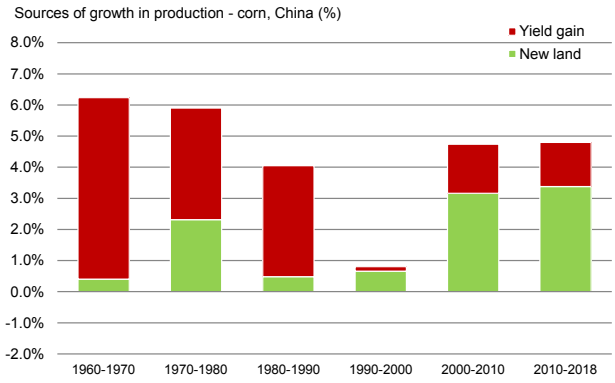
Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 76: Crop acreage allocation - China
The priority will move from corn to soybean



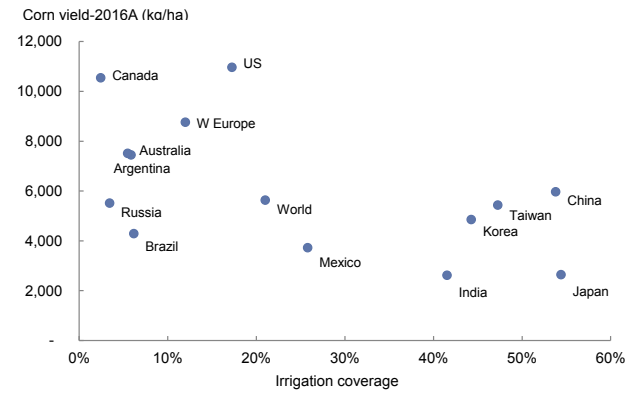
Source: NBS, Goldman Sachs Global Investment Research

Exhibit 77: Corn production growth - China
Supply growth increasingly relying on land expansion rather than yield gain, at the expense of less land for soybean



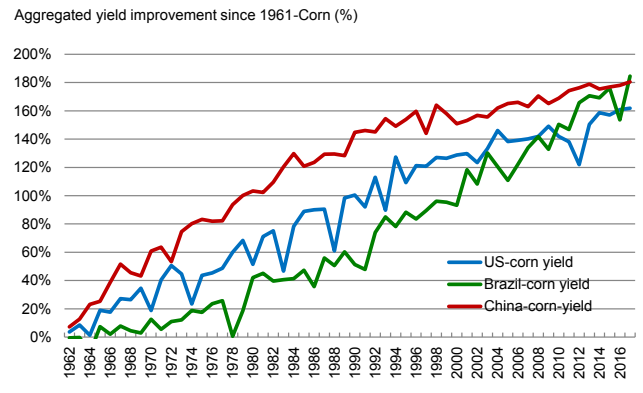
Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 78: Corn yield - China versus peers
China already has high Irrigation coverage but corn yield remains average versus peers



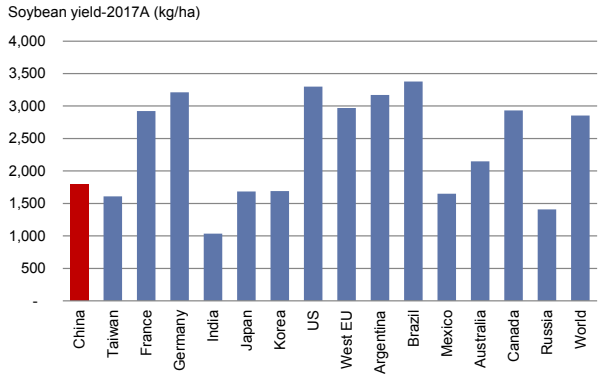
Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 79: Aggregated yield improvement - China versus peers
China has taken nearly 180% aggregated yield improvement in corn in the past 50 years, yet pace is decelerating



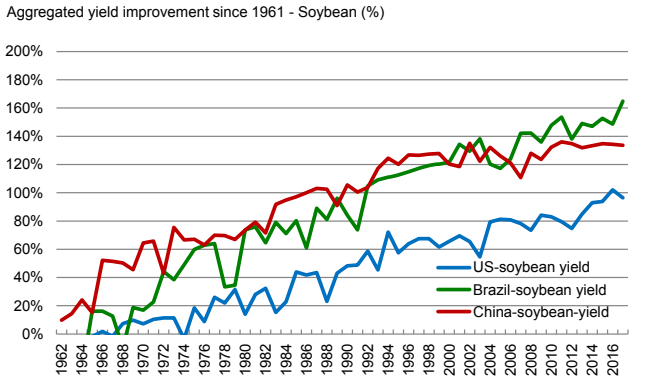
Source: FAO, Goldman Sachs Global Investment Research

Exhibit 80: Soybean yield- China versus peers
The natural climate and soil condition has led to lower yield in China versus others



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 81: Aggregated soybean yield - China versus peers
China has delivered 140% aggregated yield improvement in soybean, yet not further improvement in the past 10-20 years.



Source: FAO, Goldman Sachs Global Investment Research

According to the FAO, an agri-technology revolution is emerging led by "precision farming", and "non-GMO based plant breeding technology."

Technology innovation: Hybrid seeds and precision farming

The call for technology innovation in the agriculture sector to improve productivity has never been stronger. According to the FAO, an agri-technology revolution is emerging led by "precision farming" (an optimized management of inputs based on actual crop needs, through data-based technologies such as GPS, remote sensing, and internet), and "non-GMO based plant breeding technology." Based on analysis done by our US team (Precision Farming: Cheating Malthus with Digital Agriculture), precision farming may have the potential to deliver 70% higher yields, through precision fertilizer application, precision seeding and planting, precision spraying, precision irrigation, field monitoring, and data management. Specifically, the team estimates a 15-20% improvement in yields and a 4% reduction in fertilizer consumption with the broad-based adoption of precision fertilizer application technology, and precision irrigation may improve crop yields by least 10%, while reducing water consumption by up to 50%.

While innovation in China's agriculture sector remains early in stages, there are signs of improvement — for example, hybrid rice seeds in development for 30+ years by Longping High Tech may have the potential to deliver 30% more yield (experimental max yield vs. realized yield at mass application). Meanwhile, XAG, a private, Guangdong-based precision farming provider is using drone-based smart agriculture solutions to sustainably grow crops and effectively manage farmlands with less chemical use.

Precision farming: XAG

XAG Co. Ltd. is an agricultural technology company founded in 2007. It is one of largest UAS (Unmanned Aerial System) R&D manufacturers and a smart agriculture solution providers in China. Headquartered in Guangzhou, XAG has developed its own patented agriculture drones, sensors, and other digital farming tools for precision spraying, granule spreading and mapping. According to the company, XAG has conducted UAV plant protection services on over 6 million hectares of farmlands and served 4.74 million farmers, appliying to nearly all major crops. Based on the case studies provided on XAG's homepage, precision farming technology can finish seeding work 150x faster than typical manual seeding, and can perform precision perticides spraying based on AI-backed HD maps.

- Case 1 from XAG: Rice field seeding — The walking-type transplanter, requiring three to four laborers to operate, can only cover two hectares of farmland per day. XAG's JetSeed™ Granule Spreading System can project the demanded dosage of seeds and fertilizers uniformly wherever needed. According to XAG, the efficiency of the drone operation can reach up to five hectares per hour, 150 times faster than manual seeding and five times faster than the high-speed transplanter.
- Case 2 from XAG: Precision spraying on fruit trees — Traditionally, managing orchards, especially those located in mountainous or hilly terrain, is a physically difficult and time-consuming task given fruit growers need to manually collect data and conduct hand spraying for pest control. XAG engables the farmers to free themselves from an overwhelming amount of physical labor, through drone and AI

technology. First, a centimeter-level surveying UAS XMission drone flies over the orchard to capture high-definition field images with minimal errors. Then, XAG Agriculture Intelligence (XAI) carries out intelligent analysis of the orchards, automatically identifying the boundaries and obstacles as well as calculating the statistics of fruit trees, i.e., the position of each fruit tree, including its center and perimeter. These AI-backed HD maps can be directly applied to XAG P Series Plant Protection UAS for autonomous, precise spraying over the targeted area.

Exhibit 82: XAG - Agriculture drones empowers farmers for precision seeding

Source: XAG

Exhibit 83: A2 PILOTPHONE-a smartphone type UAS controller customised for plant protection

Source: XAG

Exhibit 84: XAG Agriculture Intelligence (XAI) identifies the location of fruit trees based on HD maps

Source: XAG

Exhibit 85: AI-backed HD maps can be directly applied to XAG P Series Plant Protection UAS for autonomous, precise spraying over the targeted area

Source: XAG

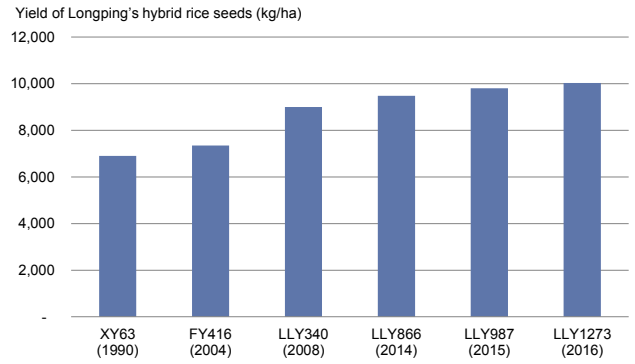
Hybrid Seeds: Another 30-40% potential in Longping

As genetically modified organisms (GMOs) are still not allowed to be planted in China, hybrid technology can contribute to yield improvement for crops in China. The first generation of three-line hybrid rice seed was developed by agronomist Yuan Longping in the 1970s, which had a 20% higher yield than conventional rice seed at that time. With

persistent R&D and product upgrades, the yield of Longping High-Tech's hybrid rice seed has improved by c. 20% in the last 10 years, reaching the range of 10,000 kg/hectare. There is still room for improvement in the future. According to Xinhua.net, the latest experimental yield of hybrid rice seed developed by Yuan Longping has exceeded 15,000 kg / hectare, c.30-40% higher than the major products of Longping High-Tech. Notably, the maximum yield is achieved in experimental conditions, carefully attended to by experts, and has still not been achieved in mass production.

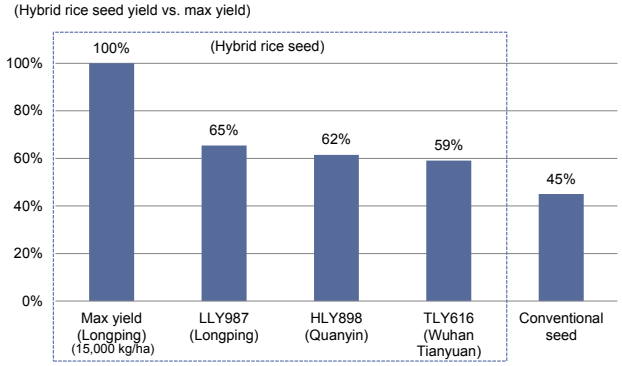
On the other hand, GM seeds developed by leading global seed companies have significant advantages in terms of simplicity in weed management, though improvement in yield is rarely described in research articles. Take Monsanto's Roundup Ready (RR) soybean seed as an example. The GM soybean is tolerant to a herbicide called Roundup (also developed by Monsanto), and significantly reduces the difficulty of weed management. Farmers were able to use one herbicide product for a wide range of weeds, without injury to the crop. Since the introduction of the seed in 1996, the adoption of RR soybean is estimated to have accounted for 50% of planted soybean acreage in 1999.

Exhibit 86: Yield of hybrid rice developed by Longping
Longping High-Tech's product has improved over the past 20 years



Source: Company data, China Rice Data Center

Exhibit 87: Yield of hybrid rice seed developed by Longping
There is still a wide gap between realized yield and theoretical yield



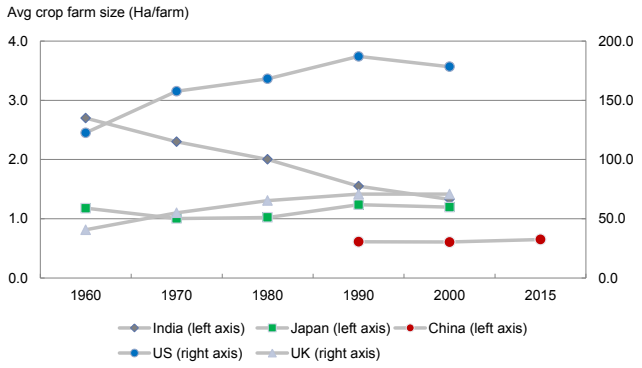
Source: Company data, National Rice Data Center, Data compiled by Goldman Sachs Global Investment Research

Industry consolidation: A mixed view

China's agriculture sector is highly fragmented and consolidation remains relatively slow. China's average farm size was only c. 0.7 hectares in 2015, lower than peers such as the US (170 ha), Japan (1.1 ha) and India (1.2ha), and has only shown minor improvement from 0.67 hectares in 1997. Nevertheless, with the rural land transfer policy implemented, more rural land has been transferred to large-scale professional operators or individuals. According to Ministry of Agriculture, total rural land transferred has reached 34mn ha, accounting for 25% of total farmland in China. In addition, enhanced enforcement in environmental regulation and an aging labor force in rural areas should also help accelerate the consolidation process.

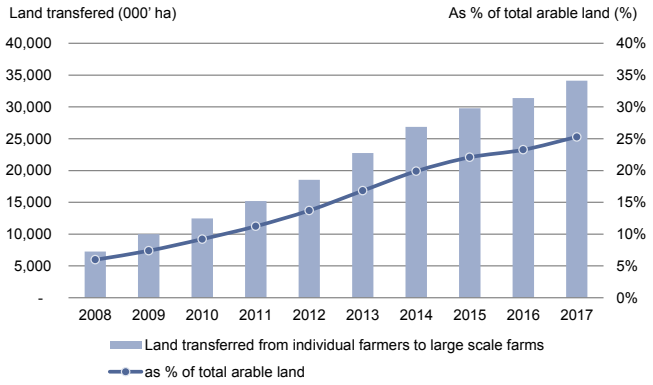
In theory, consolidation in the cropping industry could help improve yields as larger farms are more suited to irrigation and apply large agriculture machines and other modern farming practices. For example, Jiangsu Agriculture Reclamation and Development (601952.SS; Not Covered), a large-scale crop company in China, has had gross margins of 10-20% for wheat and 17-22% for rice in the last five years, while the average farmer's gross margin has been almost zero or even loss making. For hog production, industry leaders have unit costs of c. Rmb12/kg, 20% lower than farmers, mostly due to advantages in breeding, feed conversion efficiency, and labor costs. Nevertheless, we also highlight that the intrinsic fragmented nature of land in China suggests not all benefits of consolidation can be realized as expected.

Exhibit 88: Average crop farm size - China versus peers
Farm size in China is smaller than major countries



Source: FAO, NBS, Data compiled by Goldman Sachs Global Investment Research

Exhibit 89: Land transferred from small farmers to larger farms - China
Rural land transfer rapidly increased since 2008 and reached 25% of the total arable land on aggregated basis by 2017

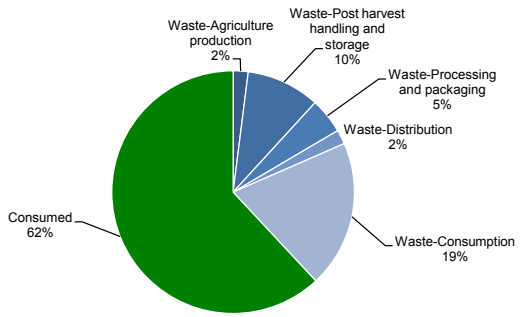


Source: Ministry of Agriculture, Goldman Sachs Global Investment Research

Food waste management

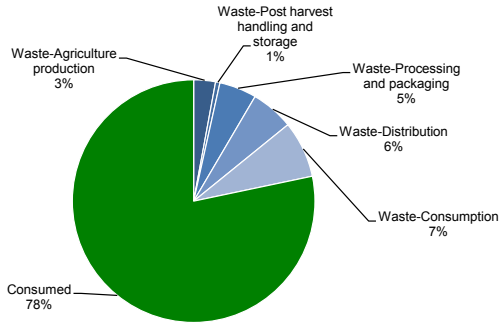
As food demand grows with urbanization, it is typically accompanied by more processed food consumption, thus higher waste from distributions and the production process. Based on data from FAO, total food waste in northern Asia (including Japan, Korea, and China) could be as high as 38% for cereal and 22% for meat, in the process of production, post-harvest handling and storage, processing and packaging, distribution, and consumption. More efficient logistic distribution and changes in consumer behavior on food waste, would help address the stress on food supply in the long run. This factor is not included in our S/D model at this point.

Exhibit 90: Cereal waste - North Asia (China, Japan, and Korea)



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 91: Meat waste - North Asia (China, Japan, and Korea)



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Environment and climate: More supply risk

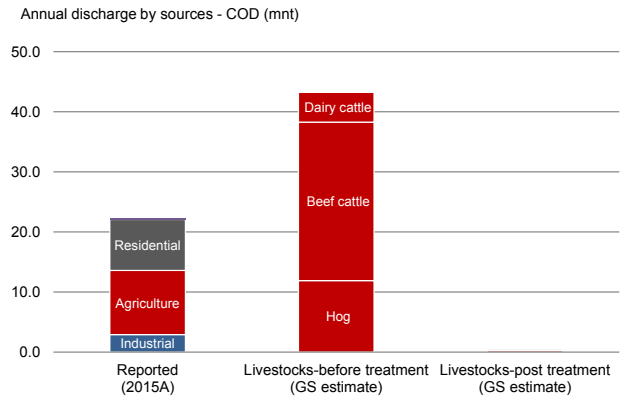
Environmental stress from air and water pollution, along with the global climate changes, further constrain food supply, in China and globally.

We believe Chinese government efforts to enforce environmental compliance in the agriculture sector will tighten over time, imposing challenges for both costs and future supply

According to Bo et al., 2012, lake eutrophication in China has been rapidly increasing since 2000. Nitrogen concentration in large rivers, especially the Yangtze and the Yellow Rivers, has been increasing in recent years. Overuse of fertilizer is also a source of pollutants. According to J.H.Guo et al., 2010, the overuse of fertilizers has been responsible for soil acidification in China since 1980. With nearly 2/3 of the ground water and 30% of the surface water no longer suitable for drinking, and 19.4% of the soil suffering from heavy metals and pesticide pollution, China has been trying to reverse trends in its environment since 2013. More importantly, the marginal impact of incremental fertilizer and pesticide use on crop yields has been diminishing in recent years.

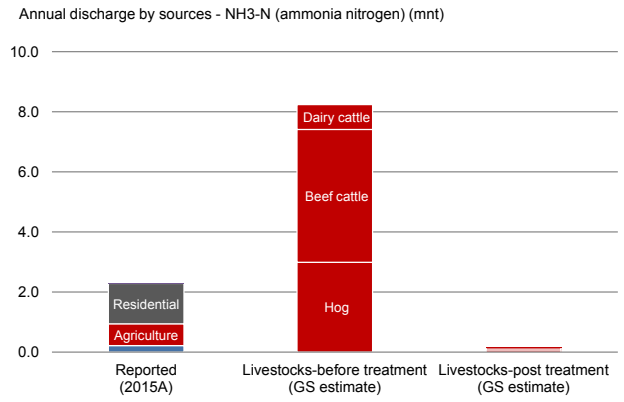
China's agriculture sector contributes to 48% of reported COD discharge (11mnt) and 32% of ammonia nitrogen discharge (0.7mnt) each year, based on the MEE's annual report. Most discharge comes from animal farming. In reality, discharge estimates are likely to be higher, taking into consideration the theoretical emissions from water discharged from animal farms and the potential low-pollutant discharge post proper treatment. We believe government efforts to enforce environmental compliance in the agriculture sector will tighten over time, imposing challenges for both costs and future supply.

Exhibit 92: Annual COD discharge - China total and agriculture sector
Reported discharge from the agriculture sector accounted for 48% of COD discharge



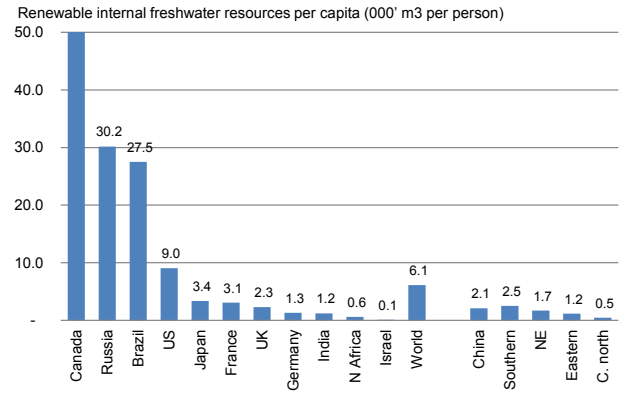
Source: MEE, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 93: Annual ammonia nitrogen discharge - China and agriculture sector
Reported discharge from the agriculture sector accounted for 32% of total ammonia nitrogen discharge



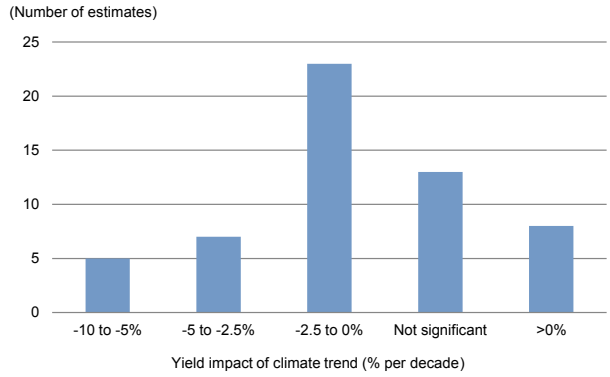
Source: MEE, Company data, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 94: Water resources per capita -China versus peers
China holds one of the lowest water resources



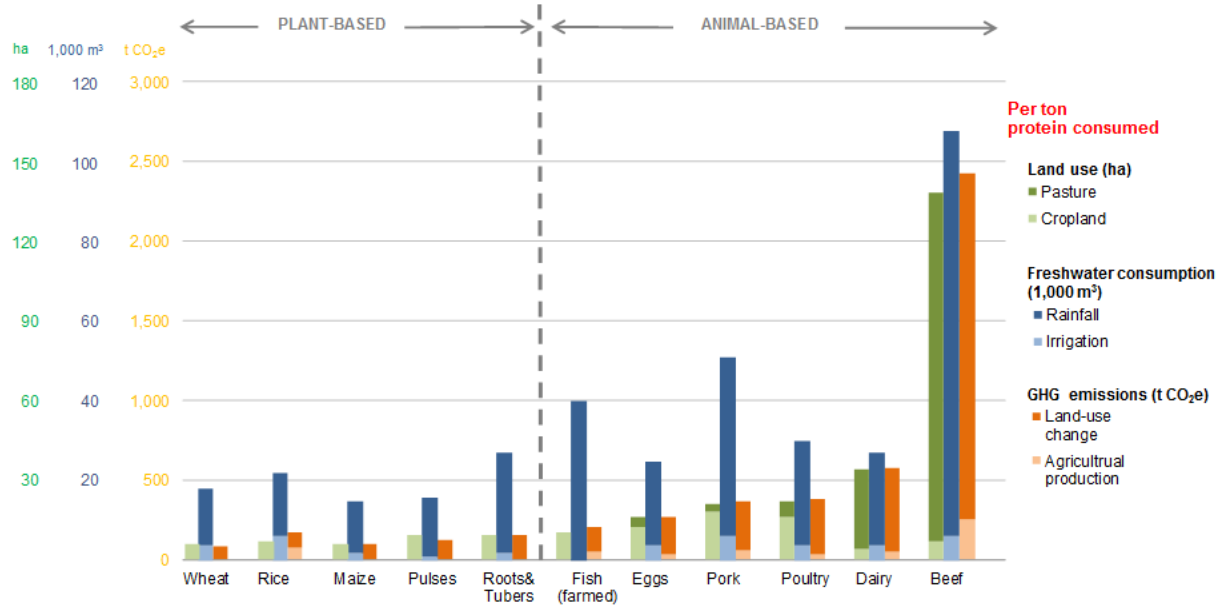
Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Exhibit 95: Potential impact on crop yield from climate change
Most studies have estimated a -2.5% to 0% impact of climate change on yield



Source: IPCC

Exhibit 96: The resource intensive nature of animal protein versus crops



Source: FAO

According to the IPCC, yield and animal productivity can be negatively impacted by extreme temperatures, ozone, and structural temperature changes in the course of global warming

Agriculture production is highly dependent on weather conditions. There are many cases of reduced crop yields due to drought, flood, and unusually hot or cold weather. Predicting climate events could be difficult, yet various studies have found evidence that link crop yields to temperature trends. According to the IPCC (Intergovernmental Panel on Climate Change), yield and animal productivity can be negatively impacted by extreme temperatures, ozone, and structural temperature changes in the course of global warming.

- Various studies have found evidence that high temperatures (above 30°C) have a negative impact on crop yields. Unusually high temperatures, both day and night, have a negative impact on crop yields, although warming has helped crop production in some high latitude regions. In the studies summarized by the IPCC on climate

impact in the past, most (23 estimates of 56) have pointed to a 0-2.5% negative climate impact on crop yields over the last decade.

- In addition, the rise in ozone associated with rising CO2 is also found to have a negative impact on crop yields.
- Regarding future potential global warming, the IPCC concluded that global warming of 1.5°C would present much less risk than 2°C.
- For each Celsius degree increase in the global mean temperature, projected global production of wheat/rice/corn and soybean would be reduced by 6%/3.2%/7.4%/3.1%.
- Temperatures may also have an impact on livestock productivity. According to studies summarized by the IPCC, as animal productivity increases, their heat tolerance tends to drop. High temperatures are also found to be linked with higher mortality in cows and affect reproductive efficiency in pigs. Climate change could also indirectly impact livestock through feed quality changes and the spread of disease, as well as through changing water resources for livestock. Globally, a decline in livestock of 7-10% is expected at about 2°C of warming, according to the IPCC.

Global supply responses: Feeding China's rising imports

Global trade volume could see further increase by 12-51% in the coming years, due to increasing import demand from China, assuming all else equal

Global trade in agriculture products totaled US$1.6trn as of 2016, and has grown 2.8x or at nearly an 8% CAGR since 2000 (FAO). In 2018, we estimate 7-42% of the major agriculture supply is traded globally, including over 300mnt of corn and soybeans, over 30mnt of major animal proteins and 45mnt of raw milk and equivalent. Global trade volume could see further increases of 12-51% in the coming years, due to increasing import demand from China, assuming all else equal. Specifically, we expect rising beef and milk imports to China to boost global trade by 40-50% in the coming years, followed by an increase of more than 20% from pork, soybeans, and corn. The grain-equivalent import requirement for corn and soybeans could increase by 63mnt in corn and 50mnt in soybeans by our estimates.

Supply additions are unlikely to meet demand without challenges

On a global basis, we see certain potential sources of further supply growth in major agriculture supply countries, including the US, Brazil, Canada, Australia, and New Zealand. Yet supply additions are unlikely to meet demand without challenges. We estimate the aggregated grain-equivalent supply additions from major agriculture suppliers may reach 40-70mnt for corn and 20-50mnt for soybeans between 2030-2050E, or 5-19% of the current global market. Versus the grain-equivalent Chinese import requirement of 50-63mnt, global supply is likely to remain in a deficit between 2030-2050, depending on the pace of Chinese demand growth, land supply in Brazil, and any meaningful revolution in yields.

There are tangible and intangible barriers for global trade

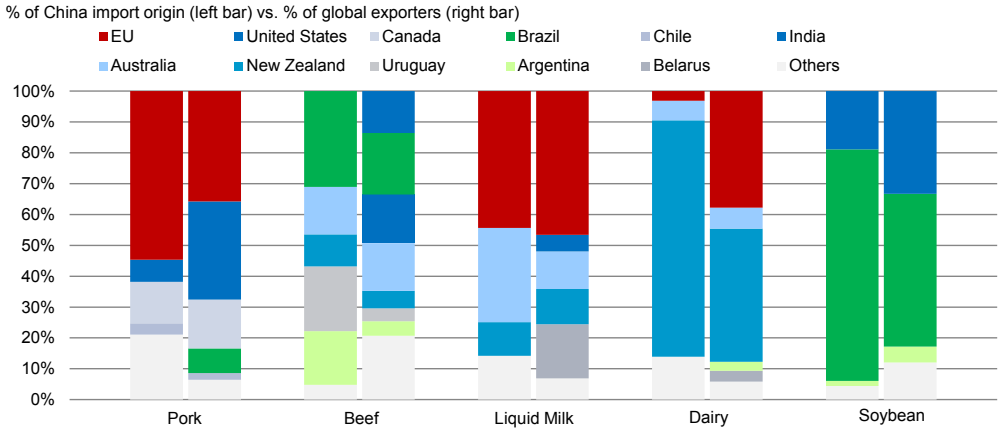
Given the unique nature of agriculture commodities, there are tangible and intangible barriers for global trade, including food safety (disease control), political considerations (tariffs), and logistics, especially given the perishable nature of the products. Nevertheless, trade and new parity prices would still mostly find their way to bring supply to meet demand, in our view. We estimate China's production cost for major crops to be nearly twice as high as peers, mostly due to the higher land and labor costs that have emerged in the past years as a result of urbanization, which suggests imports are mostly competitive on a CIF basis and thus part of the relevant food supply. Based on higher import tariffs imposed in recent months, we estimate the imported CIF price remains attractive for soybeans, corn, and beef from South America, and pork from the EU. US imports of beef are on par with Chinese domestic prices, yet corn, soybean, and pork prices are higher versus domestic pricing at present. The intangible cost of trade may also be reflected in the weight of imports in total versus overall global trade market - for example, China imports un-proportionally higher agriculture products EU on pork, Brazil on beef and soybean, and Australia and New Zealand on milk and dairy.

Exhibit 97: Major producers, exporters of key agriculture commodities, and current tariff to China
7-42% of the agriculture supply is traded globally today, and the trade volume could grow by 12-51% due to increase imports from China in the coming years

		Corn	Soybean	Pork	Beef	Chicken	Raw milk Equiv.
Global market-2018	**mn t**	**1100**	**367**	**113**	**63**	**96**	**606**
Top five producers							
United States	mn t	366	125	12	12	19	99
China	mn t	257	16	54	7	12	31
Brazil	mn t	95	121	4	10	14	
European Union	mn t	61		24	8	12	159
Argentina	mn t	46	56				
India	mn t		11		4	5	167
Russia	mn t			3			31
Global trade-2018	**mn t**	**167**	**155**	**9**	**11**	**11**	**45**
as % of production	**%**	**15%**	**42%**	**8%**	**17%**	**12%**	**7%**
Top five exporters							
United States	mn t	62.2	51.7	2.7	1.4	3.2	3.7
Argentina	mn t	29.0	8.0				
Brazil	mn t	29.0	77.0	0.7	2.1	3.7	
European Union	mn t			3.1		1.4	18.2
New Zealand	mn t				0.6		14.0
Australia	mn t				1.6		3.6
Ukraine	mn t	28.5					
Russia	mn t	3.0					
Paraguay	mn t		5.9				
Canada	mn t		5.5	1.4			
Chile	mn t			0.2			
India	mn t				1.7		
Thailand	mn t					0.9	
China	mn t					0.5	
Belarus	mn t						3.3
Tariff imports to China							
United States	%	26%	28%	62%	37%	30-40%	40%
Argentina	%	1%	3%	12%	12%	6-12%	15%
Brazil	%	1%	3%	12%	12%	6-12%	15%
European Union	%	1%	3%	12%	12%	6-12%	15%
New Zealand	%	NA	NA	0%	0%	0%	0%
Australia	%	NA	NA	2.4%-4%	7.2%	2-4%	9%
Chgs (2018E-LT)							
CN import demand	mnt	45.9	33.9	1.8	5.3	1.4	15.2
Global trade mkt	%	27%	22%	21%	51%	12%	34%
CN import-grain eqv	mnt	62.5	49.2	n/a	n/a	n/a	n/a
Global trade mkt	%	37%	32%	n/a	n/a	n/a	n/a
Global mkt	%	6%	13%	n/a	n/a	n/a	n/a
Ex-CN supplies 2030	mnt	41.2	19.9	n/a	n/a	n/a	n/a
Global mkt		4%	5%	n/a	n/a	n/a	n/a
Ex-CN supplies 2050	mnt	71.1	49.8	n/a	n/a	n/a	n/a
Global mkt		6%	14%	n/a	n/a	n/a	n/a

Source: USDA, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 98: Comparison of market shares in China import versus global trade (2018A)
China imports un-proportionally higher agriculture products EU on pork, Brazil on beef and soybean, and Australia and New Zealand on milk and dairy



Source: General Administration of Customs, China Dairy Association, USDA, Goldman Sachs Global Investment Research

We expect the ex-China supply to come from marginal increase from the US, Australia and New Zealand, with the major supply growth driven by Brazil/South America, however likely at the expense of amazon conversion

Potential new global supplies

We expect the ex-China supply to come from: 1) marginal increase of grain-equivalent exports from the US by 5.6mnt in corn and 4.0mnt in soybeans from 2018-2030, through continued yield improvement; and 2) marginal increase in grain-equivalent exports from Australia and New Zealand of 6.4mnt in corn and 2.7mnt in soybeans, in the form of beef and milk. 3) The major supply growth would depend on Brazil/South America, with the potential to increase grain-equivalent export of corn and soybeans by 29 and 13mnt, respectively, in the same period, through both yield improvements in corn and land addition (based on FAO projected growth).

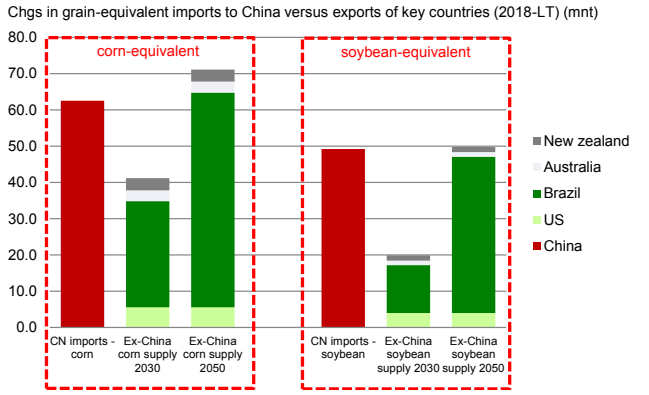
US - Our estimates for soybeans, corn, beef, and chicken are based on USDA long term projections. According to the USDA, US soybean/corn exports can increase by 3.4/7.9mnt from 2018 to 2029. Including animal proteins measured in grain-equivalent exports of soybeans and corn, we estimate that the grain-equivalent export of soybean and corn from the US may increase by 4.0 and 5.6mnt from 2018 to 2030.

Brazil - According to the USDA, Brazil has been rapidly adding cropland in the past decade. Soybean production in Brazil has increased at a 7.6% CAGR in 2009-2018, in which land area expansion contributed 5.6%. Corn planted acreage also increased at 2.2% CAGR in the same period, with yield improving at a 4.1% CAGR. While corn yields in Brazil may still have room for improvement (5,400kg/ha vs. US at 11,000 kg/ha), soybean yields in Brazil may have plateaued at a level close to the US (c. 3,300 kg/ha), suggesting future production increases would need to rely more on area expansion. According to FAO estimates, Latin America has already converted 60mn hectares of land from forests, or 17% of the Amazon over the past 30 years, as of 2005. FAO forecasts in its base case that the continent could add 49mn hectares of arable land from 2005-2050, implying a 1.0% CAGR in land expansions. This would imply further conversion of Amazon forest, reaching potentially 31% of the Amazon by 2050 or earlier, by our estimates (assuming all new land conversion comes from the Amazon region).

