HSBC Climate Change

HSBC Global Research

Economics/Climate Change/Equity
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Global agricultural commodities

Demand is shifting to the finer foods

Energy and metals prices were the main drivers of higher commodity prices in the last decade, but in coming years we expect the strength to come more from agriculture

As middle class incomes rise in emerging markets, agricultural commodities demand should be strongest for the finer foods, such as meat, dairy, sugar and edible oils. At the same time, climate change could disrupt supply

This could present investment opportunities in agriculture, with the greatest upside potentially coming from producers of the finer foods

By Paul Bloxham, Adam Richardson and the HSBC Research team

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Finer foods in favour

- **Agricultural product prices have risen by far less than metals and energy prices over the past decade, but could be the next big story.** As incomes rise and the middle classes expand in the emerging economies, populations are expected to demand more and better quality food.
- **History shows that as countries get richer, demand for the finer foods, such as meat, dairy, sugar and edible oils, rises faster than for the more basic foods, like cereals.**
- **Our estimates show that human per-capita consumption of grains may already have peaked**, because many countries have passed the low levels of per-capita GDP at which demand for grains ramps up. Grain consumption rises fastest for economies with per-capita GDP under USD5,000 and then falls, although demand for feedstock and grains for energy generation does support overall demand for longer.
- In contrast, demand for meat, dairy, sugar and edible oils usually ramps up as countries shift from low to middle income levels, and continues to rise as countries reach high income levels. **Demand for the finer foods tends to keep growing until per-capita GDP reaches USD20,000 to USD30,000, depending on the type of food. As per-capita GDP in many countries is still below these levels, demand for the finer foods is set to rise for many years yet.**
- **Climate change is also set to limit the supply of both grains and animal products, further supporting agricultural commodity prices.** Water shortages and pollution are a key issue in China in particular (see *No water, no food*, 18 March 2014).
- **We favour investment strategies that target large producers of the finer foods.** As emerging market middle class incomes rise, **demand for meat from Latin America**, **Australia and New Zealand** should expand. **China's demand for dairy products** is expected to continue to grow quickly, benefiting Chinese dairy producers and countries like New Zealand. **Demand for sugar and palm oil should also grow**, positive for Brazilian and Asian producers, respectively.
- As we have noted previously, we expect the **global commodity prices 'super-cycle' to be more 'super' and less 'cycle'**, leaving commodity prices structurally high (see *Global commodity prices: More super, less cycle*, 5 September 2013). As emerging economies continue to grow faster than Western economies and remain in the 'commodity-intensive' stage of their development, we expect demand for commodities to continue to rise, supporting prices. While **global commodity prices** have fallen in the past couple of years, they **are still high** at over 110% above their 1990s average in inflation-adjusted terms.
- **Our expectations of strong growth in demand for the finer foods support our view that global commodity prices will remain structurally high.**

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More super, less cycle: The role of food

- Commodity prices have risen over the past decade, as global growth has become dominated by the emerging economies which are at the 'commodity-intensive' stage of development
- Almost all commodity prices have risen relative to the prices of other goods and services, but the price gains have been far larger for metals and energy than for agricultural products
- As more countries move to middle income status, the next commodities boom could be in agricultural products

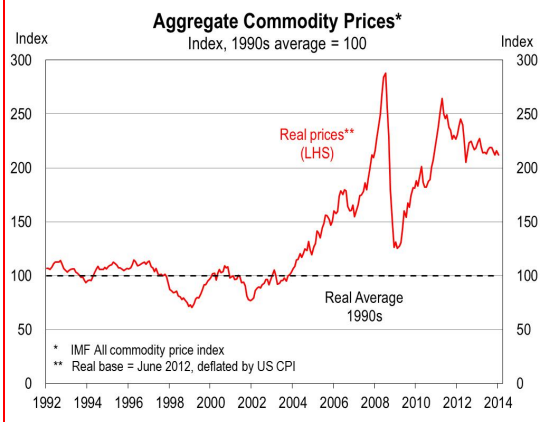
Prices are still high

Global commodity prices are significantly higher than they were a decade ago. Indeed, despite falling around 20% in the past couple of years (Chart 1.1), commodity prices remain on average over 110% higher than in the 1990s in inflation-adjusted terms.

This ramp-up in commodity prices over the past decade has been labelled by some analysts as the upswing in a 'super-cycle'. For the same analysts, the question now is whether the super-cycle over.

We have done a significant amount of research to try to find an answer (see our most recent report *Global commodity prices: More super, less cycle*, 5 September 2013). In this report, we delve even deeper into the issues.

1.1) Commodity prices still much higher than in the 1990s



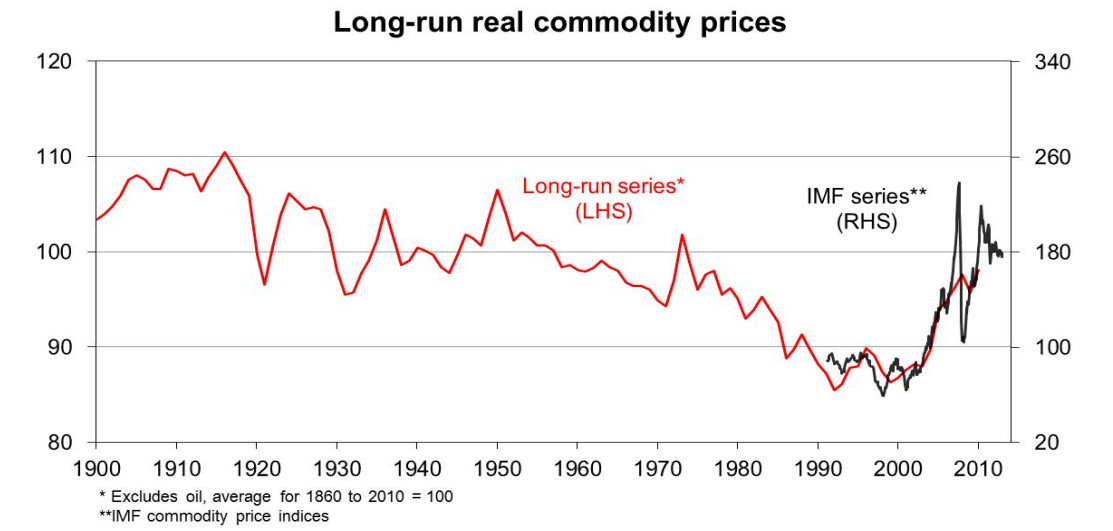
Source: IMF based on Thomson Reuters Datastream data

While there is a great deal of uncertainty about the outlook for commodity prices we remain of the view that commodity prices are likely to stay structurally high, at well above their 1980s and 1990s levels. We see the 'super-cycle' as more 'super' and less 'cycle'.

Paul Bloxham
Chief Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9255 2635
paulbloxham@hsbc.com.au

Adam Richardson
Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9006 5848
adamrichardson@hsbc.com.au

1.2) Commodity prices were well below average in the 1980s/90s and are now back around their long-run average levels



Source: UN; IMF based on Thomson Reuters Datastream data

Our theory: Commodity prices driven by composition of global growth

The starting point for this analysis was a closer look at the long-run history of commodity prices. Indeed, a look at the very long run reveals global commodity prices are not actually at exceptionally high levels now, but rather, they were unusually low in the 1980s and 1990s (Chart 1.2).

In our view, the unusually low level of commodity prices in the 1980s and 1990s reflected the composition of global growth.

Growth in the 1980s and 1990s was much less 'commodity intensive' than at previous times in history. This is because, in the 1980s and 1990s, global growth was dominated by the Western economies, whose growth was driven by their services sector (information technology and finance were key growth industries) rather than commodity-intensive activity, like infrastructure.

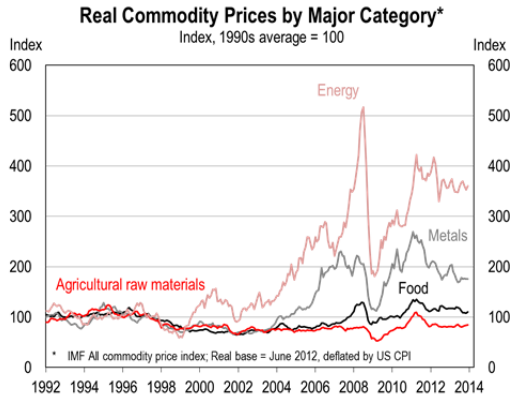
In short, global growth was less commodity-intensive because it was being driven by economies that had already built the bulk of their roads, bridges, airports and housing.

But by the early 21st century this situation changed significantly, as emerging economies, particularly China, became much larger contributors to global growth. This resulted in greater commodity demand, given a surge in urbanisation and infrastructure investment in the emerging economies. Strong demand for commodities was also met by only weak supply, because previously low commodity prices had reduced the incentive for resources companies to invest in mines and resource extractive capacity. As a result, commodity prices ramped up from around 2003.

Indeed, from a commodities perspective, global growth has been more similar in the past decade to the distant past, than to the 1980s and 1990s. In 1950s, 1960s and 1970s global growth was being driven by what we now call the developed world economies, but back then these economies were still at the 'commodity-intensive' stage of their development. During this earlier period, the US was building out its major highway systems and airports; Europe was also rebuilding after the war; and Japan was industrialising.

For the reasons outlined above, the ramp-up in commodity prices has been largely driven by higher metals and energy prices. In the first decade of the new millennium, prices for hard commodities rose the most, with metals prices peaking at 160% above their 1990s average in inflation-adjusted terms (Chart 1.3). The increase in energy prices was even more significant, with prices peaking at 420% above the 1990s average.

1.3) Energy and metal prices have driven the ramp-up, so far



Source: IMF based on Thomson Reuters Datastream data

The 'commodity-intensive' stage of development

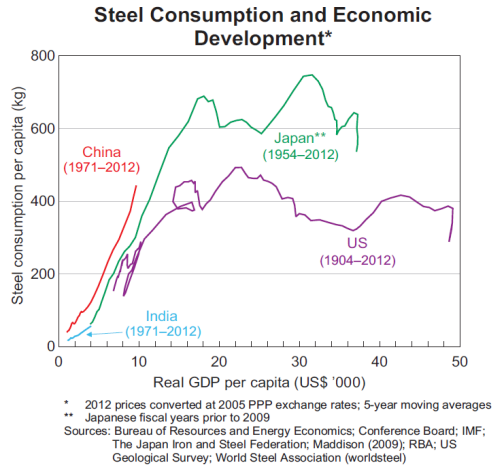
Developing our theory, we looked at data on how commodities usage changes as economies develop. We focused mostly on hard commodities, as that was where most of the rise in prices came from over the past decade.

History showed that at low levels of economic development consumption of commodities was also low and as countries develop their demand for commodities rises. Interestingly though, demand does not rise in a linear fashion as countries develop.

At low to middle levels of income, commodity demand accelerates because, at this stage of development, urbanisation and industrialisation imply that more infrastructure is required.

This can be seen in demand for steel, which starts to ramp up at per-capita GDP levels of around USD3,000, as an economy shifts from one based on agriculture and subsistence to one driven by industrialisation and urbanisation (Chart 1.4). But demand does not ramp up indefinitely. The ramp-up in steel demand starts to level out when a country gets to per-capita GDP of around USD20,000. By that stage, the country has built much of its infrastructure and housing, and its growth becomes more dominated by its services sector.

1.4) Steel consumption rises with economic development



Source: RBA

Energy demand shows a similar pattern although for energy it appears that growth in demand continues to rise for longer (Chart 1.5).

This may be because at these higher levels of development a country's infrastructure needs are largely met (houses and roads have been built) but households still need more energy to power washing machines, flat screen televisions and automobiles.

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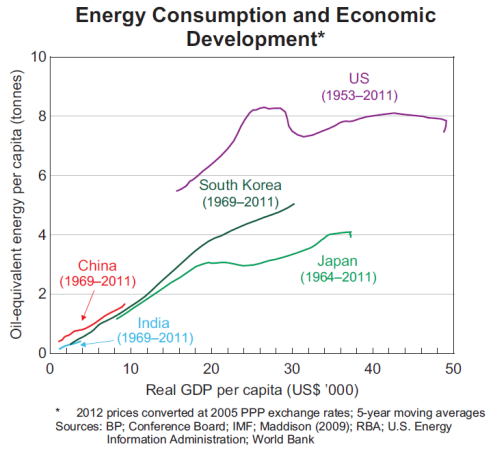
1.5) Energy consumption is still low in China and India



Source: RBA

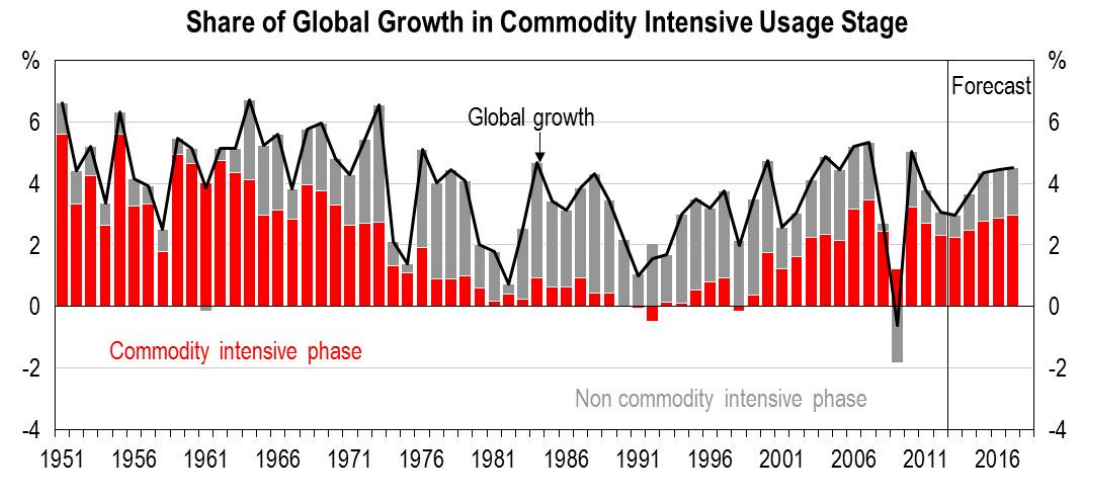
It seems from previous work (see our report *Commodities and the global economy: Are current high prices the new normal?*, 8 August 2012) that countries went through a 'commodity-intensive' stage of development. We estimated that this stage of development occurred when countries had per-capita GDP of between USD3,000 and USD20,000. This allowed us to look at the composition of global GDP growth to see if the changes in its composition could help to support our thesis on commodity prices.

As it turned out, it could. A look at patterns in global GDP revealed that global growth had been dominated by countries with per-capita GDP between USD3,000 and USD20,000 in the 1950s, 1960s and 1970s and in the 2000s. Because global growth was dominated by countries at this stage of development, demand for commodities was high during these periods. In contrast, global growth in 1980s and 1990s was dominated by countries with higher levels of per capita GDP – that is, countries where growth was driven by their services sectors (Chart 1.6). Simply put, when the red bars in Chart 1.6 are larger commodity demand is strong and commodity prices have increased, as Chart 1.2 shows.

Next story could be food

Agricultural commodity prices have not, so far, played a big role in our overall view. In contrast to energy and metals prices, food prices peaked at only 35% above their 1990s average in 2011, and today sit only 10% above 1990s levels in inflation-adjusted terms. But they certainly could play a larger role. This is the topic of this report.

1.6) Global growth is being driven by economies that are at the 'commodity-intensive' stage of their development



Source: Total Economy Database; IMF based on Thomson Reuters Datastream data

It may, in fact, be the case that food prices have the potential to outperform relative to metals and energy prices in coming years, as growing middle class incomes continue to boost demand.

Our estimates suggest that an additional 1.3bn people are expected to attain at least middle-income levels by 2030 – a number that is equivalent to four times the current population of the US. Another 2.6bn people are expected to obtain middle income status by 2050 (see *The Consumer in 2050: The rise of the EM middle class*, by Frederic Neumann and Karen Ward, 15 October 2012). As a result, there is likely to be a continued shift in the type of food that is in demand.

The next chapter looks at the agricultural demand story in more detail to draw lessons from history and look for clues to the outlook for agricultural commodity prices.

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A deeper look at food demand and development

- Historical patterns show as a country develops, demand for grains rises first. Demand for better quality food picks up later, as middle class incomes increase
- The on-going expansion of the emerging market middle class is expected to see demand for agricultural commodities rise rapidly
- As incomes rise and diets change, demand rises for animal products, such as milk and meat, and for other finer foods, like sugar and edible oils

Paul Bloxham
Chief Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9255 2635
paulbloxham@hsbc.com.au

Adam Richardson
Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9006 5848
adamrichardson@hsbc.com.au

Food prices have lagged

Food prices have risen by far less in the past decade or so than energy and metals prices. There are many possible reasons for this, but the most plausible may be that it reflects the way that soft and hard commodity demand evolves as countries develop. As the schematic below shows, demand for different types of commodities arises at different stages of a country's development (Chart 2.1).

At early stages of development, when incomes begin to rise in subsistence economies, it may be expected that per-capita consumption of grains rise rapidly, as increasing incomes allow the population to boost their calorie intake from very low levels. As grains are the cheapest source of sustenance, demand for them ramps up first.

At the same time, these least developed economies might be expected to have very low demand for metals and energy, as their populations are largely in the rural areas, with limited infrastructure.

When an economy begins to emerge, however, this picture should be expected to change. As countries urbanise and industrialise they build

2.1) Types of commodities in demand may change as countries develop

	Commodity demand growth by development stage		
	Least developed	Emerging	Developed
Cereals	High	Modest	Low
Metals	Low	High	Modest
Animal products	Low	High	High
Vegetable oil	Low	High	High
Energy	Low	High	High

Source: HSBC

more infrastructure and housing, which increases demand for hard commodities and energy.

As we noted in the previous chapter, our estimates, which are based on historical comparisons, suggest that countries appear to go through a 'commodity-intensive' stage of their development when per-capita GDP is between USD3,000 and USD20,000.

For food, the story might also be expected to evolve. As a country develops, its population might be expected to shift from consuming mainly grains to consuming more of the finer foods, such as meat, dairy products and sugar. As more processed food is consumed, the demand for edible oils, such as vegetable and palm oil might also be expected to rise.

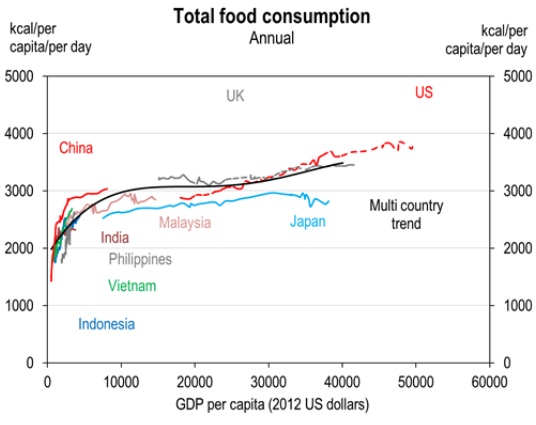
Changing diets

One way to assess likely patterns of food demand is to look at the history of food consumption in a range of countries to identify common trends.

Chart 2.2 shows how the average per-capita consumption of total food products has evolved as per-capita GDP has risen across a number of different countries. The black line in the chart shows the trend of per-capita calorie intake by level of development across 37 of the world's largest economies between 1961 and 2009.

Interestingly, this analysis shows that while there is a sharp run-up in demand for food at low levels of development, by the time a country reaches per-capita GDP of around USD10,000, the average diet provides a similar amount of energy to the average diet in a developed nation. For example, the calorie intake in the average Chinese diet already provides more energy than the average intake in Japan and is comparable to the average intake of a British citizen. For a detailed analysis of changing diets in China, and how the government is working to ensure both food security and food safety given water shortages and pollution (see *No water, no food*, 18 March 2014.

2.2) Food intake rises rapidly at low levels of development

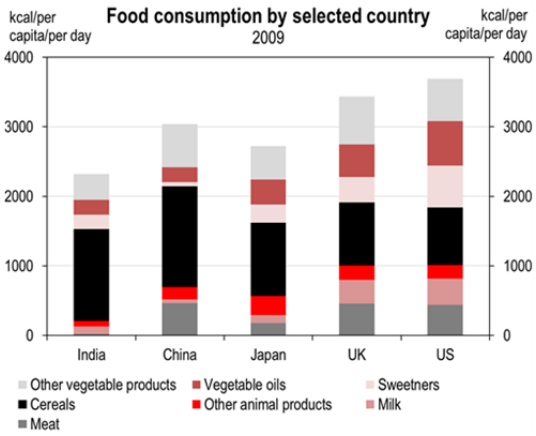


Source: FAO, Conference Board, HSBC

But while total dietary energy intake is similar across developing and developed countries, the types of food consumed across nations differ substantially.

Generally, a developing nation consumes more cereal products than richer countries, as these staple products provide a cheaper source of calories. By comparison, developed nations consume a wider variety of products. The diet of richer countries includes greater consumption of fruit, sugar, meat, milk and alcohol. At the same time, total per-capita consumption of cereal products tends to be lower amongst wealthier nations (Chart 2.3).

2.3) Developed nations consume more dairy, meat and sugar



Source: FAO

As Chart 2.3 shows, cereals consumption only accounts for 22% and 26% of the average diet in the US and UK, while it accounts for 48% in China and 57% in India.

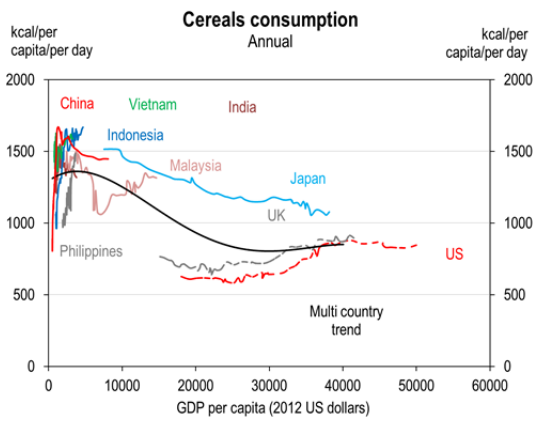
Examining these historical patterns of food consumption across countries in more detail can help us to try to forecast future demand for food and what types of food will be in highest demand.

Cereal demand peaks early

Historical assessment of cereals usage confirms our prior assumption: that cereals demand increases fastest at very low levels of development (Chart 2.4). Indeed, human consumption of cereal products tends to peak at fairly low levels of per-capita GDP.

As Chart 2.4 shows, across a range of countries, cereals consumption generally peaks prior to a country reaching per-capita GDP of USD5,000. Cereals consumption per person begins to decline after this point in a country's development path. Indeed, per-capita consumption of cereals in China is currently around 1.7 times greater than in the US.

2.4) Cereal consumption tends to peak early



Source: FAO, Conference Board, HSBC

This leads us to quite a strong conclusion. Per-capita human consumption of cereal products in the majority of these countries is likely to have already passed its peak.

To extend this analysis further, we are also able to make some key assumptions about consumption paths, economic and population growth, which together gives us a rough guide as to whether total consumption of cereal products has reached a peak.

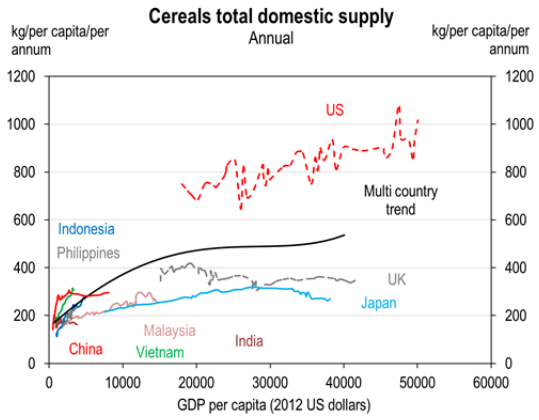
Assuming developing countries follow the trend path of per-capita cereals consumption (the black line in the chart) and that developed countries maintain their recent per-capita consumption levels, we use IMF per-capita GDP projections and UN population projections to estimate total consumption of cereal products between 2009 (the last data point in the FAO database) and 2018.

Combining these assumptions suggests that total consumption of cereal products amongst these 37 countries would be expected to grow at an average pace of only 0.2% a year from 2010 to 2018, well down from the 1.0% annual average pace of growth seen in the 2000s and the 1.6% annual pace seen in the 1990s.

However, while human intake of grain products peaks at an early stage of development, an economy's total use of these products has a much more drawn out development path, as grains are also used as animal feed, sweeteners and, in some cases, energy.

Overall, while per-capita human consumption of cereals peaks at per-capita GDP of around USD5,000, our estimates suggest that total use of cereal products per person ramps up until per-capita GDP reaches around USD20,000 (Chart 2.5).

2.5) Total use of cereal products is more drawn out



Source: FAO, Conference Board, HSBC

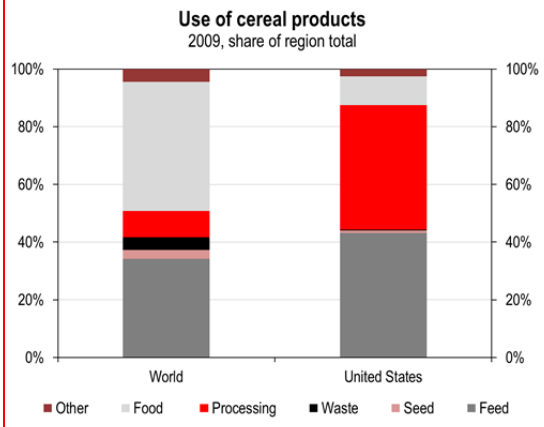
Because the US is a very large user of grains to produce energy, we also calculated our multi-country trend excluding the US, but found similar results.

If we assume developing countries follow the (ex-US) average development path for total cereals use and developed countries maintain recent trends, total use of cereal products is projected to grow at an average 1.7% a year between 2010 and 2018, down slightly from 2.1% a year in the 2000s. This is in line with FAO projections, where annual growth in total use of wheat, coarse grains and rice is forecast to average around 1.6% between 2010 and 2018.

The US is a prime example of this trend away from cereals consumption towards cereals processing. Amongst developed nations, the US stands out in terms of its total per-capita use of cereal products, well ahead of the multi-country trend for its stage of development. In part, this reflects higher than average feed use in its meat and dairy industries.

More importantly, the US processes significantly more of its available cereal stocks than other countries into a range of final uses including; sweeteners, starch, vegetable oil, ethanol and bio-products (Chart 2.6). This likely reflects the country's role as a major cereal producer (second behind China), subsidies and final use targets for the agriculture and ethanol industries, as well as the pattern of final demand (skewed away from cereals consumption given its development stage) in the country.

2.6) The US processes more corn products than average



Source: FAO

Animal product demand rises later

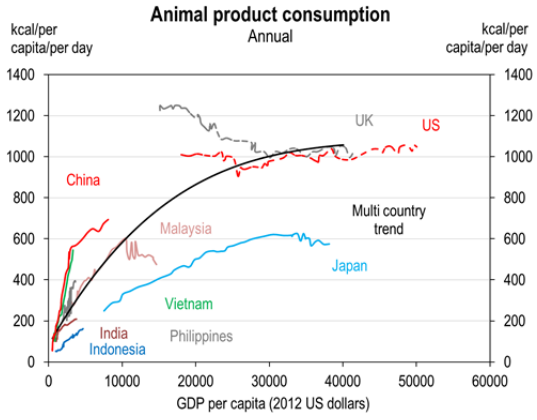
Animal product consumption (such as meat and dairy) might be expected to follow quite a different pattern to cereals consumption, in part due to the much higher cost of producing animal products. This is confirmed in the historical data (Chart 2.7).

As Chart 2.7 shows, animal product consumption ramps up as a country develops. Unlike cereals consumption, the upward slope in demand for animal products continues while economies move from low to emerging and to high levels of income.

Indeed, consumption per person typically continues to rise well beyond USD20,000 GDP per capita – although the behaviour across countries and commodities is diverse. The UK and US appear to have similar levels of daily per-capita consumption of animal products, which is likely to reflect cultural similarities. Japan's much lower level of animal product consumption

reflects that this measure excludes seafood, which is a staple of the Japanese diet. Despite these cultural differences, it seems likely that many emerging Asian economies will see greater animal product consumption in future years as their diets change to be more similar to those in the developed world.

2.7) Animal product consumption continues to rise



Source: FAO, Conference Board, HSBC

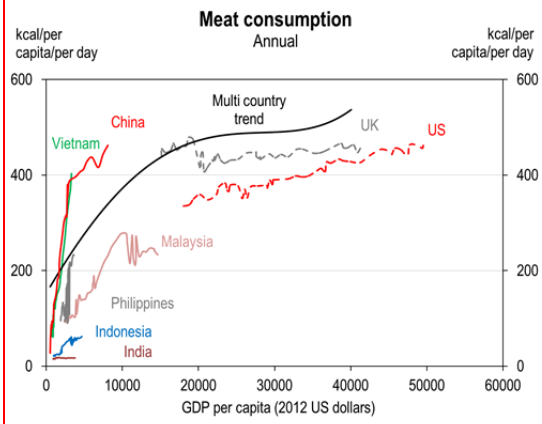
In general, this analysis suggests that the outlook for animal product consumption over the next decade is much stronger than for cereals.

Using the 37 countries in our sample (which account for around 84% of total animal product consumption) and assuming the developing countries follow the average trend path for animal product consumption (the black line in Chart 2.6), and developed countries maintain their recent per-capita consumption, we can use growth and population projections to estimate a rough outlook for total consumption. Using population estimates from the UN and per-capita GDP forecasts from the IMF, total consumption of animal products would be projected to grow at an annual pace of 2.1% from 2010 to 2018. This is above the average annual pace of growth seen in the preceding two decades.

Meat consumption to rise

Within the animal products category, per-capita meat consumption tends to peak at around USD20,000, although the story varies by country and across types of meat. For example, the average Chinese diet already contains more meat products than the UK or the US, despite having per-capita GDP of only 20% of the US, but this reflects unusually high rates of consumption of pork (Chart 2.8).

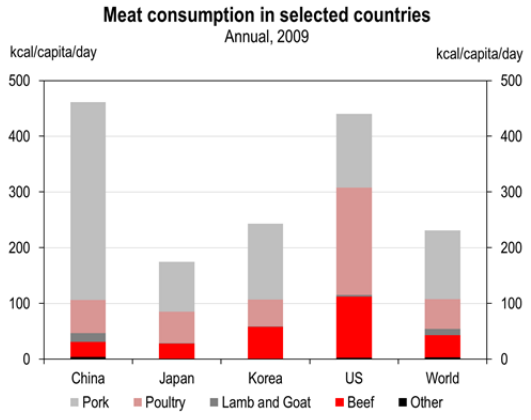
2.8) Meat consumption differs significantly across countries



Source: FAO, Conference Board, HSBC

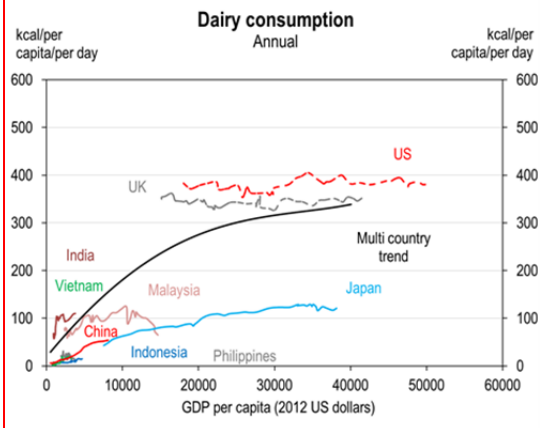
China consumes a substantial amount of pork, with the 15th highest per-capita consumption in the world (Chart 2.9). By contrast, Chinese consumption of beef lags behind other Asian nations and the world average. As Chinese diets become more Western in flavour, beef consumption has the potential to pick up strongly.

2.9) Chinese consumption of beef lags behind other nations



Source: FAO

2.10) Per-capita dairy consumption rises at higher incomes



Source: FAO, Conference Board, HSBC

In contrast, meat consumption in India lags significantly behind the average level of consumption for a country at India's stage of development. This is likely to reflect cultural preferences, with a high proportion of the country adopting an essentially vegetarian diet, and religious beliefs that discourage the consumption of beef.

Dairy a long drawn out process

Historical analysis shows that the evolution of dairy demand is more drawn out than that of meat, with consumption continuing to rise beyond per-capita GDP of USD30,000 (Chart 2.10). Again, there are significant differences in consumption patterns across countries. Generally, however, the growth path of per-capita dairy consumption within Asia is similar to that in the West, but converges to a lower level. India looks to be an exception, with milk consumption rising in line with the world average so far in the country's development.

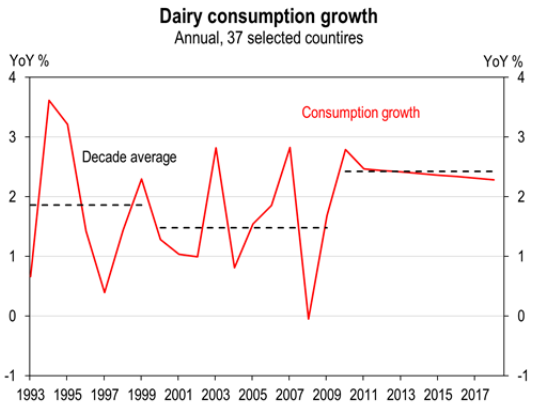
The outlook for global consumption of dairy products is strong. Assuming the following we can get a rough estimate of the outlook for dairy consumption between 2009 and 2018:

- Developing Asian nations follow the dairy consumption path of Japan
- Other developing nations follow the multi-country trend (while Pakistan and the Ukraine maintain their unusually high share of dairy consumption)
- Developed nations maintain their recent per capita consumption of dairy products
- Per-capita GDP growth estimates from the IMF and population projections from the UN are assumed

Using these assumptions, dairy consumption amongst these 37 countries (which account for 83% for total global consumption) is projected to rise by 2.4% a year on average between 2010 and 2018.

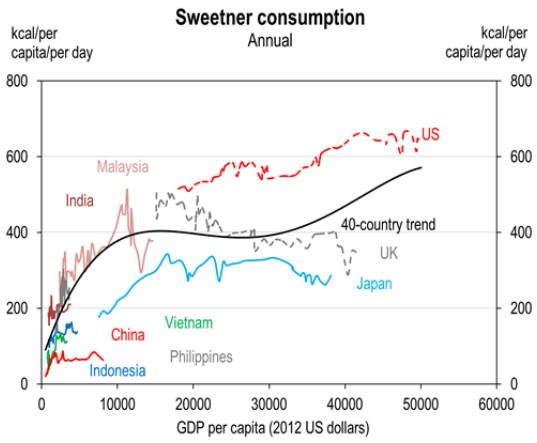
This is a significant step up from the rates of growth experienced through recent decades. Dairy consumption grew at 1.5% a year during the 2000s and at a 1.9% annual pace during the 1990s (Chart 2.11). These estimates are broadly similar to those of the FAO for dairy consumption over the period, with the FAO projecting average annual demand growth of 2.1%.

2.11) Dairy demand could rise strongly in the coming decade



Source: FAO, IMF, HSBC

2.12) China has lagged behind in sweetener consumption



Source: FAO, Conference Board, HSBC

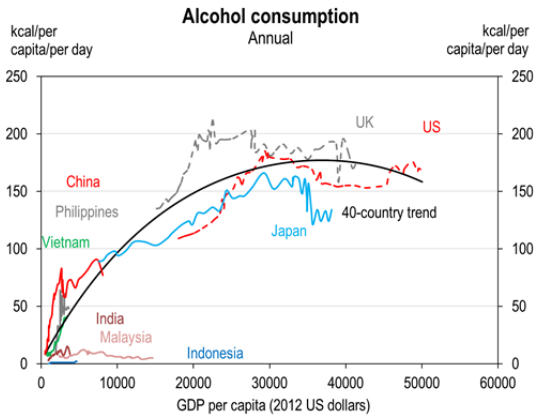
Developing a sweet tooth

As a country's gets richer, its citizens also tend to consume more of the guilty pleasures, including sugar and sweeteners, alcohol and edible oils. Per-capita consumption of sugars and sweeteners tends to peak earliest amongst this group around USD10,000 per capita, after rising rapidly in the period of development preceding this (Chart 2.12).

Demand for sweeteners tends to rise in a relatively uniform manner across economies as they develop. One notable exception, however, is China. Again, this reflects cultural preferences, with Chinese food preparation traditionally using fewer sweeteners. However, if diets in China become more Western-like, China could see a significant rise in demand for sugar and sweeteners.

Per-capita alcohol consumption tends to be more drawn out than sugar, and more akin to dairy products (Chart 2.13). Consumption continues to rise beyond per-capita GDP of USD20,000, peaking at around USD30,000. This suggests the outlook for alcohol consumption could be as robust as that for dairy products.

2.13) Alcohol consumption patterns similar across regions



Source: FAO, Conference Board, HSBC

In contrast to other commodities, alcohol consumption levels are similar amongst Western and Asian developed countries. Religious and cultural traditions limit the expansion of alcohol consumption in some economies, most notably in Malaysia, Indonesia and India.

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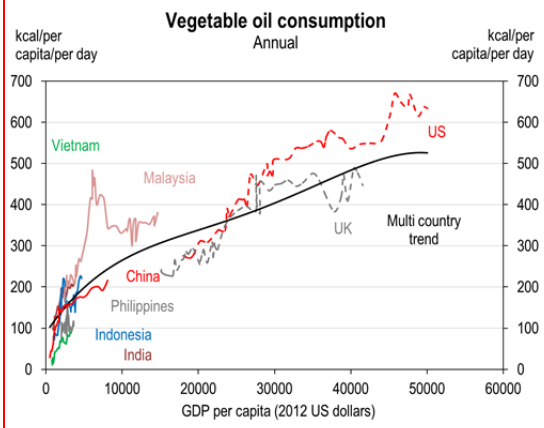
The good oils

The outlook for vegetable oil consumption is also favourable. Consumption of vegetable oils tends to rise right through a country's development phases. Even some of the most advanced economies have continued to increase their per-capita consumption of vegetable oils in recent years, with consumption continuing to rise even past USD30,000 per capita (Chart 2.14). Consumption trends are relatively uniform across markets and regions.

Palm oil is the most commonly consumed oil amongst Asian nations, accounting for 26% of total vegetable oil consumption in the region. In total, India, Indonesia, China and Malaysia already consume 50% of the world's palm oil. Demand for these products is likely to rise further, as developing Asian nations continue to boost their consumption of vegetable oils as incomes rise.

2.14) Consumption of vegetable oils peaks very late



Source: FAO, Conference Board, HSBC

Summing up the food story

As emerging economies continue to develop, hard commodity demand may begin to plateau, but consumption of soft commodities, particularly animal products, is expected to continue to rise.