ANZ - Australia and New Zealand are major exporters of beef and dairy, and we expect future growth would mainly come from dairy in New Zealand. Per estimates from our Australia team, Australia/New Zealand could increase exports of beef by 0.5mnt from 2018-2030, and dairy (in raw milk equivalent) by 11.4mnt. Converted into grain-equivalent exports, Australia/New Zealand could increase grain-equivalent exports of corn and soybeans by 6.4mnt and 2.7mnt.

Exhibit 99: The import requirement of grain-equivalent crops demand from China, versus major global supply additions in the coming years

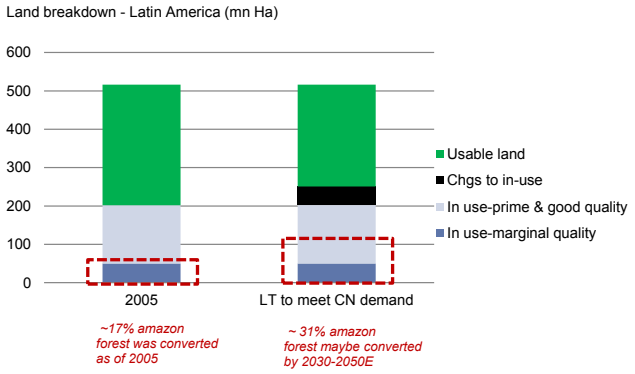
Depending on the pace of Chinese food demand upgrade, deficit in meeting Chinese demand is likely to persist until 2050, based on land expansion projects by FAO



Source: Goldman Sachs Global Investment Research

Exhibit 100: Arable land breakdown - LT versus current

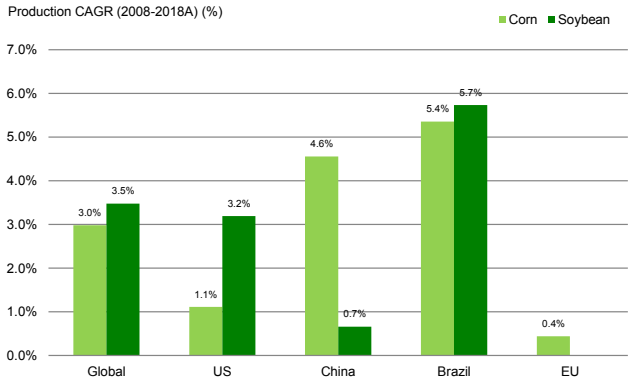
Based on FAO's projection of LAM land additions, we may see nearly 1/3 of the Amazon forecast converted some times between 2030-2050, to meet China's import requirements



Source: FAO, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Exhibit 101: Production growth of corn and soybean - global and major producing countries

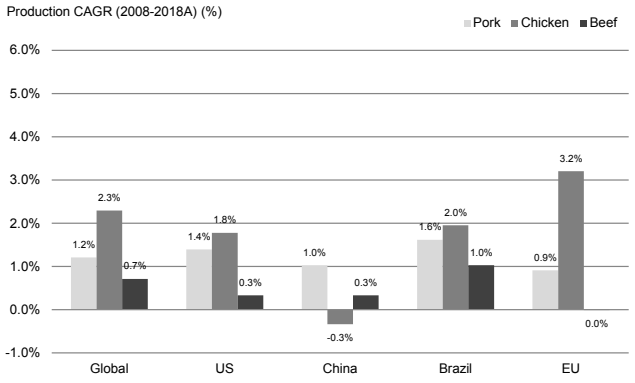
In 2008-2018, global output grew at 3.0% CAGR for corn and 3.5% CAGR for soybean



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 102: Production growth of animal protein- global and major producing countries

In 2008-2018, global animal protein production grew at 1.2% CAGR for pork, 2.3% in chicken, and 0.7% in beef



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Cost comparison: Higher labor and land costs reduce China's advantages

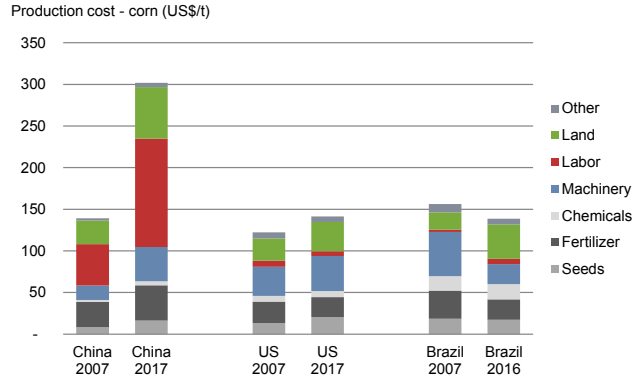
China has moved to nearly twice the production costs compared with peers from par, over the course of past decade, due to aggressive inflation in labor and land

Among the major agriculture producing countries including China, the US, Brazil, and Argentina, China has moved to high production costs compared with peers, versus on-par a decade ago. Specifically, we estimate the unit cost of producing each ton of corn in China is now 115% higher than the US/Brazil, 100-107% higher for each ton of soybeans, and 70% higher for hogs, based on data from the NDRC and the USDA. The change has been mostly due to higher labor and land costs that have emerged in the past 10 years as the result of urbanization.

Unit production costs for corn in China in 2007 were below US$150/t, similar to the US and Brazil. A decade later, costs in China have more than doubled to US$303/t today (2017A), now standing more than two times higher than the US and Brazil (US$140/t). The implied cost inflation was over 8% CAGR each year in China, mostly driven by higher unit labor costs that have nearly tripled over the period and land costs that more than doubled. In fact, land cost per ton of corn produced has more than doubled to US$62 per ton, versus the US at US$35/t. The cost of production for soybeans also suggests a similar trend, with China standing at US$707/t in 2017, versus US$342/t in the US and US$262/t in Brazil, much of the cost gap that has emerged in the past decades has been due to land and labor cost inflation. In the hog industry, where feed and feeder pigs account for 85% of total costs, higher corn and soybean costs put China at natural disadvantage. The total unit cost for hog production in China is also twice as high as unit costs in the US or Europe.

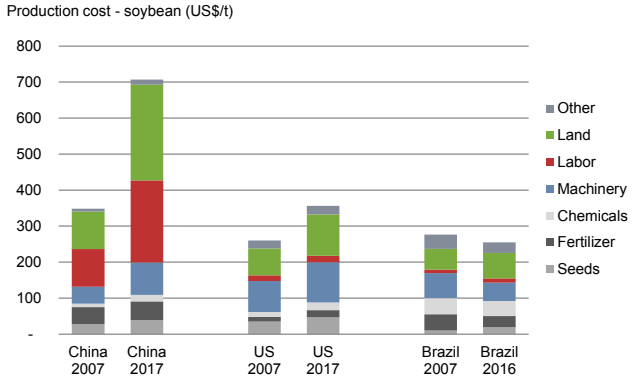
In the coming years, we expect cost inflation related to land and labor to decelerate, yet rising demand should lead to higher costs for feed in the long run, driving up animal protein production costs in China. In addition, we estimate likely higher environmental costs for the Chinese hog industry in the coming years, as the industry will be required to enhance the proper treatment of waste water. Untreated waste water pollutant content can be as high as 5,000-10,000mg/L in COD by our estimates. We estimate treatment charges could translate to Rmb0.3-0.5 per kg of pork assuming benchmark waste water treatment capex and treatment costs for waste water of similar pollutant concentration.

Exhibit 103: Production cost of corn - China versus peers
Cost of corn production is at nearly twice as much as US and Brazil, due to aggressive cost inflation in labor and land



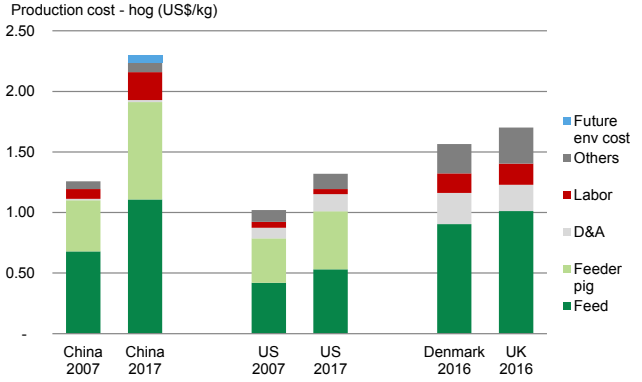
Source: NDRC, USDA, CONAB, Data compiled by Goldman Sachs Global Investment Research

Exhibit 104: Production cost of soybean - China versus peers
Cost of soybean production is at nearly twice as much as US and Brazil, due to aggressive cost inflation in labor and land



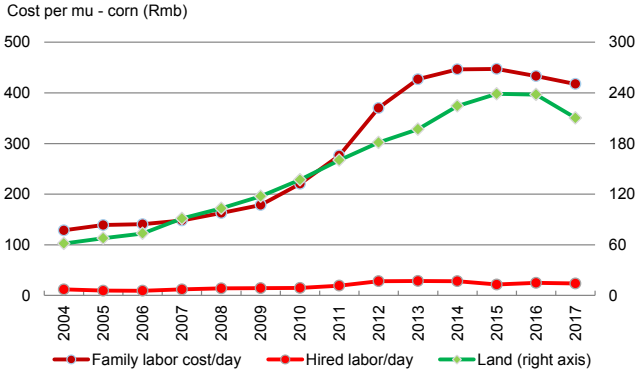
Source: NDRC, USDA, CONAB, Data compiled by Goldman Sachs Global Investment Research

Exhibit 105: Production cost of hog- China versus peers
Higher feed costs put China at disadvantage versus peers



Source: NDRC, USDA, AHDB, Data compiled by Goldman Sachs Global Investment Research

Exhibit 106: Cost inflation in labor and land - corn, China
Unit labor wages in farming went up nearly 4x in the past decades, similar trend in land costs



Source: NDRC

Global trade: Trade will find its way

There are tangible and intangible barriers for global trade, including food safety (disease control), political considerations (tariffs), and logistics

Given the unique nature of agriculture commodities, there are tangible and intangible barriers for global trade, including food safety (disease control), political considerations (tariffs), and logistics, especially given the perishable nature of the products. For example, regulatory differences in the use of Ractopamine for disease control in pork and beef have resulted in disproportional pork and beef imports into China's . The Free Trade Agreements (FTAs) China entered with Australia and New Zealand in 2008 and 2015 have led to higher dairy imports and higher tariffs on soybeans have led to a 50% reduction in US soybean imports into China in 2018. The most recently imposed higher tariffs have reset the parity price of US imports to China versus peers.

Nevertheless, trade and new parity prices will likely still find their way to bring supply to meet demand, in our view. For example, in 4M19, pork imports into China have increased by 8% yoy, or 37kt, according to NBS data. Imports into China increased from Canada (up 17kt or 31% yoy) and Spain (up 15kt or 17% yoy), whereas imports from the US declined (down 22%). Over the same period, pork has also gone from the US to Canada — Canada has turned from a 26kt net importer of pork from the US in 4M18 to a net exporter of 1kt to the US, based on data from the USDA. As Brazilian soybeans remain more competitive as imports to China versus the US, prices has been moving up and the CIF gaps between US and Brazilian soybeans in China are narrowing. At present, our imported CIF price estimates remain attractive for soybeans, corn, and, beef from South America. Import prices for US beef are on par with Chinese domestic prices, yet import prices for corn, soybeans, and pork prices are higher versus domestic pricing at present.

Infrastructure requirement for global trade

Our discussion with an international agriculture trader suggests the most difficult barriers for the soft commodity trade, especially in animal proteins, are government-level agreements on quarantine standards. For example, to reopen beef imports from the US in 2017, the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and the USDA went through negotiations and published an agreement on inspection and quarantine requirements. The second step was to register qualified US exporting companies with the Certification and Accreditation Administration (CNCA). Beef could only be imported into China from companies on the registered list. Each batch of beef exported to China must have attached certificates from the USDA proving it meets the inspection and quarantine standards of the Chinese government. Nevertheless, most of the infrastructure for both regulatory and logistics are already in place for large agriculture suppliers and importers, according to traders. What is and will drive the trade going forward would be the economics, determined by production cost, transportation, and tariffs.

Import tariffs sets new parities

At present, for most countries, China imposes import tariffs of 1% for corn, 3% for soybeans, 12% for beef and pork, 6-12% for chicken, and 15% for milk. In the course of increased trade tensions between China and the US, import tariffs have increased to

26% for corn, 28% for soybeans, 62% for pork, 37% for beef, 30-40% for chicken, and 40% for milk, since July 2018.

Specifically, from March 2018, the US imposed tariffs on imported goods from China. In response, China also imposed a series of tariffs on imported goods from the US, among which agriculture products are a key category. On April 1, 2018, China imposed a 15-25% tariff on $30bn worth of imported goods from the US, mainly pork and fruit. On June 16, 2018, China proposed a 25% tariff on $50bn worth of imported goods from the US. More agriculture products are on the list, effective from July 6, including soybeans and corn, pork and fruit (again), beef, chicken, and aquatic products, etc.

These additional tariffs have a material impact on the profitability of agriculture imports, and reset parity prices. However, it is worth noticing that importers are forward-looking, as it generally takes 2.5 to three months from signing a contract, transportation, inspection, and storage to getting the cargo.

- Soybeans - With a 28% tariff, soybeans imported from the US become less competitive compared with soybeans imported from South America. We estimate the average CIF price of US imported soybeans to be Rmb3,700/t in 1H19, versus Brazil imports at Rmb3,388/t, and imported soybean prices at Chinese ports of Rmb3,200/t. With a 25% additional tariff on US soybeans from July 2018, China has significantly reduced soybean imports from the US. The import seasons for US soybeans is 1Q/4Q, but 4Q18/1Q19 soybean imports from the US declined 99%/79% yoy. With China import demand absent, US soybean inventory would likely rise to 27mnt as of Sept. 2019, vs. 12mnt as of Sept 2018, according to the latest USDA forecast. In the same period, soybean imports from Brazil/Argentina increased 60%/90% yoy. USDA projected this would contribute to Brazil's soybean inventory declining from 33mnt as of Sept. 2018 to 26mnt as of Sept. 2019. Despite the uncertainty around US-China trade tensions, we have not observed a material increase in planted soybean acreage in Brazil or Argentina. Other countries like Russia are starting to increase soybean exports to China but volumes are limited (0.8mnt in 2018). If the import gate from US remains shut, more demand would need to be filled by South America.
- Pork - The 62% tariff on pork also makes imports from the US unattractive versus domestic prices at present — we estimate the CIF price from US imported pork currently stands at Rmb25-26/kg, including an FOB price of US$2.0/kg as of June 2019, US$40/t US inland transport cost, US$100/t in freight cost, Rmb855/t in 62% import tariff, and 10% VAT. At present, the CIF price is less attractive versus China domestic ex-factory price of Rmb20/kg (VAT included). In comparison, pork imported from the EU (use France as an example) would have a landed cost of Rmb16/kg, with estimates of similar transportation costs and VAT as the US, but 12% tariff.
- Beef — 37% tariff on US imported beef also makes it less attractive vs. domestic price. Using the same transportation cost assumption as pork, we estimate that the CIF price of US imported beef would be Rmb52.5/kg, compared with Rmb53/kg of domestic wholesale price. The CIF price of Brazil imported beef, on the other hand, would only be Rmb27.6/kg, with 12% tariff and other assumptions the same.

Exhibit 107: Sample calculation for CIF-China parity price for US imported pork

CIF-China parity price calculation for US imported frozen pork

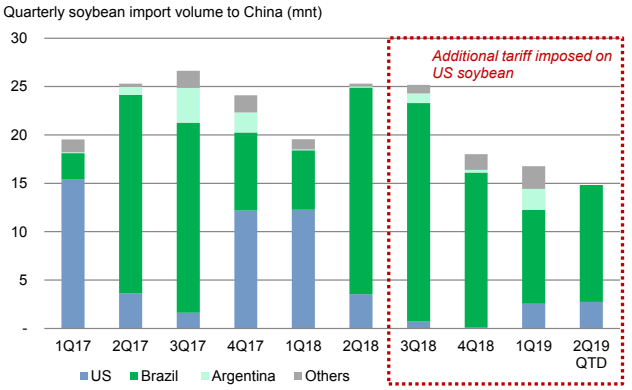
	Unit	Price
US pork cutout price	US$/kg	1.79
Inland transport in US	US$/kg	0.04
Freight - from US to China	US$/kg	0.10
CNF-China price	US$/kg	1.93
	Rmb/kg	13.07
Import tariff @ 62%	Rmb/kg	8.11
VAT @ 10%	Rmb/kg	2.12
Logistic and storage	Rmb/kg	0.35
CIF-China price	Rmb/kg	23.65

US pork cutout price as of avg Jun-19

Source: Goldman Sachs Global Investment Research, General Administration of Customs

Exhibit 108: Quarterly soybean import volume to China

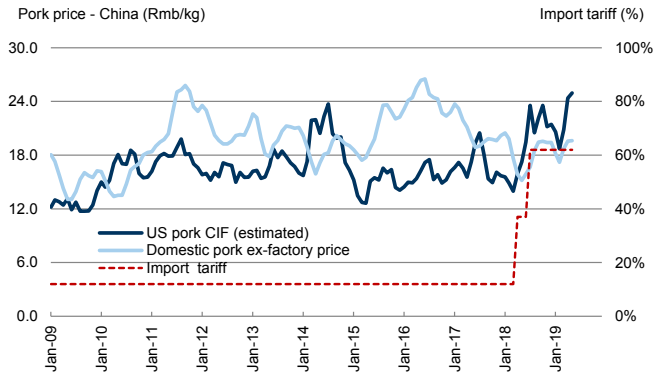
Lower market shares of US soybean into China



Source: General Ministry of Customs, Data compiled by Goldman Sachs Global Investment Research

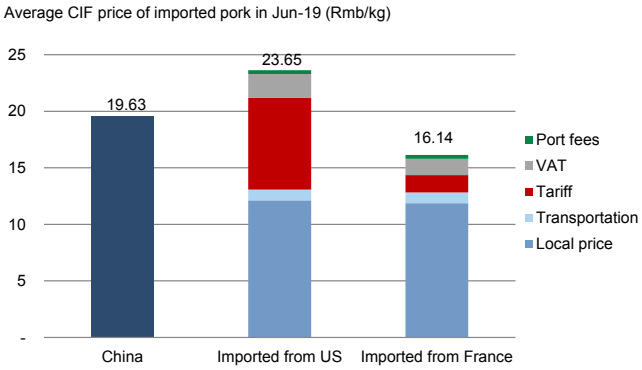
Exhibit 109: Pork prices - US imports (estimated) versus China

US pork CIF price increased in Apr & Jul 2018 with additional tariff



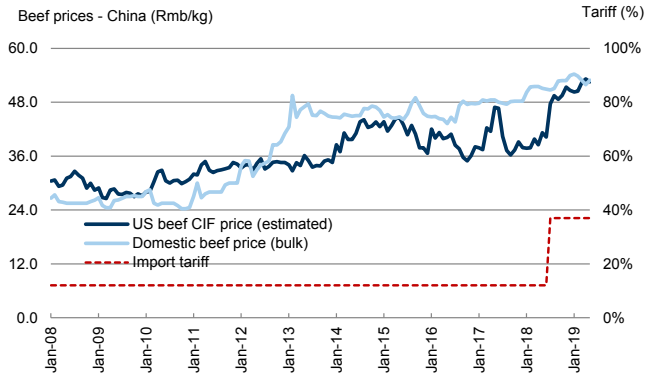
Source: Bloomberg, Ministry of Commerce, Data compiled by Goldman Sachs Global Investment Research

Exhibit 110: CIF price estimate breakdown for US and EU imported pork



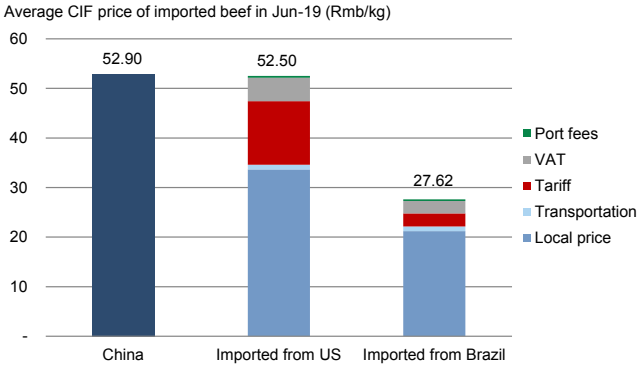
Source: Bloomberg, Ministry of Agriculture, Goldman Sachs Global Investment Research

Exhibit 111: Beef prices - US imports parity (estimated) versus China



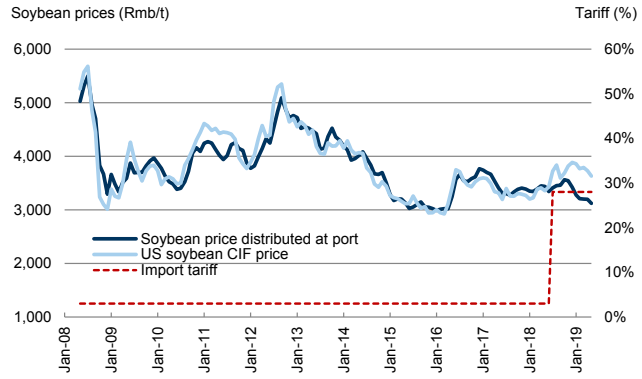
Source: Bloomberg, Ministry of Agriculture, Goldman Sachs Global Investment Research

Exhibit 112: CIF price estimate breakdown for US and Brazil imported beef



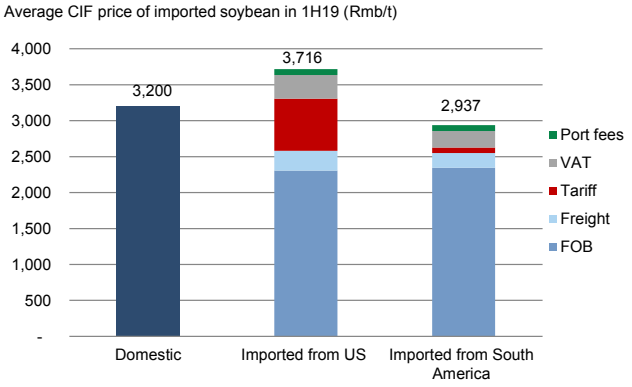
Source: Bloomberg, Ministry of Agriculture, Goldman Sachs Global Investment Research

Exhibit 113: Soybean - US imports (estimated) versus China



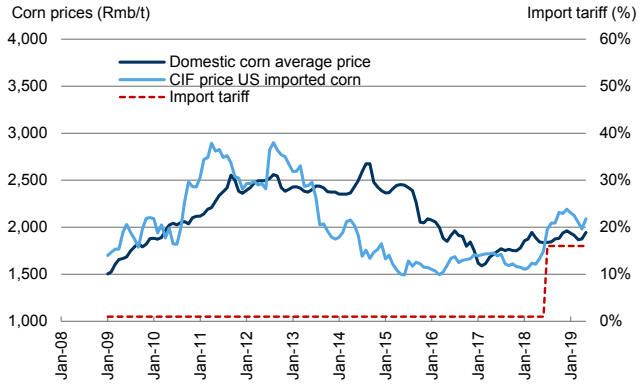
Source: CNGOIC, Wind, Data compiled by Goldman Sachs Global Investment Research

Exhibit 114: CIF price estimate breakdown for US and South America imported soybean



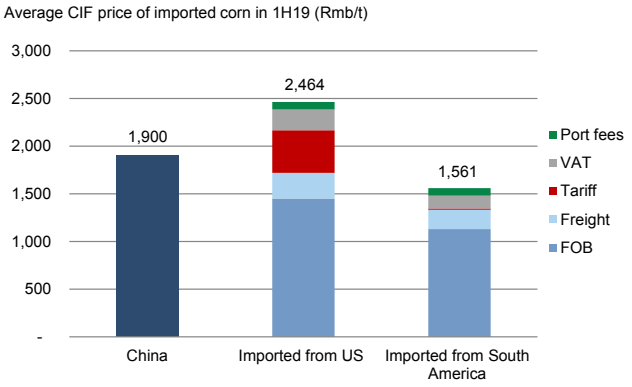
Source: Bloomberg, CNGOIC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 115: Corn - US imports (estimated) versus China



Source: Wind, Data compiled by Goldman Sachs Global Investment Research

Exhibit 116: CIF price estimate breakdown for US and South America imported corn



Source: Wind, Data compiled by Goldman Sachs Global Investment Research

Comparing the global trade market shares of major suppliers, we note imports into China can be disproportional, reflecting visible or intangible trade barriers.

- In 2018, China imported a higher portion of pork from the EU, but lower from the US and Brazil
- China imports a higher portion of beef from South America than its share in global exports
- China sources a high portion of milk powder from New Zealand
- China imports a higher portion of liquid milk from Australia
- China imported a lower portion of soybeans in 2018 due to trade tensions

Pork and beef imports to China: Ractopamine and disease control

In global pork trade market, China imports a higher portion from the EU while a lower portion from the US and Brazil, versus their respective market shares. Part of the reason is the ban on Ractopamine residue in China imposed on US and Brazil produced pork, while the US and Brazil allow the use of the additives in

pork production, and the EU bans the use of Ractopamine.

Ractopamine is a feed additive which improves feed efficiency and promotes leanness in animal meat. According to Apple et al. 2007, the use of Ractopamine in finishing swine yields about 3kg of additional lean pork and improves feed efficiency by 10%. However, there have been unresolved disputes regarding the potential risk to human health of Ractopamine residue in animal meat. The 2009 European Food Safety Authority's opinion concluded that there has been insufficient evidence to derive a maximum residue amount that is safe for human consumption. Thus the attitude toward Ractopamine use and imports is divided among major agriculture countries. Globally about 160 countries ban the use of Ractopamine, while the use of such additives is allowed in certain countries like the US/Mexico/Brazil/Japan, subject to different dosages and maximum residue limits. Canada started to remove Ractopamine from 2013, in order to satisfy the requirements of China's large pork market. According to China Daily, Canada's hog farmers have almost completely removed Ractopamine as of 2017. The US is also promoting Ractopamine-free meat. Leading pork producers like Smithfield have 100% Racto-free plants. But, generally, the country is less willing to completely reduce the additive. According to Reuters, only about 50% of US pork is Racto-free.

Exhibit 117: Major countries' policies regarding ractopamine

Country/regions	Policies regarding ractopamine
China/EU/Russia	Bans the use of ractopamine in meat production and imports of meat with any ractopamine residue
US	Ractopamine is allowed to be used at a feed concentration of 5–10 mg/kg feed for finishing pigs and 10-30mg for finishing cattle. The maximum residue limit for ractopamine for meat in the USA is 30/50/100 parts per billion (ppb) for cattle/swine/turkey
Canada	Allowed in swine (starting at 70 kg of body weight), cattle (greater than 400 kg body weight), and turkey (last 7 to 14 days prior to slaughter) production
Brazil	The use of ractopamine is allowed in pork production. Its use in cattle was suspended in 2012 though residues was still reported to be found in beef shipped to Russia.

Source: USDA, FDA

Exhibit 118: Major restricted import origins due to animal disease

Country of origin	Related disease	Restricted product
India	FMD	Artiodactyla animals (cattle, swine) and products
	Avian Flu	Poultry and products
Japan	Mad cow disease	Cattle and products*
	FMD	Artiodactyla animals and products
	Avian Flu	Poultry and products
Spain/France/ UK/Germany	Mad cow disease	Cattle and products*
	Avian Flu	Poultry and products
Russia	FMD	Artiodactyla animals and products
	ASF	Swine and products
	Avian Flu	Poultry and products
US/Canada	Mad cow disease	Cattle and products*
	Avian Flu	Poultry and products*
Brazil	Mad cow disease	Cattle and products*
	FMD	Artiodactyla animals and products

* subjects to corresponding policy updates

Source: General Administration of Customs

Regarding beef imports, South America and Australia/New Zealand account for 90%+ of China's beef imports, while imports from the US and India were lower than their portion of global export. Apart from the Ractopamine issue with US beef, disease is the major concern driving Chinese government beef import restrictions. China first imposed a beef embargo in 2001 in response to mad cow disease in Europe. Following an outbreak of mad cow disease in the U.S., China banned US beef imports completely in January 2004. The ban on US beef had been in place for 13 years until it was lifted in 2017. Bone-in and boneless beef under 30 months were allowed to be exported to China subject to conditions: (1) Ractopamine and other Chinese government restricted additives should not be detected; (2) beef should be able to be traced to the cattle's birth farm; (3) quality inspection and quarantine standards, including no mad cow and other animal disease symptoms in the slaughtered cattle. According to our US agribusiness analyst, these requirements actually exclude 90% of US beef production from being exported to China. China also prohibits cattle and related product imports from India due to epidemics of FMD (Foot and Mouth Disease). Other countries are on the General Administration of Customs' restricted list of protein imports, though beef imports from the US and EU have been gradually reopened since 2017.

Global supply response - US and Brazil

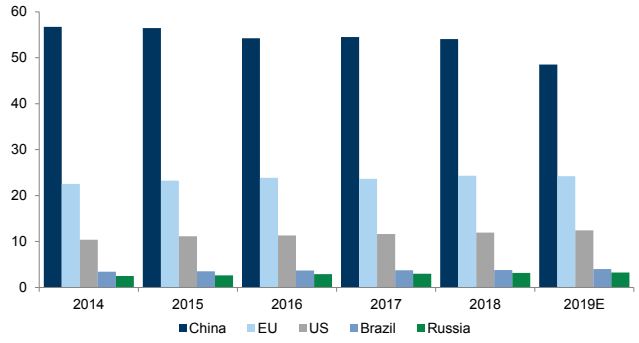
This section is contributed by Adam Samuelson, GS US agri-business analyst

With a 20% or more reduction in Chinese pork production due to African Swine Fever, global protein markets will face a supply deficit of 5% or more. China being both the largest producer and consumer of pork will need to import additional protein, not just pork, to be able to fill this demand gap.

Pork

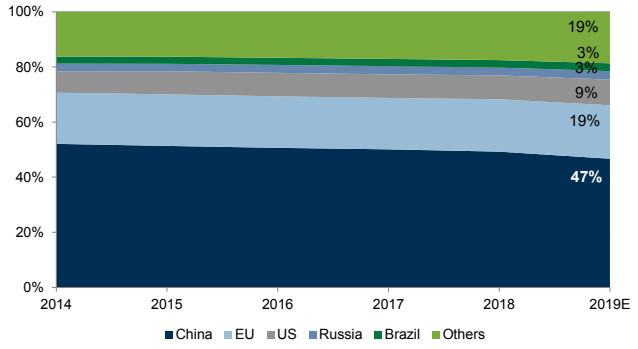
We expect higher exports to China in 2019 driven by its top suppliers EU (63% market share of China imports in 2018), Canada (14% market share), Brazil (13% market share), and the US (7% market share) playing definitive roles. Despite China imposing a hefty 62% retaliatory tariff on US pork imports since last year, we see opportunity for the US to play a significant role in supplying additional pork to China based on recent export sales. Outside of exporting to China, we expect the United States to be able to export to other pork-exporting to backfill trade into China.

Exhibit 119: China remains the largest producer of pork following the ASF outbreak
Select countries pork production (mmt)



Source: USDA

Exhibit 120: China is also the largest consumer of pork by a large margin
Global share of pork consumption

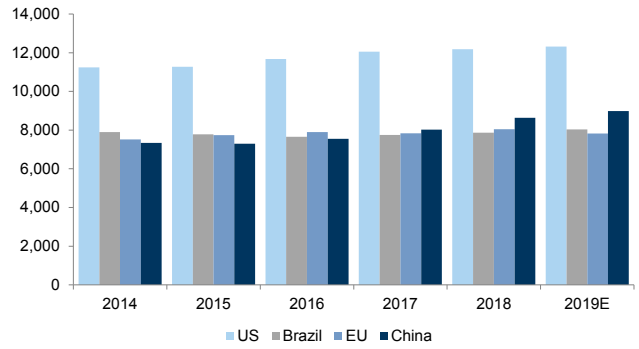


Source: USDA

Beef

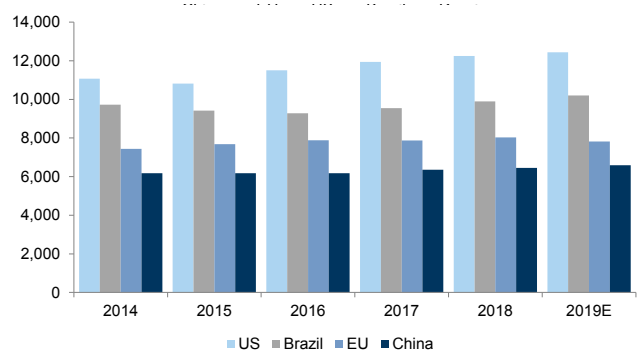
Due to self-imposed standards on the tractability of beef, China's imports of US beef is limited, with mainland China making up less than one percent of total US beef exports, and Hong Kong and Taiwan representing 8.7% and 5.9% of US exports , respectively. Because of this there is a greater opportunity for Brazil, the world's largest exporter of beef to grow exports. The USDA expects a 6.1% Y/Y increase in exports in 2019 vs +3.1% for the US and +2.7% globally.

Exhibit 121: China is expected to consume 4.0% more beef in 2019 vs world growth of +0.8%
Select countries beef consumption (kmt)



Source: USDA

Exhibit 122: Brazil and the United States are expected to grow Beef production 3.0%, and 1.5% Y/Y, respectively vs world beef production growth of 0.6%.
Select countries beef production (kmt)



Source: USDA

Crops

The USDA is estimating a 95% increase in annual soybeans exported to China from the US in the 2019/20 marketing year. Total harvested area has been stable, only growing 0.2% Y/Y on average. Production in the US has increased an average of 1.4%Y/Y almost entirely due to yield improvements over time. Area harvested, grew at 3.6% CAGR for soybean (5.0%) and corn (1.7%) in the past, has been the primary source of production growth (5.2% on average, with 5.8% on soybean and 4.5% on corn) for Brazil.