With the world's middle classes projected to grow strongly in coming decades, demand for finer foods is likely to remain strong. It may even be the case that soft commodity prices outperform relative to hard commodities in coming years, as a growing middle class boosts demand for animal products, such as meat and dairy.

Collecting together our calibrated estimates, which are based on historical patterns of food consumption as well as projections for GDP and population, we find support for the view that growth in demand for the finer foods is likely to accelerate further in coming years than demand for cereals (even accounting for grain usage as feedstock).

Table 2.15) Average annual growth in consumption (%)

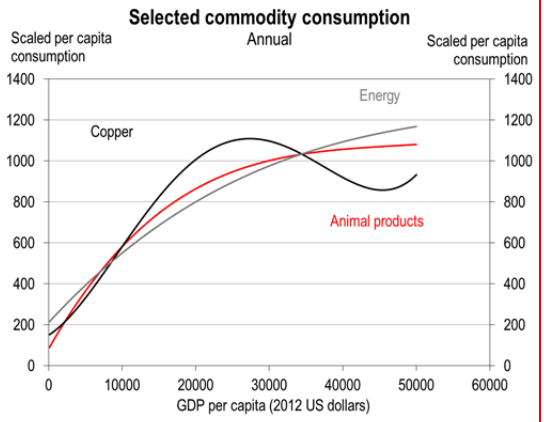
	2000-09	2010-18e
Cereals		
Consumption	1.1	0.2
Total use	2.1	1.7
Meat	2.1	2.4
Dairy	1.5	2.4
Sweeteners	1.0	1.9
Vegetable oil	2.6	1.7

Source: FAO, HSBC estimates

Food vs. metals and energy

Now that we have estimates of historical patterns of demand we can also assess what history tells us about which commodities are likely to see the strongest demand in the future. In broad terms, the demand estimates suggest that metals demand is likely to peak before energy or animal product demand (Chart 2.16). The demand for energy products evolves in a similar way to animal products through a country's development. As a result, emerging market demand for energy products, including natural gas, coal and oil, should remain robust as incomes continue to rise.

2.16) Demand for soft commodities is more persistent



Source: FAO, World Bank

More super, less cycle

As we noted in the previous chapter, our own view on the commodity price super-cycle is that we expect commodity prices to remain structurally high and well above the lows of the 1980s and 1990s. This view is borne out in our hard commodity, energy and soft commodity prices forecasts (Table 2.17).

The supply side matters too

This chapter has focused on demand for food products and clearly the supply-side matters too. One of the key factors on the supply side is climate change, which is the topic of Chapter 3.

Chapter 4 then looks at which countries are the largest producers of each of the finer foods. Of course, because many of the supply side issues are determined by commodity-specific factors, the best approach is to look at each of the specific commodities in turn. Chapter 5 looks at demand and supply of meat with a focus on Brazil's supply capacity. Chapter 6 looks at sugar and Brazil. Chapter 7 covers palm oil and the Asian supply story. Chapter 8 covers dairy demand and supply in the Chinese market, which is currently a key source of new demand. Finally, Chapter 9 looks at demand and supply of fertiliser, a key fuel for growing feedstock and the finer foods.

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Table 2.17) Prices of most commodities are forecast to stay much higher than their 1990s levels

Commodity price forecasts	Unit	2013	2014e	2015e	2013-2015 (%)	2015 relative to 1990s****
Base metals						
Aluminium	USD/t	1,847	1,950	2,050	11.0	-23
Copper	USD/t	7,335	7,750	7,250	-1.2	161
Nickel	USD/t	15,040	15,270	17,000	13.0	81
Zinc	USD/t	1,918	2,080	2,300	19.9	38
Precious metals						
Gold	USD/oz	1,412	1,292	1,310	-7.2	208
Silver	USD/oz	23.9	20.8	20.3	-15.1	251
Platinum	USD/oz	1,487	1,595	1,850	24.4	302
Palladium	USD/oz	725	825	900	24.1	274
Bulks & Energy						
Ferrochrome	USD/lb	1.16	1.21	1.25	7.8	-
Alumina	USD/t	277	293	308	11.2	-
Iron ore	USD/t	136	125	105	-22.8	636
Coking coal	USD/t	159	152	168	5.7	-
Thermal coal spot	USD/t	84	83	84	0.0	75
Oil (Brent)	USD/bbl	109	97	93	-14.7	343
Natural gas* (Henry hub)	USD/mmbtu	3.7	4.7	4.2	13.1	41
Food and Agriculture						
Beef and veal**	USD/t	4,654	4,716	4,731	1.6	25
Raw milk (China)	RMB/kg	3.62	3.91	4.07	12.4	-
Palm Oil	USD/t	764	808	853	11.6	44
Soybeans***	cents/bu.	1,271	1,359	1,178	-7.3	54
Sugar	cents/lb	18.3	17.2	21.4	16.9	39
Wheat***	cents/bu.	718	661	677	-5.7	24

*Bloomberg consensus estimates ** OECD-FAO estimates
*** CBOT forward curve, all other forecasts HSBC estimates **** Real prices

Source: Bloomberg; IMF; HSBC estimates

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Climate change factors act as supply disrupter

- Agriculture is a contributor to greenhouse gas emissions, but is also a victim of the effects of higher temperatures, which constrain the supply of agricultural products
- Supply-side constraints come from regulation to tackle climate change and lower yields as a result of weather disruption
- We expect global cereal growth to be lower with climate change, which is expected to reduce the availability of edible grains and animal feedstock

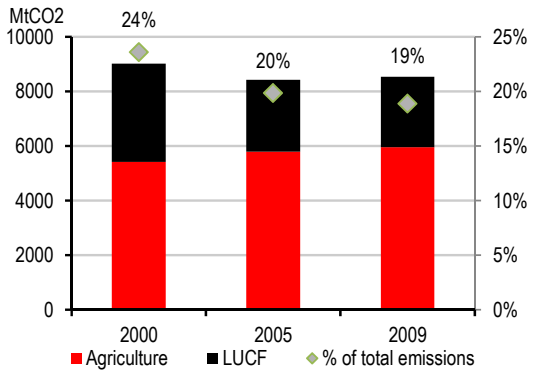
Perpetrator and victim

Climate change can disrupt agricultural output. This happens in two ways: it is a perpetrator of global warming by contributing to greenhouse gas emissions (GHG), but it is also a victim as changing weather norms disrupts yields. Regulatory efforts to reduce GHG emissions act as a constraint on the amount of land that can be deforested and chemicals that can be used for agricultural purposes. In addition, sub-optimal temperatures and water during the growing season impact harvest volumes.

Agriculture as a perpetrator

In 2009, around 19% of total annual GHG emissions came from agriculture and deforestation (Chart 3.1). Generally, natural resources are also carbon sinks (an entity that absorbs more carbon than it releases) so that disturbing ecosystems will change carbon flows, either contributing to the accumulated stock of emissions or reducing it.

3.1) Volume and share of GHGs from agriculture and LUCF



Note: LUCF is land use change and forestry
Source: World Resource Institute (2009, most recent data), HSBC

Emission sources

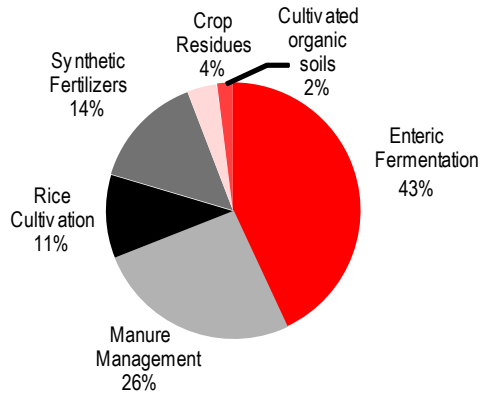
Soil, animals and forests

The majority of agricultural emissions come from nitrogen (soil and manure) and methane (cattle) (Chart 3.2). These are difficult to actively monitor and regulate, although some studies are starting to look at whether a significant difference can be made by changing livestock feed.

Wai-Shin Chan, CFA
Climate Change Strategist
The Hongkong and Shanghai Banking Corporation Limited
+852 2822 4870
wai.shin.chan@hsbc.com.hk

Zoe Knight
Climate Change Strategist
HSBC Bank plc
+44 20 7991 6715
zoe.knight@hsbcib.com

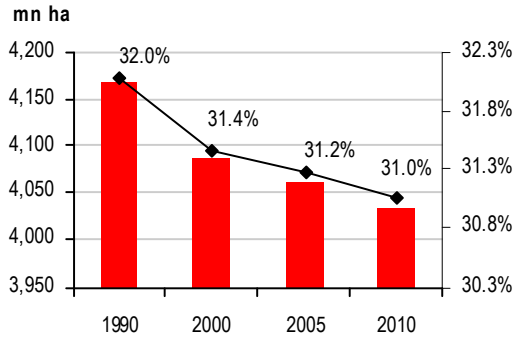
3.2) Agricultural GHGs come mainly from soil and cows



Source: FAO, data as of 2010, HSBC

Deforestation accounts for 78% of the annual GHG's arising from land use, land use change and forestry (LULUCF), with 1% of the world's tropical forest harvested between 1990 and 2010.

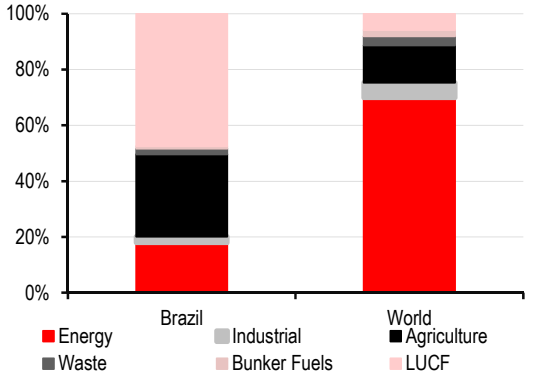
3.3) Global forest area is shrinking



Source: Forest Resource Assessment 2010, FAO, HSBC

This represents some 135m ha in total, an area the size of Peru. Or to put it another way, an area just under the size of the world's vineyards is cut down each year, thus losing the future ability of the forest to act as a carbon sink, and making land more vulnerable to soil erosion. Brazil and Indonesia accounted for two-thirds of the world's deforestation in 2005. In three out of four cases of forest clearing, agriculture (livestock, commercial, or subsistence) is the cause. When agriculture (notably pasture) competes with forestry for land, generally the result is deforestation.

3.4) LUCF is a major source of emissions



Source: WRI CAIT Database (2009, most recent data), HSBC

Fighting deforestation is an on-going battle for Brazil in particular: but the forest area has fallen from 69% of land area in 1990 to 62% in 2010. Forest preservation would retain water and help prevent climate change, but for some farmers, the differential in land price between forest and pasture is just too much to forego (Table 3.5).

Satellite monitoring of land area has become the tool of choice to tackle illegal logging in Brazil, and deforestation targets are regulated through the national climate change plan. For more on Brazil's emission reduction goals relating to agriculture see *Brazil: Latam's bio super power*, 25 April 2012.

Table 3.5) Average forest and pasture land prices (2008)

	Region	Forest R$/ha	Pasture R$/ha
Acre	North East	108	1571.8
Amapa	North	141	800
Amazonas	North East	132.4	1243.9
Para	North	457.7	1509.4
Rondonia	North East	358.5	1762.5
Mato Grosso	Central	546.1	2083.7
Average		*290.6*	*1495.2*

Source: AgraFND (2009), HSBC. Note: 2008 prices

Other GHG emissions come from changes to peat and wet lands. Organic soils, for example, peatland soils in Indonesia and Malaysia, contain high densities of carbon, accumulated over many centuries. This carbon is released as CO_2 when the soils are drained.

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Regulation targets agriculture

So far most national climate policies have focused on reducing CO_2 by changing the carbon intensity of the fuel mix and improving the energy efficiency of economic growth. However, emission reduction goals are not being reached quickly enough to stop temperatures rising, so GHG regulation is increasingly being rolled out across other sectors, and can be driven by health as well as climate concerns.

For example, in China, environmental degradation is now creeping in to land use considerations. In January 2014, China's central government published its No. 1 Document. The document recommends the termination of crop production on farmland contaminated by fertiliser overuse and heavy metals. Currently, heavy metals contaminate about 2% of arable land in China.

In Europe, fertiliser and crop protection companies are regulated by the emissions trading scheme. Companies are allocated caps on the volume of CO_2 emissions they can release each year.

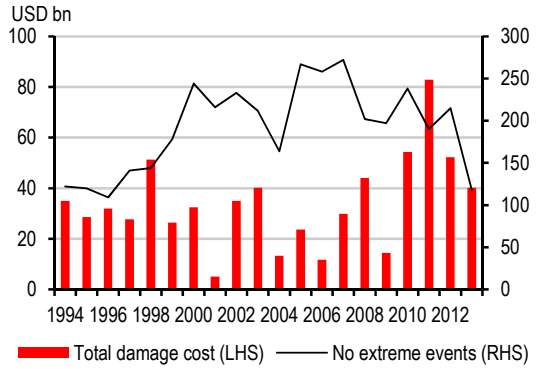
Agriculture as a victim

There is already pressure in the agricultural system as the need for more food clashes with increased environmental degradation from the overuse of fertilisers. Agriculture is a taker of four climate-related factors that act as supply-side constraints: extreme weather events, changing average temperatures, changing rates of CO_2 fertilisation and water availability.

Disruption from extreme events

Climate change disrupts historical patterns of 'average weather' and 'extreme events' (defined as wildfires, droughts, floods and extreme temperatures, sourced from the International Disaster Database from the Centre for Research on the Epidemiology of disasters), making the 'normal' processes of agriculture harder. Chart 3.6 below shows that the number of extreme events has been on the rise and this has increased cost implications.

3.6) Extreme events are unpredictable



Source: EM-DAT, HSBC

These effects on agricultural production have already been noted. For instance, Zheng Guoguang, head of the China Meteorological Administration, estimates that "in recent years, extreme weather such as floods, droughts, rainstorms, and low temperatures had caused average grain losses of 50bn kg a year in China, with drought causing the greatest harm." To put that into context, it is equivalent to approximately 10% of China's annual grain output.

In 2010, in the wheat markets, Kazakhstan, Ukraine and Russia (10.5% of global wheat production) suffered from drought-driven volume declines in excess of 15%, and the Canadian crop (3.6% of world production, second-largest exporter) fell 17% as a result of flooding.

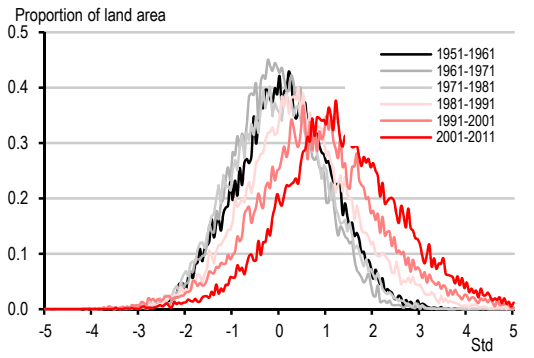
In 2011, floods in Thailand provided a poignant reminder that weather is a disruptive force. Thailand's Department of Agriculture revised down its rice forecast for 2011 from 25m tonnes to 21m tonnes after the floods (see *Floods in Thailand*, 10 October 2011). At the time, the Thai finance ministry cut its 2011 GDP growth forecast from 4.0% to 3.7% whilst the Bank of Thailand cut rates by 25bp to 3.25% "to support the economy's recovery from devastating floods".

Elsewhere, in the US in 2011, the hottest summer since 1955 caused drought and falling corn yields in the Midwest, the country's main corn-producing region. On the back of this, production forecasts were reduced by 27.4m tonnes on average – equal to around 8% of US production and a level greater than the output from the world's second biggest corn exporter, Argentina.

Currently, California is experiencing the worst drought in the 160 years since records began. Although official estimates of the exact agricultural impact of the drought are not yet available, we think it's fair to say there will be some disruption. According to the California Department of Foods and Agriculture, the state produces nearly half of US-grown fruits, nuts and vegetables. In addition, 15% of US revenue for crops and 7.1% of US revenue for livestock come from California.

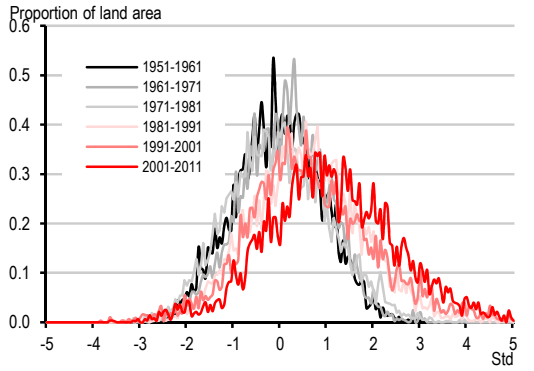
Managing future output volatility means identifying how well regional agriculture will cope with changing weather norms. 'Average weather' is expressed in terms of temperatures, seasonal variations, rainfall, as well as extreme events such as floods, storms and droughts. Climate change scientists have been talking for a while now about climate change widening the probability distribution for temperature extremes and shifting the mean and the low-probability tails toward more frequent and intense heat events. Charts 3.7 and 3.8 show that these shifts are now being observed.

3.7) Shifting summer land temperature in Northern Hemisphere



Source: Perception of Climate Change, Hansen et. Al., National Academy of Sciences, March 2012, HSBC

3.8) Shifting summer land temperature in Southern Hemisphere



Source: Perception of Climate Change, Hansen et. Al., National Academy of Sciences, March 2012, HSBC

Changing yields: Temperatures, CO_2 fertilisation and water availability

In the absence of climate change impacts, an assessment of how global production levels might evolve requires regional analysis of soil characteristics, crop variety, the cropping calendar, CO_2 fertilisation effects, irrigation and nutrient levels. Adding the climate angle means first making an assessment on how emission levels will change going forward (which impacts CO_2 fertilisation) and secondly identifying how increasing emission stocks will play out through the global climate system to change regional rainfall patterns, soil and air temperatures.

Temperatures: Volumes for agricultural output vary depending on weather conditions during the growing season. Even at moderate levels, the effects of heat can be significant for agricultural based economies, where, on average, for every 1°C temperature gain above the optimum during the growing season, yields decline by 10%.

CO_2 fertilisation: The yield effects of climate change are not always negative. Rising carbon dioxide in the atmosphere can enhance fertilisation (up to a point), which would boost productivity in some regions, due to increased photosynthesis and increased efficiency of water use.

The CO_2 fertilisation effect is highly species-dependent however, and tends to benefit some crops (such as wheat and rice) more than others (such as corn). The extent to which carbon fertilisation is used in the assumptions can result in significant variation in yield forecasts.

Water: In a warmer world crops may suffer due to increased evaporation and evapo-transpiration losses, as soil moisture gets lost more quickly, requiring additional water for irrigation. On a global basis, rain-fed agriculture uses around 80% of arable land to produce 60% of agricultural output. Irrigated agriculture produces the remaining 40% of agricultural output using c20% of global arable land area.

Furthermore, climate change impacts agriculture though destabilising rainfall patterns, although it is difficult to know how and where. Indeed, the FAO noted that "while temperature can be projected by global circulation models with a high degree of 'convergence', the same cannot be said of water vapour".

Quantifying the impacts

Quantifying the impacts of these natural capital factors is difficult, as in many cases the relationships are interdependent. We look at this in more detail for economies more broadly in our report *Natural Capital: Identifying implications for economies*, 19 November 2013, but for food in particular the most comprehensive quantitative study is the International Food Policy Research Institute (IFPRI) report 'Food Security, Farming and Climate Change to 2050 – scenarios, results, policy options' (2010).

IFPRI forecasts cereal production to 2050 using a variety of emission and climate scenarios. There are three broad steps in the forecasting methodology – emissions, temperature and rainfall changes – and then productivity analysis, which all have a variety of more detailed sub assumptions.

The result of all the modelling is that IFPRI expects global cereal production to increase 37.5% in a scenario of perfect mitigation (i.e. with no climate change), compared with a 30% increase with climate change to 2050. For more details on the modelling, see our report *Agriculture: Double trouble*, 12 December 2011.

Which countries are most impacted by climate change?

In *Scoring Climate Change Risk*, published 9 August 2011, updated on 24 September 2013, HSBC devised a framework for ranking the relative vulnerability of G20 countries to climate change impacts. In this framework, we take into consideration data related to temperature, food, energy and water risks, and rank countries according to their exposure, sensitivity and adaptability towards these risks. Rankings according to each risk factor are then combined so as to allow for cross-sectional comparison across countries.

The contribution of agriculture to global GDP is small compared to other industries, at just 3%. However, although low value in monetary terms, the agricultural sector employs over a billion people, representing 31% of the global labour force (World Bank Development Indicators, 2010). The challenge for the most climate change

vulnerable countries is that their economies are more dependent on agriculture revenues than their least vulnerable peers, as shown in Chart 3.10. The country rankings from both scoring reports are summarised in Table 3.9.

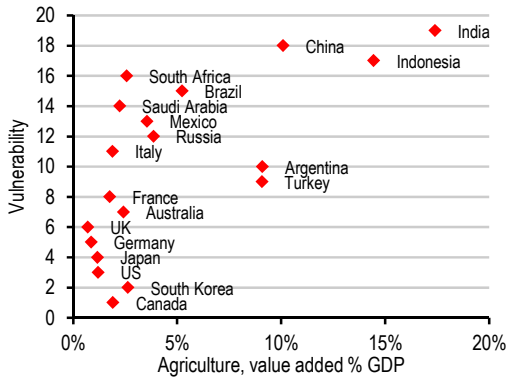
Table 3.9) India, China and Indonesia are most vulnerable to climate change

	Ranking 2011	Ranking 2013	Rank Change	
India	1	1		
China	3	2	▲	1
Indonesia	2	3	▼	1
South Africa	6	4	▲	2
Brazil	4	5	▼	1
Saudi Arabia	5	6	▼	1
Mexico	10	7	▲	3
Russia	7	8	▼	1
Italy	9	9		
Argentina	11	10	▲	1
Turkey	8	11	▼	3
France	12	12		
Australia	14	13	▲	1
UK	16	14	▲	2
Germany	13	15	▼	2
Japan	17	16	▲	1
US	18	17	▲	1
South Korea	15	18	▼	3
Canada	19	19		

Source: HSBC, 1= most vulnerable

In 2010 agriculture as a percentage of GDP was 17.4%, 10.1% and 14.4% for India, China and Indonesia, respectively, according to the World Bank. This compares with just 1.2% for the US, 2.6% for South Korea and 1.9% for Canada (for Canada agriculture as a percentage of GDP refers to 2008) – the least climate change vulnerable countries among the G20. For us, the important point is to establish how production will vary under a changing climate for the most and least climate change vulnerable countries, which together contribute around 62% to global GDP and 67% to agricultural output value.

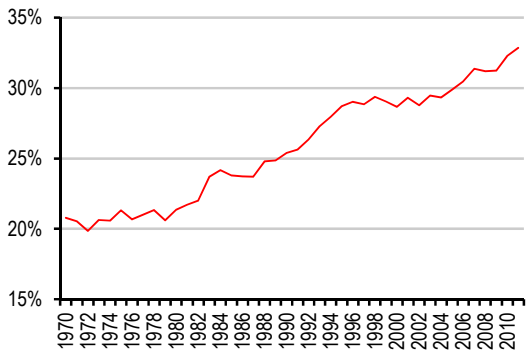
3.10) Vulnerability and agriculture dependence (20 = high relative vulnerability, 0 = low relative vulnerability)



Source: HSBC, Thomson Reuters Datastream, World Bank

India, Indonesia and China also contribute a significant proportion to global agricultural value add, at almost 33%, up from just 21% in 1970 (Chart 3.11).

3.11) Contribution of India, Indonesia, China to world agriculture value add



Source: HSBC, World Bank, Thomson Reuters Datastream

The significance of the three countries in terms of global cereal production volume is also noteworthy at 30% share for wheat, 60% for rice and 26% for corn.

To put this into context, we illustrate the volume of global production of wheat, rice and corn by region in Chart 3.12 below.

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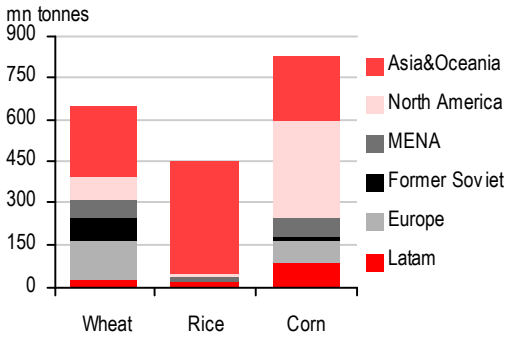
3.12) Global cereal production 2010/11



Source: USDA

The IFPRI analysis provides a detailed breakdown of production forecasts by country for the main cereals. The results are summarised in Table 3.13.

Table 3.13) Summary of production changes from 2010-2050

	Increase	Decrease
Wheat	India, Brazil, Japan, US, Canada	China, South Korea
Rice	India, US	Indonesia, China, Brazil, South Korea, Japan
Corn	India, Indonesia, China, Brazil, South Korea, US, Canada	Japan

Source: IFPRI, HSBC

The table makes the point that while production globally will increase in the next 40 years, in some cases there will be production falls from 2010 to 2050 by region and commodity.

Double trouble

In short, climate change factors add up to the two sides of a supply constraint coin. Regulatory drivers restrict the available land and amount of agricultural fertilisers that can be used to increase output capacity, and weather events create output volatility that affects the yield potential – both pointing to increased price volatility.

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Finer foods are a South-South trade story

- As countries develop, the finer foods are in highest demand
- This implies that the major upside to agricultural commodities may come from demand for meat, dairy, edible oils and sugar
- For dairy, China is a key source of demand and a large supplier although New Zealand is also benefiting; for sugar supply, Brazil is critical; for meat, LatAm and Australia are favoured; and, for edible oils, Asia's palm oil is important

A South-South story

A taste for the finer foods tends to develop as incomes rise, as we showed in Chapter 2. So with rising numbers around the globe beginning to enter the middle class, demand for foods like meat, dairy, vegetable oil and sugar is set to rise.

As a result, the regions that produce and export these key commodities may be well placed to benefit from this rise in global incomes. Many of the opportunities that are likely to be presented due to demand for the finer foods are likely to be driven by demand from the emerging economies, but also supplied by the emerging economies. The opportunities presented by this South-South trade story has been a key part of HSBC's view for many years (see *The Southern Silk Road: Turbocharging 'South-South' economic growth*, Stephen King, 6 June 2011).

The four maps on the following pages outline the key exporting and importing regions for four key commodities exposed to rising purchasing power: meat, dairy products, palm oil and sugar (Charts 4.1-4.4).

For meat, the US is the world's largest exporter, with the country shipping high quantities of beef and poultry. However, the US is also one of the world's top five importers of meat products, and the majority of their production is kept for the domestic market.

One country that punches well above its global weight in terms of meat exports is Brazil. Its share of world exports sits just behind that of the US, despite only accounting for 8% of global production, compared to the US with 14%. Brazil is amongst the top exporters of beef, pork and poultry products. As a result, the country stands to benefit from the flow-on impact of rising Asian demand for meat products, while it's a similar story for large exporting countries like Australia and Canada.

Japan is the world's largest importer of meat products, as the country only accounts for 1.1% of global production despite accounting for around

Paul Bloxham
Chief Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9255 2635
paulbloxham@hsbc.com.au

Adam Richardson
Economist, Australia and New Zealand
HSBC Bank Australia Limited
+612 9006 5848
adamrichardson@hsbc.com.au

Alexandre Falcao*
Analyst
HSBC Bank Brasil SA
+55 11 3371 8203
alexander.p.falcao@hsbc.com.br

Ravi Jain
Analyst
HSBC Securities (USA) Inc
+1 212 525 3442
ravijain@us.hsbc.com

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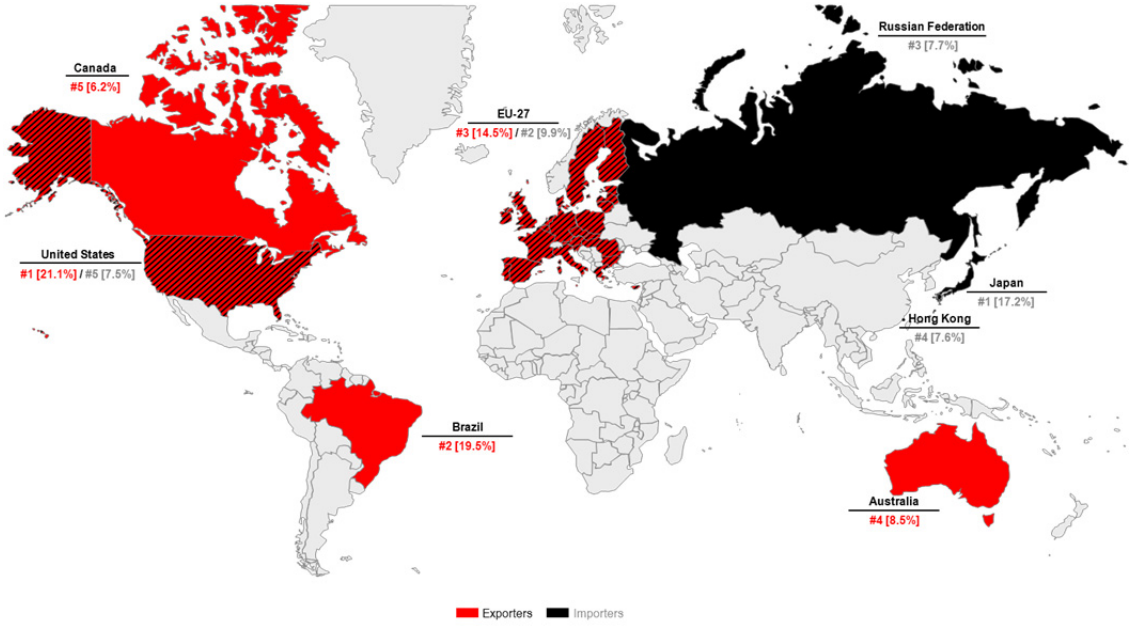
4.1) Meat importers and exporters

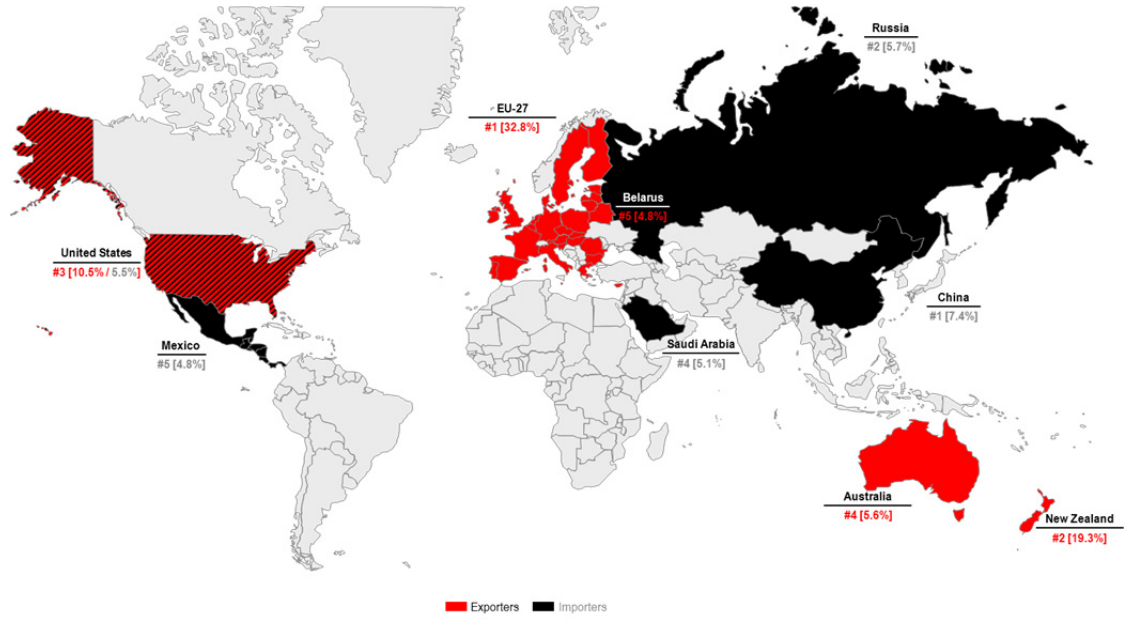


Source: FAO

7% of global GDP. China currently sits in seventh place on the 2011 ranking, although imports have risen rapidly since these data were collated, rising by 74% in value terms over 2012 and 2013.

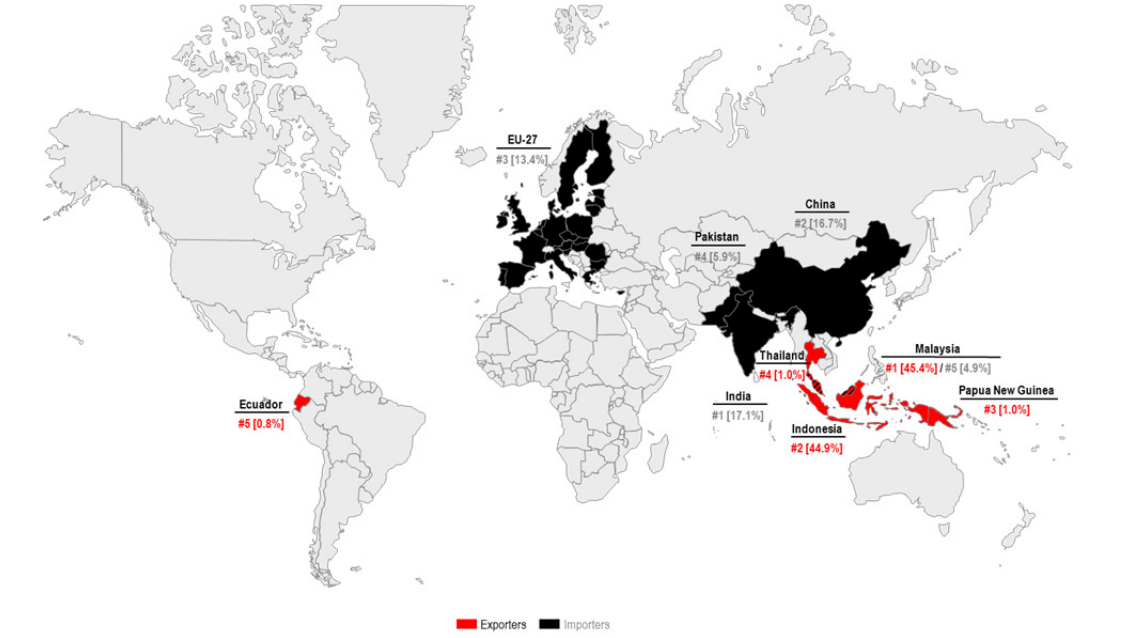
For dairy, the EU is the world's biggest exporter, accounting for one-third of total world trade in milk products. However, in terms of exposure to the fortunes of the dairy sector, New Zealand stands out amongst all countries. Despite accounting for only 3% of global dairy

4.2) Dairy importers and exporters



Source: FAO

4.3) Palm oil importers and exporters

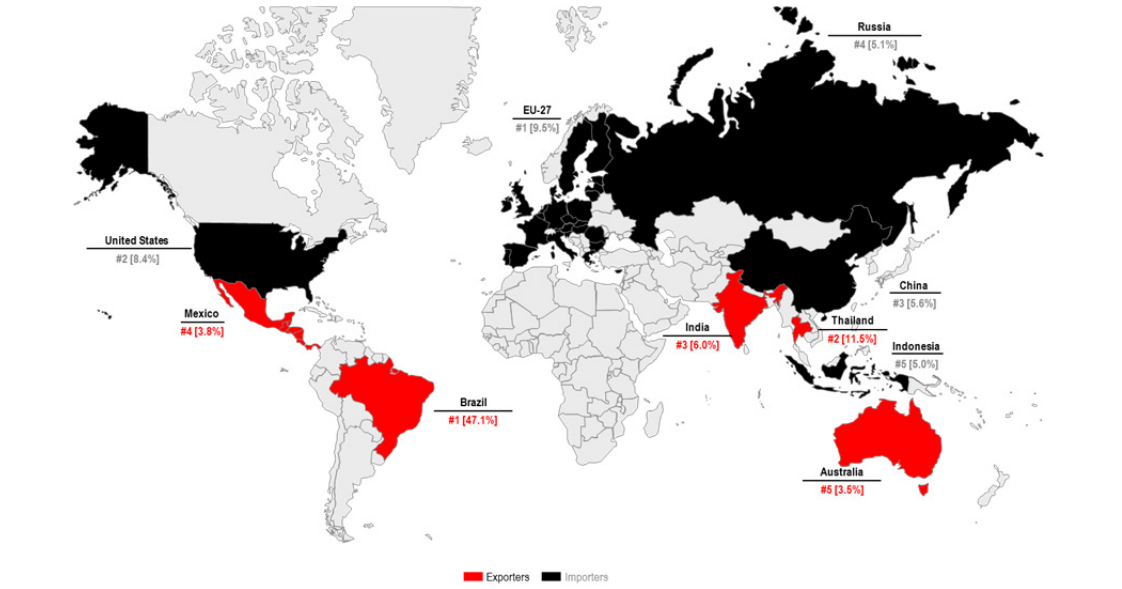


Source: FAO

production, New Zealand is involved in 20% of the world's trade in dairy products. Australia also has significant exposure to the sector, with the country accounting for 6% of world trade.

China is already the world's largest dairy importer. In 2011, Chinese imports accounted for 7.4% of the total and imports have surged since then, to be up by 97% in value terms over 2012 and 2013 – a boost that has driven dairy prices to record levels. As outlined above, strong growth is likely to continue as more and more Chinese enter the middle class.

4.4) Sugar importers and exporters



Source: FAO

The global diet is also likely to shift towards greater consumption of vegetable oils, both directly and through consumption of processed foods.

As a result, palm oil demand is likely to benefit from this shift. Malaysia and Indonesia dominate global trade in palm oil, each accounting for about 45% of global exports of the product. Smaller exporters with large exposure include Papua New Guinea, Thailand and Ecuador. The world's emerging giants, China and India, have the largest share of world imports, with both countries taking 17% of global trade in 2011, with Pakistan also featuring in the top five. Again, the outlook for demand in these economies remains strong, given their early stage of development.

For sugar, Brazil dominates world trade, accounting for almost 50% of global exports. The country itself produces 40% of the world's sugar cane. Thailand, Mexico, India and Australia are also large exporters of the commodity. The EU and US have the world's biggest sweet tooth's, with these countries taking a combined 18% of global imports – reflecting their status as some of the world's most developed nations. China, Russia and India round out the top five importers.