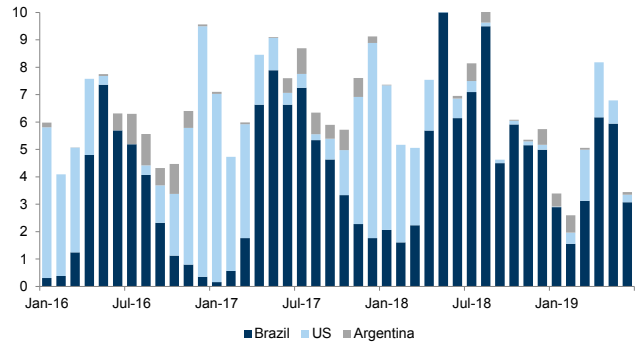
Exhibit 123: The USDA is estimating a 95% increase in annual soybeans exported to China from the US in the 2019/20 marketing year
Soybean export matrix

	Soybean trade	Destination			
	('18/'19 est., kt)	China	EU	RoW	Total
Source	US	10,500	7,988	29,390	47,878
	Brazil	65,305	3,617	9,966	78,888
	Argentina	7,003	50	899	7,952

	Soybean trade	Destination			
	('19/'20 est., kt)	China	EU	RoW	Total
Source	US	20,500	6,400	30,253	57,153
	Brazil	59,250	5,400	10,464	75,114
	Argentina	6,109	75	792	6,976

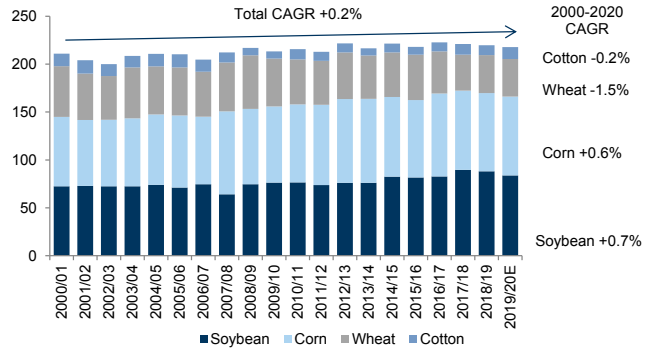
Source: Informa

Exhibit 124: Due to trade tariffs imposed on US soybeans, Brazil has gained share in Chinese imports
China soybean imports by country (mmt)



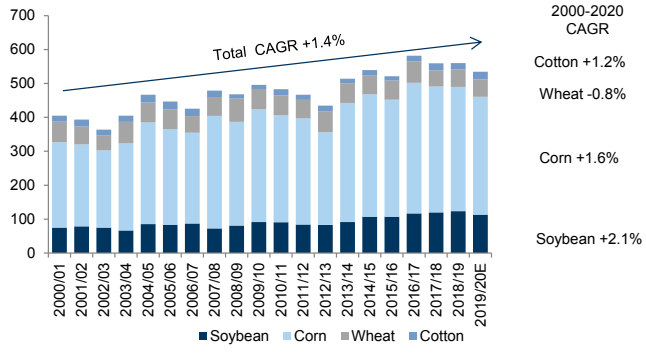
Source: Refinitiv

Exhibit 125: Total harvested area has been stable, only growing 0.2% Y/Y on average
Harvested acres (mn) for major US crops



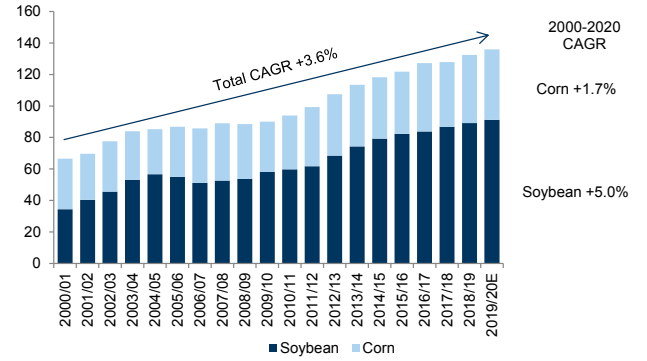
Source: USDA

Exhibit 126: Production in the US has increased an average of 1.4%Y/Y almost entirely due to yield improvements over time
Production (in mmt) for major US crops



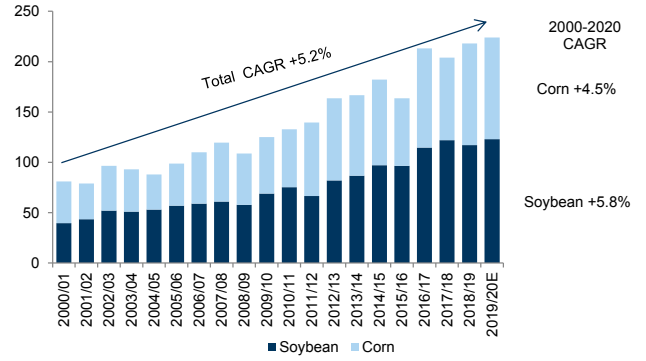
Source: USDA

Exhibit 127: Area harvested has been the primary source of production growth for Brazil
Area harvested (mn acres) for major Brazil crops



Source: USDA

Exhibit 128: Brazil has seen average production increases of 5.2% Y/Y since 2000
Production (in mmt) for major Brazil crops



Source: USDA

Global supply response - Australia and New Zealand

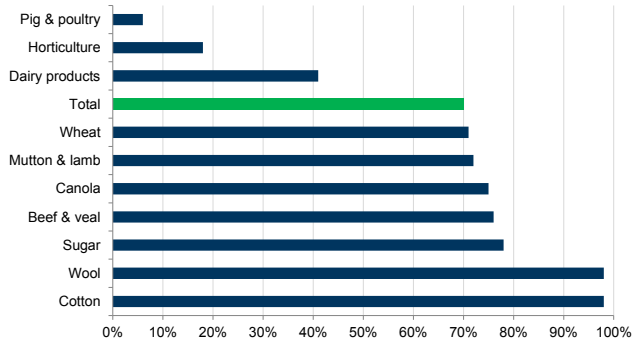
This section is contributed by Michael Peet, GS Australia analyst

Australia and New Zealand are major agriculture export regions, with a significant portion of exports to China and Asia, given the geographical proximity.

In Australia, the agriculture industry is worth A$60bn and comprises 3% of Australian GDP (2017/18). The value of Australian agriculture exports in 2017/18 was A$49bn, with 70% of production exported. Key export markets include China (A$11.9bn), Japan (A$5.1bn) and the US (A$3.9bn). By value, the largest export commodity is beef and veal with exports expected to total A$8.4bn in 2018/19E.

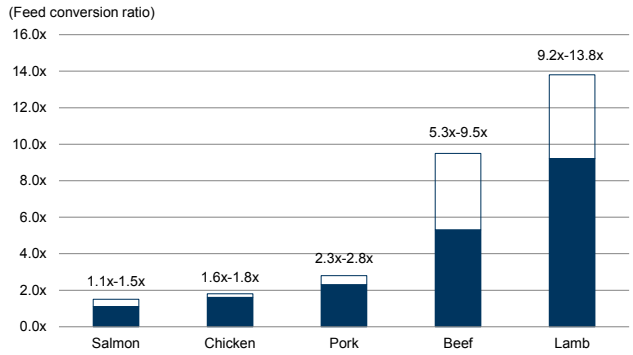
In New Zealand, primary industry export revenue is expected to increase to NZ$45.3bn (+7% YoY), accounting for 11% of GDP and 15% of employment. The largest contributor to this is the dairy industry, with export revenue forecast to be NZ$17.7bn in 2019, followed by meat and wool (NZ$10.2bn). As with Australia, the largest export market for New Zealand is China, accounting for 30% of New Zealand exports, or NZ$13.6bn. Other major export markets include Australia (NZ$4.6bn), the US (NZ$4.1bn) and the EU-ex UK (NZ$3.3bn).

Exhibit 129: On average, 70% of Australia's agriculture production is exported



Source: ABARES

Exhibit 130: Feed conversion ratio by protein



Source: Goldman Sachs Global Investment Research

Output varies considerably with weather conditions and can be volatile year-on-year. The Australian agriculture industry is currently under mounting pressure as a result of ongoing drought conditions in the Eastern states, placing upward pressure on irrigation water and feed costs. As a result of declining profitability at the farm level, many farmers are cutting back production or exiting the market altogether. At the national level, the volume of farm production is estimated to have declined by 6% for 2018/19.

Despite short-term declines, the Australian agricultural industry is resilient and familiar with climate variations. ABARES expects the volume of farm production to increase by 1.5% per year through 2023/24E, to A$65bn. Of the major animal protein sources, poultry and salmon are comparatively more efficient to produce, with a lower feed-cost ratio versus red meats. To compare, 1kg of poultry consumes 2kg of grain and 3,000 litres of water over 35 days, whereas 1kg of beef takes 365 days to produce and consumes 4kg of grain and 16,000 litres of water.

Dairy

Australia

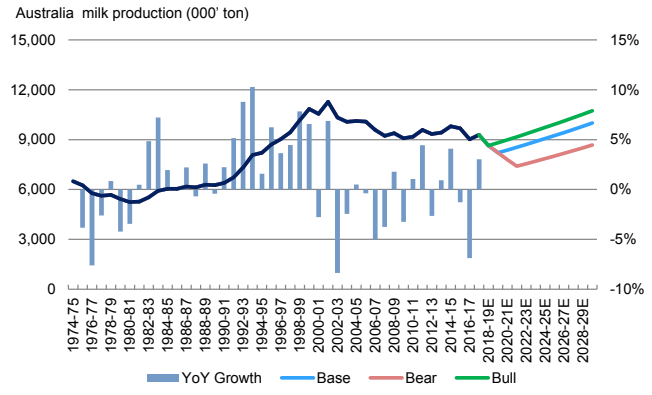
The current dairy market conditions are challenging, with national milk production down 7% YTD, as a result of farmers exiting the market due to ongoing drought. Despite weather conditions generating cyclicality in YoY production volumes, the overall milk pool has remained constant, with 0% CAGR observed in volumes over the 20 years to 2017/18. Our forecast assumes production declines in the short term as the market recovers from current drought conditions. However, considering volume growth through the cycle, we take the 5 year CAGR from 2009/10 to 2014/15 (2%) as our long term volume growth assumption. Our bull and bear cases consider variations in the drought recovery period.

As a mature dairy market, consumption of drinking milk per capita in Australia has been modestly declining (-1% CAGR 2013/14 - 2017/18). We forecast declines in per capita consumption to continue as per this trend. Combined with population growth forecasts, we expect milk for consumption to only modestly increase. On our forecasts, we expect growth in overall milk supply to outpace this increase, resulting in higher dairy available for export.

New Zealand

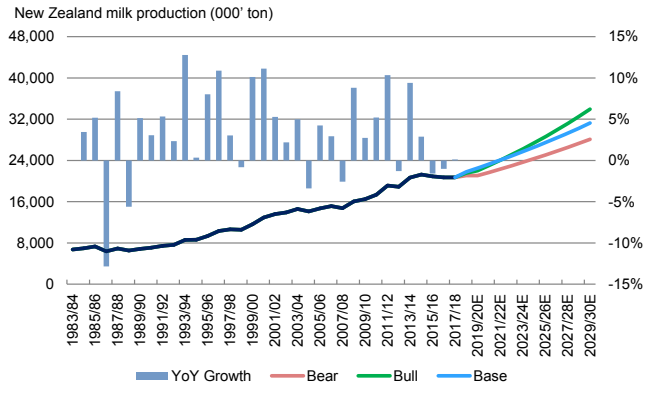
The largest agricultural output in New Zealand is dairy, with 3% of global milk supply produced in New Zealand. New Zealand is the largest exporter of dairy globally, despite being only the 7th largest producer. Dairy farm productivity has increased at 1.9% CAGR over the past ten years, and our base case forecasts assume the increase in milk solids production per cow continues at the same rate. In line with recent trends, we assume the number of herds remains constant, however we assume herd size increases by 1.4% per annum, in line with the five-year CAGR. Our bear case assumption is for milk productivity to slow to 1.5%. Our bull case assumes productivity picks up to 2.3%, and herd size increases at 2%.

Exhibit 131: Australia milk production and forecast
Our base case assumes production growth returns to trend as the drought breaks



Source: ABARES, Goldman Sachs Global Investment Research

Exhibit 132: New Zealand milk production and forecast
Our base case assumes milk processed increases to 31mnt by FY30E



Source: ABARES, Goldman Sachs Global Investment Research

Beef and other red-meat protein sources

The Australian beef industry is highly dependent on seasonal conditions, because of Australia's pasture-based grazing system. As a result of current drought conditions, there has been a halt in herd rebuilding. However, indicators suggest this will resume, with restocking purchases of breeding stock at above average levels in the second half of CY18, in preparation for an improvement in seasonal conditions. However, we highlight that if there is another season of adverse conditions, we expect herds to contract and slaughter rates to remain high.

Depending on pasture growth, ABARES forecasts that a run of good growing seasons could result in cattle herd increased to 30mn head by 2023/24. However, this forecast is dependent on seasonal conditions, with a run of poor seasons more likely to result in a herd <25mn head.

We make a base case assumption with a 50% probability of strong seasonal conditions (herd size reaching 30mn head) and 50% probability of weak seasonal conditions (herd size contracting to 25mn head). In all cases we assume production (kt) per head increases at 1%, in line with the 10% historical CAGR (2007/08 - 2017/18).

Other protein sources

Poultry

Over the 5 years to 2017 growth in chicken meat production has been 3% CAGR. Our base case assumes the number of slaughterings increases at 3% (in line with 5 year CAGR through 2017) and the average slaughter weight remains constant, ignoring fluctuations due to favourable or unfavourable seasonal conditions. Overall, this drives production in line with historical growth rates. This is in line with commentary from ING.AX, which expect demand for poultry products to continue to growth at historical levels.

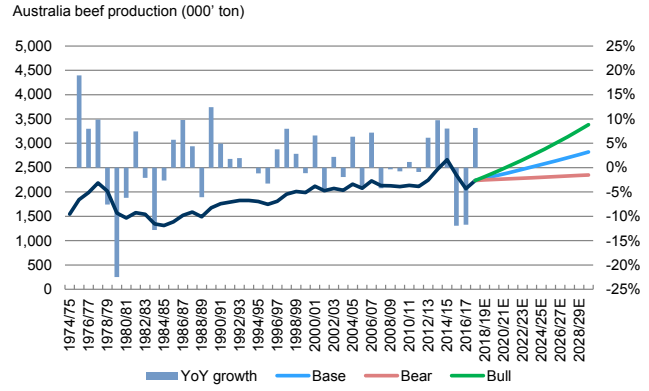
Our bear case assumes growth in the number of slaughterings slows to 2%; our bull case assumes acceleration to 4%.

We note that domestic consumption of chicken per capita has been increasing at a 2% 5-year CAGR through 2017. We assume per capita consumption to continue to increase, as a result of cultural and demographic shifts in the population.

Salmon

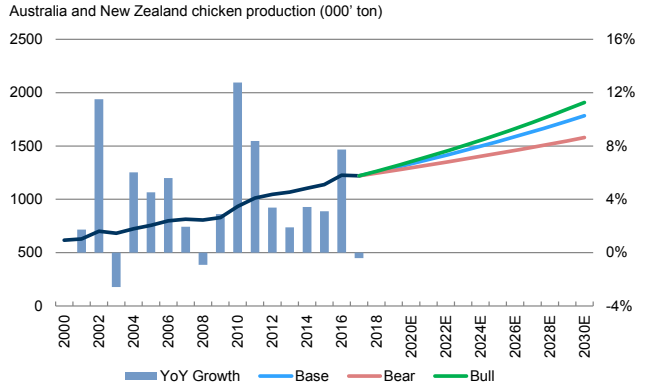
The value of Australia's fisheries and aquaculture production has experienced strong growth, in particular in salmon. ABARES expects strong growth in salmon production to continue, with growth in Tasmania's farmed salmon sector to be the largest contributor to production increases. Our base case forecasts assume 4% growth; our bear and bull cases assume 2% and 6% growth respectively.

Exhibit 133: Our base case assumes production increases to 2,822 kt by 2029/30E



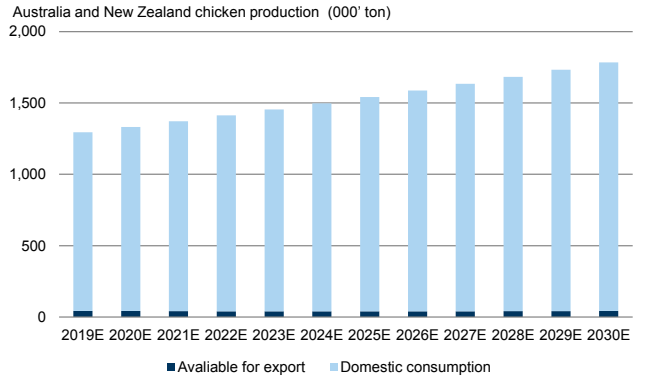
Source: ABARES, Goldman Sachs Global Investment Research

Exhibit 134: Australia and New Zealand Chicken production
Our base case assumes poultry production increases at 3% per annum



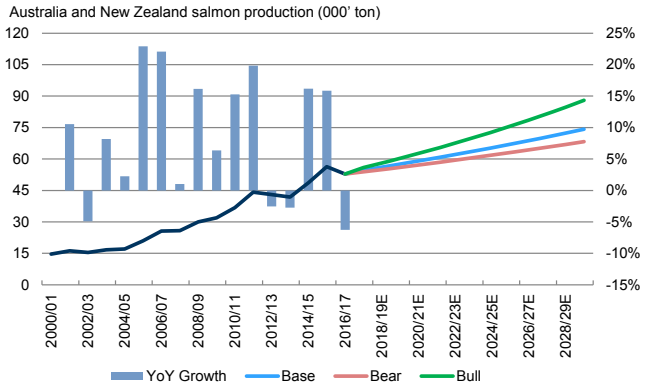
Source: ABARES, Goldman Sachs Global Investment Research

Exhibit 135: Our base case forecasts imply increases in production will be to meet domestic demand



Source: Goldman Sachs Global Investment Research

Exhibit 136: Australia and New Zealand salmon production
We assume strong growth in salmon production, off a low base



Source: ABARES, Goldman Sachs Global Investment Research

Potential China M&A: Emerging yet still slow paced

There is emerging M&A activity with Chinese companies seeking agriculture assets overseas, yet overall pace remains slow. The acquisitions include large transactions of listed companies such as ChemChina's acquisition of Syngenta in 2016, as well as smaller acquisitions of overseas farming resource, such as cattle and dairy farms in Australia and New Zealand. While acquiring foreign agriculture assets is appealing to alleviate agriculture supply issues in China, there are also some key challenges: (1) regulations on foreign countries regarding acquisition of agriculture assets and resources; (2) the price at which the asset is acquired; and (3) post-merger integration and management. As in the case of ChemChina's acquisition of Syngenta and Longping High-tech's 2017 acquisition of Amazon Agri Biotech (Brazil seed asset of Dow Chemicals), post-merger integration is still an ongoing process since the acquisitions were completed.

Exhibit 137: China's acquisition of overseas agriculture assets

Dates	Acquirers	Targets	Country	Unit	Considerations	Stakes
Grains						
Aug-16	Sinograins	Nidera	Netherland	NA	NA	49%
Live stock						
Sep-17	CITIC Agriculture	Pekin Ducks	UK	NA	NA	NA
Jun-14	Hengyang Cattle & CDH	Processing asset of Australian Brorsen Family	Australia	NA	NA	NA
Sep-14	Yiang Xiang Assets	Elizabeth Downs Cattle Station	Australia	A$ mn	11.5	NA
Oct-16	Shanghai CRED Real Estate	Kidman Farm	Australia	NA	NA	NA
May-15	Tianma Bearing	Wollogorang and Wentworth Farm	Australia	A$ mn	47	100%
Mar-19	Yili Industrials	Westland	New Zealand	NZ$mn	246	100%
Seed and chemicals						
Oct-17	Longping High-tech & CITIC	Amazon Agri Biotech	Brazil	US$ mn	400	36%
Feb-16	ChemChina	Syngenta	Switzerland	US$ mn	43,000	95%
Feb-11	SinoChem	MA Industries	Israel	US$ mn	1,440	60%

Source: Company data, Goldman Sachs Global Investment Research

Specifically, agriculture land investments in Australia require approval by the Foreign Investment Review Board (FIRB) when the cumulative value of a foreign person's agricultural land holdings exceeds A$15mn. This applies to international investors with exceptions for nationals from Chile, New Zealand, Thailand, and the US. To satisfy the FIRB requirements, there must have first been an opportunity for Australian investors to acquire the land, through an "open and transparent sale process". Across Australia, only 0.5% of agricultural land is foreign owned. Of this, 0.1% represents ownership between 10-50%; and 0.4% is >50% foreign owned. Proposed direct interests in an agribusiness also generally require approval in cases where the value of the investment is >A$58mn

In New Zealand, all purchases of rural land >5ha (except forestry blocks) will be subject to Overseas Investment Office (OIO) assessment. The OIO must determine that there will be a benefit to New Zealand that will, or is likely to be, "substantial and identifiable". The benefit test will consider economic, environmental, and other factors. As with Australia, the land must be offered for acquisition on the open market before consent can be granted. The US and China are the largest offshore investors in New Zealand dairy land area.

Pricing and margin outlook: Strong margin outlook for animal protein, best risk reward in corn

We initiate coverage on China's agriculture sector with a positive view, and set our first price forecasts for China's agriculture products including major crops (imported soybeans, domestic soybean meal, corn, and rice), and major animal proteins (hogs, broilers, pork, chicken, and beef).

Exhibit 138: Key agriculture commodity prices - global and China
Spot price as of 7/15/2019, global price forecasts are based on GS global commodities team's forecasts as of June-2019

Global futures prices		2011A	2012A	2013A	2014A	2015A	2016A	2017A	2018A	2019E	2020E	2021E	2022E	2023E	Spot	YTD
CBOT soybean	cent/bu	1,318	1,464	1,408	1,246	945	987	976	932	849	800	n/a	n/a	n/a	907	886
yoy	*%*	*22%*	*6%*	*-9%*	*-14%*	*-14%*	*-14%*	*0%*	*14%*	*-5%*	*-5%*	*n/a*	*n/a*	*n/a*	*9%*	*-10%*
FOB price	*Rmb/t*	*3,200*	*3,500*	*3,314*	*3,065*	*2,371*	*2,614*	*2,590*	*2,624*	*2,292*	*2,206*	*n/a*	*n/a*	*n/a*	*2,554*	*2,403*
CBOT corn	cent/bu	680	694	580	416	377	358	359	368	409	425	n/a	n/a	425	452	386
yoy	*%*	*59%*	*2%*	*-16%*	*-28%*	*-9%*	*-5%*	*0%*	*2%*	*11%*	*4%*	*n/a*	*n/a*	*n/a*	*32%*	*4%*
FOB price	*Rmb/t*	*1,908*	*1,911*	*1,635*	*1,249*	*1,097*	*1,141*	*1,114*	*1,385*	*1,266*	*1,322*	*n/a*	*n/a*	*n/a*	*1,423*	*1,217*
CME live cattle	cent/lb	115	123	126	152	146	119	118	115	121	120	n/a	n/a	n/a	108	120
yoy	*%*	*21%*	*7%*	*3%*	*20%*	*-3%*	*-19%*	*-1%*	*-3%*	*5%*	*-1%*	*n/a*	*n/a*	*n/a*	*1%*	*4%*
CME lean hog	cent/lb	90	85	89	106	69	66	70	65	76	91	n/a	n/a	n/a	71	73
yoy	*%*	*20%*	*-6%*	*5%*	*18%*	*-34%*	*-6%*	*7%*	*-7%*	*17%*	*20%*	*n/a*	*n/a*	*n/a*	*-11%*	*2%*
China prices - crop																
Imported soybean	Rmb/t	4,114	4,406	4,368	3,880	3,119	3,386	3,447	3,430	3,125	3,015	n/a	n/a	n/a	3,153	3,193
yoy	*%*	*9%*	*7%*	*-1%*	*-11%*	*-20%*	*9%*	*2%*	*0%*	*-9%*	*-4%*	*n/a*	*n/a*	*n/a*	*-8%*	*-6%*
Soybean meal	Rmb/t	3,202	3,710	4,135	3,720	2,863	3,083	3,024	3,211	2,742	2,714	n/a	n/a	n/a	2,886	2,791
yoy	*%*	*-1%*	*16%*	*11%*	*-10%*	*-23%*	*8%*	*-2%*	*6%*	*-15%*	*-1%*	*n/a*	*n/a*	*n/a*	*-7%*	*-10%*
Corn	Rmb/t	2,325	2,469	2,404	2,469	2,314	1,911	1,712	1,882	1,919	2,028	n/a	n/a	n/a	1,966	1,916
yoy	*%*	*16%*	*6%*	*-3%*	*3%*	*-6%*	*-17%*	*-10%*	*10%*	*2%*	*6%*	*n/a*	*n/a*	*n/a*	*7%*	*2%*
Rice	Rmb/t	2,553	2,732	2,734	2,811	2,854	2,807	2,808	2,630	2,424	2,400	n/a	n/a	n/a	2,415	2,445
yoy	*%*	*17%*	*7%*	*0%*	*3%*	*2%*	*-2%*	*0%*	*-6%*	*-8%*	*-1%*	*n/a*	*n/a*	*n/a*	*-4%*	*-10%*
China prices - animal protein																
Live hog	Rmb/kg	16.9	15.2	15.1	13.5	15.3	18.6	15.3	13.0	16.5	20.0	20.3	18.8	17.3	16.8	14.4
yoy	*%*	*48%*	*-10%*	*-1%*	*-11%*	*14%*	*22%*	*-17%*	*-15%*	*27%*	*22%*	*1%*	*-7%*	*-8%*	*46%*	*21%*
Broiler	Rmb/kg	10.1	8.9	8.6	8.8	7.3	7.7	6.7	8.5	9.4	9.2	9.1	8.6	8.4	8.0	9.5
yoy	*%*	*n/a*	*-11%*	*-4%*	*2%*	*-17%*	*6%*	*-13%*	*26%*	*10%*	*-2%*	*-1%*	*-5%*	*-2%*	*-4%*	*23%*
Pork	Rmb/kg	26.4	24.4	24.3	22.5	24.7	29.3	25.7	22.5	27.3	32.7	33.1	30.7	28.3	26.9	24.1
yoy	*%*	*42%*	*-8%*	*0%*	*-8%*	*10%*	*19%*	*-12%*	*-13%*	*22%*	*20%*	*1%*	*-7%*	*-8%*	*35%*	*9%*
Chicken	Rmb/kg	17.2	17.2	17.0	18.2	18.9	19.1	17.9	19.2	20.8	20.8	20.2	19.1	18.7	20.7	20.4
yoy	*%*	*15%*	*0%*	*-1%*	*7%*	*4%*	*1%*	*-6%*	*7%*	*8%*	*0%*	*-3%*	*-5%*	*-2%*	*12%*	*8%*
Beef	Rmb/kg	37.1	45.1	58.8	63.3	63.2	62.7	62.7	65.1	69.8	70.6	70.6	70.6	70.6	69.4	69.0
yoy	*%*	*10%*	*21%*	*30%*	*8%*	*0%*	*-1%*	*0%*	*4%*	*7%*	*1%*	*0%*	*0%*	*0%*	*9%*	*7%*
China margin and spread assumptions																
Hog - feed (spread)	Rmb/kg	8.1	5.7	5.1	3.4	5.6	9.4	6.3	3.9	7.6	11.0	11.0	9.5	8.0	7.7	5.4
yoy	*%*	*159%*	*-29%*	*-10%*	*-33%*	*64%*	*68%*	*-33%*	*-38%*	*96%*	*44%*	*0%*	*-14%*	*-16%*	*206%*	*89%*
Broiler - feed (spread)	Rmb/kg	3.9	2.4	1.8	1.9	0.7	1.5	0.6	2.3	3.3	3.0	2.7	2.2	2.0	1.7	3.3
yoy	*%*	*n/a*	*-38%*	*-25%*	*7%*	*-65%*	*120%*	*-61%*	*293%*	*46%*	*-9%*	*-10%*	*-19%*	*-9%*	*-18%*	*116%*
Corn margin	Rmb/t	557	564	323	324	(111)	(187)	(141)	(41)	59	159	259	259	259	31.4	(17.3)
yoy	*%*	*5%*	*1%*	*-43%*	*0%*	*-134%*	*68%*	*-24%*	*-71%*	*-243%*	*170%*	*63%*	*0%*	*0%*	*-135%*	*-63%*
Rice margin	Rmb/t	799	597	498	587	518	458	442	264	58	34	10	10	10	50.6	80.0
yoy	*%*	*-94%*	*-25%*	*-17%*	*18%*	*-12%*	*-12%*	*-4%*	*-40%*	*-78%*	*-42%*	*-71%*	*0%*	*0%*	*-68%*	*-77%*

(China prices for 2021-2023E are based on spread and margin assumptions above, on flat crop price assumptions)

Source: Bloomberg, Wind, Goldman Sachs Global Investment Research, Gao Hua Securities Research

- Our price forecast for global agriculture commodity prices are based on forecasts published by our global commodities team, including CBOT soybeans, corn, and CME live cattle and lean hog prices in 2019E and 2020E. We currently take their estimates for June 18, 2019.
- Our forecast for imported soybean prices in China is currently driven by the South America FOB price, which is based on global forecasts for CBOT corn futures. We forecast imported soybean prices to soften 9% yoy in 2019 and 4% in 2020, to Rmb3,125/t and Rmb3,015/t, due to lower demand from contracting hog herds. We see upside risk in the LT pricing - -we estimate the potential deficit could reach as deep as 34-60% below Chinese import demand, equivalent to 2-8% of deficit in global supply, in a downside-case scenario assuming China's consumption upgrade

maintained at current pace and Brazil land supply is disciplined. Similar deficits in 2008 and 2011-12 led to soybean prices surging 60-100%.

- We forecast domestic corn prices to improve 2% yoy in 2019 and 6% in 2020, to Rmb1,919/t and 2,028/t, as domestic corn has come to an effective supply deficit on an annual basis, due to stable demand and lower planted acreage allocation (-0.7% yoy based on CNGOIC forecast). In addition, loss-making conditions for corn farmers in China (labor accounted for as opportunity cost), suggest a floor for current pricing and attractive risk/reward in corn pricing.
- Given the impact of ASF on domestic supply, we expect strong pork prices and margins, with prices reaching Rmb27.3/kg or up 21% in 2019E, including Rmb30.6/kg in 2H19 (up 35% yoy), Rmb33.1/kg or up 21% yoy in 2020E, and remaining elevated at Rmb33.1/kg in 2021E, versus current levels of Rmb27/kg. We expect the live hog-to-feed spread to surge by 50-100% over 2019-2020E to Rmb11/kg, versus current levels at Rmb7.7/kg and mid-cycle of Rmb5.6/kg, and remains high in 2021E. We expect the pork supply deficit (8-12mnt in 2019/20E) to exceed historical cycles, in both magnitude and scale in our view —historical maximum deficit c. 2-3mnt in 2011 and 2016 per our estimates. We thus expect prices could well exceed historic peaks (Rmb20/kg and Rmb31/kg for live hogs and pork) and remain elevated for multiple years.
- In the broader animal protein space, we expect strong China pricing as well due to substitutions from pork given supply shortages, most prominently in beef and chicken. We forecast chicken prices to increase 8% in 2019E and 0% in 2020E, to Rmb20.8/kg. Beef prices are expected to increase 7% to Rmb69.8/kg in 2019E and remain high in 2020E Rmb70.6/kg, modeled in correlation with our global team's forecasts on US live cattle prices.

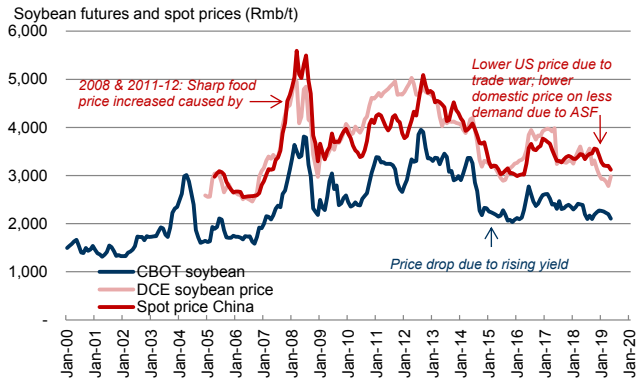
Soybean and soybean meal

General background: Soybeans are an important agriculture product both for human diet and animal feed. As of 2018, China consumes 112mn tons of soybeans, and 86% of domestic soybean supply comes from imports, among which the US, Brazil, and Argentina are the main exporters to China. Imported soybeans (genetically modified) are all used for crushing as they are cheaper and have a higher oil yield (generally around 18.5%). Domestic soybeans are mainly used for making food products, such as soybean milk, bean curd, etc., as they are GM free and have a lower oil yield (around 16.5%).

Benchmark prices: Soybean meal is the by-product of soybean crushing, accounting for c.79% of soybean weight, and the price is correlated with the price of imported soybean. Soybean meal is one of the key inputs of animal feed, usually accounting for 18-22% of the weight in animal feed. For imported soybeans, we follow prices at major ports in China (Guangdong, Shandong, Liaoning) based on CNGOIC (China National Grain & Oils Information Center), and average soybean meal prices provided by the Ministry of Agriculture. We also follow domestic soybean prices but these are less relevant to our covered companies.

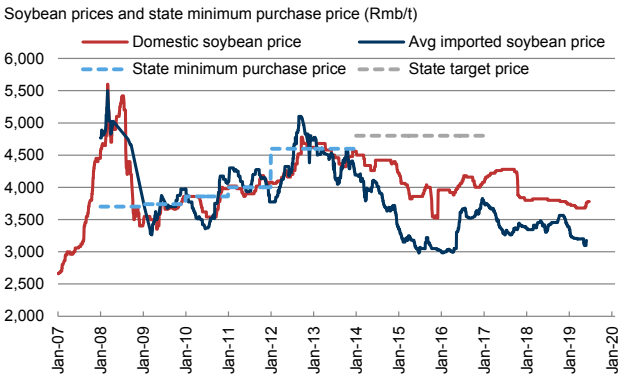
Price drivers: Imported soybean prices are highly correlated with major global producers including US/South America soybean prices. The US/South America FOB price is based on CBOT soybean futures plus a premium/discount, reflecting the demand and supply dynamics of the spot commodity plus inland transportation costs. Due to additional tariffs of 25% levied on US soybeans since July 2018, the landing price (CIF price, cost insurance and freight) of US imported soybeans is c.10% higher than those imported from South America. Domestic soybean prices are driven by domestic production costs, supported by state minimum purchase prices and subsidies. The government raised the state minimum purchase price of soybeans from 2008 to 2013. In 2014, the policy was replaced with a subsidy based on a target price. In 2016, the policy was replaced with a producer subsidy based on a planted area. Overall, due to high production cost and subsidies, domestic soybean prices are still 15-20% higher than imported soybeans.