Latin America: Outrunning the 'North'

With surging demand for soft commodities, new supply will come mostly from Latin America, we believe. As seen in the table below, South America has already become the world's leader in the export of numerous soft commodities (Table 4.5). For orange juice, soybean, sugar, and coffee, South America leads global exports by wide margins.

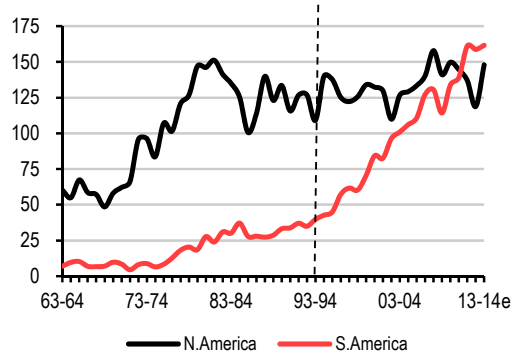
Table 4.5) Commodities for which South America is an export leader

Commodity	Share of global exports	Region in second place (share)
Orange juice	80%	N. America (14%)
Soybean	57%	N. America (40%)
Sugar	56%	Asia (23%)
Coffee	50%	Asia (36%)
Chicken	38%	N. America (33%)
Corn	35%	N. America (34%)
Beef	34%	Oceania (23%)

Source: USDA, HSBC

The tables began to turn two decades ago, when South American agricultural exports started to accelerate. In 1993-94, South American grain exports were a mere 40m metric tons. By 2013-14, they had grown four-fold or at a CAGR of 7.3% to 162m metric tons, overtaking North America as the largest exporter of the key grain commodities (corn, soybean and wheat); see Chart 4.6. In the same period, North American exports remained relatively flat.

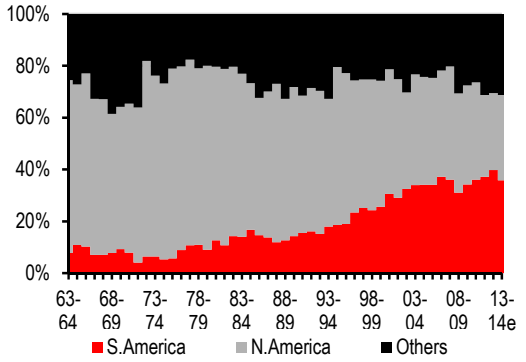
4.6) Grain exports (m metric tons): Changing landscape in the past two decades



Source: USDA, HSBC

Chart 4.7 illustrates the southward shift of food exports over the past 50 years. From a mere 8%, South America today accounts for 36% of global exports of key commodities. Meanwhile, North America has decreased from 67% to 33%.

4.7) Global share of key grain exports (corn, wheat, soybean*)



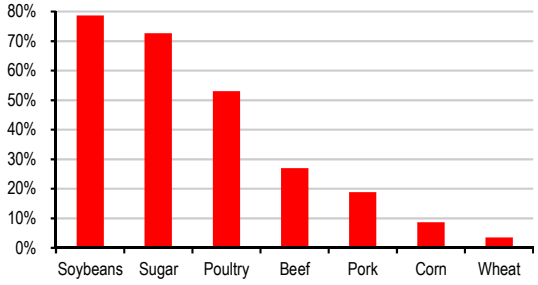
Source: USDA, HSBC

*Includes soybean oilseed, soybean oil, and soybean meal

In the global protein export market, North America still holds top spot, having even expanded its share from 29.6% 20 years ago to 33.4% (Chart 4.8). South America more than doubled its share to 29.3% from 11.5% in the same period. This came at the expense of the EU, whose share shrunk to 13.3% from 33.4%.

The trend will likely continue and the majority of additional expansion in the global grain and meat market is expected to be contributed by South America. According to USDA baseline projections, South America will provide 79% of the new soybean export volume, 73% of sugar export, 53% of poultry, 27% of beef, 19% of pork, 9% of corn, and 4% of wheat export during the next decade (Chart 4.9).

4.9) South America's contribution to global export in the next decade

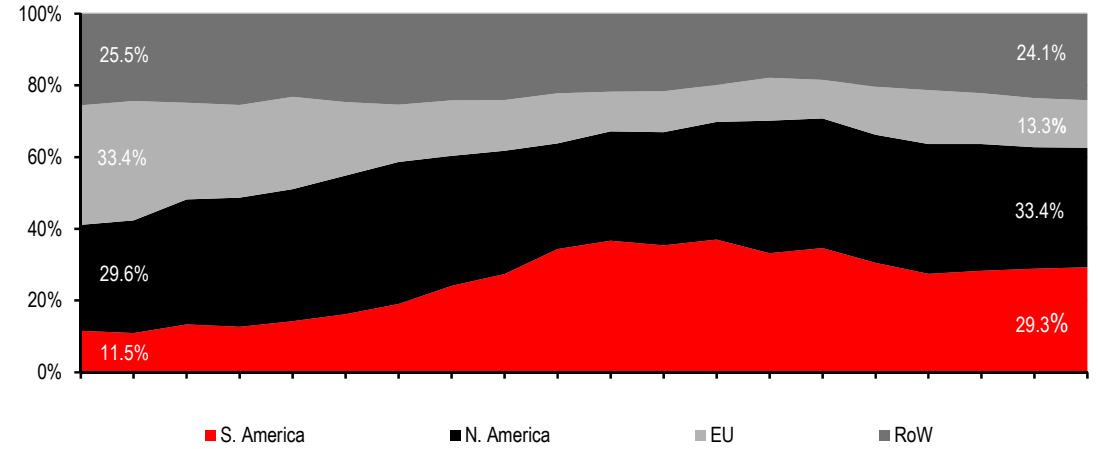


Source: USDA, Fapri

Explosion of farm acreage

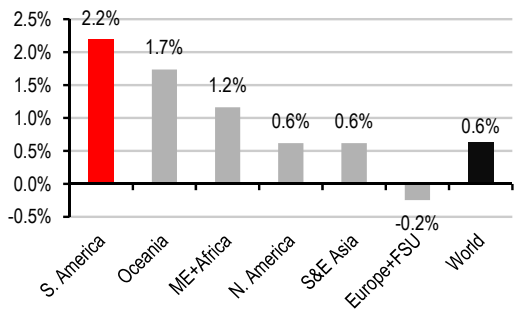
A main driving factor behind this ongoing agricultural polar reversal is South America's aggressive expansion of farming area. In the past 50 years, the global acreage has grown at a 0.6% CAGR, with South America growing the fastest (Chart 4.10).

4.8) Global share of key protein exports (beef, pork, chicken, turkey)



Source: USDA, HSBC

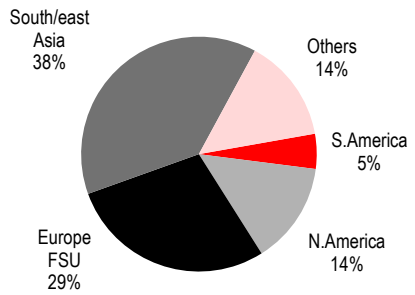
4.10) Acreage CAGRs in the past 50 years for all field crops as defined by the USDA*



Source: USDA, HSBC, *Field crops as per the USDA include barley, corn, millet, mixed grain, oats, peanuts, rapeseed, soybeans, sunflowers, rice, rye, sorghum, and wheat

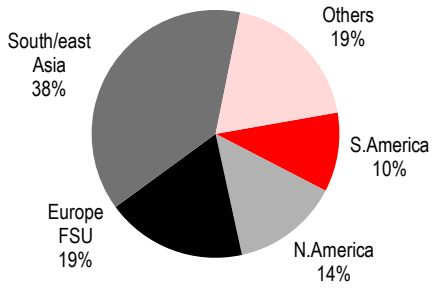
The USDA expects the planted acreage in South America to be 97m ha in 2013-14 versus only 33m ha 50 years ago, a strong 2.2% CAGR. North America and South and East Asia grew in line with the global average at 0.6%, while acreage in Europe and former Soviet states declined in the same period. In 1963-64, South America accounted for only 4.8% of global planted acreage, while today it has more than doubled to 10.4% (Charts 4.11 and 4.12). On the other hand, North America and South and East Asia have remained relatively stable in terms of shares of global acreage. The planted acreage share of Europe and former Soviet states declined significantly to 19% from 29% five decades ago.

4.11) Acreage by region, 1963-64



Source: USDA, HSBC

4.12) Acreage by region, 2013-14e



Source: USDA, HSBC

Future growth assisted by availability of land and water

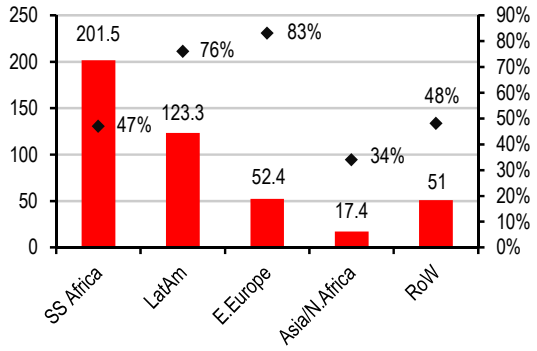
Looking forward, Latin America is the region that has the highest potential to further expand its agricultural capacity and it is well-positioned to become the breadbasket of the world. We expect solid increases in planted acreage to continue in Latin America, supported by its several competitive advantages, the most important being availability of land and water.

Availability of land

Latin America has abundant arable land yet to be converted to productive agricultural activities. According to a World Bank report, "Rising Global Interest in Farmland," the world's total current uncultivated area suitable for agriculture (un-forested, unprotected, and inhabited by fewer than 25 persons per sq km) equals 446m ha, which is about one-third of the current global planted area of 1.5bn ha. Of the 446m ha, 201.5m ha (45%), are in Sub-Saharan Africa and 123.3m ha (28%) in Latin America. Eastern Europe and Central Asia account for 12% of total, Asia, North Africa 4%, and the rest of the world 11%.

HSBC

4.13) Potential availability of land* and % situated in areas with travel time of less than six hours to market

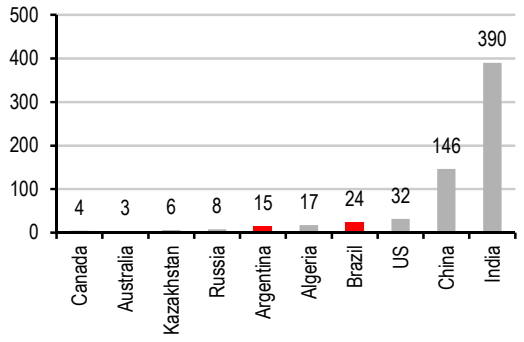


Source: World Bank, *Defined as uncultivated area suitable for cropping that is unforested, unprotected, and populated with fewer than 25 persons/km2, SS Africa: Sub-Saharan Africa

Although Sub-Saharan Africa leads the way in acreage of uncultivated arable land, we believe that Latin America has significant advantages over Sub-Saharan Africa, given substandard infrastructure in Africa, limited technological sophistication, shortages of water and irrigation, and political instability. According to the World Bank, 76% of Latin America's uncultivated land is situated within six hours of market, compared to only 47% in Africa.

The two largest countries in Latin America – Brazil and Argentina – fare well against other largest countries in the world in terms of population density (Chart 4.14). The chart shows the population density of the world's largest countries. Brazil and Argentina both have low population densities, compared to India and China. Countries such as Algeria, Kazakhstan, and Russia also have very low population densities, yet we also consider rainfall levels as a major driver of agribusiness success.

4.14) Population density (persons/sq km), 2015e

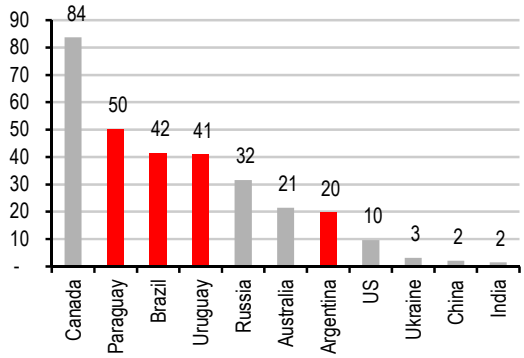


Source: UN, HSBC

Abundance of water

Without water, land is not agriculturally productive. A key competitive advantage of Latin America's agricultural industry is its abundance of water. Rainfall levels are high, and available water resources are significant. Asia has the largest water reserves in the world, c36%, but also has 60% of the world's population. On the other hand, Latin America has 26% of world's water reserves and only c8% of the world's population (Chart 4.15).

4.15) Total renewable water resources per capita (m liters/inhabitant/year)



Source: FAO

Countries in Latin American have abundant water resources, significantly higher than their Asian or African peers. For example, Brazil has 42m liters per capita and Argentina has 20m liters, versus Ukraine's 3.1m liters, China's 2.1m, and India's 1.5m on a per capita basis. Paraguay and Uruguay

also have solid water resources, at 50m and 41m liters, respectively, on a per capita basis. The US has nearly 10m liters per capita, and European countries such as France, Germany, and the UK have only 2-3m liters per capita. This again, in our view, makes Latin America one of the ideal regions in the world for farmland expansion.

The Latin American countries should continue to export surplus land and water in the form of agricultural commodities. Brazil is by far the leader in rainfall, with an average of 1,782mm per year. India is second with 1,083mm, but note that it has the highest population density at 390 persons per sq km, more than 16 times that of Brazil. Algeria has very low density, 17 people per sq km, yet it has very low rainfall levels, compared to the other countries with an average of only 89mm per year. As a result of higher rainfall levels and water availability, we believe that frontier land in Latin America is significantly more at advantage than that in Africa.

Soil fertility and yield

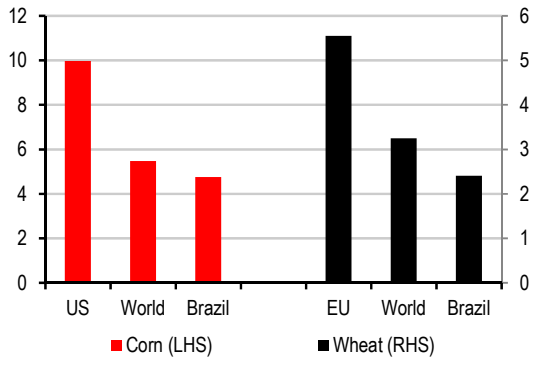
Higher rainfall and water availability translate to fertile soil and since relatively less capital is needed to convert such undeveloped land into productive uses, South America should be among the first regions to expand acreage as farmer profitability increases. For example, the humid Pampas region of Argentina is one of the most fertile agricultural regions of the world, enjoying regular and abundant rainfall and favourable climatic conditions. The need for fertilizers is minimal, and production costs are significantly low. Therefore, despite having higher commodity export taxes than other major exporters, Argentine agricultural exporters remain competitive and profitable.

4.16) South America's main agricultural areas

Source: HSBC

Crop yields in Latin America today are improving rapidly. In the past 50 years, crop yields had increased at a 2.1% CAGR, faster than most regions of the world (Chart 4.17). However, the potential for further improvements is significant, in our view, especially for corn and wheat. For example, Brazil's yields are still well below those of the leading producers, the US for corn and the EU for wheat, as well as the global average yield.

4.17) Comparison of corn and wheat yields in 2013/14e (mt/ha)



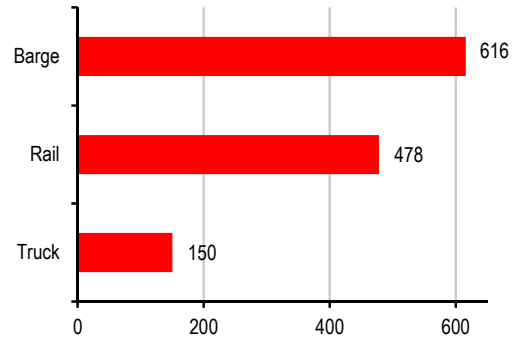
Source: USDA, HSBC

Need for logistics investment

Agriculture in South America, Brazil in particular, continues to suffer from inefficient infrastructure and logistics. The growth in productive capacity and planted area has not been accompanied by similar

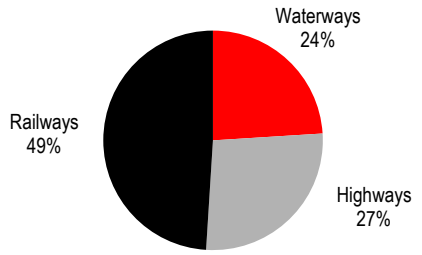
growth in logistics and infrastructure. According to the Texas Transportation Department, using one gallon of fuel, one ton of goods can be transported 616 miles by a barge, compared to 478 miles by rail and only 150 miles by a truck (Chart 4.18). Thus, we consider it an imperative for all major agricultural producers to build infrastructure that is efficient and cost-effective.

4.18) Distance 1 ton of goods is transported using 1 gallon of fuel



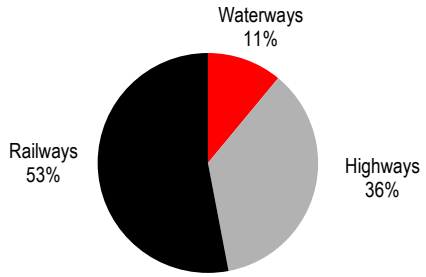
Source: Texas Transportation Institute, HSBC

4.19) Soybean transportation in the US



Source: ABIOVE, HSBC

4.20) Soybean transportation in Brazil



Source: ABIOVE, HSBC

Transportation by road, which is the most expensive, accounts for only 27% in the US but as much as 36% in Brazil. As a result, the cost of freight in Brazil is significantly higher than that in the US. For example, the cost of transporting one ton of soybeans from the Brazilian state of Mato Grosso to Shanghai (via the port of Santos in São Paulo) is 78% higher than the cost of transporting the same ton of soybeans from Minneapolis to Japan (via the US Gulf).

Note that the comparison is fair, as the distance from Minneapolis to New Orleans as well as from Sorriso, a large city in Mato Grosso, to the Santos port is the same at nearly 1,200 miles. In addition, note that the ocean freight cost from port to destination is same at cUSD51 per ton. Thus, inefficiencies lie in inland transportation. It costs USD110 to transport a ton of soybeans to the Santos port from Mato Grosso, versus only USD40 for soybeans to reach New Orleans from Minneapolis (USD12 for truck and USD28 for barge freight). The landed cost, at the buyer's door, of a ton of soybean is 3% higher for Brazil at USD610 vs USD593 per ton for Minneapolis, but due to higher transportation costs, a Brazilian farmer's selling price is as much as 11% or USD54 per ton lower. In the case of soybeans shipped from Mato Grosso, transportation costs account for 26% of the landed price, compared to only 15% for soybeans shipped from Minnesota. According to Syngenta, 49% of Brazilian production is more than 2 days from ports and this hinders expansion of planted areas (Table 4.21).

Table 4.21) Costs of shipping soybeans (USD/ton)

	North MT* to Shanghai via Santos	Minneapolis to Japan via US Gulf	Variance
Truck	110	12	
Barge	-	28	
Ocean	51	51	
Total transportation	**161**	**91**	**78%**
Farm price	448	502	-11%
Landed cost	**610**	**593**	**3%**
Transport % of landed cost	26%	15%	

*MT = Mato Grosso
Source: USDA, HSBC

HSBC

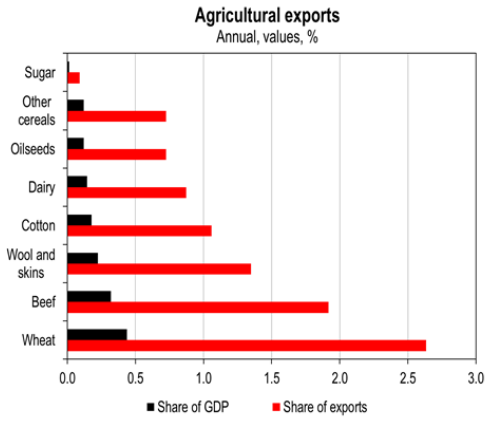
Prospects bright in the Antipodean economies

While not fitting the classic mould of a 'South' economy, the advanced southern hemisphere nations of Australia and New Zealand are also heavily exposed to food commodities.

For Australia, a large land mass and small population has seen the country become a key exporter of a number of food commodities – despite agricultural productivity lagging behind the rest of OECD in absolute terms. Australia is the world's fourth largest exporter of meat, dairy and wheat and the fifth largest exporter of sugar.

Agriculture accounts for around 12% of Australia's exports (Chart 4.22) – solid exposure but well below the resource sector's share of 57%. However, Australia's prospects in agricultural production are positive. The economy has seen strong growth in agricultural productivity in recent decades and the robust outlook for Asian demand for food commodities is likely to provide further incentives for food commodity producers to boost production.

4.22) Australia is a large wheat, beef and wool exporter



Source: Australian Bureau of Statistics

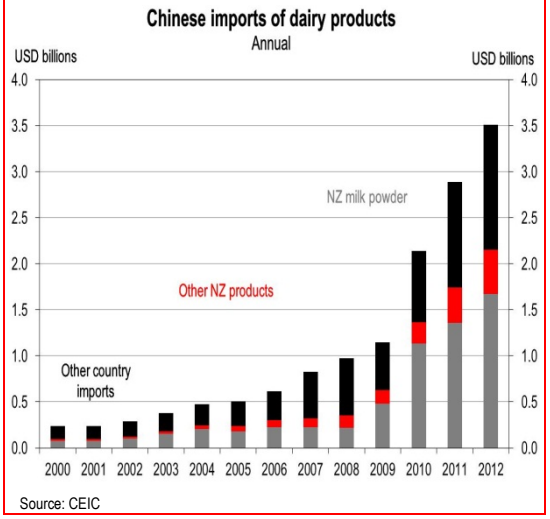
New Zealand is even more exposed to the fortunes of the food commodity sector. Despite its diminutive size, New Zealand is the world's second largest exporter of dairy products and sixth largest exporter of meat products. Agricultural exports make up 45% of New Zealand's total exports.

The agricultural sector in New Zealand is much more developed than that of South America. As a result, strong demand for agricultural commodities should incentivise continued increases in production. However, the rural sector in New Zealand has more limited growth potential than the South American economies. Instead, the biggest impact for New Zealand of strengthening demand for food commodities will be through prices.

In this regard, dairy prices have surged over the past year, as strong Chinese demand, along with earlier supply restrictions due to drought, have significantly lifted prices. Dairy prices increased by around 50% through 2013 and this has seen New Zealand's terms of trade reach 40-year highs, providing a significant boost to the economy.

A surge in Chinese demand for dairy products has significantly boosted New Zealand's exports to China in recent years. New Zealand is now, by far, China's most important source of dairy products, with New Zealand products accounting for 60% of China's total dairy imports (Chart 4.23)

4.23) New Zealand dominates China's dairy imports



Source: CEIC

HSBC

Brazil to benefit from rising meat demand

- Meat demand is set to rise as emerging Asia develops, supporting Brazil's meat industry
- Brazil is the world's most competitive producer of beef worldwide
- Tight supply and strong demand support our outlook for beef prices

Lauren Torres
Analyst
HSBC Securities (USA) Inc
+1 212 525 6972
lauren.torres@us.hsbc.com

Diego Maia*
Analyst
HSBC Bank Brasil SA
+55 11 3371 8192
diego.t.maia@hsbc.com.br

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Brazil: The most competitive beef producer worldwide

As a greater percentage of the global population adopts a more complex diet currently found in developed countries (giving a lower weight to cereal grains and higher weight to dairies and protein products), Brazil is strengthening its foothold to become the world's main protein source.

Raising cattle requires large quantities of land, water and feed. For example, producing 1 kg of chicken requires 4.5 kg of grain feed and 4.1m3 of water, whereas producing 1kg of pork requires 7.3kg of grain feed and 5.9m3 of water. For beef, the amount of inputs needed is even higher, with 1 kg of beef requiring a stunning 20.0kg of grain feed and 16.0m3 of water (see chart 5.2 for reference).

Brazil is a low-cost grain producer that does not use grains to produce biofuels as the US does (instead producing sugarcane-derived ethanol) and also has alternatives for animal feed from the derivatives of local agriculture, such as sugar cane bagasse, orange bagasse, and cotton seeds dreg. In addition, the country still has huge potential for converting unused arable land into crops and pastures (Chart 5.3) to continue to expand grain production.

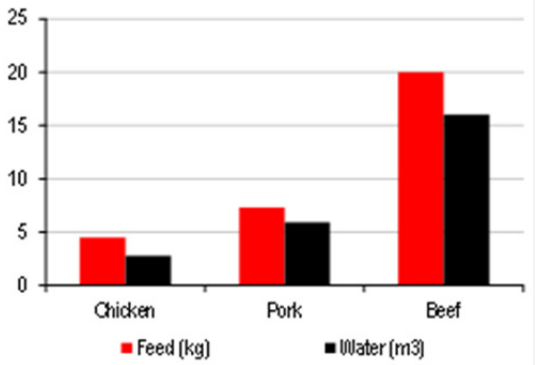
Brazil is currently the world's largest exporter of beef and chicken and the fourth-largest exporter of pork. We have been recently more optimistic about the beef sector in particular. In the 1970s Brazil surpassed the US – the world's largest producer and fourth-largest exporter of beef – in terms of the cattle herd count, and now has the second-largest cattle herd in the world after India (c35% of India's herd is comprised of buffalos). The US beef cattle herd count has not recovered to its peak-level of 1975, and recently fell to its lowest level since the mid-1960s. In contrast, Brazil has been recording historically high cattle herd counts since the late 1990s (Charts 5.4 and 5.5). In addition, the fact that

5.1) Global beef markets, 2012 data

In '000 metric tons	Brazil	US	Australia	EU	Russia	East Asia	World
Production	9,307	11,849	2,152	7,711	1,380	6,385	57,558
Imports	62	1,007	12	348	1,023	1,563	6,626
Exports	1,524	1,113	1,407	297	8	45	8,146

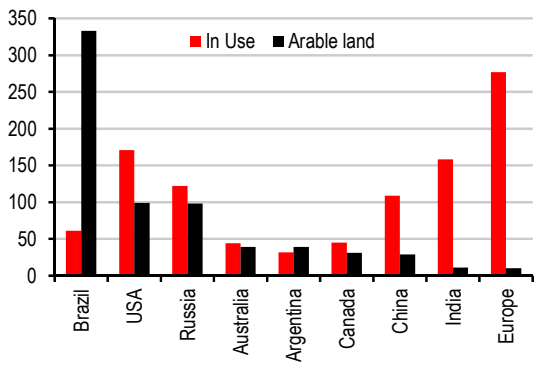
Source: USDA, HSBC

5.2) Resources required to produce 1 kg of edible meat



Source: Pimentel 2003, Chapagain & Hoekstra 2003, HSBC

5.3) Land availability (m ha)



Source: FAO, UNVESO-IHE, WBR, HSBC

Brazil prohibits the use of hormones and breeds mostly grass-fed cows places it at an advantage over its peers.

Looking forward, Brazil could boost production by achieving higher efficiencies and productivity gains, through the growing use of advanced agricultural technologies that increase carcass weights. These include selective breeding using artificial insemination, controlled use of hormones and increased penetration of feedlots, which ensures off-season supply, providing more flexibility. Finally, Brazil has not yet penetrated the Pacific Block, which constitutes c50% of global beef imports, and thus has immense potential to grow its exports beyond traditional export markets.

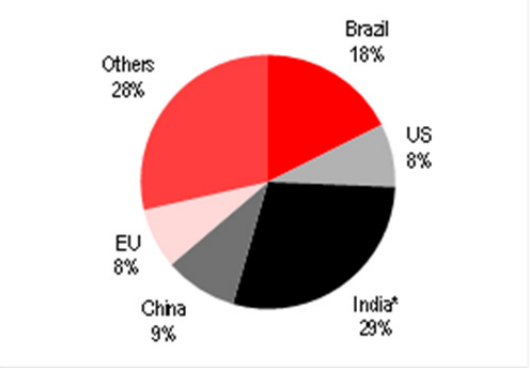
Tight supply/demand supports further beef price increases

Following an all-time high for Brazilian beef exports in 2013 (cUSD6bn, 13% higher y-o-y), 2014 started with record sales for January (USD460m, c18% higher volume y-o-y). Strong demand is due to competitive prices (helped by the currency) and production constraints worldwide. US cattle herds are at historical lows, following massive liquidation attributed to: 1) higher grain prices due to increased demand from ethanol producers, 2) farmers shifting from cattle to crops, 3) a severe drought, 4) and more recently, the cold weather. US beef production is expected to drop 6-8% y-o-y in 2014. Australia has suffered from a structural drought and scarce water resources leading to "desertification" of its pastures; farmers are liquidating herds, similar to what took place in the US, yet less severe.

Conversely, beef consumption has increased substantially in GEMs due to growing income levels, urbanization and changing diets. China stands out among these markets with its beef imports increasing ten-fold from 2011, although per-capita consumption remains very low at 5.5kg. Brazil does not export directly to China, but indirectly through Hong Kong (second-largest destination for Brazilian fresh beef, 18.5% of total exports).

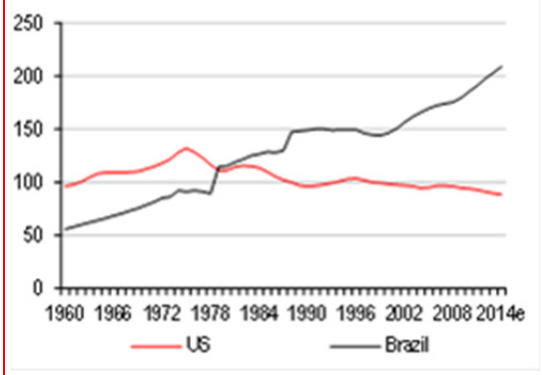
In addition, new export markets are expected to open up for Brazilian beef this year. Missions from China and Saudi Arabia will visit Brazilian plants in coming months and both countries should resume purchases soon. Other countries negotiating with Brazilian authorities include the US and Indonesia. Although the US market would not be significant in terms of incremental volume (potential 65,000 metric tons quota for "other countries"), its decision to open up to Brazilian beef could trigger the opening of major markets such as Canada and Mexico (NAFTA), Japan, South Korea, and Taiwan. Brazil is already the largest fresh beef exporter worldwide without exporting to these markets, which represent 45% of total beef imports.

5.4) Distribution of global total cattle herd count in 2014e



Source: USDA; HSBC. *c35% of India's herd is comprised of buffalo

5.5) US and Brazil total cattle herd count (million)



Source: USDA

Growing drought concerns and implications for the sector

We have seen the Brazilian beef sector underperform over the recent past. As well as an increased risk perception for Brazil in general terms (inflation, lacklustre growth, tight fiscal accounts and potential energy rationing), we believe investors are pricing-in a more negative outlook for cattle supply in the near term for two reasons: the effects of drought, and increased cow retention.

Poor rainfall levels and deteriorating pasture conditions: In Brazil, the majority of the cattle (c90%) are raised on open-grazing as opposed to feedlots (c10%). Thus, cattle availability varies across the year in accordance with rainfall patterns and pasture conditions. Historically, the cattle season begins with the arrival of the rains in late December and runs until the beginning of the dry season (April/May), when pasture conditions start to deteriorate. Given the poor rainfall levels observed so far this year, pastures have not been able to recover, causing a delay in grass-fed cattle supply to the market. As a result, live cattle prices have remained firm (up 20% since July 2013 to BRL120/arroba) at a time of year when historically they have begun to come down.

Increasing cow retention by Brazilian ranchers: The cattle potentially available for slaughtering are both male and female animals, and ranchers' decision to retain the females for calving or sell them for slaughter is a function of prices. Changes in cow supply and the lag between calves' birth and slaughtering (two to three years) explain the cyclical nature of the herd. Growing calf prices improved the economics for breeders and, as a result, there should be a higher amount of cows kept for calving this year and fewer cows sent for slaughtering.

We acknowledge supply concerns, but we expect to see better cattle supply in April/May as rains return (the cattle are there, they just didn't get as much fat as they should). It is worth highlighting there are two cattle feedlot cycles across the year (June and August) which help supply the meatpackers during the dry season, and we expect a higher number of lean cattle put into feed than in previous years given the positive returns expected for this activity. In addition, we continue to see a significant discrepancy between cattle prices in different states in Brazil, creating several opportunities for companies to arbitrage.

In addition, we believe the market is missing the demand side of the equation. We have seen a substantial increase in beef consumption from GEMs driven by urbanization, positive demographics and growing income levels. Beef imports from China have grown ten-fold since 2011, and we have seen similar trends in the Middle East, Northern Africa and Eastern Asia. Conversely, we

have seen more significant supply constraints in other exporting countries including the US (where beef production is expected to drop 6-8% y-o-y in 2014), Australia (structural drought issues), and Argentina (significant government intervention).

Under this scenario, we remain positive on the Brazilian beef sector given 1) solid demand from exports, 2) the positive outlook for beef prices and 3) cheaper cattle prices versus other major exporters in USD terms.

We acknowledge the contribution of Jacob Kim, a graduate student with HSBC's Graduate Program, to this section of the report.

HSBC

An emerging sweet tooth: Sugar and Brazil

- Brazil now accounts for half of global sugar exports
- Demand growth is mainly coming from Africa and Asia and is set to remain strong, supporting the outlook for sugar prices
- The outlook for supply coming from India and Thailand is less favourable than for Brazil

Demand growth is mainly coming from Africa and Asia

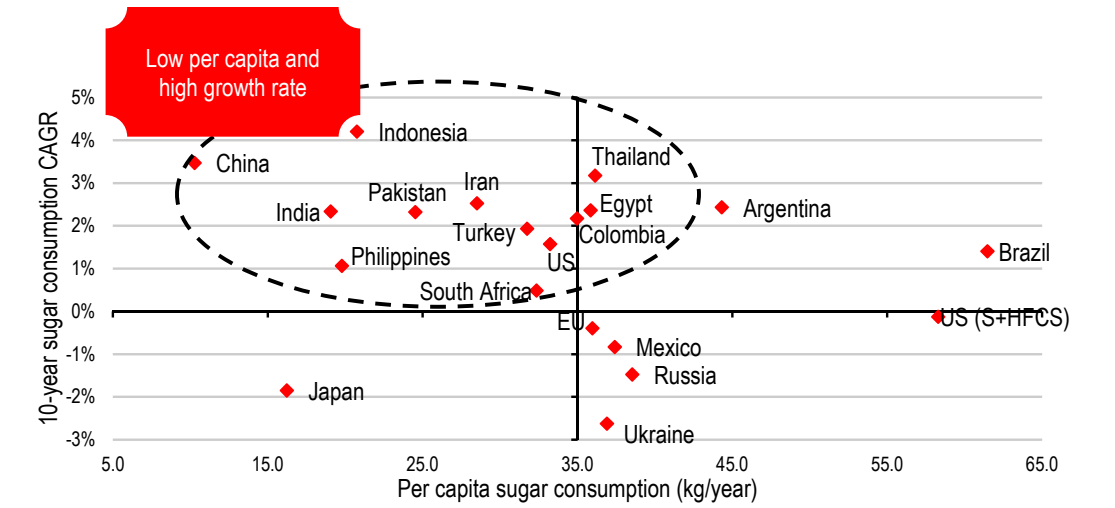
Globally, sugar demand has been growing at a very stable annual rate of c2%. As income levels rise, the sugar content in the diet increases and thus overall demand goes up. As seen below, the growth is primarily coming from Africa (3-4% per year) and Asia (2.5-3% per year). We have plotted the per-capita sugar consumption and the recent 10-year consumption CAGR. As expected, emerging nations that have lower per-capita sugar consumption show a strong growth rate: for example, China, Indonesia, India, Pakistan, Iran, Turkey, the Philippines, and South Africa. In the case of the US, sugar consumption has been growing at a surprisingly strong rate of 1.8% pa. But note that this is mainly driven by the substitution of HFCS (high fructose corn syrup) with sugar, reflecting the perceived health effects

Alexandre Falcao*
Analyst
HSBC Bank Brasil SA
+55 11 3371 8203
alexander.p.falcao@hsbc.com.br

Ravi Jain
Analyst
HSBC Securities (USA) Inc
+1 212 525 3442
ravijain@us.hsbc.com

*Employed by a non-US affiliate of HSBC Securities (USA) Inc, and is not registered/ qualified pursuant to FINRA regulations

6.1) Strong potential for growth

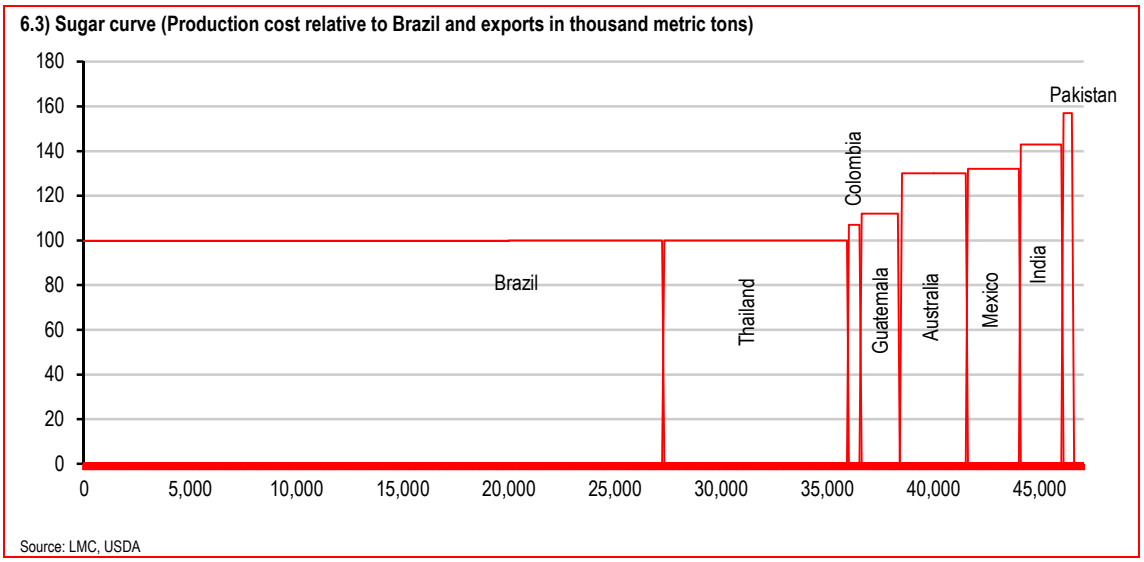


Source: USDA, UN

of HFCS. If we look at the US (HFCS and sugar), demand has been almost flat.