Exhibit 139: Global soybean price versus import spot price CIF China
Imported soybean spot price has a high correlation with CBOT soybean futures price



Source: CNGOIC, Wind, Data compiled by Goldman Sachs Global Investment Research

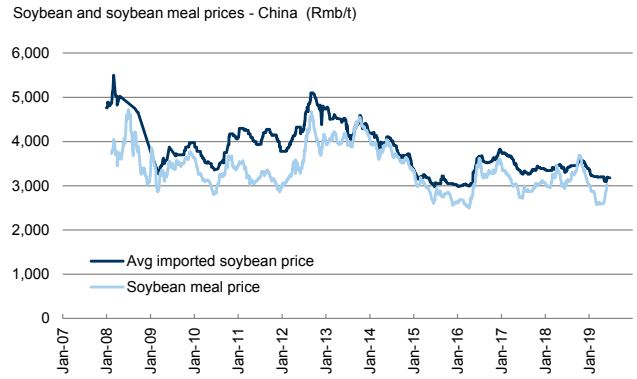
Exhibit 140: Soybean price - domestic and imported in China
Domestic soybean price is less correlated with imported price from 2014



Source: CNGOIC, NDRC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 141: Imported soybean and domestic soybean meal price - China

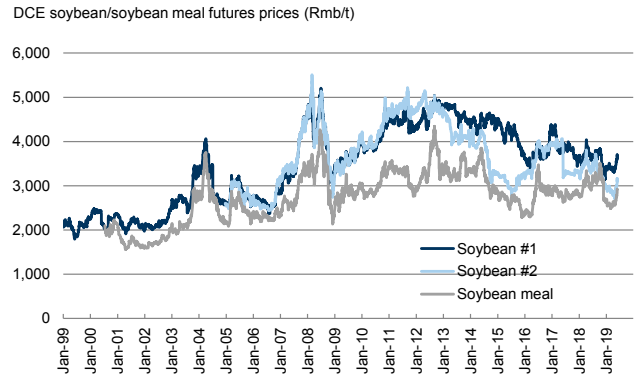
Soybean meal spot price is highly correlated with imported soybean price



Source: CNGOIC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 142: DCE Soybean and soybean meal 1M futures prices - China

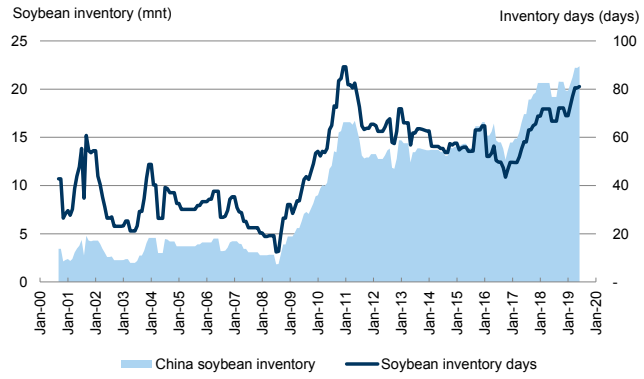
Soybean #1 refers to GM-free soybean, Soybean #2 refers to GM soybean traded at Dalian Commodity Exchange



Source: Wind, Data compiled by Goldman Sachs Global Investment Research

Exhibit 143: Soybean inventory - China, USDA estimate

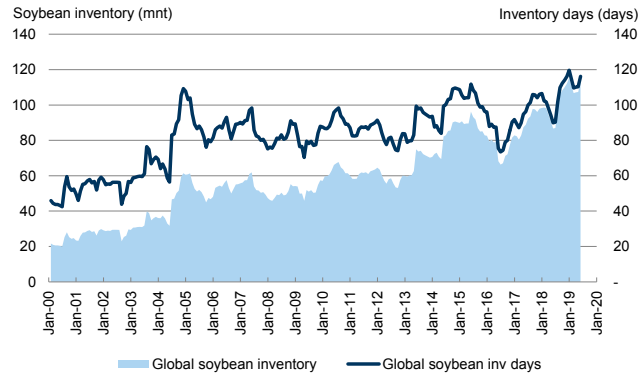
Current soybean inventory in China stands at 80 days



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 144: Soybean inventory - global, USDA estimate

Current global inventory days stand at 120 days



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Corn

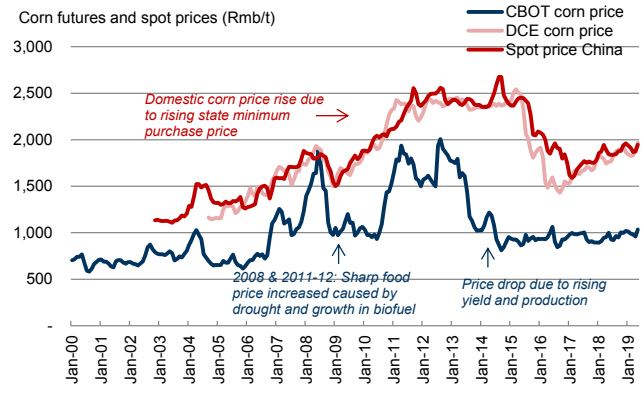
General background: According to USDA, in 2017/18, China consumed 263mnt of corn, 71% of which was used for animal feed. 98.5% of demand is fulfilled by domestic production, while imports only account for 1.5%.

Benchmark prices: The CBOT corn futures price is used as the global benchmark price, on which our GS global commodities team gives a monthly forecast. The three northeast provinces (Heilongjiang, Jilin, and Liaoning) plus Inner Mongolia are the major corn producing provinces in China, accounting for 43% of annual corn production, according to the NBS. As a result, we follow farm gate prices (tracked by CNGOIC) in these provinces. In addition, we follow selling prices at state storage facilities. We also follow the average corn price provided by Wind, which reflects the average cost of corn available for sale to feed producers.

Price drivers:

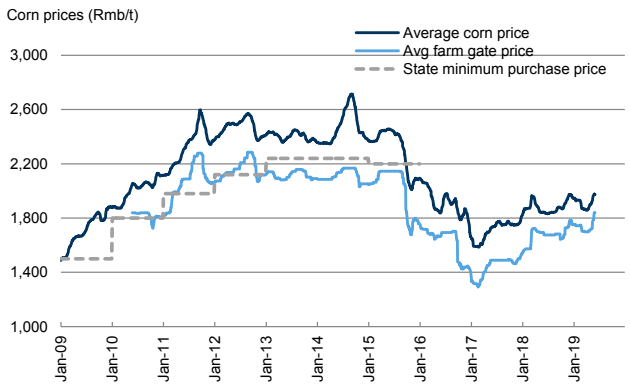
(1) Production cost. In 2018, even with an Rmb200/t subsidy, corn farmers were generally still running at a slight Rmb40/t loss in our estimates. We expect corn prices would have to rise in future years to justify planting, which is also in line with the fact that domestic production is already short of demand, despite still large inventories (190mnt as of 2018/19). (2) State minimum purchase prices and subsidies. The state minimum purchase policy for corn began in 2004, with minimum purchase prices rising from 2008, until being reduced in 2015 and replaced by subsidies in 2016. The impact of state purchases on the pricing of corn was high, as state purchase volume accounted for 15% of annual production volume in 2012/13, and 56% in 2015/16. The subsidy was Rmb150-170/mu in 2016E, 130-200/mu in 2017A, 25-94/mu in 2018, and 80-90/mu in 2019. (3) Import prices. Though imports still account for a small percentage of corn supply, we expect rising imports in the future, especially from the US and South America, thus import parity corn prices would be more relevant in the future.

Exhibit 145: Global corn futures price vs. domestic price
Corn prices in China has been less correlated with international price, yet may change in the future as imports raise



Source: Wind, Bloomberg, Data compiled by Goldman Sachs Global Investment Research

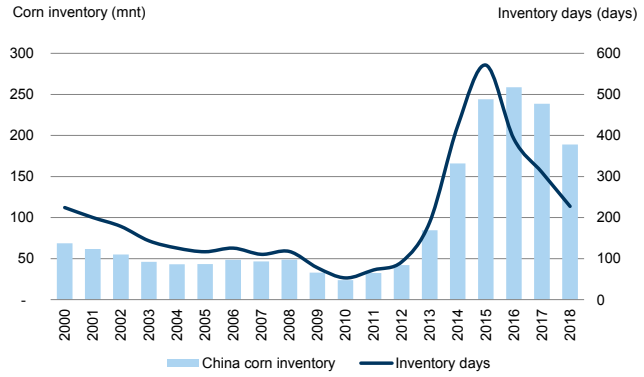
Exhibit 146: Average corn prices - China



Source: Wind, CNGOIC, Data compiled by Goldman Sachs Global Investment Research

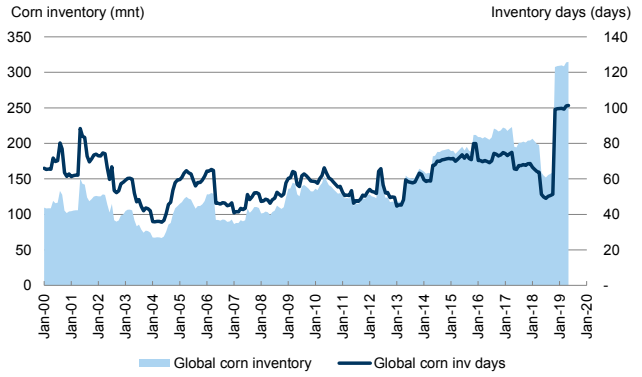
Exhibit 147: Corn inventory- China

China corn inventory built up in 2013-16 and has been on destocking in the past two years



Source: JCI, Wind, Data compiled by Goldman Sachs Global Investment Research

Exhibit 148: Corn inventory - Global



The recent spike was due to USDA significantly revised up China corn inventory in Nov 2018

Source: USDA, Data compiled by Goldman Sachs Global Investment Research

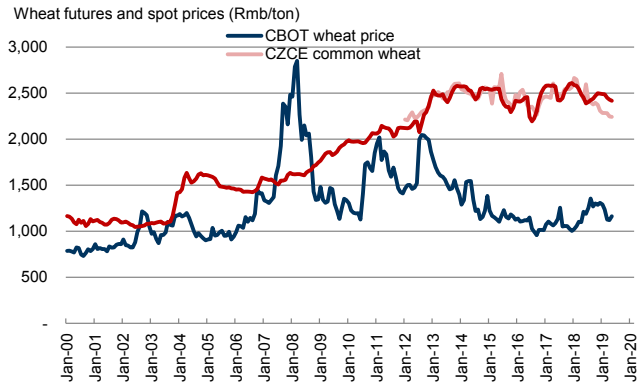
Wheat

General background: Wheat flour is the main input in making bread, dumplings, etc. The CZCE (Zhengzhou Commodities Exchange) has two wheat-related futures markets, common wheat and hard wheat. Hard wheat refers to wheat with high gluten content which is better suited for bread, noodles, etc., and is 10-15% higher than common wheat in pricing. According the CZCE, hard wheat accounts for c.25% of total wheat volume in China.

Benchmark prices: We follow common wheat spot prices provided by CNGOIC, which is more relevant to livestock production as it can be used in animal feed.

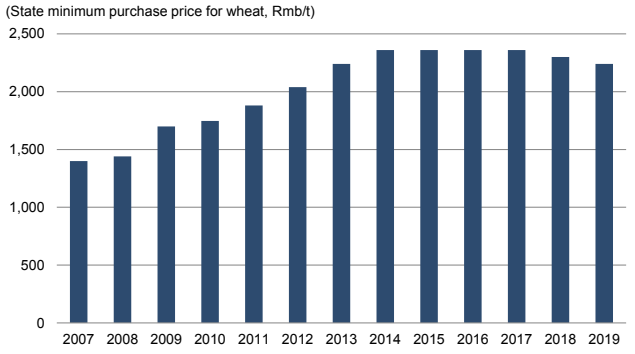
Price drivers: Domestic wheat prices are not correlated with international prices, but are supported by production costs and state minimum purchase prices. (1) The state purchase policy for wheat is still active, yet with lower minimum purchase price at Rmb2,300/t in 2018. According to the National Food and Strategic Reserves Administration, state purchased volume accounted for c.22% of annual wheat production volume in 2016. (2) Wheat farmers makes average of Rmb200/t in 2015-17, or a 10% net margin, thus downside on pricing is limited.

Exhibit 149: Wheat price - China vs. global
Domestic wheat price is not correlated with international price



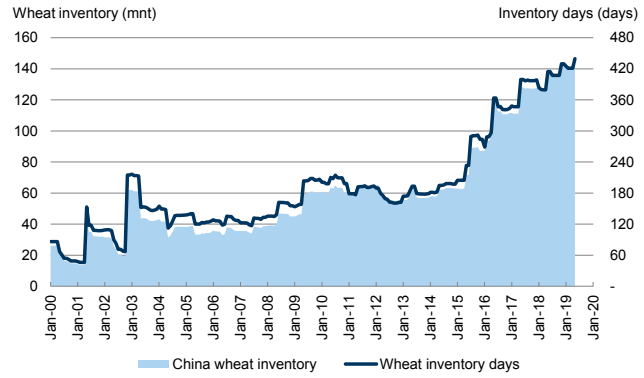
Source: Wind, CNGOIC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 150: State minimum purchase price for wheat
State minimum purchase price for wheat was reduced in 2018



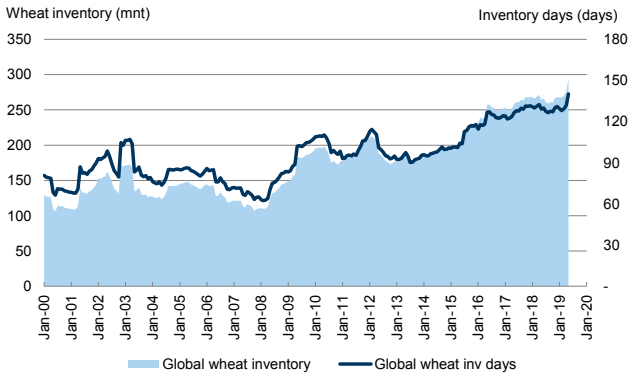
Source: NDRC

Exhibit 151: Wheat inventory - China
China wheat inventory has built up over the past few years



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 152: Wheat inventory-global



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

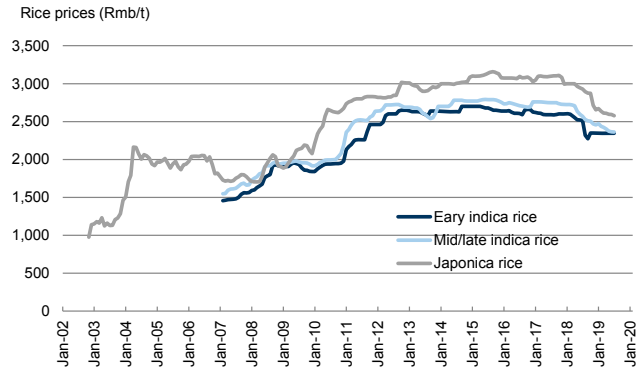
Rice

General background: Rice is one of the three major grains in China. Rice can be divided into three categories: early indica rice, mid/late indica rice, and japonica rice, accounting for c. 15%/50%/35% of total. Early indica rice has lower quality and is more commonly used for animal feed and the industrial production of starch, rice flour, etc. Mid/late indica rice and japonica rice are mainly used for food.

Benchmark prices: We follow the wholesale prices of the three categories of rice (by grain traders). Early indica rice is mainly planted in Hunan, Jiangxi, and Guangxi. Mid/late indica rice is mainly planted in Hunan, Sichuan, Hubei, Jiangxi. Japonica rice is mainly planted in the northeast region and Jiangsu.

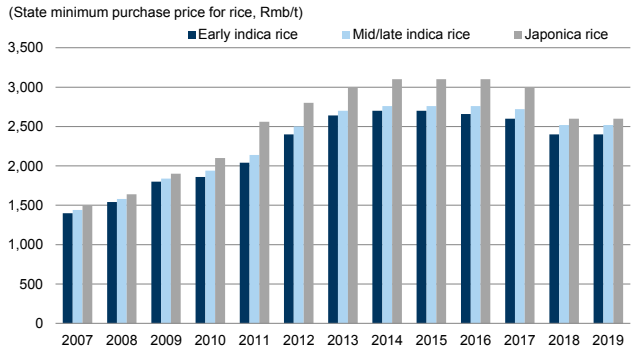
Price drivers: Domestic rice prices are not correlated with import prices, and are supported by the minimum state purchase price and production costs. (1) The state minimum purchase price of rice increased since 2007 until being reduced for the first time in 2016, leading to lower rice pricing. According to the National Food and Strategic Reserves Administration, state purchased volume accounted for c.23% of annual rice production volume in 2013-17. (2) We estimate that on average rice farmers earn profits of only Rmb0-50/t under current prices, providing support for rice prices.

Exhibit 153: Historic rice prices - China



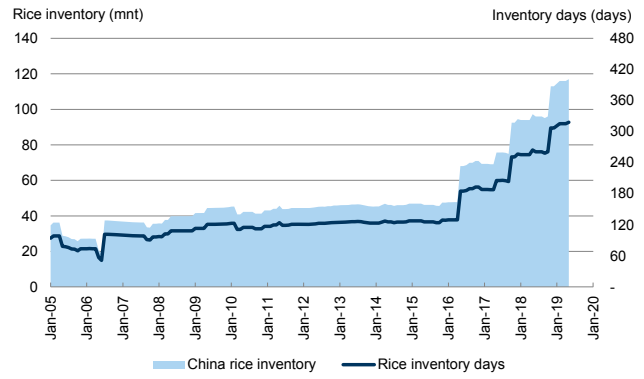
Source: Wind, CNGOIC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 154: State minimum purchase price for rice



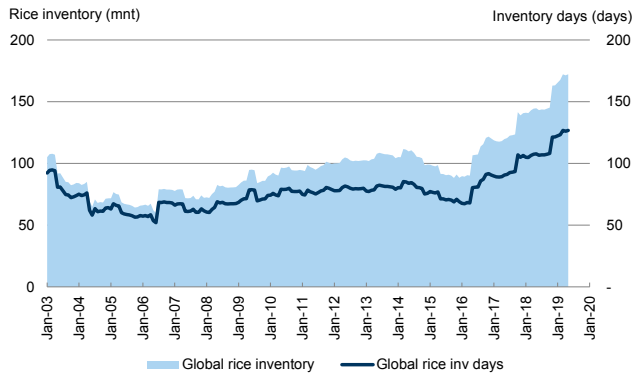
Source: NDRC

Exhibit 155: Rice inventory - China, USDA estimates
China rice inventory has built up in recent years



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 156: Rice inventory - global, USDA estimates



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Live hog

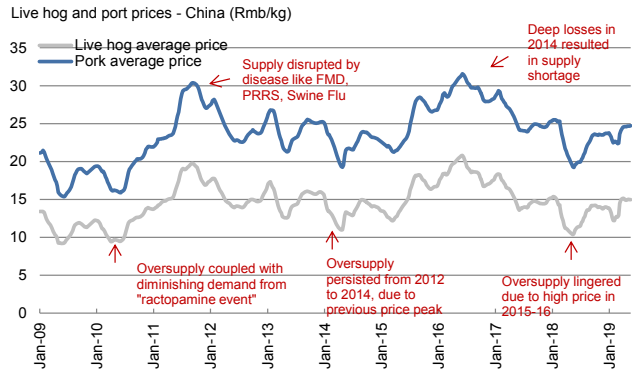
General background: Live hogs are sold by producers into slaughter houses, where they are processed into carcasses. The dress ratio (carcass weight/live weight) is generally c. 70-75%. The relationship between the pork and live hog price is generally stable: pork price/live hog price = 1.6x

Benchmark prices: We follow domestic live hog and pork prices tracked by the Ministry of Agriculture. The tracked price is the nationwide average. Generally, prices across the country do not have material differences, though in 2H18 the difference between north and south China widened due to the outbreak of African Swine Fever (ASF) and regional transportation ban policy (explained in a later section).

Price drivers:

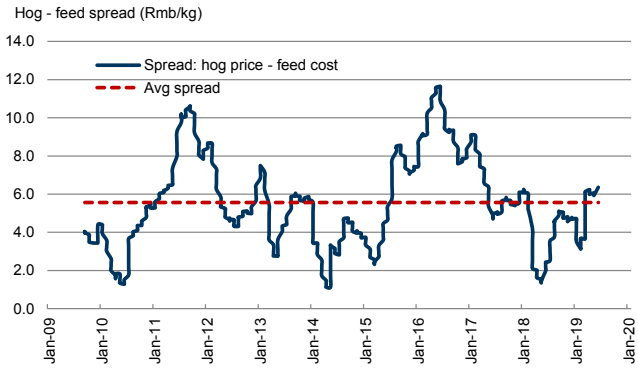
(1) Feed costs. Feed costs account for c.60% of the cost of hogs at farrow-to-finish farms, and feed costs are driven by the prices of soybean meal, corn, and other additives like amino acid. (2) Spreads. The spread refers to live the hog price subtracted by the total feed cost required to produce 1kg of live weight of hog. From 2009 to 2019, live hog prices have ranged from Rmb10/kg to Rmb20/kg, and hog spreads varied from Rmb2/kg to Rmb13/kg, with an average of Rmb7/kg. The large fluctuation in live hog prices in China is described as "the hog cycle," which is driven by the industry's fragmented production structure and the limited visibility small farms have in making production decisions based on pricing. The volatility of the hog cycle is also exacerbated by external shocks, especially outbreaks of disease. For example, outbreaks of Foot and Mouth Disease (FMD), Porcine Reproductive and Respiratory Syndrome (PRRS), and Swine Flu in 2010-2011 caused a 4-5% shortage in live hog supply, which led to live hog prices climbing 100% from bottom to peak in 2010-2012. The current outbreak of African Swine Fever (ASF) has resulted in an unprecedented reduction in pig herds and hog supply with hog prices potentially exceeding historic peaks. (3) International prices. Historically domestic live hog and pork prices have a low correlation with US prices, as pork imports account for only 2% of total supply in China.

Exhibit 157: Historic Hog and pork prices



Source: MOA, Data compiled by Goldman Sachs Global Investment Research

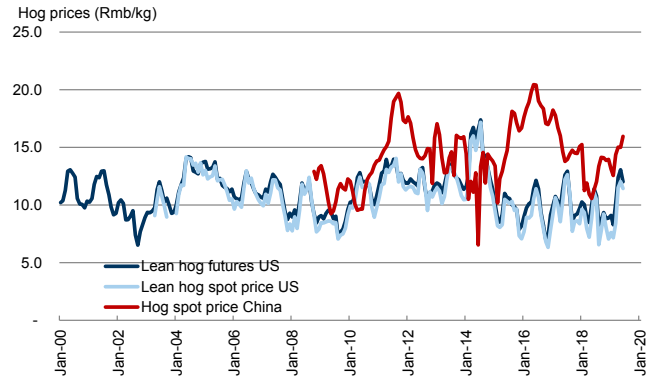
Exhibit 158: Historic spread of hog price over feed cost - China
Historical range was Rmb1-12/kg in average spread



Source: MOA, Data compiled by Goldman Sachs Global Investment Research

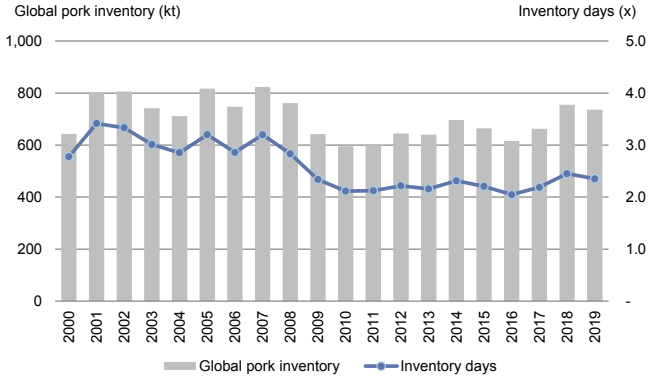
Exhibit 159: Hog price - China versus US

Domestic hog price has not been closely correlated with US



Source: MOA, Wind, Bloomberg, Data compiled by Goldman Sachs Global Investment Research

Exhibit 160: Pork inventory - Global



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

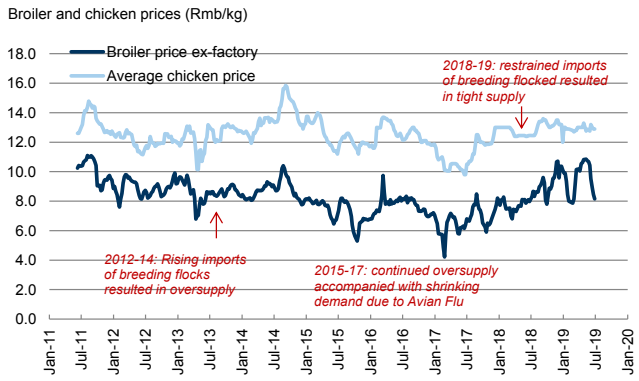
Poultry and chicken

General background: White-feather broilers are broilers with imported breeding flocks. White-feather broilers comprise about 60% of China's chicken meat supply. Yellow-feather broilers are domestic broilers that comprise about 30% of chicken meat supply.

Benchmark prices: We follow the ex-factory price for white-feather broilers and chicken wholesale prices provided by the Ministry of Agriculture.

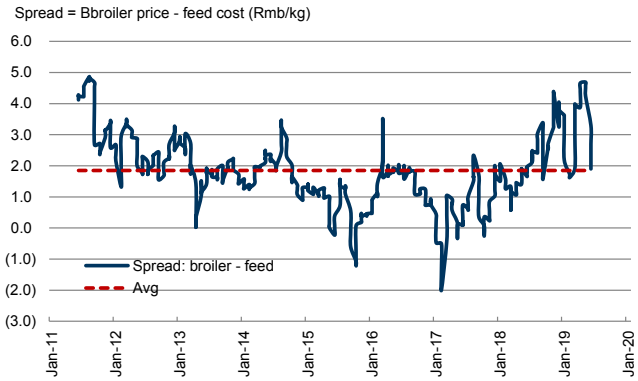
Price drivers: Similar to live hogs, broiler prices are driven by feed prices and the spread between broiler prices and the total cost of feed to produce 1kg of live-weight broiler. From 2011 to 2019, broiler prices fluctuated from Rmb4/kg to Rmb10/kg, and the spread went from Rmb-2/kg to Rmb5/kg. The average spread is Rmb2.0/kg. The current spread is trending toward and even exceeding historic peaks, due to growing substitution demand from pork and relatively tight supply. But in the long term, spreads should return to historic averages given the flexibility of capacity adjustment. Domestic chicken prices are not correlated with international prices as China's poultry imports only account for 1.5% of total poultry demand.

Exhibit 161: Broiler and chicken prices



Source: Wind, Data compiled by Goldman Sachs Global Investment Research

Exhibit 162: Historic broiler spread over feed price



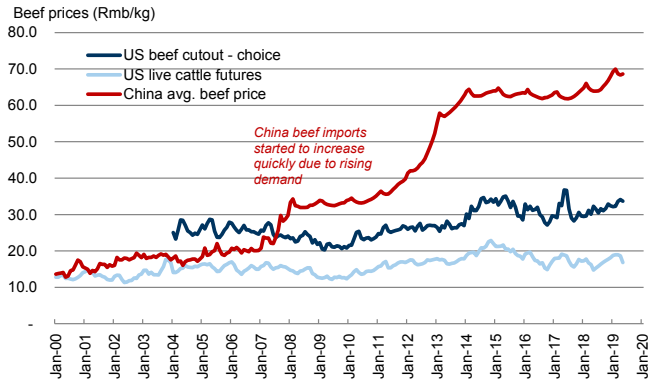
Source: Wind, Data compiled by Goldman Sachs Global Investment Research

Beef

Benchmark prices: We follow average domestic beef prices tracked by the Ministry of Agriculture and collected from 500 wholesale and retail markets across the country.

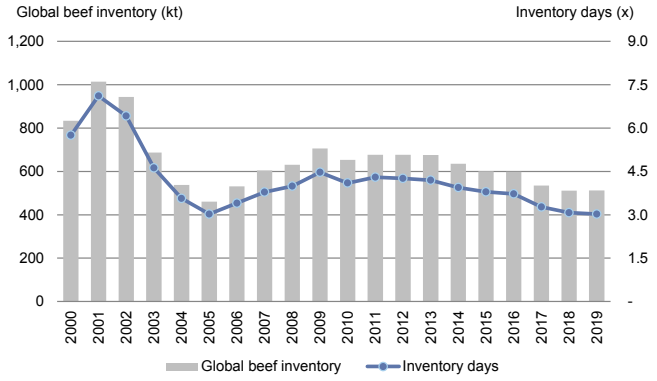
Price drivers: From 2009-2019, beef prices in China have increased more than 100%, with the steepest increase happening in 2011-2013, driven by rising demand, constrained supply, and rising imports. China's beef imports increased from 0.1mnt in 2012 to 1.2mnt in 2018, accounting for 14% of domestic consumption. The main sources of imports are Brazil, Australia, Uruguay, and Argentina. But as the US has the most available data, we track US beef prices and cattle futures as indicators of international pricing. As we expect a higher percentage of rising beef demand would need to be satisfied by imports, we expect a higher correlation between domestic and international beef prices going forward.

Exhibit 163: China beef price vs. US beef and cattle prices



Source: Bloomberg, MOA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 164: Beef inventory - global



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

China sub-sector 1: Live hog breeding and cultivation

Consolidation will be an ongoing theme in the large yet fragmented livestock production industry, driven by the cost advantages of industry leaders, tightening environmental policy. Recent ASF may serve as a catalyst to accelerate the process

We think consolidation will be an ongoing theme in the large but fragmented livestock production industry, driven by the cost advantages of industry leaders, tightening environmental policy. Recent ASF may serve as a catalyst to accelerate the process. We see industry leaders like Wens Foodstuff and Muyuan Foods as beneficiaries of industry consolidation, with the potential to expand market shares from 2-3% to 5-6% in the next five to six years. We expect live hog prices to remain high over the next few years, due to pork supply shortages caused by ASF. The cost advantage of industry leaders, which comes from advantages in breeding, experience and management skills, will likely be the source of sustainable profit generation in the next few years, in our view.

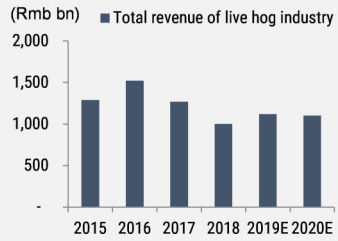
Total demand may have peaked, consolidation underway: While pork demand may have peaked, the live hog production industry is undergoing a consolidation trend, which we think will persist for many years. We see several key drivers of industry consolidation: (1) cost advantage of industry leaders. Due to leading techniques in breeding and economies of scale, cost advantages enable industry leaders to make more profit through the ups and downs of the hog-price cycle, while high-cost producers tend to be loss making and even exit the market during industry downturns (when live hog prices can remain lower than Rmb15/kg for six months or longer. (2) Environmental policy tightening. Policies forbidding or restricting livestock production in certain areas has already resulted in numerous small producers exiting the industry in 2015-17. We think environmental policy still has room to tighten in the future, in terms of the level execution, which would pose additional costs to smaller producers who have not met current emission standards. Industry leaders on the other hand, have built their hog farms according to environmental standards and face less such risks.

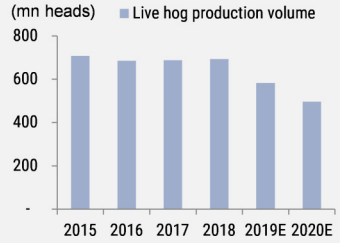
ASF as catalyst for industry consolidation: The spread of ASF has resulted in major damage to the live hog production industry in China, but we think it could be a catalyst for industry consolidation. To protect from ASF, industry leaders are investing c. Rmb1.0/kg on various measures, including the segregation of production and sales to prevent contact as well as sterilization and ventilation systems, while small producers are spending less than Rmb0.5/kg. Thus, we think industry leaders are better positioned to protect against ASF risks and are more likely to succeed in capacity expansion against an ASF backdrop. International experience suggests that eradication of ASF will likely be a long term effort. In the case of Russia, where ASF has spread for eight years, the top-three live hog producers have increased their market share by 40-100% from 2011 to 2018.

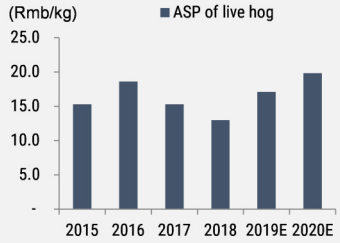
Exhibit 165: Overview of China live hog breeding and cultivation industry

Overview of China live hog breeding and cultivation industry

Market size

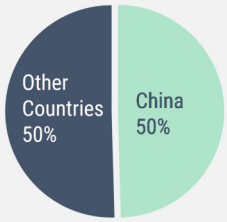






China in global context (volume share)

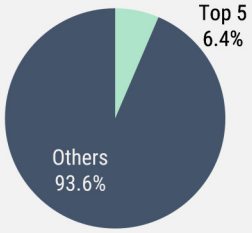
China demand of pork as % of world



Import volume as % of domestic demand:
2.6%

Export volume as % of global demand:
0%

Competitive landscape



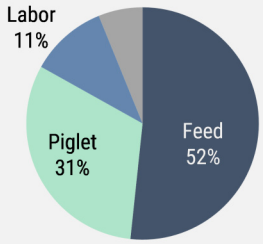
Entry barrier

The entry barrier of the industry includes **capital and experience.** Building a hog farm (including breeding and cultivation) with 100,000 heads output capacity requires Rmb100mn of capex. It also requires years of experience to improve the efficiency and productivity of pig farms.

Industry trend

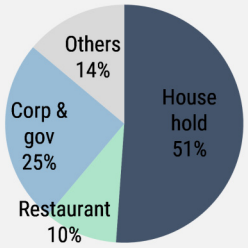
Key drivers of industry consolidation:
(1) cost advantage of industry leaders;
(2) environmental regulation on small players and backyard farming;
(3) an aging farmer population is a pressure on working labor and requires higher efficiency from scale production.

Upstream / key inputs



The upstream players of the industry are **feed producers**. But leading cultivation companies like Wens Foodstuff and Muyuan Foods tend to **expand vertically and self-supply feed.** In the cases their upstream is grain producers and soybean oil companies (who crush soybean and sell soybean meal). **The upstream of the industry is very fragmented.**

Downstream / demand breakdown



Downstream players of the industry are slaughter houses, which purchase live hogs from breeding companies through the hands of distributors.

The live hogs are then slaughtered, sliced and sold to various consumer channels, including restaurants, super markets and open fairs. End consumers include household, restaurants, corporate and government, etc. **The downstream of the industry is also very fragmented.**

Substitution

Pork is still the major source of animal protein in China. Substitutes include chicken, beef, mutton, etc.

Source: Goldman Sachs Global Investment Research

Total demand may have peaked, consolidation underway

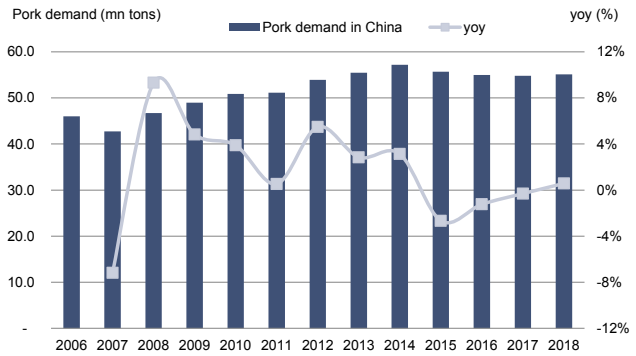
Pork consumption may have peaked: Pork is the most important source of animal protein for Chinese consumers (60% of animal meat consumed). Over the last few decades, pork consumption increased until 2014, and has seen a gradual decline of 0-1% p.a. since then. As we have analyzed above, pork consumption may have begun to decline, as Chinese consumers trade up and opt for "healthier" animal protein choices, including beef and poultry. However, we note that the process will likely be slow and pork would remain the largest segment of animal protein in the foreseeable future.

Significant but fragmented market: China's live hog industry is large with c.Rmb1.0 trillion in annual revenue. However, the hog production industry is extremely fragmented, consisting of many small-scale and backyard farms. In 2016, hog operations with less than 500 head in output accounted for c.40% of total hog production in China. In 2018, the top-4 players accounted for only 6% market share.

Consolidation underway: We are already seeing concentration in the hog production industry. Large hog operations (with output of more than 1,000 head) accounted for 42% of total hog production in China in 2016, up from 24% in 2007. Leading players are also rapidly expanding. For example, Wens Foodstuff increased its hog production volume from 12.2mn head in 2014 to 22.3mn in 2018. Meanwhile, Muyuan Foods increased hog production from 1.9mn head in 2014 to 11mn in 2018.

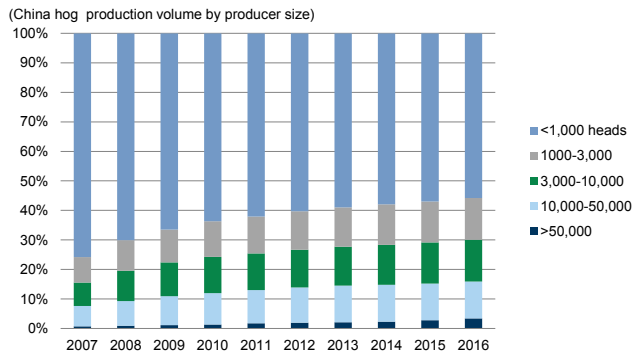
We see three drivers of industry concentration, which we will further analyze below: (1) cost advantage of industry leaders; (2) environmental policies; (3) external supply shocks, like disease, etc.

Exhibit 166: Total pork demand in China
Pork demand may have peaked since 2014



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 167: Output by herd size
China's hog industry is concentrating towards large operations



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Driver 1: Cost advantage of industry leaders

Hogs are a commoditized product, and players in the hog market are essentially price takers. But industry leaders like Wens Foodstuff can achieve lower unit costs allowing them to enjoy higher margins and ROI, which facilitates capacity expansion. Cost advantages can be attributed to several factors:

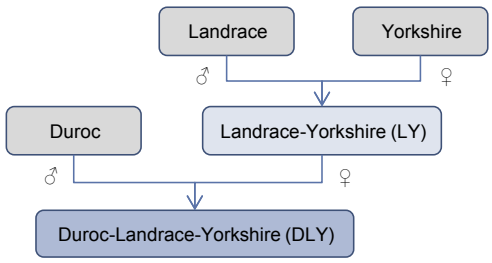
(1) Breeding: Due to a biological phenomenon called "hybrid vigor", hog producers can use cross-breeding techniques to obtain the best genetic hog traits and achieve higher

productivity, feed conversion ratios, and other aspects. For example, most large-scale hog operations in China use a cross-bred hog type called "Duroc-Landrace-Yorkshire" (DLY). It is produced first with a Landrace hog as boar and a Yorkshire as gilt, the female decedent of which is then crossbred with Duroc as boar. According to Scale Pig Raising Technique published by China Agriculture University, the DLY hog has significantly higher productivity and feed conversion efficiency than local varieties of hogs in China.

Industry leaders like Wens Foodstuff and Muyuan Foods have been breeding hogs for more than 20 years, and have accumulated high quality genetic resources with a large base of boars and gilts as well as sustainable investment in R&D. As a result, their hogs have better genetic traits than those of average hog producers in China. For example, pigs per sow per year (PSY) refers to the number of feeder pigs a sow can produce in a year and is used to measure the productivity of sows. Industry leaders can achieve a PSY of 25, while the industry average is around 17. Feed conversion ratio (FCR) refers to the volume of feed that is required for a hog to gain 1 kg of weight. Industry leaders have an FCR of 2.4-2.5 while the industry average is 3.0

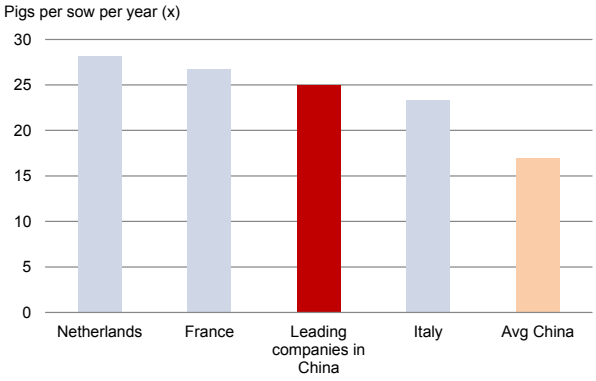
Backyard farms and mid-scale producers usually do not have breeding techniques due to scale disadvantages and a lack of genetic resources. Accordingly, they need to purchase feeder pigs (piglets that have been weaned and raised to 15-20 kg) from farrow-to-feeder operations. When market demand is brisk, feeder pigs can sell at Rmb600+ per head, accounting for a considerable part the final product cost. Industry leaders like Wens Foodstuff and Muyuan Foods produce their own feeder pigs and can even supply feeder pigs to the market.

Exhibit 168: Cross breeding three types of hogs to produce the descendant with best genetic traits



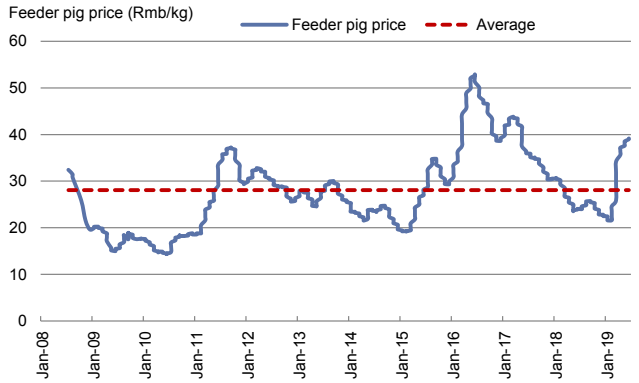
Source: Goldman Sachs Global Investment Research

Exhibit 169: Number of weaned pigs per sow per year (PSY)
Leading companies in China can achieve almost as good productivity as EU



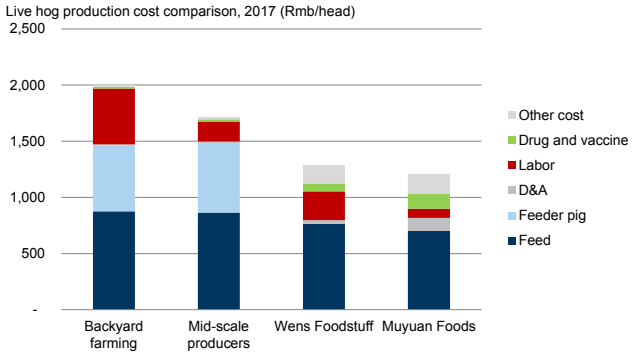
Source: Company data, IFIP, Data compiled by Goldman Sachs Global Investment Research

Exhibit 170: Feeder pig market price
Feeder pig prices could reach as high as Rmb50/kg



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 171: Cost per head breakdown, 2017
Industry leaders have lower costs than smaller scale producers



Source: Company data, NDRC, Data compiled by Goldman Sachs Global Investment Research

(2) Experience and skills: Raising hogs requires considerable experience and skill throughout the process, including building pig farms, breeding, feeding, vaccination and sterilization, etc. Wens Foodstuff has rich experience and skill in hog raising, and can provide farmers with technical support to help them achieve better performance. For example, the average mortality rate for Wens Foodstuff is 6%, while industry average is 10%+.

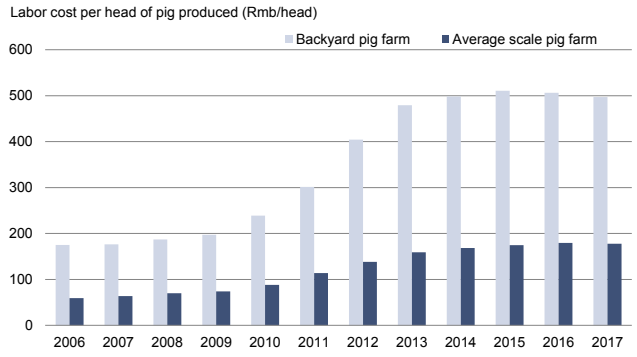
(3) Economies of scale: Labor costs are a material part of COGS for smaller scale hog farmers, but large producers have scale advantages and can achieve lower labor costs per head. For Wens Foodstuff, the average farm size is 500 head, and for newly signed contracts, the average farm size has already reached 2,000 head, while the industry average farm size is less than 50 head. For Muyuan, each feeding staff member can take care of 2,700 - 3,500 head of hogs, the average labor cost per head of output is only Rmb78 in 2017.

Due to the above cost advantages, Muyuan Foods has a unit cost of Rmb11.5/kg and Wens Foodstuff has a Rmb12/kg unit cost which compares favorably with smaller scale producers at Rmb13/kg, and backyard farms at around Rmb15/kg (taking into consideration the opportunity cost of labor).

Driver 2: Rising labor cost and aging labor force

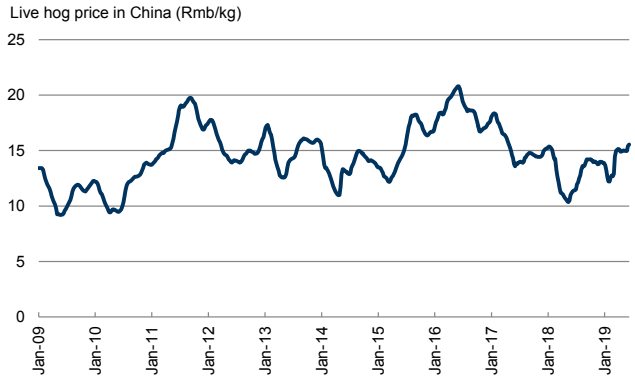
It has become increasingly difficult for small-scale operations to turn a profit due to rising labor costs. In the last ten years, labor cost per head has increased almost two fold, which is in line with the rise in urban and rural disposable income. However, live hog prices fluctuated over the last ten years, but the midpoint has not seen a material increase. Thus profit margins for small-scale producers are shrinking. Adding to these challenges, productivity rates could trend lower as urbanization and lower birth rates have partially led to a declining labor pool and a rising average age in the agriculture labor force.

Exhibit 172: Labor cost per head
Labor costs have been rising for pig farms



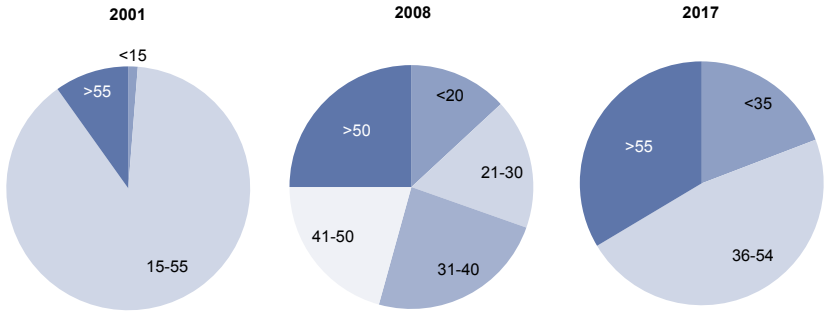
Source: NDRC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 173: ASP of live hogs in China
Live hog prices have been fluctuating but the mid-point has barely increased



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 174: China agriculture labor force breakdown by age



Source: NBS

Driver 3: Environmental policy tightening

Since 2014, Ministry of Ecology and Environment (the MEE) has implemented a series of policies, with sections related to agriculture. Three major policies to note:

(1) Prohibiting the raising of livestock in certain areas, mainly water resource areas, natural reserves, urban residential areas, etc. Livestock farms in these areas should be shut down or moved by 2017. Execution of the policy has been quite strict. For example, Zhejiang Province removed 70,000 hog farms in 2017. Some of the larger scale farms in Zhejiang Province were moved to other provinces like Jiangsu, while some smaller farms and backyard farms exited the business.

(2) Installing manure utilization facilities: According to the MEE, comprehensive fecal utilization is the preferred way to treat livestock fecal matter. The basic practice is to install a multi-stage precipitate pool and/or fermenting facility to treat livestock feces and apply the manure onto farms as fertilizer, subject to national standards such as roundworm oval mortality rate, fecal coliform value, etc. The MEE's target is for the nationwide livestock fecal utilization rate to reach 75% by 2020. For livestock operations that do not have corresponding farms to apply manure, the disposal of waste and sewage should meet national standards outlined below.

(3) Installing waste & sewage treatment facilities: Large scale hog producers are required to install waste and sewage treatment facilities, to meet national and provincial standards such as livestock farm waste & sewage discharge standard. According to the Ministry of Ecology and Environment, sewage disposal standards for large-scale hog farms were raised in 2015, compared with the original 2001 practice.

According to Wens Foodstuff and Muyuan Foods, both companies have been making environmental protection investments that meet or exceed government requirements. These facilities could account for 10-15% of capex for a hog farm. Most small-sized operations and backyard farms, on the other hand, have under spent on environmental facility installment. Generally, small-sized operations at the local level have not seen strict enforcement of the most stringent environmental standards. If the implementation of environmental policy tightens, we would expect rising spending and higher costs for smaller operations.

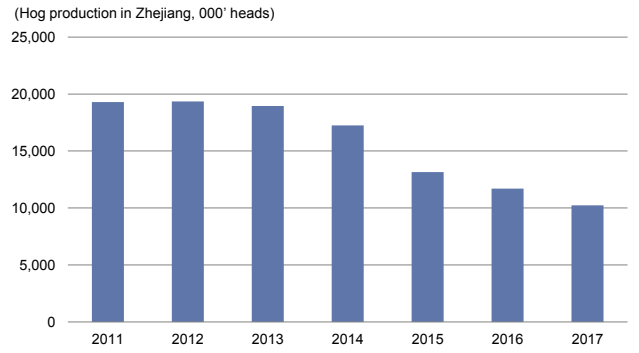
In conclusion, we think large hog farms are better positioned in environmental practices, while smaller ones may experience lower profitability should environmental policy tighten in the future.

Exhibit 175: Environmental policies related to agriculture

Implementation	Policy	Requirement related to livestock raising
Jan-14	Livestock raising pollution control measures	Livestock farms should install facilities to treat waste and sewage, utilize fecal and dispose dead bodies. Units that have failed to comply with such requirements should not be in operation
Apr-15	Water pollution control action plan	1. Set livestock raising forbidden areas, shut down or move livestock farms in such areas by 2017 2. Livestock raising forbidden areas include water resource areas, natural reserves, urban residential areas, etc. 3. Large scale livestock farms should install fecal sewage treatment facilities accordingly
Jun-17	Plan to accelerate livestock waste utilization	By 2020, nationwide livestock waste utilization rate should exceed 75%. Waste and sewage facility installment at scale livestock farms should exceed 95%.
Jan-18	PRC Environmental Tax Law	Livestock farms with >500 head inventory, and have not set up livestock wastes utilization facilities, should pay environmental tax

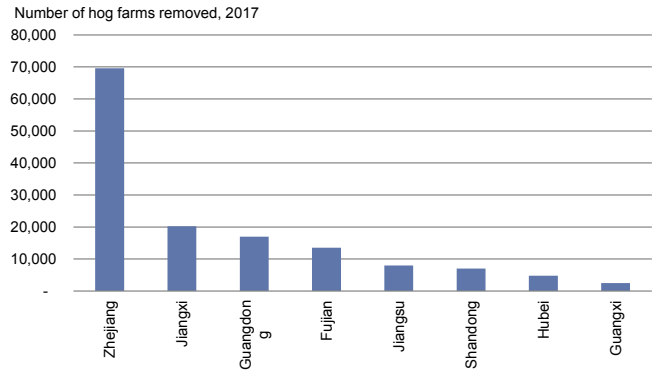
Source: Ministry of Ecology and Environment

Exhibit 176: Hog production in Zhejiang
Hog production in Zhejiang has been declining sharply since 2014



Source: NBS

Exhibit 177: Number of hog farms removed in 2017
Zhejiang removed a large number of hog farms



Source: Provincial Agriculture Department

Exhibit 178: Environmental requirement for livestock manure fertilize production

Item	Requirement
Mortality rate of roundworm ova	95-100%
Fecal coliform	0.01-0.1
Flies	No live maggot or fly should be detected in or around the manure

Source: Ministry of Ecology and Environment, Data compiled by Goldman Sachs Global Investment Research

Exhibit 179: Environmental requirement for livestock farm sewage disposal

		Definition of scale operations	BOD	COD	NH3-N
			mg/L	mg/L	mg/L
Nationwide	2001	hog inventory >= 3,000 heads	150	400	80
Nationwide	2015	hog inventory >= 500 heads	40	150	40

		Water discharge vol
		m3/(00' head*day)
Nationwide	2001	2.5
Nationwide	2015	1.2

Source: Ministry of Ecology and Environment, Data compiled by Goldman Sachs Global Investment Research

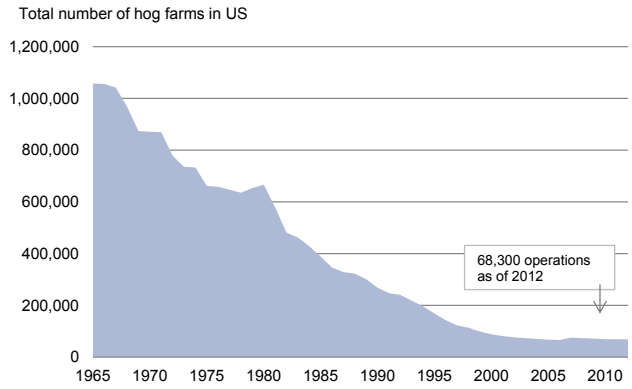
What could be the path for China?

US and EU more concentrated than China

Looking at developed countries, we find that the concentration of hog production is the common trend in the US and Europe. In past decades, the number of small hog operations has declined and large operations have gained share, and this trend has persisted in recent years.

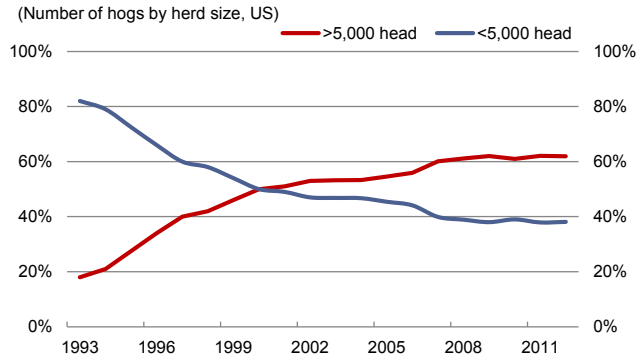
> "Large farms are accounting for more and more sows to the detriment of the smallest farms. Generally speaking, in these countries the surviving farmers are only those that have understood the need of having sustainable production based on investments in technology, genetics, nutrition and integration."— Eurostat, 2014

Exhibit 180: Number of hog farms in US
US has experienced a rapid decline of hog farms



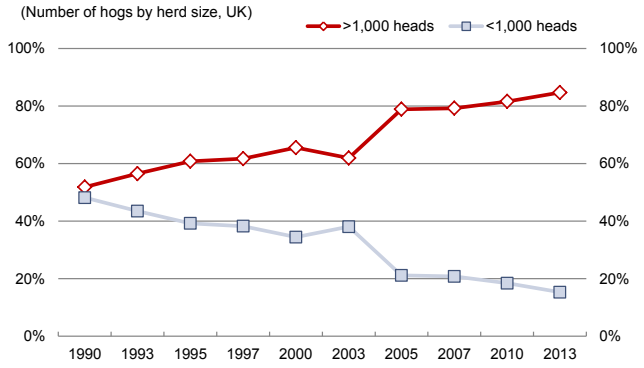
Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 181: Number of hog by herd size, US
Large farms are taking more share



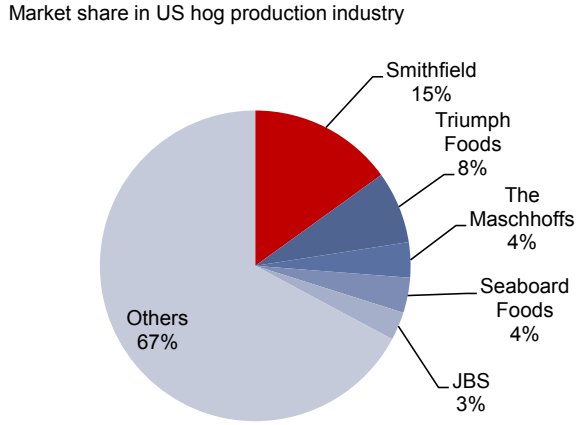
Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 182: Number of hogs by herd size, UK
A similar trend is observed in UK



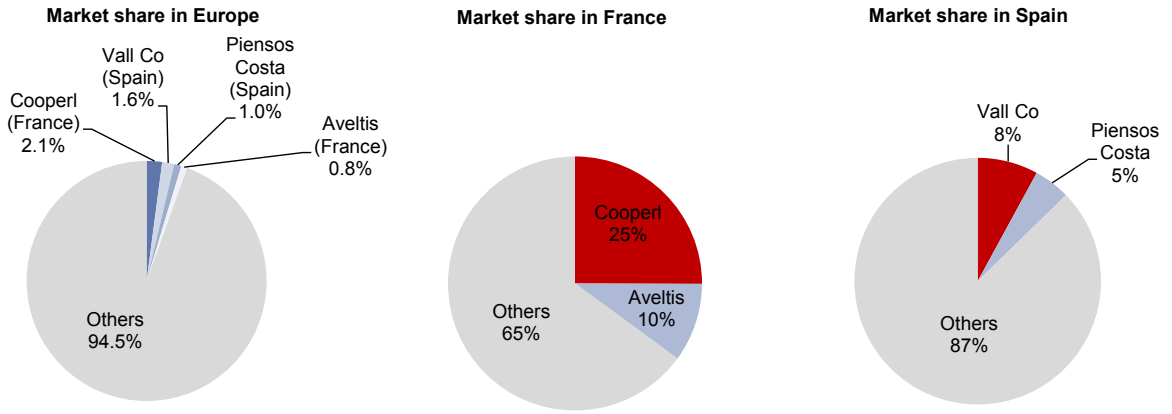
Source: Eurostat, Data compiled by Goldman Sachs Global Investment Research

Exhibit 183: US hog production industry is quite consolidated
Market share by number of sow inventory



Source: Company data, USDA

Exhibit 184: Market share by number of breeding sows
Overall concentration in EU is low, but could be high in a certain country



Source: Company data, Eurostat, Data compiled by Goldman Sachs Global Investment Research

What could explain the different degree of concentration?

Apart from the general trend of concentration, we note a different degree of concentration among US and different countries in the EU with the US having the highest degree of concentration. Hog production in developed countries in Europe is also quite concentrated, while new members in the EU, i.e. less developed countries, exhibit a lower degree of concentration.

We try to identify the key factors affecting speed and degree of concentration:

(1) Economic development levels: We observe a correlation between economic development (measured at GDP per capita) and concentration in hog farming. The hypothesis is that higher economic development enables leading companies to spend more in R&D, leading to higher concentration.

(2) Agriculture population: In countries with relatively large agriculture populations, like Romania, Poland, and China, the level of concentration is lower. Workers in countries with a higher population in agriculture could find it difficult to exit farming and find jobs elsewhere, hence slowing the pace of concentration.

(3) Political and social factors: We note that the overall concentration in Europe is quite low, which may be attributed to large producers finding it difficult to establish subsidiaries in other countries. Each country likely has a desire to maintain a reasonable level of self-sufficiency in pork. In comparison, China and the US are large, united countries which enable hog producers in a certain provinces/states to expand to other provinces/states.

Regulatory concerns are also influencing the pace of concentration. If governments indicate a willingness to file anti-trust actions to protect small farmers, then large operations could find it more difficult to expand.

(4) Capital support to expansion & acquisition: Access to capital markets could provide an engine for leading companies to grow through capacity expansion and

acquisition. For example, Smithfield has been a listed company since 1987 and has gained capital support through its acquisitions. In comparison, the largest hog producers in the EU are not listed.

(5) External factors: In the case of Poland, we note that post EU accession, the country increased its imports of feeder pigs and pork from countries with higher efficiency like Denmark. Not only did total hog inventory decrease significantly, it also reduced the profitability of domestic hog operations, hindering their expansion.

Exhibit 185: Smithfield issued equity to finance many of its acquisitions
Smithfield's acquisitions

Time	Target	Target info	Consideration
Horizontal expansion			
1982	Gwaltney	US competitor in pork processing	NA
1995	John Morrell	US competitor in pork processing	$25mn cash + $33mn stock (1.1 mn shares)
1996	Lykes	US competitor in pork processing	$34.8mn cash + $10.6mn ST debt
1998	North Side	US competitor in pork processing	Issuing 0.46mn shares
International expansion			
1998	Societe Bretonne de Salaisons	Pork producer in France	NA
1998	Schneider Corporation	Pork producer in Canada	2.5mn shares of SFD Canada
Vertical integration			
1992	Brown's of Carolina, Inc.	US hog production company	NA
1999	Carroll's Foods	US hog production company	Issuing 4.2mn shares
2000	Murphy Family Farms	US hog production company	Issuing 22.6mn shares

Source: Company data

Analyzing the degree of concentration from the above angles, we hypothesize that the US has the highest level of concentration with many supportive factors, while developing EU nations have a large farmer population, are relatively difficult for foreign players to enter, lack major leading companies and capital market support, and have exposure to external factors such as growing imports that are disrupting domestic supply.

In the case of China, the farmer population is large, but it is declining as urbanization continues. It is relatively easy to expand geographically, and there are a few leading companies with capital market support. So we think the degree of concentration in China could be much higher in the long term, even reaching the level of the US and developed EU countries.

African Swine Fever - What's the impact on industry structure?

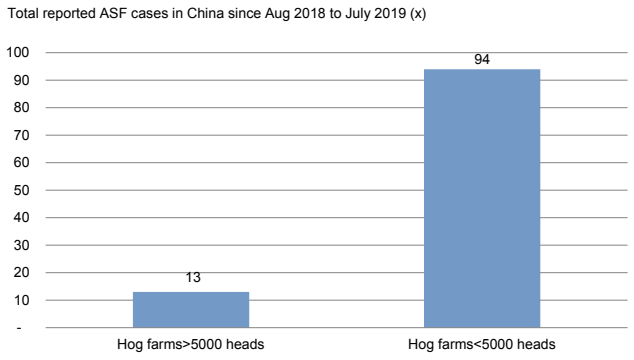
Large hog producers are better positioned to protect against ASF. From the cases reported by the Ministry of Agriculture, it appears that small-size hog farms have been hit more frequently by ASF. Among the 107 ASF cases reported, 13 are from farms with less than 5000 head inventory, while nine cases are from those with more than 5000 head. A plausible explanation is that large scale farms are more industrialized and have standardized procedures for feeding, catering, and transporting pigs.

We think large scale hog farms would be better positioned to guard against potential ASF infection with investments in ASF protection. Industry leaders like Wens Foodstuff and Muyuan Foods are renovating their hog farms by: (1) separating the production and selling facilities to prevent contact with potential external carriers of the ASF virus; (2) installing automated feeding systems and high-temperature sterilization facilities; (3) install ventilation systems. According to management, these extra investments could cost Rmb0.5-1.0/kg averaged to the number of pigs produced. In comparison, small operations, like those with inventories of less than 500 sow, are spending less on ASF protection, <Rmb0.5/kg, according to our channel checks. Based on the above observations, we think small-scale producers and backyard farms would be more severely impacted by ASF, while large operations are relatively better able to protect themselves.

A certain portion of the reduced capacity is likely permanent, leaving space for industry leaders to expand. We learned that a certain portion of the reduced capacity in live hog production is from small farmers who may have difficulty resuming capacity expansion due to an aging labor force and tough financial conditions, even if hog price increase in the future. **(1) Aging labor force.** Our interviews with industry contacts indicated that some farmers older than 50 plan to exit the labor-intensive industry, resulting in permanent loss in supply. **(2) Tough financial conditions.** Against the backdrop of ASF, some small producers who were affected by ASF have reduced their sow inventory by more than 50%. Due to a lack of government subsidies and losses from ASF affected pigs, many small scale hog producers are suffering from severe losses. We met one hog producer in Henan who had 200 sows two years ago, and had only 10-20 head as of May 2019. He indicated that he suffered from substantial losses, owed a lot of debt, and was not in a position to add back capacity. Generally speaking, in the absence of government support, it will likely be difficult for these producers to replace their capacity.

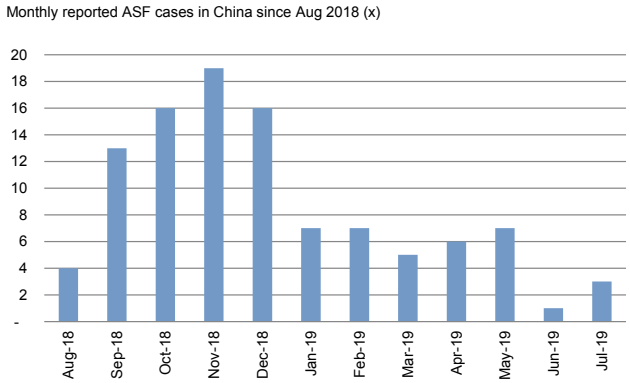
We estimate that such permanent capacity loss might account for 10-15% of reduced capacity in the industry, or 2-3% of total production capacity in China, which leaves space for large scale producers to expand.

Exhibit 186: Number of reported ASF cases in 2019 YTD, by hog inventory
Small size hog farms are 6x more likely to be affected



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 187: Monthly reported ASF cases - China
Reported cases has been decelerating, yet there were conflicting information suggesting disease is not fully under control



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

International comparison: Eradication requires long-term effort

African Swine Fever was first reported outside of Africa in Portugal in 1957. The disease then spread to Spain and France in 1960s. With no vaccine for the disease, eradication of ASF in many Western EU countries took more than ten years. In 2007, ASF spread to Europe again in Georgia, and quickly spread to a few Eastern Europe countries, including Romania, Russia, Poland, etc. These countries still have not managed to eradicate ASF.

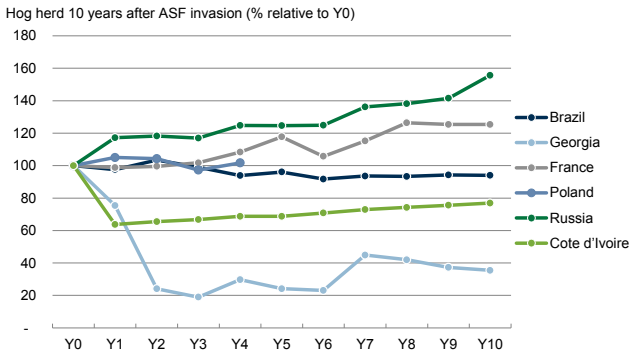
Countries affected by ASF have taken various measures to fight the virus including culling infected pigs, upgrading bio-security standards for hog production facilities, etc. In most countries, ASF did not result in a prolonged loss in hog herds, while in the case of Georgia, hog stocks remained 60% below levels prior to ASF introduction for ten years.

Exhibit 188: Eradication of ASF is generally a long term effort

Country	First case reported	Official announce of eradication	Years of endemic
Portugal	1957	1999	42
Spain	1960	1995	35
France	1964	1974	10
Brazil	1978	1984	6
Georgia	2007	Still exists	NA
Russia	2007	Still exists	NA
Poland	2014	Still exists	NA

Source: OIE

Exhibit 189: Hog stock 10 years after ASF invasion
In the worst case of Georgia, hog stock remained 60% below level prior to ASF introduction



Source: FAO, Data compiled by Goldman Sachs Global Investment Research

Case study on Russia: Consolidation of pork production under the spread of ASF

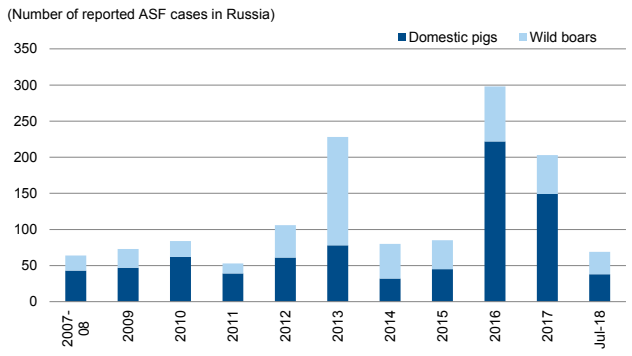
ASF spread to Russia in 2007 and the country has seen a series of outbreaks since then. Wild boars are a key carrier of the virus. There have been over 1,000 cases of ASF spread through its vast land area (probably finally into China). We try to analyze the impact of ASF to hog supply and prices in Russia. Key conclusions:

(1) ASF related import bans have caused fluctuations in hog prices. Russia banned imports of pork from EU in Feb. 2014 and hog price rallied, though the rally faded as domestic production increased.

(2) Outbreaks of ASF did not result in a structural shortage of hogs in Russia. On the contrary, pork production in Russia has been steadily increasing since 2007, as large operations expanded their capacity very quickly. These large operations in Russia are generally vertically integrated, from feed supply to production of pork. Through industrial production and strict control of production processes, they appear to have kept themselves free of ASF.

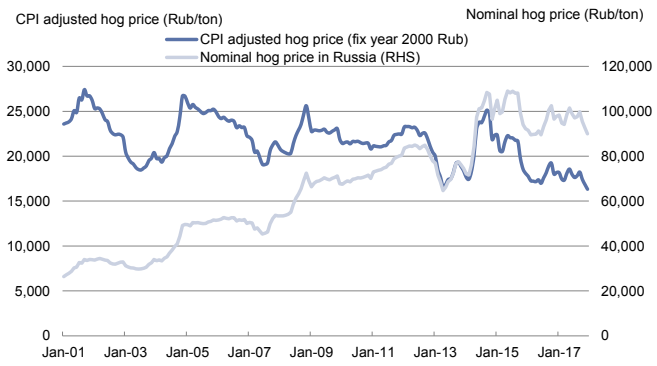
(3) Large pork producers have gained significant market share. Large integrated producers are presumably better positioned to protect against ASF, while smaller producers and backyard farms have been severely affected. From 2011 to 2018, the Top-10 producers in Russia have generally increased their pork production by 100-200% and have doubled their market share.

Exhibit 190: Number of reported ASF cases in Russia
Russia has seen an outbreak of ASF since 2007



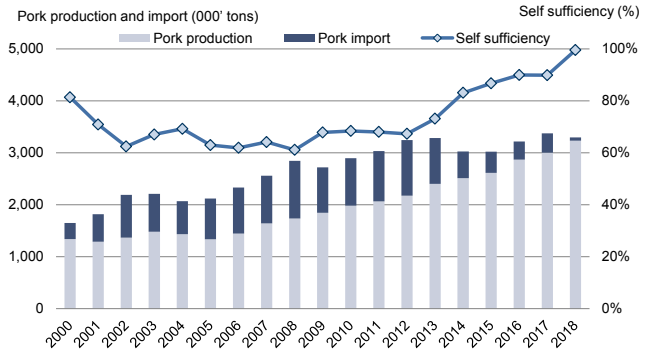
Source: OIE, Data compiled by Goldman Sachs Global Investment Research

Exhibit 191: Nominal and CPI adjusted hog price in Russia
Russia has not seen a structural increase in hog price



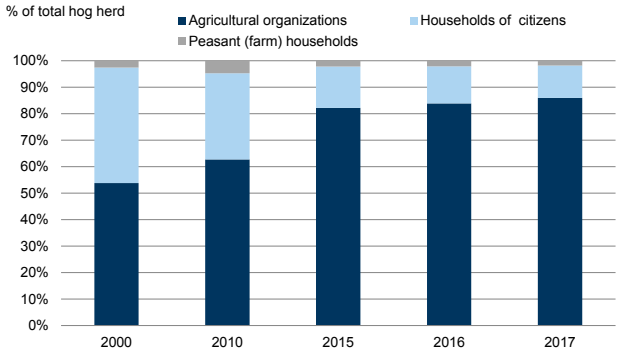
Source: Rosstat, Data compiled by Goldman Sachs Global Investment Research

Exhibit 192: Pork production and import of Russia
Russia has steadily ramp up domestic pork production



Source: USDA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 193: Hog inventory by type of enterprise
Hog inventory at agriculture organizations has increased vs. household



Source: FSSS, Data compiled by Goldman Sachs Global Investment Research

Exhibit 194: Production and market share of top pork producers in Russia
Large pork producers in Russia have gained significant market share

		2011		2018	
		Pork production live weight	Market share	Pork production live weight	Market share
		000' tons	%	000' tons	%
1	Miratorg	144.8	5.1%	422.3	10.2%
2	Cherkizovo	101.0	3.5%	250.1	6.1%
3	Agro Belgorje	106.0	3.7%	219.4	5.3%
4	Rusagro	63.0	2.2%	218.5	5.3%
5	Velikoluskiy	NA	NA	215.8	5.2%
6	AgroProm Komplektatsia	NA	NA	192.5	4.7%
7	Agroeko	NA	NA	159.3	3.8%
8	Agrarian Group	61.0	2.1%	150.0	3.6%
9	Kopitaniya	60.0	2.1%	107.6	2.6%
10	Agro Industrial Holding	NA	NA	104.5	2.5%
	Top 10			2,040.0	49.4%

Source: National Union of Swine Producers

China sub-sector 2: Feed

Chinese animal feed demand has entered a slow growth stage — we estimate total feed demand to grow at 1% CAGR in the coming years. We prefer the aqua feed segment which should deliver higher growth rates versus others going forward. With significant potential for product upgrades, both from higher growth potential in high-end aqua products, and product upgrades in pellet feed to extruded feed, leaders in the aqua-feed industry can enjoy product mix upgrades and margin expansion.