Brazil accounts for half of global sugar exports

Brazil's share of global sugar exports has shot up to c50% from 4% in 1990-91 (Chart 6.2). The solid increase in exports has been as a result of the expansion of sugarcane acreage as well as Brazil's competitive cost of production. The country's sugarcane acreage has increased dramatically in the last decade. According to the Food and Agricultural Policy Research Institute, cane acreage in Brazil has grown at a 7.2% CAGR in the last 10 years. In addition, Brazil is the lowest cost producer of sugar among the key producing and exporting nations. With the exception of Thailand, the other major exporting countries such as Australia, Mexico, India and Guatemala have a significantly higher cost of production (Chart 6.3). We estimate the Brazilian cost of production to be USDc17/lb of sugar. The cost in Australia is almost 30% higher and that in India more than 40% higher than Brazil. As a result, Brazilian exports of sugar have soared in the last two decades. Note that in Brazil, the industry also



HSBC

6.4) Sugar price forecasts (real terms)

	2013/14e	2014/15e	2015/16e	2016/17e	2017/18e	Long term
Sugar price (USDc/lb)	**17.05**	**17,20**	**20,50**	**23,00**	**22,80**	**16,50**
FX rate	2,23	2,43	2,50	2,56	2,62	2,67

Source: HSBC estimates

produces ethanol from the sugarcane crushed, which is used as a fuel and to blend in gasoline.

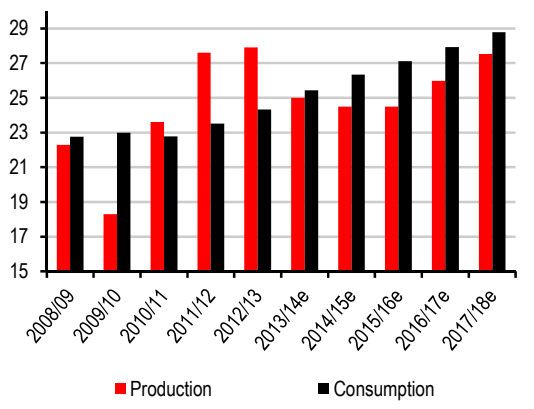
Current supply/demand dynamics

In our Brazil sugar/ethanol report, *Time to buy sugar* (6 February 2014) we argued that sugar prices have hit the bottom, and we expect price recovery starting in 4Q14 (Chart 6.4).

It's no longer about India

Historically, Indian sugar production had been the determining factor for global sugar prices. India's shorter cane cycle of two years always gave farmers more flexibility to switch crops leading the country to produce between 14-28m metric tons. When prices went up, farmers would plant sugarcane, and India would switch from a net importer to a net exporter (Chart 6.5); a collapse in sugar prices, caused by the switch to exports, would pressure the margins of millers and cause them to lower the price paid for cane and eventually to delay payments to farmers. The farmers who in turn switch to other crops, forcing India to switch back to being an importer of sugar.

6.5) India expected to switch from a swing state to a net importer



Source: ISMA, USDA, OECD, HSBC estimates

Minimum crop prices changed the dynamics: In 2010, the dynamics changed, as the Indian government drastically increased minimum prices for sugar cane. This increase disrupted the relationship between sugar prices and cane prices in India, which has helped maintain production at higher levels even though sugar prices have come down.

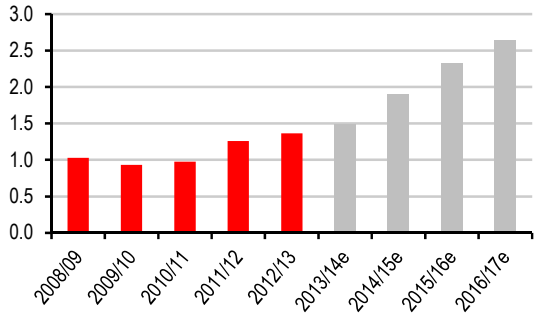
Measures to help the sector will not be enough: Going forward, however, we see a high risk to Indian sugar production as several mills have been operating with very low to negative margins, and the levels of arrears to farmers is reaching historic highs. In an effort to minimize this problem, the government recently announced several programs to help farmers, including interest free loans. However, despite these programs, we believe that while sugar prices remain low and minimum prices stay high, we will continue to see an increase in arrears between millers and farmers, leading to an inevitable decrease in cane supply in the country.

Long term, India should stop exporting: In our long-term projections, we believe that India's internal sugar consumption will be equal to its production capacity. Currently, India's production capacity is close to 30m metric tons, with consumption being close to 26m metric tons. Going forward, we expect consumption to match production levels, effectively removing India as the largest swing exporter in the world.

Thailand should also run out of steam

Since the 2009-10 sugar harvest, Thailand has increased its sugar production by 3.5m metric tons. This increase was mostly driven by Thailand's position in the global cost curve. By having low costs and being located in Asia, where demand is growing faster, Thailand was in a good position to increase its sugar production (Chart 6.6). However, going forward, we do not believe Thailand will add any meaningful sugar output in the coming years.

6.6) Thai sugar cane planted area (m ha)

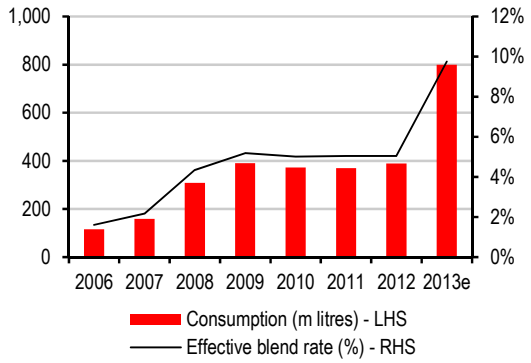


Source: HSBC, FAO, Thai Agriculture and Cooperatives Ministry

Ethanol consumption should drive expansion in the industry: In efforts to reduce petroleum imports, the Thai government has taken several steps to increase the ethanol consumption in the country. Although there are no blending mandates established in Thailand, the government has been incentivizing increased ethanol consumption (Chart 6.7).

Government is incentivising ethanol consumption: As of January 2013, the government stopped the sale of 91-Octane gasoline, leaving consumers with a choice between E10 "Gasahol" and the more expensive 95-Octane gasoline. This move alone should increase the effective blend rate in Thailand from 5% in the last few years to close to 10% in 2013. Furthermore the government has also been taking steps to incentivize the sale of E20 vehicles, by charging a lower excise tax on these cars. Given the dynamics of Molasses-ethanol production, we believe that the new increase in demand will be met from sugar cane ethanol.

6.7) Thai ethanol consumption (m litres)



Source: HSBC, FAO, Thai Agriculture and Cooperatives Ministry

Limited production in other regions will force focus on Brazil

In our view, given current sugar prices, we do not expect to see meaningful increases in sugar production in other countries. Given current sugar prices, we do not expect to see any meaningful increases in exports in other regions. Consequently, we believe that prices will have to go up to not only fix current problems in Brazil but also trigger organic expansion.

Brazil will have to grow capacity by 30m metric tons per year: As mentioned above, in our view, Brazil is still the lowest-cost producer of sugar, and the country with the best potential for growing capacity. We estimate Brazil will maintain its market share of close to 50% of global exports in the coming years, and in order to do so it will have to grow its crushing capacity by 30m metric tons per year in the short to medium term, leading us to believe sugar prices will have to pay for this capacity.

We acknowledge the contribution of Jacob Kim, a graduate student with HSBC's Graduate Program, to this section of the report.

HSBC

Opportunities in palm oil: An Asian story

- Rising economic development and urbanisation will propel an increase in edible oil consumption – particularly in emerging markets
- This is expected to support demand for the world's most traded edible oil, palm oil
- Slower supply growth than in the past will pressure balances, providing a boost to prices

A lot more headroom to grow

We expect to see edible oil consumption increase rapidly with economic development. This echoes the arguments earlier in this report, setting out growing food consumption patterns as per-capita GDP rises.

Higher income levels and increasing urbanisation are changing consumption behaviour in emerging markets. Households are starting to leave sustenance living behind and starting to focus on higher end, value-added consumption.

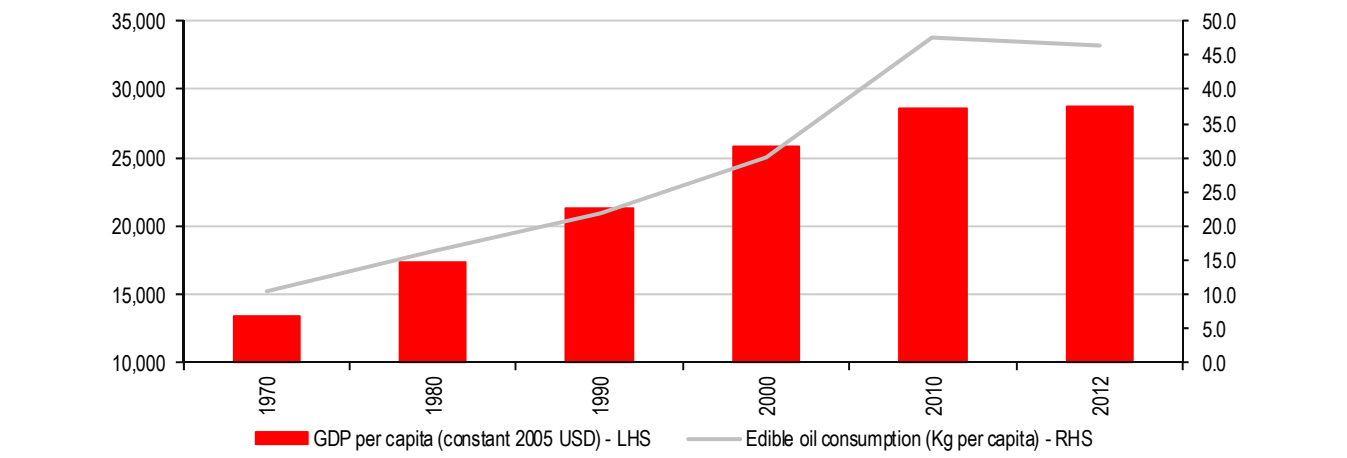
Emerging markets-driven demand growth

The EU is a good example of how affluence and income underpin higher edible oil consumption (Chart 7.1). In the 1980s, the EU's per-capita

Thilan Wickramasinghe*
Analyst
The Hongkong and Shanghai Banking Corporation Limited, Singapore Branch
+65 6658 0609
thilanw@hsbc.com.sg

*Employed by a non-US affiliate of HSBC Securities (USA) Inc, and is not registered/ qualified pursuant to FINRA regulations

7.1) EU: Per-capita edible oil consumption versus GDP per capita

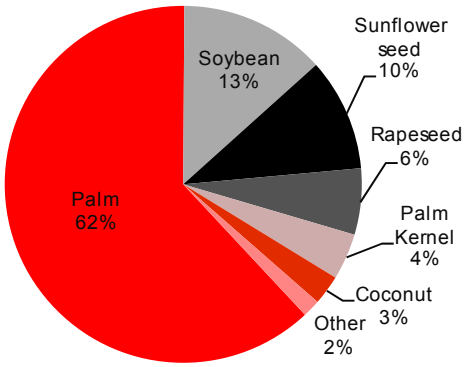


Source: USDA, World Bank, HSBC

edible oil consumption was similar to the levels seen in India today. Between then and now, the EU's per-capita income levels have almost doubled. Importantly, the per-capita edible oil consumption has tripled during the same period.

As the world's most traded edible oil, we believe palm oil will disproportionately benefit from these trends (Chart 7.2).

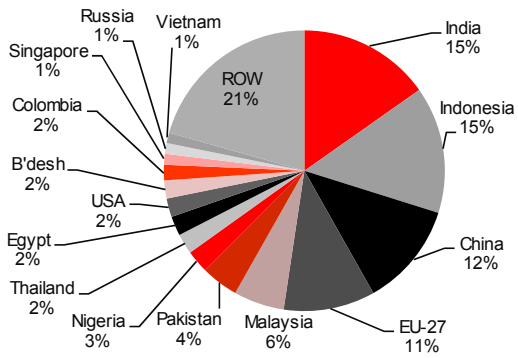
7.2) Mix of global edible oils traded



Source: USDA, HSBC

Indeed, emerging markets account for c80% of global palm oil consumption. Half of it is consumed by just four countries: India, Indonesia, China and Malaysia (Chart 7.3).

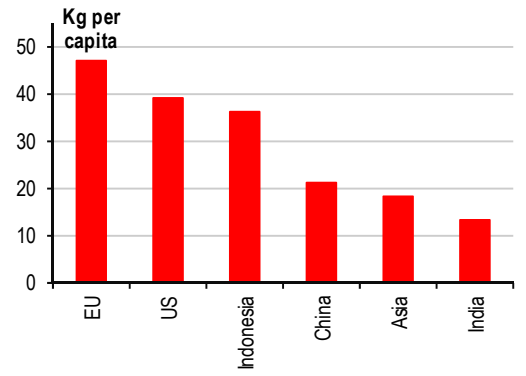
7.3) Palm oil consumption by geography (2012)



Source: USDA

Emerging markets have the greatest potential for growth, in our view. Two of the largest palm oil consumers globally, India and China, have seen GDP per capita increase 92% and 198%, respectively, between 2000 and 2012. We believe, over time, continued growth in incomes will repeat trends seen in the EU and bridge the per-capita edible oil consumption gap between developed and developing markets (Chart 7.4).

7.4) Per-capita edible oil consumption by geography



Source: USDA

Pace of supply set to weaken

In the 30 years up to 2010, palm oil harvested area globally grew at a 7.2% CAGR. We estimate, based on past planting records, the harvested area will grow only at 3.8% during 2010-15, a significant decline.

Indeed, in the past few years, we have many companies not achieving their yearly new planting targets. This is increasingly becoming the rule, not the exception.

We believe several factors are contributing to this, all of which are structural.

- Limited availability of suitable land
- Limited access to capital required for consolidation, economies of scale
- Stricter environmental oversight

All the easy acreage is already planted

Palm oil acreage expansion has proceeded at a rapid pace for nearly three decades in Southeast Asia. We can assume that the acreage that was the most conducive to planting palm oil and had the best access to infrastructure would have had planting priority.

Incremental acreage that is being planted would require more extensive land and infrastructure preparation. This would drive up cost per acre for the new plot, but the output would likely be similar or lower than existing acreage and not better (assuming use of similar planting material). Hence, incremental returns per new acre would keep getting progressively lower. As a result, access to good plantable land is decreasing significantly

A marginal player seeking access to similar acreage would need to take this in to account as part of its cost of production.

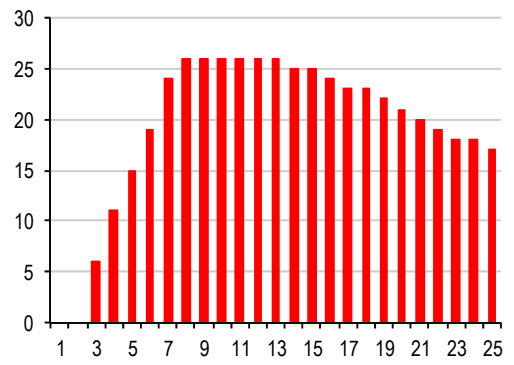
Limited access to capital

Palm oil cultivation is highly capital-intensive. As we discussed earlier, incremental land access costs have risen significantly in the past decade.

Additionally, palm trees do not start yielding until around three years of age and are not productive at commercial quantities until they reach seven years (Chart 7.5). Hence, apart from significant upfront capital, these businesses require large pools of working capital.

Furthermore, given these are live assets, until a palm tree actually starts producing fruits, its viability and its ability to deliver a full yield is unknown. With long gestation periods as we discuss above, earnings visibility carries significant risks.

7.5) Palm oil yield curve (tons per ha)



Source: First Resources, HSBC

These factors create significant barriers to accessing bank and capital market credit.

Stricter environmental oversight

The palm oil industry has attracted considerable controversy for allegedly contributing to deforestation and global warming, endangering native species and exploiting labour.

As a result, there has been a keen focus on palm oil sustainability in recent years, which is leading to increasing demand for responsibility from the industry. Two of the key drivers here are:

- Rising end-user demand for sustainability driven by better awareness and the need to be associated with responsible products. Higher income levels are a major catalyst for this, in our view.
- Higher capital markets dependency as costs of acreage expansion increases. However, rising dependence on capital markets and bank debt is coming at a time when global capital providers are looking to de-risk regulatory, reputational and counterparty exposure following the global financial crisis in 2008. Hence, capital providers are looking for a higher burden of proof in terms of ESG reform and management from the plantations sector.

These twin changes should progressively shift the sector towards an increasing focus on environmental, social and governance issues and result in slower new planting progress as more due diligence and certifications take place (see *Asian Palm Oil: Does sustainability matter?*, 12 November 2013).

Expect prices to head higher

The combination of robust demand growth and decelerating supply will drive palm oil prices higher over the long term, in our view. Substitute edible oils – such as soybean oil, rapeseeds and sunflower – are also facing their own supply constraints and are priced at a premium to palm oil.

So declines in supply of palm oil are unlikely to be filled by substitutes.

In the near-to-medium term, we see the dual drivers of higher domestic demand and rising industrial production driving palm oil price growth (see *Asian Palm Oil: A better year than last*, 28 January 2014).

HSBC

The dairy story: Chinese demand in focus

- Per-capita dairy consumption in China is still low, suggesting the growth potential in the coming years is high
- Industry consolidation and consumers trading up should remain the key trends; leading players should enjoy greater pricing power
- Chinese dairy producers are expected to be well supported as are large exporters such as New Zealand

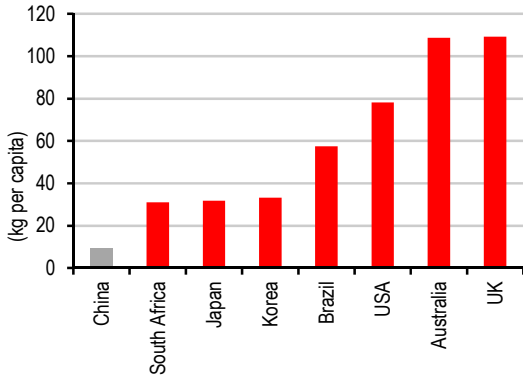
Solid growth outlook

We are positive on the long-term prospects for the China dairy market. With per-capita dairy consumption in China still low, demand for dairy products (including milk powder and infant formula) is expected to show solid growth in coming years, driven by rising incomes and changes in dietary patterns. At the same, we expect industry consolidation and consumers trading up to remain two important trends in China's dairy sector, enabling the leading upstream and downstream companies to continue to gain pricing power and scale.

Per-capita consumption of milk remains low

Liquid milk is the China dairy market's core product, representing more than 80% of total consumption. While liquid milk per-capita consumption in China has grown strongly from 1kg in 2000 to 9.4kg in 2011 (23% CAGR), this still remains low compared with that of other developed and emerging markets. The levels in South Africa, Japan and Korea are 3.4-3.6x as large as that in China, and those in Australia and the UK are as high as 12x that in China (Chart 8.1).

8.1) Liquid milk consumption per capita in 2011



Source: Holstein Farmer, Dairy Consultants, HSBC

Christopher K Leung*
Analyst
The Hongkong and Shanghai Banking Corporation Limited
+852 2996 6531
christopher.k.leung@hsbc.com.hk

Alice Chan*, CFA
Analyst
The Hongkong and Shanghai Banking Corporation Limited
+852 2996 6535
aliceptchan@hsbc.com.hk

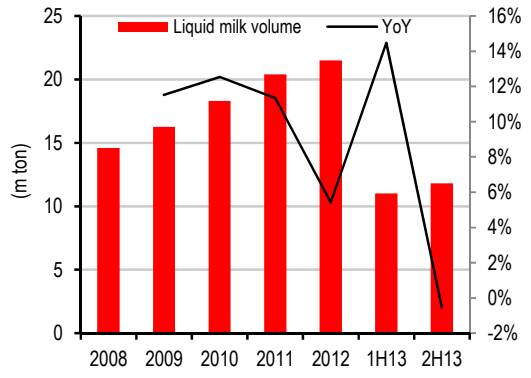
*Employed by a non-US affiliate of HSBC Securities (USA) Inc, and is not registered/ qualified pursuant to FINRA regulations

Liquid milk demand

This low penetration rate suggests there is substantial growth potential in liquid milk over the next decade in China.