Total volume of industrial feed has entered a slow-growth stage: The total production volume of industrial feed in China entered a slow-growth stage in 2013 (low single digit growth), as the higher penetration of industrial feed is offset by an improving feed conversion ratio and increasing self-supply of feed. Further room for industry volume to expand resides in an increase in industrial feed penetration (industrial feed as a percentage of intrinsic feed demand), which is relatively high in poultry (97%) and swine feed (c. 40%) while still low in aqua feed (c.30%) and ruminant feed (c.10%). These levels are much lower compared with developed countries (50-100% for the US, EU and Japan). We expect higher industrial feed penetration in the next few years, especially in aqua feed and ruminant feed, driven by increasing industrialization and consolidation in downstream sectors.

Fragmented competitive landscape suggests room for consolidation: The livestock feed industry in China is very fragmented, with the top-five players accounting for 15% market share, compared with 30% in US. We see further room for consolidation in the feed industry, driven by consolidating downstream sectors, as well as the cost advantages of industry leaders.

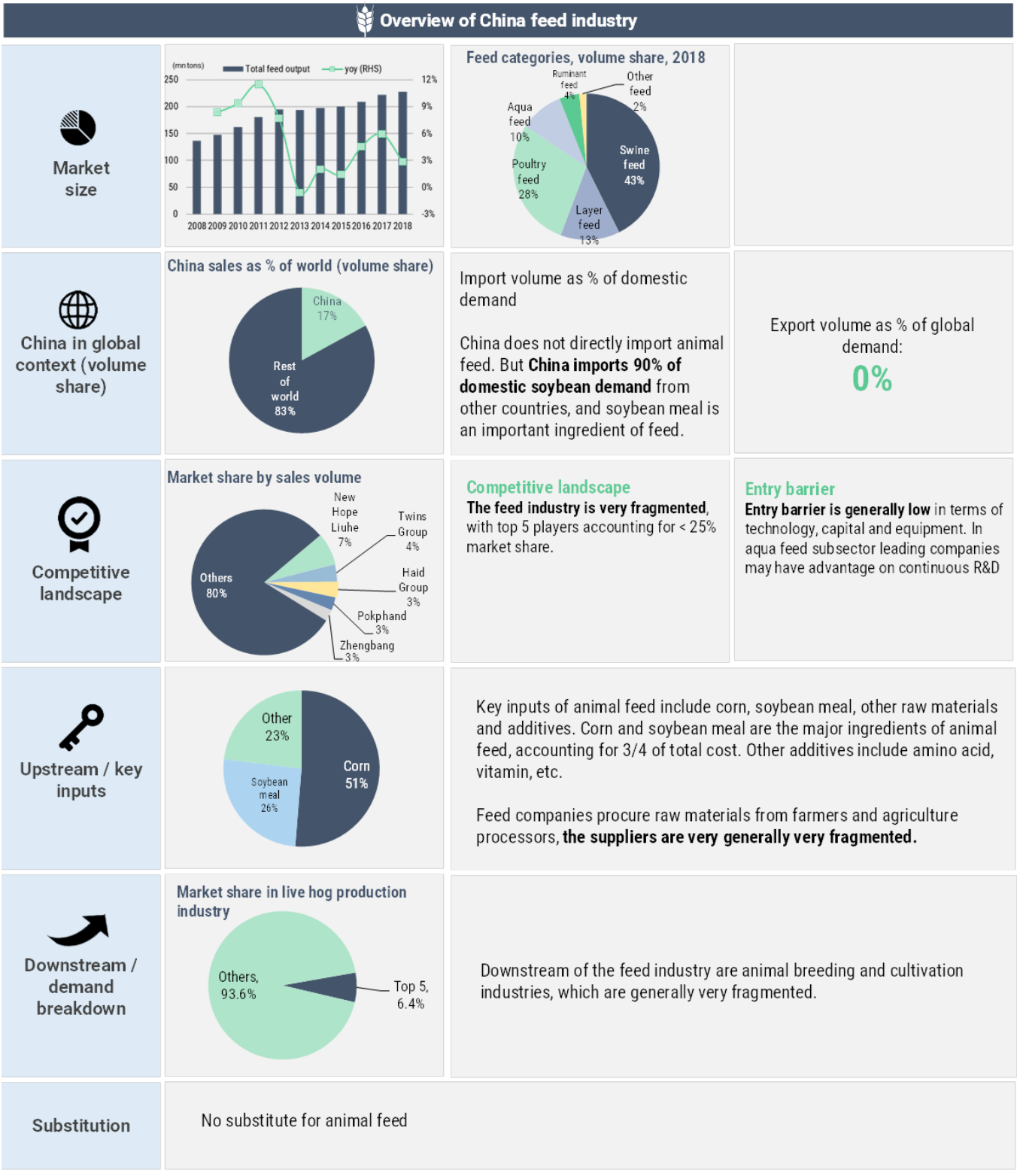
Look for differentiation in a commoditized industry: The feed industry is generally a commoditized business in a mature stage with relatively low value-add, especially in areas like swine feed and poultry feed. However, in the aqua feed sector, leading companies can make higher margins due to:

(1) Product upgrades. Currently, conventional pellet feed is still the major type of aqua feed, accounting for roughly 86% of total feed sales volume. As the aquaculture industry industrializes, we see higher penetration for extruded feed and advanced extruded feed (for high end fish) given better qualities compared with pellet feed, such as easier digestion for aquatic animals and a lower likelihood of disease and parasite infection, etc.

(2) Product mix up-shift: Carp and Crucian are the most common fresh water fish in China, accounting for c. 70% of production volume. As consumers grow wealthier their demand on special aquatic animals is growing, as demonstrated by higher volume growth in categories such as perch, mandarin fish, crayfish, etc. For example, production volume of freshwater perch increased at 14% in 2011-2017, vs. 2% for carp. Crayfish, which has become a popular food in younger demographics, enjoyed 20% and 30% volume growth in 2017 and 2018.

(3) Better product quality: Aquatic animals have many subcategories, their biological characteristics vary widely and require product research specific to each category. Thus companies with consistent investment in R&D and better product quality would likely be in a position to charge a higher premium.

Exhibit 195: China feed industry overview



Source: Goldman Sachs Global Investment Research

Industrial feed - growth ahead, but decelerated rate

The total volume of industrial feed still has room to grow given relatively low penetration. Yet the production volume of feed entered a slow-growth stage in 2013

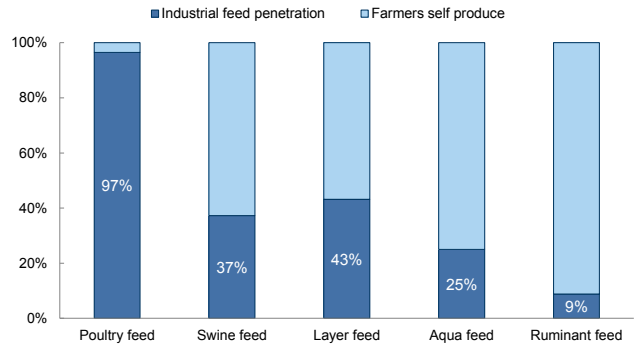
Industrial feed refers to feed produced by companies and sold to animal breeding and cultivation operations and does not include feed used by farmers or feed used internally used by animal breeding and cultivation companies. The total volume of industrial feed still has room to grow given relatively low penetration. Yet the production volume of feed entered a slow-growth stage in 2013, as a higher penetration of industrial feed is offset by an improving feed conversion ratio and an increasing self-supply of feed. We see several key trends regarding China's feed industry:

(1) Increase in industrial feed penetration as downstream industries concentrate: Currently industrial feed penetration is high for the poultry industry, relatively lower for swine and low for aquatic animals and cattle / sheep. As downstream industries concentrate, as we analyzed with live hog production, the use of industrial feed would tend to increase.

(2) Improving feed conversion ratio: Large industrialized animal cultivation companies tend to have higher efficiency and consume less feed per animal live weight. This works negatively on total feed demand but the impact is limited as the room for feed conversion improvement is c.10%.

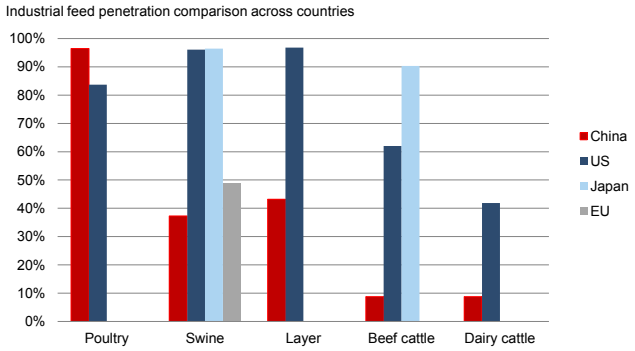
(3) Increasing self-supply of feed. There is a growing trend with large animal production companies supplying feed for themselves, as in the case of Wens Foodstuff and Muyuan Foods. But as these industry leaders still account for small market share (Top-5 hog producers accounted for 6.5% of market share in 2018), the impact on total industrial feed demand is limited.

Exhibit 196: Industrial feed penetration - China
Industrial feed penetration is still low for most feed categories



Source: China Industrial Feed Association, Goldman Sachs Global Investment Research

Exhibit 197: Industrial feed penetration - China vs. global
Industrial feed penetration in developed countries are quite high



Source: China Feed Industry Association, AFIA, IFIF, Goldman Sachs Global Investment Research

Look for differentiation in a commoditized industry

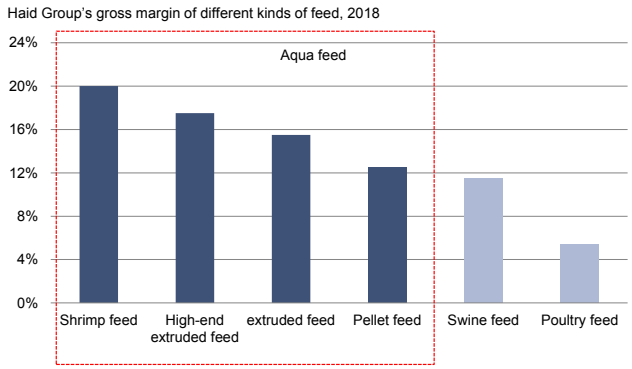
The feed industry is generally a commoditized business in a relatively matured stage with low value-add, especially in categories like swine feed and poultry feed. As reflected in companies' gross margins, swine feed generally earns c.10% margin, and poultry feed only c.5%. However, there are also paths to differentiate. For example, in the aqua-feed sector, leading companies can make higher margins due to product upgrades, category expansion, and better product quality.

Product upgrades: Currently conventional pellet feed is still the major type of aqua feed, accounting for 86% of total feed sales volume. Compared with pellet feed, extruded feed has better qualities, such as easier digestion for aquatic animals and a lower possibility of disease and parasite infection, etc. As the aquaculture industry industrializes, extruded feed and high-end extruded feed may gain more market share.

Category expansion: Carp and Crucian are the most common fresh water fish in China, accounting for c. 70% of production volume. As consumers grow wealthier, demand for high-end aquatic product is growing, as demonstrated by higher volume growth in categories such as perch, mandarin fish, crayfish, etc. For example, production volume of freshwater perch increased at 14% in 2011-2017, vs. 2% for carp. Crayfish as a new popular food for the younger demographic, enjoyed 20% and 30% volume growth in 2017 and 2018. We think growing demand for high-end aquatic products would drive sales volume for (high-end) extruded feed, which is used in feeding high-end aquatic products.

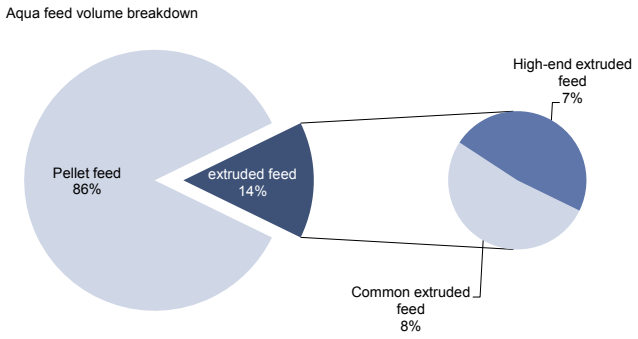
Better product quality: Aquatic animals have many subcategories with many different kinds of fish, shrimp, lobster, etc. Their biological characteristics vary widely and aqua feed product research is more difficult. Companies with better product quality are likely in a position to charge a higher premium.

Exhibit 198: Feed product gross margin of Haid Group
Aqua feed has higher margin than other feed products



Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 199: Aqua feed industry sales volume by category
High-end extruded feed still account for a small share in the industry



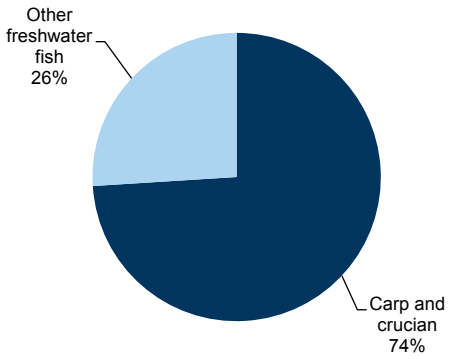
Source: China Aquatic Product Cultivation, Data compiled by Goldman Sachs Global Investment Research

Exhibit 200: Comparison of aqua feed categories

Category	Introduction
Pellet feed	Conventional aqua feed, typically used in feeding carp fish
Extruded feed	Using extrusion technique and high temperature processing to process the feed. This technique (1) Making it easier for aquatic animals to digest protein and starch; (2) Sterilize the feed to prevent disease and parasite. Currently the adoption is high in feeding tilapia.
High-end extruded feed	Extruded feed that's used for special aquatic categories with higher economic value, such as mandarin fish and perch.

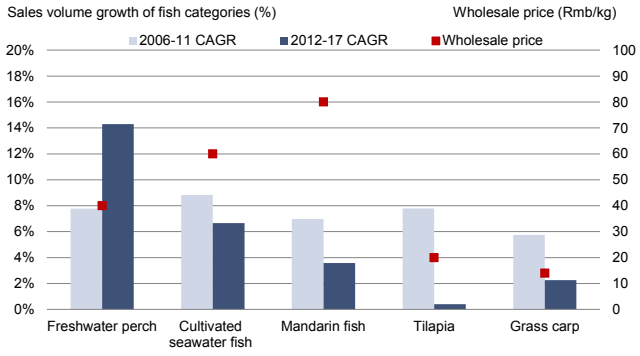
Source: Goldman Sachs Global Investment Research

Exhibit 201: Cultivated freshwater fish production volume
Carp and crucian still account for the majority of fish production volume



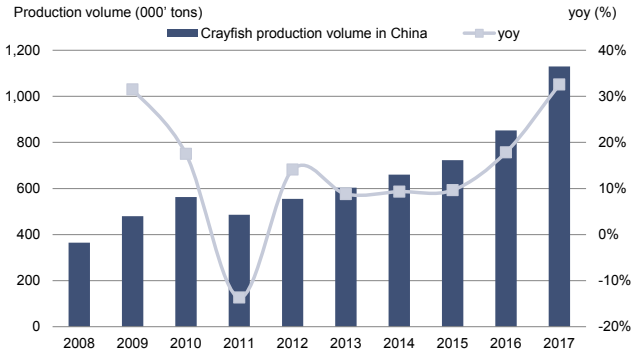
Source: China Aquaculture Yearbook

Exhibit 202: Production volume growth of fish categories
High-end fish enjoyed faster volume growth than conventional fish (carp)



Source: China Aquaculture Yearbook, Data compiled by Goldman Sachs Global Investment Research

Exhibit 203: Crayfish volume enjoyed rapid growth in past several years
Production volume of crayfish



Source: Ministry of Agriculture of China, Data compiled by Goldman Sachs Global Investment Research

China sub-sector 3: Animal health

We see product upgrades and ASP improvement in the China animal vaccine industry

The animal health industry in China, or more specifically, the animal vaccine industry, is relatively concentrated with high entry barriers. We see structural product upgrades and ASP growth in the animal vaccine industry including: 1) the gradual exit of mandatory vaccination policies; and 2) consolidation trends in the livestock production industry which are leading to calls for higher vaccine quality, which would correspondingly bring higher ASPs. We expect companies that have leadership in product quality and persistent spending in R&D as beneficiaries of the changing animal health industry.

Relatively concentrated industry with high entry barriers: China's animal health industry had c.Rmb50bn in revenues as of 2017, c.70% was chemical drugs and c. 30% was bio-pharmaceuticals, with revenue of Rmb13.5bn. This section of our report focuses on the bio-pharmaceuticals animal sector (vaccines), which have relatively a higher concentration compared with other agriculture sub-sectors, with theTop-10 players accounting for 56% market share. Entry barriers are quite high and include licensing, technology, and talent. Manufacturers of animal vaccines are required to follow GMP (Good Manufacturing Practices) and obtain animal drug manufacture licensing for factories from the Ministry of Agriculture as well as documents and licensing for each animal drug to be launched. For example, for FMD (Foot and Mouth Disease) vaccine, the regulatory body has only issued eight animal drug manufacture licenses.

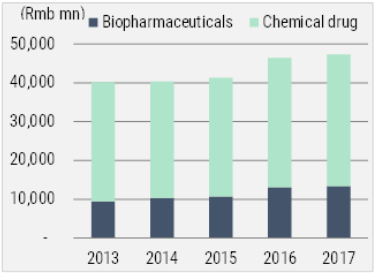
The shift from government tender to market purchase drives product quality improvements. The Ministry of Agriculture has required mandatory vaccination for several key animal diseases since 2012, for the purpose of supporting small producers and farmers through the protection of their livestock from herd losses. Yet in the wake of the policy, many challenges including reports of fraud and low product quality have surfaced. The government exited mandatory vaccination policies for Porcine Reproductive and Respiratory Syndrome (PRRS) and Classic Swine Flu in 2017. We think the direction of policy reform is toward market oriented procurement of animal vaccines, where pricing is determined by supply and demand instead of the government. In such a system, buyers could demand higher quality vaccines which would benefit leaders with quality advantages and ongoing investment in R&D.

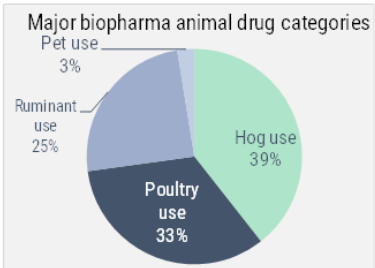
Consolidation of downstream provides sources of ASP growth. Government tenders for vaccines are mainly distributed for free to small producers and farmers, while large livestock producers would purchase vaccines at two to three times the price of government tenders. In addition, small scale operations / backyard farms tend to spend less on animal drug and vaccines (1% of COGS according to NDRC), while large operations could spend up to 10% of COGS per head on drug and vaccines. As we expect the consolidation of the livestock cultivation sector to be an ongoing theme in the next few years, major animal vaccines also have potential to increase ASP.

Exhibit 204: Overview of China animal health industry

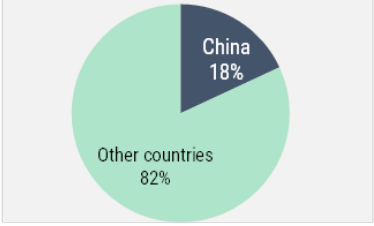
Overview of China animal health industry

Market size





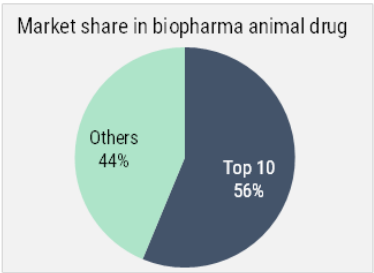
China in global context (volume share)



Import value as % of domestic sales: **5%**

Export value as % of global sales: **1%**

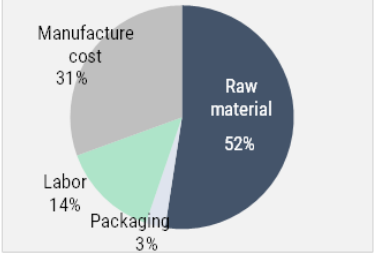
Competitive landscape



Competitive landscape
The biopharma animal drug industry is quite consolidated, top 10 players account for 50%+ market share.

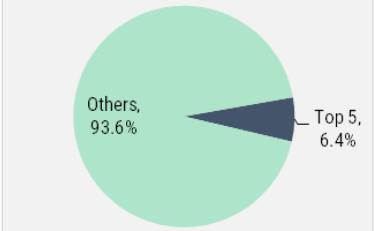
Entry barrier
Biopharma animal drug industry has **high entry barrier**, including **license, technology, talent**, etc.

Upstream / key inputs



Upstream / suppliers of animal drug companies are suppliers of chemicals and raw materials, equipment and others. For biopharma industry, which is R&D intensive and high value-add, **the gross margin is generally 50%+**

Downstream / demand breakdown



Downstream of the industry are farmers and breeding and cultivation companies. Take the live hog industry as example, the industry is very fragmented with top 3 players accounting for < 5% market share. So **downstream players are very fragmented.**

Substitution

Animal drug is a critical input to animal breeding and cultivation operators. **New technology may be considered as substitutes for existing technology.** For example, new forms of vaccine include synthetic peptide vaccine, DNA vaccine, etc.

Source: Goldman Sachs Global Investment Research

Industry background

According to The International Federation for Animal Health (IFAH), the revenue size of global animal health industry was $32bn in 2017, with China's animal health industry totaling $7.1bn, accounting for 18%. Roughly 70% of revenues in China's animal health industry came from chemical drugs with the remaining c.30% coming from bio-pharmaceuticals, totaling $2.0bn in revenue size (Rmb13.5bn) as of 2017. Demand for bio-pharma animal health in China is mainly driven by livestock, with 39% of revenue from hogs, 33% from poultry, and 25% from ruminant animals. In terms of disease, Foot and Mouth Disease (FMD) and Asian Highly Pathogenic Avian Influenza (HPAI/Avian Flu) are among the major animal diseases requiring vaccines.

Relatively concentrated industry with high entry barriers

As shown in the above chart, the bio-pharmaceutical animal health industry is quite concentrated, with the Top-10 players accounting for 50%+ of market share. The entry barriers to the industry are relatively high as companies need to have relevant licenses, technology, and talent. Manufacturers of animal vaccines are required to follow GMP (Good Manufacturing Practices) and obtain animal drug manufacture licenses for factories from the Ministry of Agriculture as well as documents and licenses for each animal drug to be launched (see below). Take the FMD vaccine as an example. According to the World Organization for Animal Health (OIE), Foot and Mouth Disease (FMD) is a severe, highly contagious viral disease in livestock with a significant economic impact. The disease affects cattle and swine as well as sheep, goats, and other cloven-hoofed ruminants and is categorized as one of the most severe animal diseases. The China's regulatory body only issued seven manufacture licenses for FMD vaccines prior to 2015. In 2013, Shanghai Hile (603718.SS, NC) cooperated with Biogénesis Bagó S.A., a world leading FMD vaccine producer in Argentina, to establish a JV in China. However, it took almost five years from establishing JV, building a factory, obtaining GMP and necessary licenses, to finally launch the JV company's first FMD vaccine. This case reflects the relatively high entry barriers in the bio-pharmaceutical animal drug industry as licensing can be a lengthy process requiring considerable investment.

Exhibit 205: Regulations and approvals for animal drug manufacturers

Regulation	Regulation (CN)	Content
GMP regulation (Good Manufacturing Practices)	兽药生产质量管理规范制度	New animal drug company must obtain GMP qualification before applying for manufacture license.
Animal drug manufacture license	兽药生产许可证制度	Animal drug companies need to have relevant staff, operation and equipment, and obtain license from Agriculture Bureau, which is valid for 5 years.
Document for registered animal drug	兽药产品批准文号制度	Approval for a specific animal drug, issued by Agriculture Bureau, and valid for 5 years. After expiration, companies may file for document renewal.
License for new animal drug	新兽药证书	Applicant should apply for new animal drug license after clinical trial is completed

Source: Ministry of Agriculture

Shift from government tender to market purchase

Background of mandatory vaccinations

The Ministry of Agriculture has required mandatory vaccinations for several animal disease since 2012, including FMD, Classic Swine Flu, Porcine Reproductive and Respiratory Syndrome (PRRS), Avian Flu, etc. The purpose of the policy was to support small producers and farmers to protect their livestock from diseases. In such practice, the government would procure vaccines and distribute for free to farmers. The procurement of vaccines takes the form of bidding and the bid price is predetermined by the government. Meanwhile, relatively large producers would purchase vaccines from manufacturers or distributors, usually at much higher prices (2-3 times) than the government tender, for better quality vaccines.

What challenges surfaced in the wake of the policy?

First, constrained by low prices, the quality of vaccines tended to decline and many lacked efficacy, resulting in wasted resources and ineffective vaccinations. Second, media reports have indicated some cases of companies resorting to corrupt practices to win certain bids. Third, distribution systems in local areas tended to lack effectiveness, due to low efficiency, lack of cold-chain facilities, etc. This resulted in wasted resources as well.

Solution: Gradual government exit from mandatory vaccinations, market purchases increase

To address the series of problems noted above, in 2017, the Ministry of Agriculture exited mandatory vaccination of PRRS and Classic Swine Flu, while FMD and Avian Flu are still on mandatory vaccination list. For PRRS and Swine Flu, the government encourages hog farms to procure vaccines at their discretion, and then apply for subsidies, subject to certain requirements like having disease protection certificates and the ability to store vaccines.

What is the impact of exiting mandatory vaccinations?

We think the shift from government procurement to market purchase would benefit vaccine companies with better product quality and sustainable R&D.

The government's exit of mandatory vaccinations for PRRS and Swine Fever has resulted in a 50%+ sales decline in hog use mandatory vaccines in 2017. Listed companies with large exposure to government purchased vaccines suffered revenue declines of 10-15% in 2017. For example, animal vaccine revenue of China Animal Husbandry Industry (600195.SH, Not Covered) declined 10% in 2017 due to lower revenue from PRRS and Swine Flu vaccines. For FMD, the mandatory vaccination policy is still in place, but the government is starting to experiment with market purchases and subsidies for qualified producers. The exit of mandatory vaccination creates room of growth for market purchased vaccines. As vaccines are purchased at a company's discretion, animal farms that can afford higher prices may demand better quality vaccines. We think the shift from government procurement to market purchase would benefit vaccine companies with better product quality and sustainable R&D.

Exhibit 206: Key regulations regarding Mandatory vaccination of animals

Mandatory vaccination of animals	
2007	The government started procuring vaccines of Swine Fever and PRRS, and distribute to farmers for free
2012	The government required mandatory vaccination for several diseases: ● Foot and Mouth Disease (FMD) ● Porcine Reproductive and Respiratory Syndrome (PRRS) ● Asian highly pathogenic avian influenza (HPAI) ● Classic Swine Flu, etc.
2012	In mandatory immunization, local government would purchase vaccines from suppliers at pre-determined price, much lower than market purchase, and distribute for free to farmers.
2017	Formally exit mandatory vaccination for PRRS and swine fever. Hog operators can procure vaccines first and apply for subsidy from government. FMD and Avian Flu is still mandatory immunized

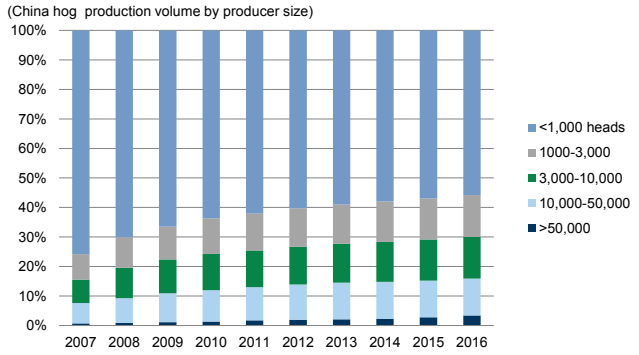
Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Consolidation of downstream provides source of ASP growth

The livestock raising industry in China is extremely fragmented and consists of many small-scale operations and backyard farms. But concentration is already happening, as seen in the live hog industry. We think concentration in the livestock raising industry is beneficial to animal drug companies, as small scale operations / backyard farms tend to spend less on animal drugs and vaccines (1% of COGS), while large operations could spend up to 10% of COGS per head on drug and vaccine. Also, small-scale operations / backyard farms tend to use government distributed vaccines, while large operations tend to purchase vaccines, at two to three times the price of government purchased prices. According to our estimates, the penetration of market purchased FMD vaccines was 20-30% in 2018, while government tenders accounted for 70-80%.

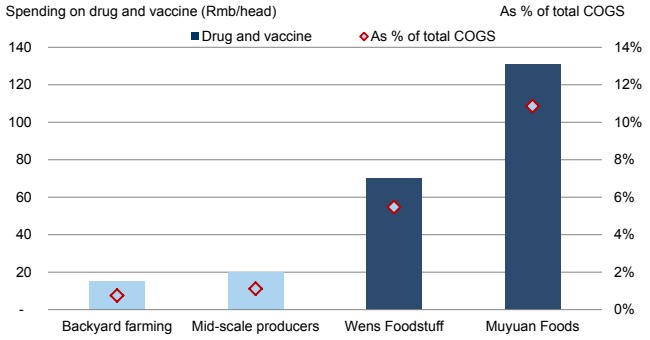
As analyzed in above, we see a concentration in the hog industry as a persistent trend in the next few years, contributing to structural growth in market purchased vaccines and ASP growth in the animal vaccine industry. As we forecast industry leaders in the live hog production industry like Wens Foodstuff and Muyuan Foods to expand their hog output by 100-200% by 2025E, with market share expanding from current 2-3% to 6-7%, the size of market purchased vaccines has the potential to increase 100%+ in the same period.

Exhibit 207: Number of hog production by herd size
Hog industry in China has been concentrating to large operations



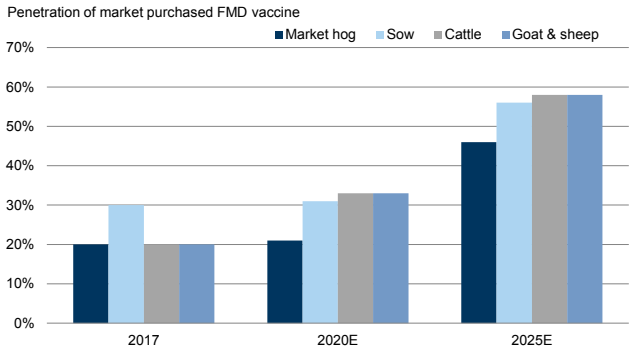
Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 208: Drug and vaccine spending per head
Large scale operations spend much more drug and vaccine per head



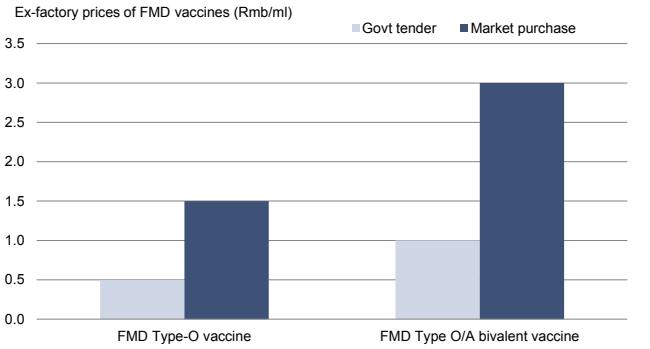
Source: Company data, NDRC, Data compiled by Goldman Sachs Global Investment Research

Exhibit 209: Penetration of market purchased FMD vaccine
We expect penetration of market purchased FMD vaccine to increase



Source: Goldman Sachs Global Investment Research, China Veterinary Association

Exhibit 210: ASP of Jinyu Bio-Technology's FMD vaccine (Ex-factory)
Market purchased vaccine has higher ASP



Source: Company data

China sub-sector 4: Seeds

Seed is a key segment that will drive the future non-input based productivity growth in the agriculture sector. We see R&D and product quality as key factors to drive market share expansion for industry leaders

China's hybrid seed industry is still fragmented compared with the US, and is a key segment that will drive the future non-input based productivity growth in the China agriculture sector. We see R&D and product quality as key factors to drive market share expansion for industry leaders. The barriers for seed companies are quite high with long R&D cycles, and once the advantage is established, it has tended to be difficult for competitors to catch up. Despite near-term cyclical pressures including grain destocking in China dragging revenue growth for seed companies, we believe leaders in the hybrid seed industry can recover with better product offerings.

R&D and product quality underscores differentiation: The focus of this section is mainly the hybrid crop seed production sector, which is an R&D heavy business. A successful product could take five to six years of R&D, from choosing a parent plant,to producing hybrid descendants, and applying for the necessary approvals. The key to R&D is germplasm resources, which refers to the variety crop parent types with different biological characteristics. The more diversified a company's resources, the higher the probability that the company can produce better quality hybrid seeds. We think companies with continuous spending on R&D have higher potential to produce better products and could thus gain more market share.

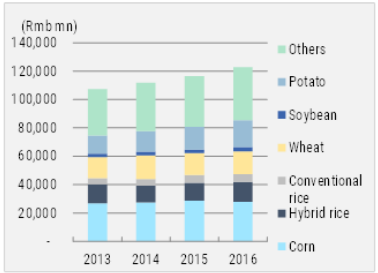
Still a fragmented domestic market: The domestic seed industry is generally still fragmented, with a higher concentration in hybrid rice seed (Top-10 accounting for 40% market share) and lower in hybrid corn seed (Top-10 accounting for 20%). In comparison, the global seed industry is highly consolidated, dominated by a few large company's (Monsanto, DowDuPont, and Syngenta have 50%+ market share in total) with clear advantages in R&D. While the global seed industry is driven by R&D in GM (genetically modified) seeds, the domestic seed industry could share similar consolidation trends as industry leaders continue to spend on R&D and copyright protection improves in China.

Short-term cyclical pressure remains: Seed sales volume is highly correlated with planted acreage of relevant crops and crop prices. Especially for hybrid rice, i.e., when rice prices are lower, farmers tend to use less hybrid rice seeds, which are 50-60% more expensive than conventional seeds on a per hectare usage basis. As China is undergoing a destocking process for rice and corn, lower prices and reduced planted acreage still pose some near-term pressure on hybrid seed sales. However, we do not expect crop prices to materially decline given low profitability (almost zero in rice and corn, with labor accounting for as opportunity cost). We also do not expect corn planted acreage to have much room to decline, as corn in China is effectively in deficit on an annual supply/demand basis.

Exhibit 211: Overview of China seed industry

Overview of China seed industry

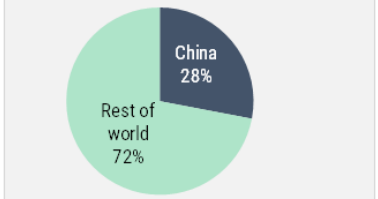
Market size



The seed industry in China is growing at a slow pace, at c. 5% CAGR. Major crops like rice and wheat have reached ceiling in terms of consumption volume, and seed volume growth potential is limited.

For pricing, seed cost as % of total agriculture cost in China is still low compared with US.

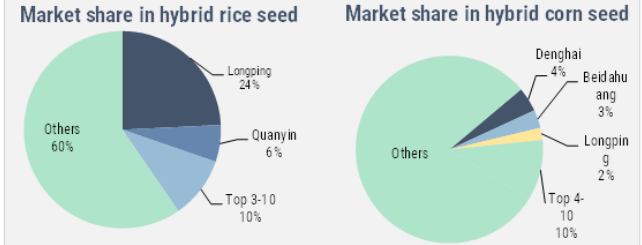
China in global context



Import value as % of domestic sales: **4%**

Export value as % of global sales: **0%**

Competitive landscape



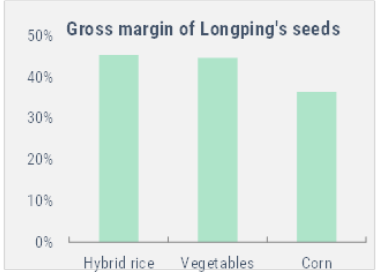
Competitive landscape

The seed industry is overall fragmented, while concentration is higher in hybrid rice seed sub-segment.

Entry barrier

Entry barrier is relatively high as good product quality relies on R&D, and R&D cycle of seeds can be 5-6 years long.

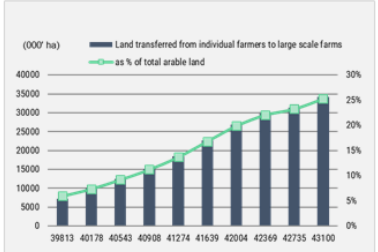
Upstream / key inputs



There are three production models for seed companies: **(1) self-production**: companies lease lands, where companies incurs the cost of land and materials, such as fertilizers and pesticide; **(2) Cooperate with production base**, in which case a mgmt. feed is paid to production base; **(3) Outsource to large scale producers**, in which case production cost is pre-determined in contracts.

The suppliers of seed companies are very fragmented and low value-add. Hence, gross margin of seed companies are quite high.

Downstream / demand breakdown



Downstream of seed industry are distributors and farmers. **The downstream is very fragmented**, as unit farm size in China is very small.

As the % of land transfer has been growing, there are **more large scale farms** in China, which **may demand higher quality seeds.**

Substitution

Hybrid seeds and conventional seeds maybe considered as substitutes. GM seeds maybe considered substitutes for hybrid seeds/conventional seeds, subject to policies.

Source: Goldman Sachs Global Investment Research

R&D and product quality underscores differentiation

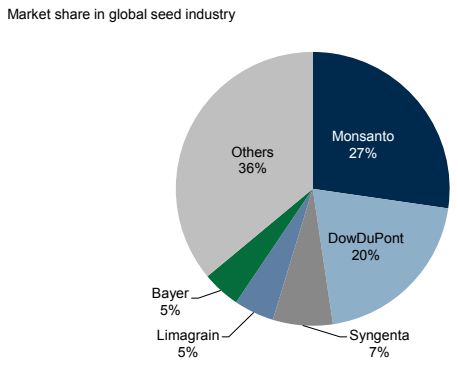
Seeds are one of the most important sources of yield improvement for crops. Over the past decades, global leaders in seeds have been using genetically modified (GM) technology or hybrid technology to produce seeds that have better biological characteristics, like higher yield, resistance to insects or pesticide, etc. As GM planting organizations is still debatable in China, seed companies in China mainly use hybrid technology to produce better seeds.

While global seed industry is dominated by a few leading companies, the seed industry in China is still very fragmented. We think the seed industry in China still has potential to concentrate given high entry barriers, which is underscored by germplasm resources and R&D investment.

Germplasm resources: Germplasm resources are the variety of parent types that a company owns, with different biological characteristics. Hybrid seed R&D is based on the germplasm resources. The more diversified a company's resources, the higher the probability that the company can produce better quality hybrid seeds.

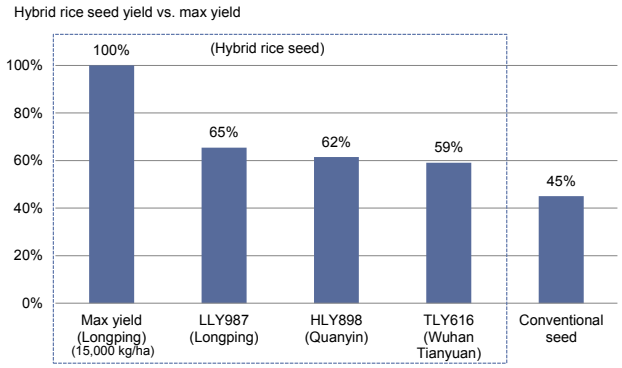
R&D investment: R&D investment is key to producing better quality seeds. Most domestic companies still under spend in R&D (in terms of R&D spending as percentage of revenue) compared with international leaders. Moreover, R&D of a successful hybrid seed could take five to six years, from choosing a parent plant, to producing hybrid descendants, and applying for the necessary approvals. We think companies with continuous R&D spending have a higher potential to produce better products, and could thus gain more market share.

Exhibit 212: Market share in global seed industry
Global seed industry is dominated by a few leaders



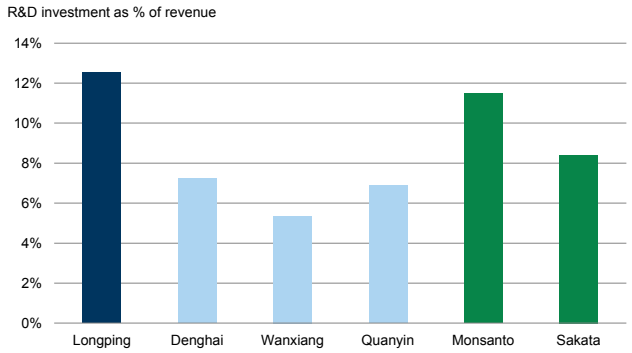
Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 213: Yield comparison vs. max yield of hybrid rice seed
Hybrid rice seed tend to have higher yield than conventional seed



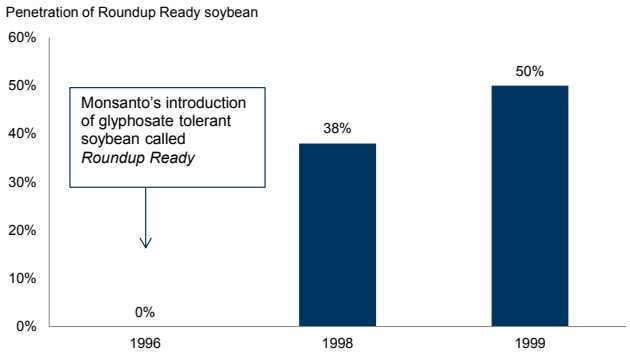
Source: Company data, Data compiled by Goldman Sachs Global Investment Research

Exhibit 214: R&D spending as % of revenue, 2018
Most domestic companies still lag international leaders in R&D spending



Source: Company data

Exhibit 215: Adoption of Monsanto's Roundup Ready soybean seed
A blockbuster seed product could enjoy significant increase in adoption



Source: National Center for Food and Agricultural Policy

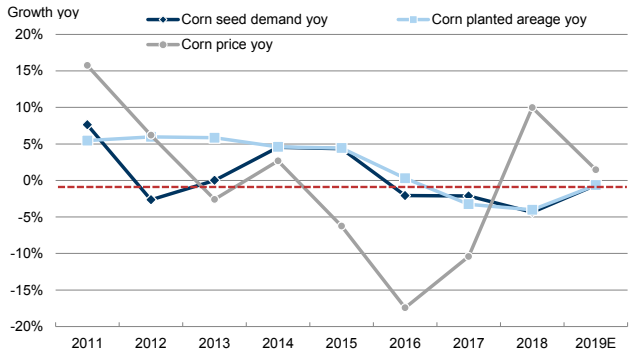
Short-term cyclical pressure remains

Seed sales volume is highly correlated with the planted acreage of relevant crops and crop prices. Especially for hybrid rice, for which the hybrid penetration is c.50%, farmers can trade-off between hybrid rice and conventional rice. When the rice price is lower, farmers tend to use less hybrid rice seeds, which are 50-60% more expensive than conventional seeds on a per hectare usage basis.

As explained in the previous section, China is undergoing destocking process for rice and corn. The state minimum purchase price for rice was reduced by 2%/10% in 2017/2018, resulting in declining rice price and posing pressure in hybrid rice seed sales. The state minimum purchase price policy for corn was replaced with subsidy policies in 2016, and corn prices decreased by 17%/10% in 2016/17. Accordingly, Denghai Seeds (002041.SZ, Not Covered), with 90%+ revenue exposure to corn seed sales, experienced a revenue decline of 50% in 2017.

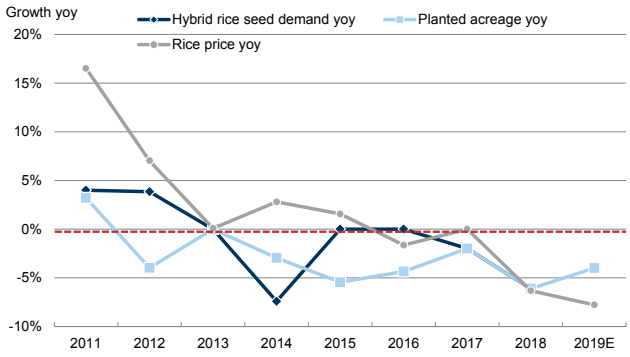
In the near term, cyclical headwinds still remain for the seed industry as rice prices arestill declining (-10% YTD) and the planted acreage of corn is being adjusted downward (-1% yoy for 2019) by reduced subsidies. However, we do not expect rice prices to materially decline further, given low profitability (almost zero). We also do not expect corn planted acreage to have much room to decline, as corn in China is effectively in deficit on an annual supply demand basis.

Exhibit 216: Hybrid rice seed demand vs. rice price
Hybrid rice seed demand negatively impacted by lower rice price



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Exhibit 217: Corn seed demand growth vs. corn price
Corn seed demand experience negative growth in 2016-17 due to lower corn price



Source: Ministry of Agriculture, Data compiled by Goldman Sachs Global Investment Research

Stock picks: China and global

We initiate coverage of five Chinese agriculture stocks: 1) Wens Foodstuff (300498.SZ) with Buy and a target price of Rmb58.8/sh; 2) Muyuan Foods (002714.SZ) with Buy and target price of Rmb83.3/sh; 3) Guangdong Haid Group (002311.SZ) with Buy and target price of Rmb36.4/sh; 4) Jinyu Bio-Technology (600201.SS) with Neutral and target price of Rmb15.9/sh; and 5) Longping High-Tech (000998.SZ) with Neutral and target price of Rmb12.0/sh.

Our top picks are the two hog producers Wens Foodstuff and Muyuan Foods, as key beneficiaries of higher for longer hog prices on the back of ASF. Risks on the call are potential ASF infection; uncertainty in hog price and cost inflation, and uncertainty in sales volume.

On global basis, we also highlight positive views on major global protein players, including WH Group (0288.HK; Buy; 12-m TP of HK$10.1/sh), Tyson (TSN; Buy; 12-m TP of US$91.0), BRF (BRFS; Buy; 12-m TP of US$10.2/sh), Freedom Foods (FNP.AX; Buy, 12-m TP of A$6.2/sh), Tassal Group (TGR.AX; Buy; 12-m TP of A$5.5/sh), and feed additive company DSM (DSMN.AS; Buy; 12-m TP of EUR 125/sh).

Exhibit 218: Major agriculture peers - China and global

Company	Ticker	Rating	TP	Price	ccy	Mkt cap	PE			PB			ROE			EV/EBITDA		Div yield		YTD
Price as of 15-Jul-2019				Local		US$ mn	18A	19E	20E	18A	19E	20E	18A	19E	20E	19E	20E	19E	20E	%
Protein																				
Wens Foodstuff	300498.SZ	Buy	58.8	40.2	CNY	31,018	54	20	10	6.2	5.1	3.8	12%	28%	46%	15.1	7.7	1.8%	3.7%	53%
Muyuan Foods	002714.SZ	Buy	83.3	68.3	CNY	20,902	274	34	11	11.6	9.3	5.9	4%	31%	65%	26.3	10.2	0.9%	2.7%	138%
Zhengbang Tech	002157.SZ	NC	NA	19.4	CNY	6,857	243	24	7	7.2	5.5	3.2	3%	23%	45%	n.a.	n.a.	0.2%	0.6%	266%
Tech-bank Food	002124.SZ	NC	NA	13.6	CNY	2,284	n.a.	24	6	6.5	4.9	2.9	-21%	21%	46%	n.a.	n.a.	0.0%	0.0%	99%
Sunner Development	002299.SZ	NC	NA	26.3	CNY	4,735	22	12	12	4.2	3.3	2.7	22%	28%	24%	n.a.	n.a.	1.4%	1.4%	65%
Jiangsu Lihua	300761.SZ	NC	NA	51.4	CNY	3,017	14	16	13	4.5	3.1	2.5	37%	20%	19%	n.a.	n.a.	0.0%	0.0%	49%
Shandong Yisheng	002458.SZ	NC	NA	25.1	CNY	2,088	39	15	18	9.0	5.7	4.3	26%	39%	24%	n.a.	n.a.	0.0%	0.0%	198%
Average China protein peers							**108**	**21**	**11**	**7.0**	**5.3**	**3.6**	**12%**	**27%**	**38%**	**20.7**	**9.0**	**0.6%**	**1.2%**	**124%**
Tyson Foods Inc.	TSN	Buy	91.0	79.1	USD	29,953	13	13	11	2.3	2.0	1.8	26%	17%	17%	9.2	8.1	1.8%	2.1%	48%
Hormel Foods Corp.	HRL	Sell	31.0	41.2	USD	22,531	22	24	25	3.9	3.6	3.4	19%	16%	14%	16.6	16.6	2.0%	2.3%	-3%
Pilgrim's Pride Corp.	PPC	Neutral	26.0	26.0	USD	6,621	19	12	10	3.2	2.5	2.0	13%	24%	22%	7.5	6.4	0.0%	0.0%	67%
Sanderson Farms Inc.	SAFM	Neutral	143	129.8	USD	2,992	126	18	14	2.1	1.9	1.7	4%	11%	12%	8.0	6.3	1.0%	1.1%	31%
WH Group	0288.HK	Buy	10.1	8.0	HKD	14,767	15	12	11	2.0	1.8	1.6	12%	15%	16%	7.5	6.5	3.8%	4.4%	32%
JBS SA	JBSS3.SA	Neutral	20.5	23.9	BRL	17,910	n.m	10	8	2.6	2.0	1.6	0%	22%	22%	6.2	5.4	0.0%	0.0%	106%
BRF SA	BRFS	Buy	10.2	8.7	USD	7,174	n.a.	n.a.	19	3.9	4.2	3.5	-49%	-5%	20%	15.4	9.0	0.0%	1.3%	52%
COFCO Meat	1610.HK	NC	NA	2.1	HKD	1,057	n.a.	11	6	1.8	1.5	1.1	-4%	15%	24%	8.5	4.4	0.0%	0.0%	48%
Freedom Foods	FNP.AX	Buy	6.2	5.0	AUD	874	55	62	31	2.1	1.9	2.0	3%	3%	7%	23.7	16.3	1.0%	1.8%	8%
Tassal Group	TGR.AX	Buy	5.5	4.8	AUD	502	16	14	12	1.4	1.4	1.3	9%	10%	11%	8.8	7.2	3.8%	4.6%	7%
Average Global protein peers							**39**	**14**	**13**	**2.7**	**2.4**	**2.1**	**3%**	**14%**	**18%**	**9.9**	**7.8**	**1.1%**	**1.4%**	**48%**
Ag processors																				
Haid Group	002311.SZ	Buy	36.4	27.4	CNY	6,400	30	24	17	5.6	4.8	4.0	20%	22%	26%	15.7	11.6	1.3%	1.8%	18%
New Hope Liuhe	000876.SZ	NC	NA	19.4	CNY	11,889	48	26	15	3.8	3.3	2.8	8%	13%	18%	n.a.	n.a.	1.2%	1.5%	167%
Beijing Dabeinong	002385.SZ	NC	NA	4.7	CNY	2,928	39	23	10	2.0	2.0	1.7	5%	9%	18%	n.a.	n.a.	1.1%	1.5%	51%
Shenzhen Kingsino	002548.SZ	NC	NA	11.2	CNY	705	n.a.	29	6	n.a.	2.8	2.0	-18%	10%	32%	n.a.	n.a.	1.4%	5.8%	67%
Tangrenshen Group	002567.SZ	NC	NA	12.5	CNY	1,514	78	22	8	3.1	2.9	2.5	4%	12%	25%	n.a.	n.a.	1.5%	3.7%	122%
Average China feed peers							**49**	**24**	**11**	**3.6**	**3.1**	**2.6**	**4%**	**13%**	**24%**	**15.7**	**11.6**	**1.3%**	**2.9%**	**85%**
Bunge	BG	Neutral	64.0	55.8	USD	8,063	20	20	14	1.4	1.3	1.3	4%	7%	10%	9.1	7.7	3.8%	4.1%	4%
ADM	ADM	Buy	50.0	40.8	USD	23,625	12	13	10	1.2	1.2	1.1	10%	9%	11%	9.0	7.8	3.4%	n.a.	0%
C. P. Pokphand	0043.HK	NC	NA	0.7	HKD	2,118	63	69	69	n.a.	11.5	9.9	14%	17%	18%	n.a.	n.a.	0.7%	1.4%	7%
Chubu Shiryo	2053.T	NC	NA	1,294	JPY	364	10	11	11	n.a.	n.a.	n.a.	0%	0%	0%	n.a.	n.a.	2.0%	2.0%	5%
Feed One	2060.T	NC	NA	194	JPY	355	8	11	11	n.a.	n.a.	n.a.	0%	0%	0%	n.a.	n.a.	2.3%	2.3%	9%
Average global feed peers							**23**	**25**	**23**	**1.3**	**4.7**	**4.1**	**6%**	**7%**	**8%**	**9.0**	**7.8**	**2.4%**	**2.5%**	**5%**
Animal health																				
Jinyu Bio-Technology	600201.SS	Neutral	15.9	15.0	CNY	2,586	23	29	25	3.5	3.2	3.0	16%	12%	12%	21.4	18.5	1.4%	1.5%	-10%
China Animal Husbandry	600195.SS	NC	NA	15.7	CNY	1,378	23	22	19	2.4	2.1	1.5	11%	11%	9%	n.a.	n.a.	2.3%	2.7%	48%
Tianjin Ringpu Bio-Tech	300119.SZ	NC	NA	13.1	CNY	769	45	28	21	2.6	2.4	2.2	6%	9%	11%	n.a.	n.a.	1.6%	2.3%	76%
Pulike Biological	603566.SS	NC	NA	13.2	CNY	619	32	30	24	2.6	2.5	2.3	n.a.	n.a.	n.a.	n.a.	n.a.	1.9%	1.1%	15%
Average China animal health peers							**31**	**27**	**22**	**2.8**	**2.5**	**2.3**	**11%**	**10%**	**11%**	**21.4**	**18.5**	**1.8%**	**1.9%**	**32%**
Zoetis	ZTS.N	NC	NA	113.3	USD	54,237	36	33	29	24.9	20.4	15.0	77%	69%	58%	22.9	20.8	0.6%	0.6%	33%
Elanco	ELAN.N	NC	NA	33.3	USD	12,182	28	30	26	2.3	2.3	2.2	7%	8%	9%	19.3	16.8	0.6%	0.7%	6%
DSM	DSMN.AS	Buy	125.0	114.7	EUR	22,330	20	21	19	2.6	2.6	2.5	15%	12%	13%	11.3	10.1	2.1%	2.3%	60%
Average global animal health peers							**32**	**31**	**28**	**13.6**	**11.3**	**8.6**	**42%**	**38%**	**33%**	**21.1**	**18.8**	**0.6%**	**0.6%**	**19%**
Seeds																				
Longping Hi-Tech	000998.SZ	Neutral	12.0	13.6	CNY	2,628	23	29	23	2.6	2.5	2.3	12%	9%	10%	20.8	17.8	1.2%	1.5%	-8%
Denghai Seeds	002041.SZ	NC	NA	9.2	CNY	1,170	248	83	56	2.9	2.8	2.6	1%	3%	5%	n.a.	n.a.	n.a.	n.a.	73%
Sakata Seeds	1377.T	Buy	4,200	3,440	JPY	1,431	27	23	24	1.6	1.5	1.5	6%	7%	6%	14.1	13.1	1.0%	1.1%	2%
Average seed peers							**78**	**37**	**29**	**2.2**	**2.1**	**2.0**	**8%**	**7%**	**8%**	**17.5**	**15.4**	**1.1%**	**1.3%**	**19.3%**

Source: Datastream, FactSet, Goldman Sachs Global Investment Research, Gao Hua Securities Research

Wens Foodstuff (300498.SZ) - Buy with target of Rmb58.8/sh

Exhibit 219: Key financial summaries - Wens Foodstuff

Company	Wens Foodstuff Group 温氏股份	Rating	Buy
Ticker	300498.SZ	Target price CNY	58.8
Core operations	Live hog and chicken	Share price CNY	40.1

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	Rmb mn	59,355	55,657	57,244	69,807	88,860	101,472
yoy	%	23%	-6%	3%	22%	27%	14%
Gross margin	%	28%	20%	17%	24%	32%	32%
NP	Rmb mn	11,790	6,751	3,987	10,670	22,303	25,725
EPS	Rmb/sh	2.71	1.29	0.75	2.01	4.20	4.84
YoY	%	58%	-52%	-42%	168%	109%	15%
ROE	%	43%	21%	12%	27%	44%	38%
ROIC	%	39%	18%	10%	23%	36%	32%
OCF	Rmb mn	14,653	7,994	6,494	12,233	24,744	28,476
ICF	Rmb mn	(8,580)	(8,765)	(8,501)	(8,080)	(8,002)	(8,572)
Implied PE	x	14.8	31.0	53.5	20.0	9.6	8.3

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Initiate at Buy. We initiate Wens Foodstuff at Buy with a 12-m TP of Rmb58.8/sh, implying 46% upside.

Company background: Wens Foodstuff is one of the largest live hog and chicken producers in China, with 3% market share in live hog production and 11% market share in the live chicken production industry as of 2018. The company is located in Guangdong, and 47% of its 2018 revenue was from Guangdong and Guangxi. Its business model is "company + farmer", meaning the company is responsible for producing feeder pigs and supplying feed, while the farmers are responsible for raising the animals.

Investment thesis: (1) Significant earnings growth in the protein upcycle. We think the company is going to benefit from higher hog and chicken prices in the near term and a more sustainable hog price upcycle, as shortages in pork supply impact the larger protein space. We also expect rising cash flow to significantly improve the balance sheet, from net debt of Rmb1.6bn in 2018 to net cash of Rmb12.8bn in 2020E. (2) Steady market share gain. We are positive on the company's potential to gain share in a fragmented market, driven by cost advantage and stable capacity expansion.

Valuation: We value Wens Foodstuff using 14x P/E applied to 2020E earnings, and our 12-m TP of Rmb58.8/sh implies 47% upside. With the stock trading at 10x 2020E P/E, we think this does not fully reflect potential upside and sustainability of the hog price and thus we initiate at Buy.

Key risks: (1) lower than expected live hog and chicken prices; (2) lower-than-expected sales volume; (3) higher than expected crop prices; (4) potential ASF infection.

Muyuan Foods (002714.SZ) - Buy with target price of Rmb83.3/sh

Exhibit 220: Key financial summaries - Muyuan Foods

Company	Muyuan Foods	牧原股份	Rating		Buy
Ticker	002714.SZ		Target price	CNY	83.3
Core operations	Live hog		Share price	CNY	68.9

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	Rmb mn	5,606	10,042	13,388	22,368	34,469	44,854
yoy	%	87%	79%	33%	67%	54%	30%
Gross margin	%	46%	30%	10%	23%	41%	41%
NP	Rmb mn	2,322	2,366	520	4,251	12,872	17,347
EPS	Rmb/sh	2.25	2.04	0.25	2.04	6.17	8.32
YoY	%	95%	-9%	-88%	717%	203%	35%
ROE	%	51%	26%	4%	28%	61%	54%
ROIC	%	23%	12%	4%	19%	36%	37%
OCF	Rmb mn	1,282	1,787	1,358	4,246	13,329	17,968
ICF	Rmb mn	(3,866)	(6,441)	(5,781)	(6,400)	(7,700)	(8,299)
Implied PE	x	30.7	33.8	276.3	33.8	11.2	8.3

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Initiate at Buy. We initiate Muyuan Foods at Buy with TP of Rmb83.3, implying 21% upside.

Company background: Founded in 1992 in Henan Province, Muyuan Foods has been focusing on hog raising business for nearly 30 years. The company is the No.2 hog producer in China, with 2% market share as of 2018. The company's internal cultivation model gives it full control over the hog production process, from the breeding herd to market hogs.

Investment thesis: (1) Positive earnings momentum. We expect Muyuan Foods to benefit from the hog price upcycle in China for multiple years, driving unit net profit of market hog from Rmb0.1/kg in 2018 to Rmb2.7/kg in 2019E, Rmb7.1/kg in 2020E, and Rmb7.5/kg in 2021E. We expect the strong earnings and cash flow to significantly improve the company's gearing in the next two years, from 65% in 2018 to 27% in 2020E.

(2) Strong potential to gain market share and cost advantage. We are positive on Muyuan's potential to gain share in the fragmented live hog production industry. Thanks to leading techniques in breeding and large-scale industrial production, Muyuan Foods has the lowest unit production cost in the industry (c. Rmb11.5/kg in 2018 vs. smaller players Rmb13-15/kg), which we think is a sustainable advantage.

Valuation: We value Muyuan Foods using a PE multiple of 13.5X to 2020E earnings, to reflect a sustainable hog price upcycle over the next two years. 13.5X PE multiple is derived from a 10% discount to Wens Foodstuff's mid cycle PE, to reflect the higher volatility of Muyuan's earnings.

Key risks: (1) lower-than-expected hog prices; (2) lower-than-expected sales volume; (3) potential ASF infection

Guangdong Haid Group (002311.SZ) - Buy with target price of Rmb36.4/sh

Exhibit 221: Key financial summaries - Haid Group

Company	Guangdong Haid Group 海大集团	Rating	Buy
Ticker	002311.SZ	Target price	CNY 36.4
Core operations	Feed	Share price	CNY 27.8

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	Rmb mn	27,185	32,557	42,157	49,438	59,239	71,513
yoy	%	6%	20%	29%	17%	20%	21%
Gross margin	%	9%	11%	11%	11%	12%	12%
NP	Rmb mn	856	1,207	1,437	1,839	2,617	3,457
EPS	Rmb/sh	0.56	0.77	0.91	1.16	1.65	2.19
YoY	%	9%	38%	19%	28%	42%	32%
ROE	%	16%	19%	19%	21%	25%	27%
ROIC	%	17%	17%	17%	17%	21%	23%
OCF	Rmb mn	1,142	494	1,036	1,972	2,568	3,460
ICF	Rmb mn	(996)	(1,071)	(2,006)	(1,820)	(1,745)	(2,495)
Implied PE	x	50.1	36.3	30.6	23.9	16.8	12.7

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Initiate at Buy. We initiate Guangdong Haid Group at Buy with TP of Rmb36.4, implying 33% upside.

Company background: Guangdong Haid Group is one of the top five feed companies in China, with 50% gross profit exposure to aqua feed. The company also produces swine feed and poultry feed and has an animal cultivation business including hog production.

Investment thesis: (1) Solid margins on structural growth drivers: Aqua feed comprises 35% of Haid's revenue and 50% of its gross profit. We expect Haid to benefit from product mix upgrades as consumers shift to high-end aquatic products and fish farmers upgrade to high-margin extruded feed from conventional pellets. We forecast a 19% revenue CAGR and a 34% profit CAGR in 2018-2021E, along with net margin improvement from 3.4% in 2018 to 4.9% in 2021E.

(2) R&D to drive product quality and share gains: Haid's R&D advances in aqua feed have played a key role in its market share gains. We expect the company's consistent investment in R&D to drive product quality and help consolidate its market position.

(3) Full value-chain service: In addition to feed products, Haid provides technical support, fish and shrimp seed supply, as well as animal health products. While these services represent incremental revenue opportunities, they should also support Haid's expansion into new regional markets and generate customer loyalty.

Valuation: Our 12m TP of Rmb 36.4 implies 33% upside (based on 22X 2020E EPS; 10-year avg.) and reflects sustainable earnings growth in 2019-21E (c.35% p.a.). Haid trades at 23.9X 2019E and 16.8X 2020E, which is attractive to us given its growth profile.

Jinyu Bio-Technology (600201.SS) - Neutral with target price of Rmb15.9/sh

Exhibit 222: Key financial summaries - Jinyu Bio-tech

Company	Jinyu Bio-Technology 生物股份		Rating		Neutral
Ticker	600201.SS		Target price	CNY	15.9
Core operations	Animal health		Share price	CNY	15.2

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	Rmb mn	1,517	1,901	1,897	1,525	1,717	2,004
yoy	%	22%	25%	0%	-20%	13%	17%
Gross margin	%	78%	79%	73%	70%	71%	71%
NP	Rmb mn	645	870	754	613	688	813
EPS	Rmb/sh	1.05	0.97	0.64	0.52	0.59	0.69
YoY	%	26%	-8%	-33%	-19%	12%	18%
ROE	%	22%	21%	16%	11%	12%	13%
ROIC	%	17%	19%	14%	10%	11%	12%
OCF	Rmb mn	756	891	422	725	901	1,046
ICF	Rmb mn	(383)	(2,099)	(125)	(305)	(257)	(301)
Implied PE	x	14.5	15.7	23.6	29.0	25.8	21.9

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Initiate at Neutral. We initiate Jinyu Bio-Technology with a Neutral rating and TP of Rmb15.9, implying 6% upside.

Company profile. Jinyu Bio-Technology ("Jinyu") is the leader in China's animal health industry, with c.60% market share in market-purchased Foot-and-Mouth Disease (FMD) vaccines as of FY18. Roughly 90%+ of Jinyu's revenue comes from FMD vaccines sales, of which c.30% comes from government tenders with the remaining 70% comprised of market purchases from livestock producers and distributors.

Investment thesis: (1) Positioned to maintain market share in the growing FMD vaccine industry: With 80-90% of its revenues from large-scale hog producers, we see Jinyu benefiting from structural growth in the FMD vaccine industry driven by a consolidation trend in livestock production. As large producers expand operations, Jinyu should see increased demand for its high-quality, high-margin vaccines. And, with the highest spending on R&D among listed animal health companies in China, we expect to Jinyu to maintain market share with improved production techniques.

(2) Poised for volume recovery amid declining hog herds: We forecast Jinyu's revenue to decline 20% yoy in 2019 as average domestic hog herds decline 20%. However, as Jinyu's large-scale customers tend to invest more in ASF disease control and have higher bio security standards, we forecast a recovery in 2H20 with sales volume up 5% yoy in 2020E and 9% yoy in 2021E.

Valuation: We value Jinyu based on a PE multiple of 27X (in line with its 5-year historic average) applied to 2020E EPS, to reflect a mild recovery from 2020E. Out 12m TP of Rmb 15.9 implies 6% upside, and we therefore rate the stock Neutral.

Key risks: (1) lower than expected sales volume of FMD vaccine. (2) More intense competition in China animal healthcare industry.

Longping High-Tech (000998.SZ) - Neutral with target price of Rmb12.0/sh

Exhibit 223: Key financial summaries - Longping High-Tech

Company	Longping Hi-Tech	隆平高科	Rating		Neutral
Ticker	000998.SZ		Target price	CNY	12.0
Core operations	Hybrid seed		Share price	CNY	13.7

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	Rmb mn	2,299	3,190	3,580	3,929	4,406	4,863
yoy	%	14%	39%	12%	10%	12%	10%
Gross margin	%	41%	46%	44%	43%	43%	42%
NP	Rmb mn	501	772	791	624	788	880
EPS	Rmb/sh	0.40	0.61	0.60	0.47	0.60	0.67
YoY	%	-19%	54%	-2%	-21%	26%	12%
ROE	%	12%	13%	11%	8%	9%	10%
ROIC	%	8%	8%	9%	7%	8%	8%
OCF	Rmb mn	314	520	(14)	952	1,193	1,291
ICF	Rmb mn	(2,267)	(3,593)	764	(589)	(617)	(681)
Implied PE	x	34.4	22.3	22.8	29.0	22.9	20.5

Source: Goldman Sachs Global Investment Research, Gao Hua Securities Research

Initiate at Neutral. We initate Longping High-Tech at Neutral with TP of Rmb12.0, implying downside of 12%.

Company background: Longping High-Tech ("Longping") has been focused on the R&D of hybrid rice for more than 20 years. The company is the dominant player in China hybrid seed industry, with c.25% market share in hybrid rice seed and c.2% share in hybrid corn seed as of FY18. The company is also expanding into other seed categories like wheat, vegetables, etc., as well as agriculture service businesses.

Investment thesis: (1) Sustainable R&D investment and leading product quality: Longping High-Tech spends an average of 10x more on R&D than peers in the China's seed industry, and has better germplasm resources through years of accumulation and overseas acquisitions. The company has established a clear dominant position in the hybrid rice segment, and we believe the company's competitive advantage in the industry will facilitate its market share gain in fragmented hybrid corn segment in the near future.

(2) Improved growth prospects beyond 2020: While we see rice de-stocking and higher gearing creating an overhang on the revenue growth and margins through 2020, we expect the growth to rebound and margins to expand in 2021 and beyond as the company leverages its improved product positioning in corn and other product offerings.

Valuations: We value Longping on a P/E multiple of 20x (average trading multiple in 2018) on our 2020E EPS, to reflect the company's lower growth in the next 2 years vs. history. Our 12-month target price of Rmb12.0/sh implies 12% downside, and hence we rate the stock Neutral.

Key risks: uncertainties in policies regarding crops and seeds; more/less intense competition in the hybrid rice/corn seed industry; better/worse weather conditions.

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WH Group - Buy with target price of HK$10.1/sh

Exhibit 224: Key financial summaries - WH Group

Company	WH Group	Rating	Buy
Ticker	0288.HK	Target price	HKD 10.1
Core operations	Pork and live hog	Share price	HKD 8.0

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	US$ mn	21,534	22,379	22,605	24,153	26,129	26,900
yoy	%	2%	4%	1%	7%	8%	3%
Gross margin	%	20%	21%	20%	20%	19%	19%
NP	US$ mn	1,014	1,090	1,046	1,233	1,434	1,470
EPS	US$/sh	0.07	0.07	0.07	0.08	0.09	0.10
YoY	%	17%	7%	-4%	18%	16%	3%
ROE	%	15%	14%	13%	14%	14%	13%
ROIC	%	21%	25%	18%	18%	18%	17%
OCF	US$ mn	1,850	1,512	1,255	1,738	1,979	2,003
ICF	US$ mn	(141)	(784)	(1,217)	(714)	(560)	(607)
Implied PE	x	15.2	14.2	14.8	12.5	10.8	10.5

Source: FactSet, Goldman Sachs Global Investment Research

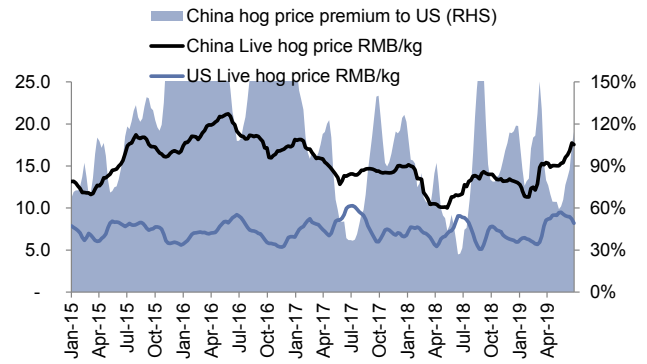
Company background. WH Group operates its pork business mainly in China, US and Europe. WH Group owns subsidiary companies of Henan Shuanghui Investment & Development Co. Ltd., the biggest packaged meat producer and slaughtering house in China, and Smithfield Foods, Inc., the biggest vertically integrated pork food company in US.

Investment thesis. China to drag profit margin but US recovery on track. We are Buy-rated on WH Group. We believe WHG is well positioned to benefit from the upcoming China hog price upcycle (net of US/China impact). As Chinese pork industry represents roughly 20% of global protein production, the potential 3-5% reduction to global protein will have far-reaching impact globally, which is also likely to keep global pork price at high levels and increase the US export demand from 2H. This is evidenced by the growth acceleration in pork exports from US to China in recent weeks along with the rally of hog prices in China, even though the 62% tariff is still in place. On US side, we expect double digit OP growth in 2Q, as hog production business is likely to reach US$20 plus profit per hog from rising hog prices, which was partially offset by the decline in slaughtering business due to currently weak pork price and negative packer margin. Going into 2H, we believe that rising export demand should also gradually lift US pork prices and packer margin. On China side, packaged meat margin is under pressure from rising input costs, but the company plans for more ASP hikes and higher imports to help mitigate the impact in 2H19. We expect these initiatives to help stabilize FY19 packaged meat margin at 17%.

Valuations: It is currently trading at 7.6X 2020E EV/EBITDA. Our 12-month target price is at HK$10.1, still based on SOTP EV/EBITDA in 2020E (unchanged multiple).

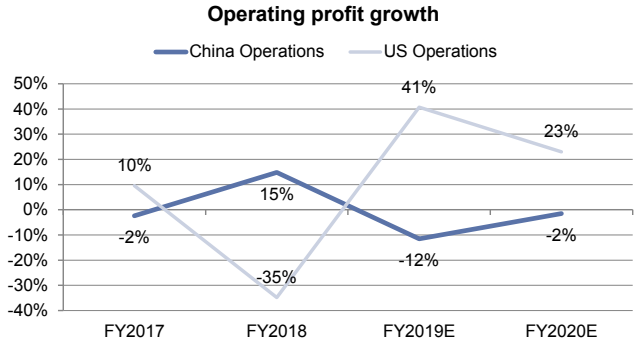
Key risks: ASF risks in US, disruption on China pork imports, higher-than-expected input costs in China.

Exhibit 225: US hog price softened recently, but we expect it to maintain at high levels due to a global shortage.



Source: Bloomberg, Wind

Exhibit 226: The improving US business will more than offset pressure in China business; overall we expect 9% growth for group operating profit in 2019E.



Source: Company data, Goldman Sachs Global Investment Research

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TSN: Buy with target price of US$91/sh

Exhibit 227: Key financial summaries - Tyson Foods

Company	Tyson Foods Inc.	Rating		Buy
Ticker	TSN	Target price	USD	91.0
Core operations	Protein provider	Share price	USD	81.8

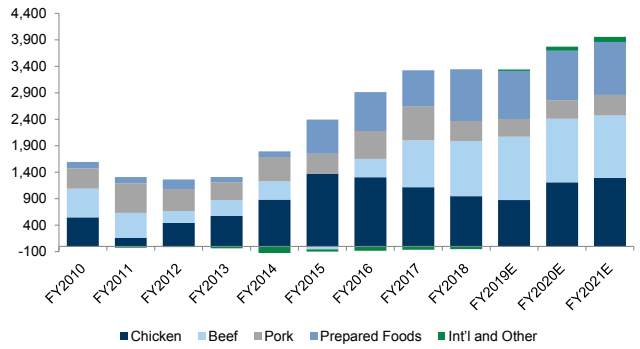
Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	US$ mn	36,881	38,260	40,052	43,835	45,706	46,384
yoy	%	-11%	4%	5%	9%	4%	1%
Gross margin	%	13%	14%	13%	12%	13%	13%
NP	US$ mn	1,714	1,966	2,273	2,250	2,576	2,747
EPS	US$/sh	4.39	5.31	6.16	6.15	7.08	7.89
YoY	%	37%	21%	16%	0%	15%	11%
ROE	%	18%	19%	19%	16%	17%	17%
ROIC	%	12%	11%	11%	10%	12%	12%
OCF	US$ mn	2,722	2,603	2,960	3,129	3,572	3,899
ICF	US$ mn	(684)	(4,164)	(1,906)	(3,466)	(1,200)	(1,200)
Implied PE	x	18.6	15.4	13.3	13.3	11.5	10.4

Source: Goldman Sachs Global Investment Research

US Protein leader, well positioned for ASF upside

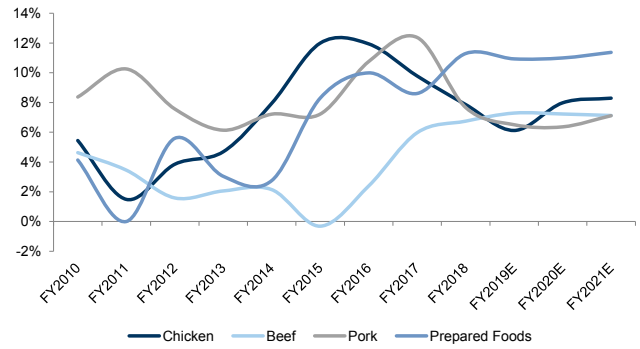
Company background: Tyson is the largest protein producer in the US, holding the #1 position in Chicken (vertically integrated), #1 in Beef, and #3 in Pork, with the company responsible for roughly 20% of all meat produced in the US. In addition to its slaughter and processing operations, TSN has a larger Prepared Foods business in the US serving both retail and foodservice markets, with leading brand positions in frozen breakfast, sausage, lunchmeat, hot dogs, and frozen/prepared poultry. Following the acquisitions of Keystone and BRF's Thai and European operations over the past twelve months, TSN also has developed a unique international footprint with production assets and foodservice customers across Asia.

Exhibit 228: We expect TSN's international segment to increase its contribution to operating income
TSN Operating income by segment (US$mn)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 229: We expect Chicken margins to recover with a normalization in prices
TSN Operating margins by segment



Source: Company data, Goldman Sachs Global Investment Research

Investment thesis: We are Buy-rated on TSN, where we see the company's portfolio diversity and balance across proteins providing the most attractive way for US large-cap investors to gain exposure to nascent protein industry inflation in the wake of African Swine Fever in China. We expect increased US exports of protein to help fill Chinese supply deficits (either direct or indirect) to drive both domestic US protein inflation across proteins but also improved business mix (notably in beef) to support TSN margins

in FY20. Importantly, we do not need to assume a return a prior peak margins in the Chicken business (GSe 8% in FY20 vs. 11.9% in FY16) to reach our above consensus FY20 estimates, with additional upside if productivity and operational improvement actions are successful.

Valuations: Against this backdrop, we see valuation at ~11.5x FY20 P/E as undemanding relative to a five-year average of 12.3x and protein peer HRL at 25.4x FY20. Our $91 12-month price target is based on equal blend of 13.0x Q5-Q8 P/E and 8.5x Q5-Q8 EV/EBITDA.

Key risks: involve (1) commodity price volatility, (2) acquisition integration, (3) litigation, and (4) trade disruptions.

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Goldman Sachs & Co. LLC

BRF (Buy): Buy with target price of US$10.2/sh

Exhibit 230: Key financial summaries - BRF

Company	BRF SA	Rating		Buy
Ticker	BRFS	Target price	USD	10.2
Core operations	Chicken producer	Share price	USD	8.8

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	US$ mn	9,680	10,482	9,451	8,327	8,866	9,264
yoy	%	0%	8%	-10%	-12%	6%	4%
Gross margin	%	22%	21%	15%	21%	25%	27%
NP	US$ mn	(107)	(352)	(1,217)	(78)	369	459
EPS	US$/sh	(0.13)	(0.43)	(1.50)	(0.10)	0.45	0.56
YoY	%	-112%	230%	246%	-94%	-571%	24%
ROE	%	-3%	-9%	-46%	-4%	19%	21%
ROIC	%	8%	2%	-12%	3%	10%	10%
OCF	US$ mn	1,940	653	(51)	887	4,135	4,168
ICF	US$ mn	(4,160)	(2,288)	(1,416)	805	(1,942)	(2,029)
Implied PE	x	(67.3)	(20.4)	(5.9)	(91.6)	19.4	15.6

Source: Goldman Sachs Global Investment Research

Best placed to benefit from higher chicken exports.

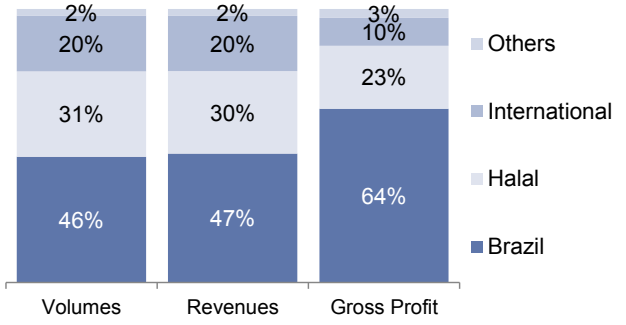
Company background. BRF is the largest chicken producer in Brazil, the second in the World and the largest global exporter. BRF business mix is equally split between the domestic market where the company has a large branded portfolio in cold cuts and frozen food and it international export division. The company is also the largest producer of pork and turkey in Brazil although primarily for internal consumption. The company has strong competitive advantages in Brazil, owing to its high market share through its Sadia and Perdigao brands (c.49% combined market share) and in the international business, most notably in the Middle East (c. 1/3 of the export business) where the company has both a local presence through its Sadia brand and is the larger exporter of Halal meat.

Investment thesis. We are Buy-rated on BRF as we see the company has leaving behind a challenging period of mixed execution, management turmoil and over-leverage. More specifically, between early 2017 and late 2018, BRF was negatively impacted by reduction in chicken exports due to various restrictions, which caused excess supply in the domestic market and, consequently, price deflation and margin pressure. We now see the company benefiting from an ongoing cyclical normalization in supply, higher pricing in both domestic and export market and renewed focus on balance sheet deleveraging. Importantly, ASF disruption in global supply should play into BRF's strength, given: (i) we view chicken as the most advantaged protein to benefit from growing demand and favorable substitution effect and higher prices; (ii) we expect greater export of chicken from Brazil into China (currently BRF has 5 plants authorized to export), expanding on the existing trade relationship while China still does not import from the US.

Valuations: We are Buy rated on BRF with a 12-month price target of R$40.0/US$10.15 based on a target 9.5x 2020E EV/EBITDA.

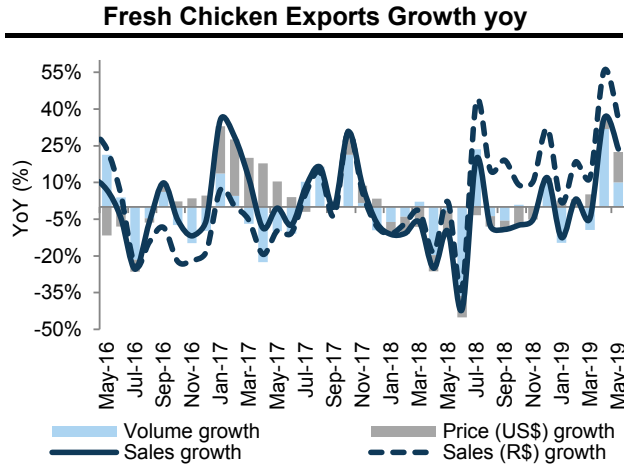
Key risks: The main downside risks to our estimates and price targets are weaker pricing recovery in export prices, sustained weak demand in processed food in Brazil and FX volatility.

Exhibit 231: BRF is the market leader in cold cuts and frozen food in Brazil and the largest global chicken exporter
BRF Business Split



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 232: Brazil chicken exports have returned to grow after a challenging period in 2017-18
Brazil Chicken industry exports



Source: Secex, Goldman Sachs Global Investment Research

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JBS (Neutral): Neutral with target price of BRL 20.5/sh

Exhibit 233: Key financial summaries - JBS

Company	JBS SA	Rating	Neutral
Ticker	JBSS3.SA	Target price	BRL 20.5
Core operations	Protein provider	Share price	BRL 24.6

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	R$ mn	170,381	163,170	181,680	192,948	198,390	202,295
yoy	%	5%	-4%	11%	6%	3%	2%
Gross margin	%	13%	15%	14%	15%	16%	16%
NP	R$ mn	376	603	25	6,374	7,950	8,402
EPS	R$/sh	0.14	0.22	0.01	2.37	2.98	3.15
YoY	%	-91%	57%	-96%	n.a.	26%	6%
ROE	%	1%	3%	0%	22%	22%	19%
ROIC	%	12%	12%	13%	15%	13%	12%
OCF	R$ mn	716	5,204	7,442	8,900	12,245	12,669
ICF	R$ mn	(3,818)	(2,427)	(2,365)	(3,610)	(3,876)	(4,112)
Implied PE	x	177.4	112.7	2,688.3	10.4	8.2	7.8

Source: Goldman Sachs Global Investment Research

Largest and most diversified exposure to ASF

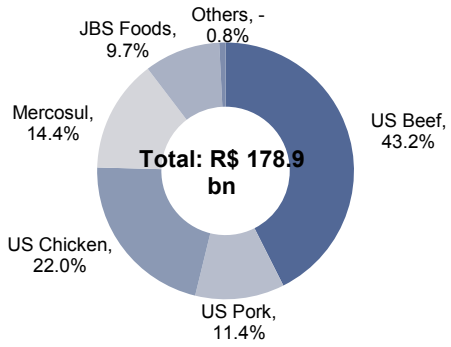
Company background. JBS is the largest protein company in the World by revenue, reaching US$49bn in 2018. The company is present across 15 countries and operates in all the major protein categories, beef, chicken and pork. While the company originated as a beef packer in Brazil, the US is currently its largest market accounting for 51% of revenues, primarily through its beef operations, as well as chicken (JBS owns 75% of Pilgrim's Pride) and pork. In Brazil, in addition to its original beef business, the company also operates in chicken and processed food, mainly with the Seara brand which competed directly with BRF in both domestic and export markets. The company diversified product and geographic portfolio creates opportunities for cross selling and scale leveraging and, more importantly, mitigates the industry cycle as these typically do not occur in the same products and in all the markets at the same time. After several years of M&A-led growth, the company has been focusing on deleveraging its balance sheet as well as on improving its cost of financing.

Investment thesis. We are Neutral-rated on JBS as we believe the current share price already reflects the stronger operating performance and improving outlook. We note however that, given the company large scale and more diversified product and geographic portfolio, it could continue to benefit from accelerating short term momentum in investors interest as they seek exposure to ASF related investment ideas, until the sequencing of impact of the expected global protein deficit are fully understood and manifested. On the other hand, we note two potential risks for the investment thesis: (i) the Brazilian Development Bank (BNDES) remains a large shareholder in JBS (with c. 20% stake) and has manifested an interest in divesting this stake which may now be greater following JBS strong share price performance, and create a potential overhang in the shares; (ii) we see the company as already earning above its normalized margins levels, most notably in its most important US beef division, thanks to favorable cyclical tailwinds which will eventually abate.

Valuations: Our 12-month PT of R$20.50 is based on a multiples-based SOTP analysis.

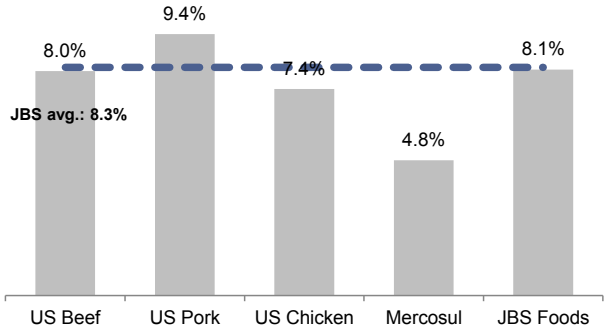
Key risks: Downside risks include lower supply of beef in the US, FX volatility and dilutive acquisitions. Upside risk includes faster margin recovery in Brazil.

Exhibit 234: JBS is the largest protein company in the World by revenue and the most diversified geographically
JBS Revenue split



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 235: Higher margins in the US beef business division have been the main driver of earnings
JBS EBITDA margin by division 2018



Source: Company data, Goldman Sachs Global Investment Research

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Freedom Foods Group - Buy with target price of A$6.2/sh

Exhibit 236: Key financial summaries - Freedom Foods

Company	Freedom Foods Group	Rating	Buy
Ticker	FNP.AX	Target price AUD	6.2
Core operations	Health food	Share price AUD	5.0

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	A$ mn	170	262	353	485	672	855
yoy	%	n.a.	54%	34%	37%	39%	27%
Gross margin	%	30%	23%	25%	25%	25%	25%
NP	A$ mn	51	8	13	17	44	75
EPS	A$/sh	0.06	0.05	0.09	0.08	0.16	0.27
YoY	%	n.a.	-20%	77%	-11%	99%	69%
ROE	%	n.a.	2%	3%	3%	7%	11%
ROIC	%	n.a.	4%	5%	4%	7%	11%
OCF	A$ mn	7	5	24	10	37	69
ICF	A$ mn	(19)	(213)	(73)	(134)	(124)	(35)
Implied PE	x	78.3	98.0	55.2	62.2	31.3	18.5

Source: Goldman Sachs Global Investment Research

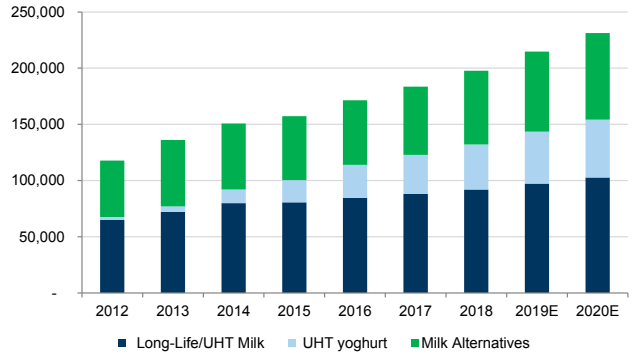
Company background: Freedom Foods (FNP) is the largest player in the Health Food category in the Australian Supermarket channel. It has the largest Australian production capacity in UHT milk and strong positions in plant-based beverages, cereals and snacks.

Investment thesis: FNP is benefiting from the shift to healthier lifestyles, functional foods and rising incomes in emerging markets. We see these trends driving strong global demand for the key nutritional products FNP is targeting.

1. China and Asia are net importers of dairy products and also demonstrating high demand for plant-based beverages. FNP is well-placed to benefit from growth in these markets and China's plan to encourage cross-border collaboration, with key JVs and partnerships already established.
2. Ramp up of processing capacity post the capex program: FNP is in the final stage of an A$400mn capex program that has seen the establishment of state of the art processing facilities in nutritional, dairy and plant-based beverages. The company expects +40% ROCE on A$150mn of high-value nutritional capex and +15% ROCE on UHT dairy and plant-based beverages. This implies c.A$100mn of incremental group EBITDA.

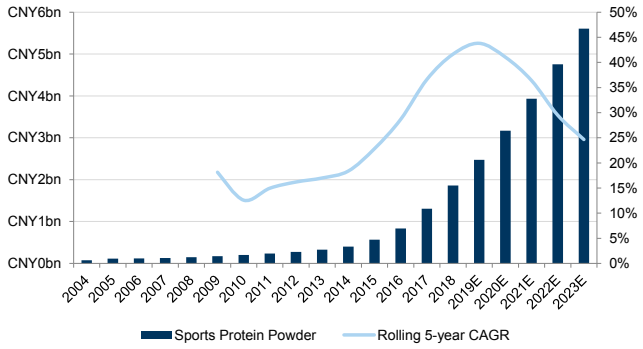
Financials and valuation: We forecast a 3-yr CAGR in group revenue of 34%; EBITDA 52%; and EPS 44%. Group returns should rise as capacity utilisation rises through to FY22. FNP is trading at 18.5x FY20 EBITDA vs. domestic growth peers at 24.2x; yet we expect FNP will grow EBITDA >2x faster than peers. Our 12-month target price of A$6.2 is derived using equal-weighted DCF and SOTP methodologies. Our A$5.90 share DCF is based on cash flow forecasts through until FY30E, 9.2% WACC and 2.5% terminal growth rate. Our A$6.40 SOTP valuation is derived by applying a premium or discount to the FY20E June year-end adjusted EV/EBITDA multiple of relevant global peers on our FY21E EBITDA forecasts for the same period. We use FY21E EBITDA forecasts for roll forward purposes and to capture some earnings benefit from phase two and three of the capex expansion.

Exhibit 237: Dairy products are experiencing high growth in China
Retail sales 2012-2020E (RMB mn)



Source: Euromonitor, Company data, Goldman Sachs Global Investment Research

Exhibit 238: ...2) with macro trends supportive of nutritionals category demand in China...



Source: Euromonitor

Key risks: Competition risk, customer risk, execution risk around growth strategy and NPD, adverse price changes for finished goods and raw materials.

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Tassal Group - Buy with target price of A$5.5

Exhibit 239: Key financial summaries - Tassal Group

Company	Tassal Group	Rating	Buy
Ticker	TGR.AX	Target price AUD	5.5
Core operations	Salmon producer	Share price AUD	4.8

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	A$ mn	431	450	509	577	646	692
yoy	%	39%	5%	13%	13%	12%	7%
Gross margin	%	19%	20%	20%	21%	23%	26%
NP	A$ mn	38	42	50	58	71	87
EPS	A$/sh	0.26	0.27	0.29	0.33	0.40	0.48
YoY	%	8%	5%	7%	14%	20%	22%
ROE	%	10%	9%	9%	10%	11%	13%
ROIC	%	10%	10%	10%	10%	11%	13%
OCF	A$ mn	50	51	44	79	79	103
ICF	A$ mn	(99)	(49)	(69)	(126)	(67)	(55)
Implied PE	x	18.5	17.6	16.4	14.4	12.0	9.9

Source: Goldman Sachs Global Investment Research

Company background: 1) TGR is Australia's largest Atlantic salmon producer based in Tasmania. Its product range includes fresh, smoked, canned and frozen salmon products for distribution in retail, wholesale and export markets. TGR has recently entered the Prawn farming industry diversifying it product exposure.

Investment thesis: Global Atlantic salmon demand is growing at mid-single digits per year and is seen as a healthier choice protein vs beef and other meats. China/HK is one of the fastest growing markets. Australia, while still a small producer, has a geographic (shorter distribution chain) advantage over many other Salmon exporting nations when it comes to access to China. The highest value is fresh product and time to market is the critical driver.

For us the key appeal of TGR as a compelling investment revolves around potential earnings growth and returns that we expect to be generated from the execution of management's strategy in prawns and salmon.

It is targeting c10% p.a. NPAT growth which will be largely driven by the ramp up of production in the prawn assets in the next 2-3 years. Significant salmon volume growth for TGR from here will be more long-dated and reliant on opening up new lease areas with the support of the Tasmanian Government and local communities.

The focus currently is on supplying the domestic Australian salmon market, however, China exports are coming off a low base and could grow meaningfully over the medium to long term as consumers shift to this relatively healthier protein.

Exhibit 240: Global Atlantic Salmon volume by market (tons)
We expect volumes to continue to grow over the medium term in line with the last 12 months

	Estimated volumes		Compared to Q1 2018		Est. volumes	12 month comparison		
Markets	Q1 2019	Q1 2018	Volume	%	Q4 2018	**NTM**	**PTM**	%
EU	224,100	214,600	9,500	4.4%	275,400	966,300	932,100	3.7%
Russia	18,100	21,200	-3,100	-14.6%	24,000	83,800	76,100	10.1%
Other Europe	22,600	21,300	1,300	6.1%	25,800	86,500	84,100	2.9%
Total Europe	**264,800**	**257,100**	**7,700**	**3.0%**	**325,200**	**1,136,600**	**1,092,300**	**4.1%**
USA	111,200	108,100	3,100	2.9%	107,600	430,800	405,000	6.4%
Brazil	26,500	24,500	2,000	8.2%	24,000	91,300	84,100	8.6%
Other Americas	31,600	28,800	2,800	9.7%	38,700	126,200	112,400	12.3%
Total Americas	**169,300**	**161,400**	**7,900**	**4.9%**	**170,300**	**648,300**	**601,500**	**7.8%**
China / Hong Kong	29,200	24,900	4,300	17.3%	25,800	105,900	93,700	13.0%
Japan	13,100	12,800	300	2.3%	16,400	54,300	56,500	-3.9%
South Korea / Taiwan	13,700	14,800	-1,100	-7.4%	15,600	55,000	50,000	10.0%
Other Asia	19,300	21,200	-1,900	-9.0%	22,100	71,100	84,300	-15.7%
Total Asia	**75,300**	**73,700**	**1,600**	**2.2%**	**79,900**	**286,300**	**284,500**	**0.6%**
All other markets	31,300	27,700	3,600	13.0%	32,400	117,100	107,200	9.2%
TOTAL	**540,700**	**519,900**	**20,800**	**4.0%**	**607,800**	**2,188,300**	**2,085,500**	**4.9%**

Source: Marine Harvest, Data compiled by Goldman Sachs Global Investment Research

Valuation: Our 12-month target price of A$5.50 is based on an equal weighted blend of FY20E EV/EBITDA and P/E based valuations and a DCF methodology to derive our A$5.20 valuation (previously A$4.90), which we roll forward using cost of equity (9%) less dividends. We retain our Buy rating. We use the long term average discount TGR has traded on vs. the Small Industrial Index (24% for EV/EBITDA and 16% for P/E).

Key risks: Disease outbreak, global supply fluctuations, competition, environmental risk, regulatory risk, sea temperature/ climate change.

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Goldman Sachs International

DSM: Buy with target price of EUR 125/sh

Exhibit 241: Key financial summaries -DSM

Company	DSM	Rating	Buy
Ticker	DSMN.AS	Target price	EUR 125
Core operations	Animal nutrition	Share price	EUR 113

Financial summary	Units	2016A	2017A	2018A	2019E	2020E	2021E
Revenue	A$ mn	7,920	8,632	9,267	9,518	10,109	10,688
yoy	%	-11%	9%	7%	3%	6%	6%
Gross margin	%	34%	34%	37%	37%	37%	37%
NP	A$ mn	508	686	1,024	898	1,019	1,129
EPS	A$/sh	2.90	3.92	5.84	5.34	6.15	6.81
YoY	%	36%	35%	49%	-9%	15%	11%
ROE	%	9%	10%	14%	12%	13%	14%
ROIC	%	11%	13%	16%	14%	16%	16%
OCF	A$ mn	867	833	1,333	1,420	1,458	1,566
ICF	A$ mn	(1,194)	689	(605)	(894)	(636)	(673)
Implied PE	x	39.1	28.9	19.4	21.2	18.4	16.6

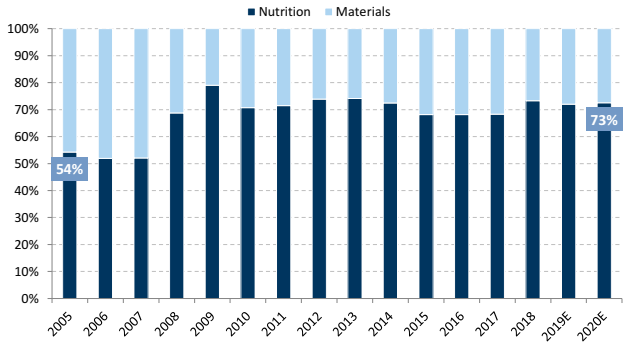
Source: Goldman Sachs Global Investment Research

Quality nutrition play in European Chemicals

Company background: In Europe, **DSM**, covered by Theodora Lee Joseph, is our top pick with exposure to agriculture, with c.75% of its EBITDA exposed to animal and human nutrition. Through its production of feed additives for the animal nutrition sector, we see DSM as a key enabler in China's rising appetite for proteins, generating higher yields in protein production despite the challenge for agriculture. DSM has undergone a considerable transformation over the past twenty years into becoming a Nutrition company, with disposal of its Petrochemicals and Base Chemicals businesses. The company still trades at a material discount to Nutrition peers which we believe is unjustified as DSM continues to deliver consistent margin improvements and earnings growth, offering upside to current prices if the market appreciates the improved fundamentals of the business.

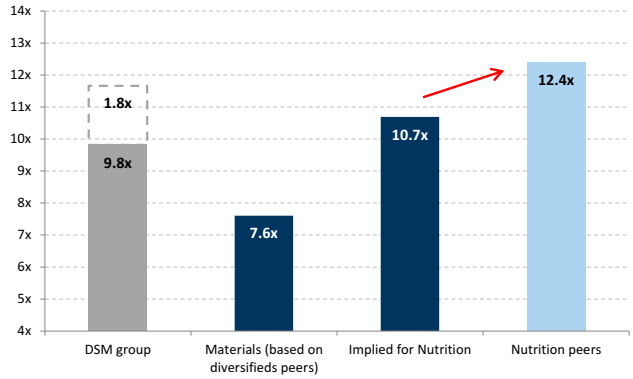
Investment thesis: DSM stands out as one of our top picks across European Chemicals in 2019 for three main reasons: (i) Underappreciated defensive earnings with limited downside; (ii) Best in-class balance sheet optionality; (iii) Continuing portfolio transformation story at a discount. In addition to the operational, returns, and valuation potential, we also see possible upside from DSM's considerable innovation pipeline.

Exhibit 242: DSM is now predominantly a Nutrition company...
% total EBITDA



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 243: ... but its nutrition business still trades at a discount to peers
2020E EV/EBITDA implied for Nutrition if Materials were to trade in line with diversifieds and group if Nutrition did the same



Source: Company data, Goldman Sachs Global Investment Research

Valuation: We are Buy rated on DSM, with a 12-month target price of €125. We value DSM on 13.1x 2020E EV/DACF, based on a factor of 1.27 applied to its historical multiple of 10.3. This factor is determined by the average cash returns (CROCI) in 2020-23E relative to historical returns. Our SOTP suggests a similar outcome, yielding an implied value roughly similar to our intrinsic cash-based approach.

Key risks: (1) Prices for vitamin A and E have rebounded from October's lows, but if this stabilisation does not continue and prices were to trend down again, pricing and margins in Nutrition would remain under pressure. (2) Outages at any of DSM's plants would constitute a near-term headwind to profits. (3) Profitability in Nutrition could deteriorate on the back of slower demand, higher competition and/or input cost inflation. (4) Factors such as US-China trade discussions, slowing growth in China, continued weakness in global automotive markets, and Brexit uncertainty could lead to a further worsening of the global demand environment. This would pressure the more macro-correlated Materials business. (5)Value-destructive capital allocation is a risk to the shares.

Additional disclosures

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高华证券感谢高盛分析师陈群、Adam Samuelson和Michael Peet在本报告中的贡献。

信息披露附录

申明

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投资摘要

投资摘要部分通过将一只股票的主要指标与其行业和市场相比较来评价该股的投资环境。所描述的四个主要指标包括增长、回报、估值倍数和波动性。增长、回报和估值倍数都是运用数种方法综合计算而成，以确定该股在地区研究行业内所处的百分位排名。

每项指标的准确计算方式可能随着财务年度、行业和所属地区的不同而有所变化，但标准方法如下：

增长是下一年预测与当前年度预测的综合比较，如每股盈利、EBITDA 和收入等。 回报是各项资本回报指标一年预测的加总，如CROCI、平均运用资本回报率和净资产回报率。 估值倍数根据一年预期估值比率综合计算，如市盈率、股息收益率、EV/FCF、EV/EBITDA、EV/DACF、市净率。 波动性根据12个月的历史波动性计算并经股息调整。

并购评分

在我们的全球覆盖范围中，我们使用并购框架来分析股票，综合考虑定性和定量因素（各行业和地区可能会有所不同）以计入某些公司被收购的可能性。然后我们按照从1到3对公司进行并购评分，其中1分代表公司成为并购标的的概率较高(30%-50%)，2分代表概率为中等(15%-30%)，3分代表概率较低(0%-15%)。对于评分为1或2的公司，我们按照研究部统一标准将并购因素体现在我们的目标价格当中。并购评分为3被认为意义不大，因此不予体现在我们的目标价格当中，分析师在研究报告中可以予以讨论或不予讨论。

Quantum

Quantum是提供具体财务报表数据历史、预测和比率的高盛专有数据库，它可以用于对单一公司的深入分析，或在不同行业和市场的公司之间进行比较。

GS SUSTAIN

GS SUSTAIN是一项侧重于通过发现优质行业领先企业而实现长期超额收益的全球投资策略。GS SUSTAIN 50关注名单列出了我们认为凭借出色的资本回报、具有可持续性的竞争优势和对ESG（环境、社会和企业治理）风险的有效管理而有望在长期内相对于全球同业表现出色的行业领军企业。候选企业主要基于对企业在这三方面表现的综合量化分析筛选而出。

相关的股票研究范围

戴晔：China Agriculture。

China Agriculture：Guangdong Haid Group、Jinyu Bio-Technology、Longping High-Tech、Muyuan Foods、Wens Foodstuffs Group。

信息披露

与公司有关的法定披露

以下信息披露了高盛高华证券有限责任公司（“高盛高华”）与北京高华证券有限责任公司（“高华证券”）投资研究部所研究的并在本研究报告中提及的公司之间的关系。

没有对下述公司的具体信息披露： Muyuan Foods (Rmb70.19)

公司评级、研究行业和相关定义

买入、中性、卖出：分析师建议将评为买入或卖出的股票纳入地区投资名单。一只股票在投资名单中评为买入或卖出由其相对于所属研究行业的总体潜在回报决定。任何未获得买入或卖出评级且拥有活跃评级（即不属于暂停评级、暂无评级、暂停研究或没有研究的股票）的股票均被视为中性评级。每个地区投资评估委员会管理着地区强力买入或卖出名单，该名单以总体潜在回报规模和/或实现回报的可能性为主要依据确立各自研究范围内的投资建议。将股票加入或移出此类强力买入或卖出名单并不意味着分析师对这些股票的投资评级发生了改变。

总体潜在回报：代表当前股价低于或高于一定时间范围内预测目标价格的幅度，包括所有已付或预期股息。分析师被要求对研究范围内的所有股票给出目标价格。总体潜在回报、目标价格及相关时间范围在每份加入投资名单或重申维持在投资名单的研究报告中都有注明。

研究行业：每个行业研究的所有股票名单可登陆https://www.gs.com/research/hedge.html通过主要分析师、股票和行业进行查询。

暂无评级(NR)：在高盛于涉及该公司的一项合并交易或战略性交易中担任咨询顾问时并在某些其他情况下，投资评级和目标价格已经根据高盛的政策予以除去。 暂停评级(RS)：由于缺乏足够的基础去确定投资评级或价格目标，或在发表报告方面存在法律、监管或政策的限制，我们已经暂停对这种股票给予投资评级和价格目标。此前对这种股票作出的投资评级和价格目标(如有的话)将不再有效，因此投资者不应依赖该等资料。 暂停研究(CS)：我们已经暂停对该公司的研究。 没有研究(NC)：我们没有对该公司进行研究。 不存在或不适用(NA)：此资料不存在或不适用。 无意义(NM)：此资料无意义，因此不包括在报告内。

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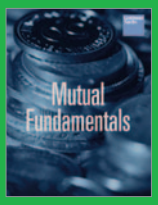
What the market pays for

Mutual Fundamentals



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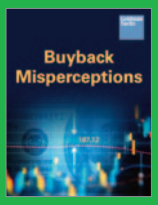
Mythbusting Buybacks



Balanced Bear

Womenomics

Closing the gender gaps

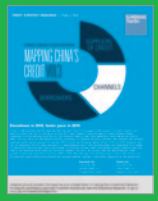
Brand Disruption's Next Phase

Asia Leisure

E-Concessions

The daigou boom

Mapping China's Credit



Top Projects 2019

China Gas Primer

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PM Toolkit

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