Liquid milk is a key product in China's dairy market, representing more than 80% of total consumption. Chinese production of liquid milk showed solid annual volume growth of 11-13% in 2009-11. While growth weakened sharply to just 4% in 2012 following a contaminated milk scandal in late 2011, it rebounded to 14% y-o-y in 1H13, as Chinese dairy companies moved to restore confidence through increased marketing efforts (Chart 8.2).

8.2) Liquid milk production volume in China



Source: CEIC, HSBC

However, liquid milk production fell slightly, by 0.5% y-o-y, in 2H13 and we expect volume growth in 2014 to be in the low single-digits given the raw milk shortage since September 2013 (more on this below).

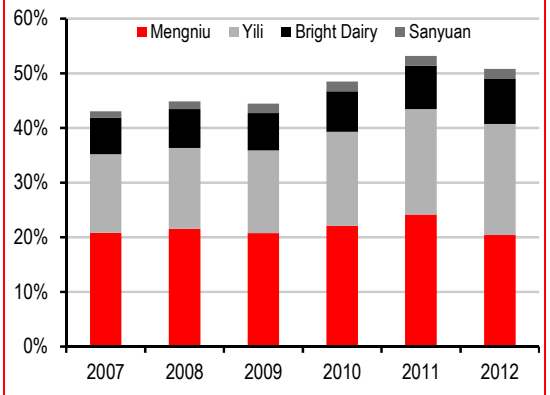
Nevertheless, liquid milk demand has remained strong and most dairy companies have been able to raise prices in the past few months to offset the upward pressure in raw milk cost.

We think the growth of liquid milk production will pick up pace from 2015 as raw milk supply improves and the demand for dairy products continues to grow rapidly.

Industry consolidation to continue

China's liquid milk market is fairly concentrated, following consolidation among producers in the past few years. Two of the largest national players have expanded their share from 35% in 2007 to 41% in 2012 (Chart 8.3). We believe consolidation will continue for another decade, with national and regional players expanding further into the rural market.

8.3) Liquid milk market share of major companies in China



Source: Euromonitor, HSBC

Milk contamination risk has fallen

A series of milk contamination scandals since 2008 has bruised consumer confidence in domestic dairy products. However, the tightening of food safety regulations governing the sector should help mitigate food safety risk.

All of the leading downstream dairy companies in China have established more concentrated milk sourcing from ranches and large-scale dairy farms in the past five years and this should enable them to better control product quality.

In addition, the rapid increase in prices in the past few years has provided farmers with greater incentive to focus on the safety and quality of their raw milk.

HSBC

Supply shortage likely to be a multi-year issue

Raw milk shortages are not uncommon in China. According to Frost & Sullivan, China had an average annual shortage of around 6m tonnes prior to 2012 (Chart 8.4). In 2013, the situation was made worse by unfavourable weather conditions and high beef prices, which led to smaller herd sizes as farmers elected to slaughter cattle.

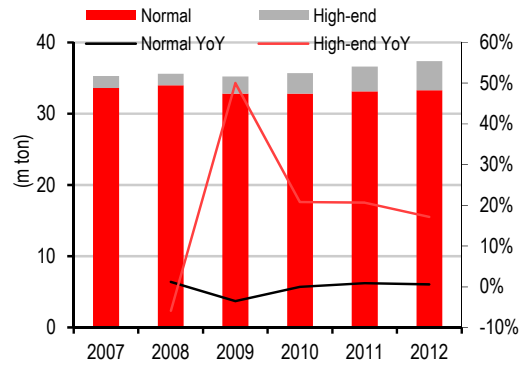
Based on our discussions with various industry professionals, we believe the shortage in 2013 could have been as much as 15m tonnes. We expect the situation to improve slightly this year due to bigger dairy imports from overseas and larger cow herd size on the back of a lower culling rate and high number of imported heifers. In 2013, China imported a total of 102,245 heifers, which was down 28% y-o-y, but this should increase sharply this year as China recently allowed imports of heifers from Romania.

Although some improvement in raw milk supply is likely in 2014, we expect the structural supply and demand imbalance will still persist in the next few years given surging demand and limited supply growth, especially in premium raw milk.

Rising demand for premium raw milk

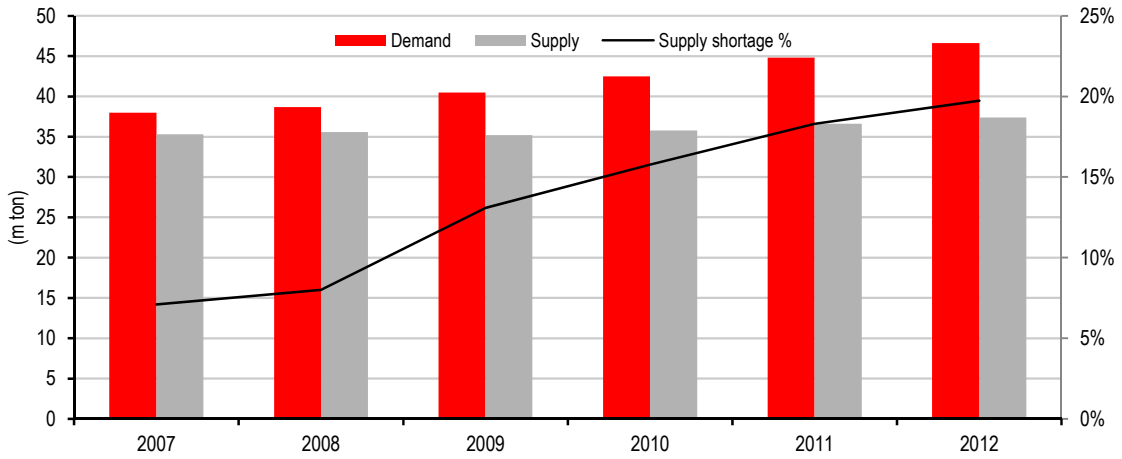
Demand for premium raw milk has been growing faster than standard raw milk in the last few years, and we believe it will remain strong in the next few years given the burgeoning demand for high-end dairy products. In China, most of the premium raw milk is supplied by large-scale dairy farms, and their raw milk price in general is 20-30% higher than the mainstream raw milk price given higher nutrition values and scarcity of premium raw milk supply (Chart 8.5).

8.5) Raw milk production in China



Source: NBS, Frost & Sullivan, HSBC

8.4) Raw milk supply shortage in China



Source: NBS, Frost & Sullivan, HSBC

HSBC

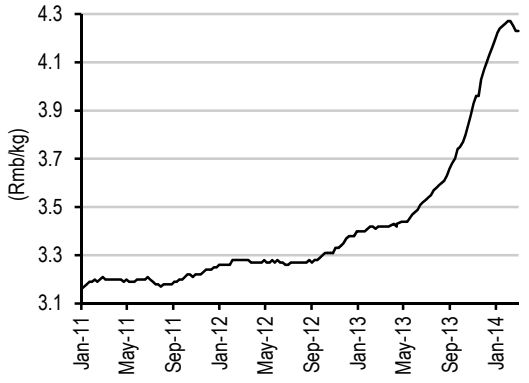
Raw milk price outlook

As a result of raw milk shortages, China's raw milk price gained 23% in 2013 and is up 2% YTD. We continue to believe the national raw milk price in China will remain high in 1H14 due to tight supply and strong demand, but there could be some retreat in 2H14 as supplies of raw milk and milk powder are likely to improve modestly (Chart 8.6). It is worth noting that we do not expect a sharp decline in raw milk prices in 2H14 and indeed over the next few years, as growth in herd size should be limited and we also do not expect a large decline in imported milk powder prices. In short, raw milk prices are likely to remain high in the years to come given the persisting supply shortage in China.

We expect the price of high-end raw milk to hold up better than average prices in China in 2H14. This is because of the scarcity of high-end raw milk, which should give high-end raw milk suppliers stronger bargaining power than the small dairy farms.

From a global perspective, milk supply remains constrained in the near term. The CEO of Dean Food, which purchases raw milk from a farmers' cooperative in the US for its downstream business, recently indicated that the growth in China demand will support milk prices in 1H14 before flattening and declining moderately in 2H14. Fonterra milk powder prices rose 58% during 2013 and have remained high ytd, reflecting the supply/demand imbalance that still exists.

8.6) Raw milk price in China



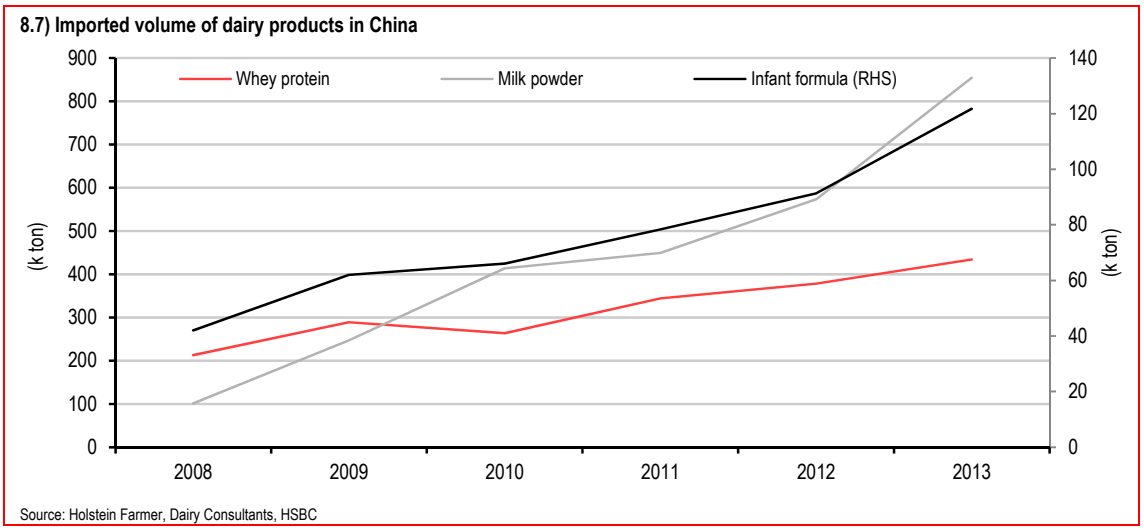
Source: Holstein Farmer, HSBC

Strong demand for imported milk formula

Imports play a key role in the milk powder market in China. It represented 33% of the market (including infant formula) in 2012, rising to 38% in 2013. Demand for imported infant formula has been exceptionally strong in the past few years as consumers have increasingly traded up to higher end infant formula products. During 2008-13, imported infant formula grew at a CAGR of 24% in terms of import volume (Chart 8.7).

We expect Chinese consumers to remain quality-conscious and continue to trade up when it comes to infant formula over the next few years. This trend should see the high-end segment continue to expand and remain an important catalyst for Chinese stocks with exposure to the infant formula. We believe the key beneficiaries of this trend will include 1) high-quality foreign brands with strong marketing and 2) domestic companies that have invested in quality control and distribution.

Moreover, the easing of the one-child policy in China will boost the growth of infant formula milk powder market in the long run, and we expect this to raise consumption of infant formula products by 4-8% per year.



In addition to the consumer trend, we expect further industry consolidation on the back of strict enforcement of food safety regulations. This should also benefit the expansion of the high-end segment and large domestic infant formula companies.

Implications for upstream companies

China's surging demand for dairy products and the tight supply of raw milk are two key positives for the large scale raw milk producers. The raw milk supply market in China is very fragmented and we expect further industry consolidation driven by the large-scale raw milk companies, given their balance sheet strength which can support herd size expansion and more effective herd management for higher milk yield.

The raw milk price is another growth driver. In China prices rose 23% in 2013 and 2% ytd. We believe this will benefit the upstream raw milk suppliers as they have more pricing power than small dairy farms.

Margins on raw milk should improve on the back of price increases. However, it is important to note that feed for dairy cows accounts for the majority of costs in dairy farming (around 60-70%), and if feed costs rise substantially this could negatively affect raw milk margins. Feed components include forage (primarily alfalfa), concentrated feeds such as corn and cotton meal, and supplementary feeds (mainly corn silage). The price of alfalfa has been trending down in the past few months and the corn price in China has also remained largely flat y-o-y.

Implications for downstream companies

Raw milk is the major cost item for liquid milk production (50% of COGS) and we believe rising raw milk prices pose a threat to the margins of downstream companies.

Historically, we have found that it is not easy for downstream F&B companies to fully pass on higher costs to consumers, and there is also a lag between price adjustment and cost increases.

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Fertiliser: The fuel for food production

- To produce more of the finer foods will demand more grain production and feedstock, supporting demand for fertilisers
- Arable land per capita will steadily decline over coming decades, requiring more intensive agricultural practices, including greater and more balanced use of soil nutrients
- We prefer phosphates over potash and nitrogen

Yonah Weisz*
Analyst
HSBC Bank plc
+972 3 710 1198
yonahweisz@hsbc.com
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Increasing yields

Fertilisers are essential plant nutrients that are applied to crops to achieve greater output and higher quality. While there are many ways to improve agricultural productivity, fertilisers may be the most effective and accessible means of boosting food output. The main soil nutrient groups are nitrogen (N), phosphorus (P) and potassium (K) (Chart 9.1). The most commonly used N-based product is urea, DAP is the most widely used P-based product, and potash is by far the most common way farmers apply K to their land. Other elements such as sulphur, boron, and magnesium are also required by plants, but only in trace amounts.

The use of fertilisers can often double or triple crop yields. The International Plant Nutrition Institute estimates that 40% of world food production is a direct result of fertiliser application. Factors such as irrigation, seed varieties and technology, cultivation practices, weed and pest control and planting density contribute the rest. But fertilisers do far more than

9.1) NPK basics

Nutrients and share of world fertiliser volume use	Benefits to plant	Recommended application	Industry structure
Nitrogen (N) - 62%	Essential for stem and cell structure growth, increases height	Every 4-6 months, nitrogen evaporates into the atmosphere, so cannot be skipped	Very fragmented
Phosphorous (P) - 23%	Accelerated plant metabolism, optimal usage of N & K	Annual, but can be skipped	Fewer suppliers than N, minimal discipline with high focus on volumes
Potassium (K) - 16%	Better root development, fills out inner cell structure, helps resist drought	Annual, but can be skipped	Limited number of suppliers, historically highly disciplined, but completely unravelled in July 2013

Source: HSBC

boost yields; they strengthen plants and speed growth and maturity, help plants survive harsh weather conditions such as dryness, and increase the size and nutritional value of produce.

N, P and K basics

Nitrogen

Among the three major nutrients, nitrogen is by far and away the most important factor in higher crop yields. It accounts for approximately two-thirds of global fertiliser volume consumption and is generally applied semi-annually to maintain yields. Nitrogen fertiliser is produced using a uniquely chemical/industrial process. Natural gas, (or coal in China) is used as an energy source to make ammonia, which is then transformed into urea, and at times into specialty N compounds called nitrates. The most commonly used product is urea; ammonia is applied to crops only in the US; while nitrates are generally seen as a European market. The three key drivers of profitability for nitrogen producers are access to a low-cost source of energy, economies of scale and proximity to the end markets.

As the feedstock for urea production is widely found, and the process is rather simple, the urea industry is very fragmented. Prices are set by using a cost curve based mainly on energy costs. Middle Eastern and North African countries with low gas costs are major exporters of urea, as is China, even though it is one of the highest cost producers in the world. North America, India, and South America are major importers of N fertiliser.

Phosphates

Making phosphates entails the use of both natural resources and chemical processes. Phosphate rock – found in a wide band of deposits spanning the southeast US, North Africa, central Asia, and China – is mined from the earth, and heated along with sulphur and ammonia to create either di-ammonium phosphate (DAP) and mono-ammonium phosphate (MAP). The difference between the two materials is the amount of ammonia used, which is varied depending on the targeted type of crops or land in question.

Integration of inputs is the key to profits in the phosphate industry. This means having access to cheap and high-quality phosphate rock, as well as non-market (or below-market price) sources of ammonia and sulphur. In principle, the price of DAP is set by the "non-integrated" producer, that is, the price that would be paid if one were to purchase all three ingredients at market prices for blending into fertiliser. Practically, this role is played by India, the world's largest DAP importer.

On the supply side, Mosaic (based in the US) is the largest DAP producer, and while it has access to rock, it is only moderately integrated in ammonia and has no proprietary access to sulphur. OCP (based in Morocco) is the world's largest producer of rock, but has no onward integration into ammonia or sulphur. Finally, PhosAgro in Russia and Maaden in Saudi Arabia are the two companies that own their rock supply, as well as having access to ammonia and sulphur through either direct supply or purchase agreements at sub-market price levels.

Potash

Potash fertiliser is derived from geological deposits, mainly the result of inland seas that evaporated millions of years ago. The main commercial deposits are found in Canada, Russia, Belarus, Germany, Israel, Jordan, and Chile. The most commonly used potash-based fertiliser is potassium chloride (the classic potash), although there are smaller markets for potassium sulphate (SoP) and potassium nitrate (NoP).

Potash extraction in Canada, the former Soviet Union, and Germany takes the form of common mining activity, while Israel and Jordan use large evaporating ponds to obtain the nutrient from the

mineral-rich waters of the Dead Sea. Chile also uses a similar evaporation process in exploiting the Salar salt flats in the country.

Given the limited sources of potash supply, producers have a natural source of pricing power over consumers. This has been further enhanced by the formation of marketing boards that regulate exports, further reducing choice for potash buyers. Two major groups controlled approximately 65% of the world market: Canada's CANPOTEX managed the exports of Potash Corp, Mosaic and Agrium outside North America, while BPC oversaw the international sales of Uralkali and Belaruskali, the two FSU potash producers.

For a number of years, this structure succeeded in matching supply with demand, keeping markets tight and prices high. However, starting in the second half of 2011, this discipline began to wane, and in July 2013, Uralkali formally withdrew from this disciplined marketing strategy, causing great upheaval and steep price declines.

The need for yield

The world's population is growing, so more food is being consumed and more of it is higher quality, primarily animal protein. Farmers lack sufficient arable land to grow the quantities demanded. They are turning to fertilisers to increase their crop output and yield.

The Food and Agriculture Organization of the United Nations, based on UN data, predicts that world's population will increase 38.8% between 2006 and 2050, from 6.59bn to 9.15bn (Chart 9.2). At the same time, prosperity is spreading to developing nations, increasing their consumption of many goods once out of reach. One of the first things that people aim for when better off economically is to improve their nutritional intake.

9.2) Macroeconomic factors influencing food demand

Population growth (% pa)	2006-30	2006-50
World (UN)	0.97	0.75
Developing countries	1.13	0.88
Developed countries	0.26	0.14
Per-capita GDP growth (% pa)	**2006-30**	**2006-50**
World	1.49	1.36
Developed countries	3.30	2.67
Developing countries	1.30	1.20

Source: FAO estimates

9.3) Global nutritional consumption estimates, per capita

Calories (person/day)	1970	1991	2006	2030	2050
World	2,373	2,627	2,772	2,960	3,070
% change		11%	6%	7%	4%
Developing countries	2,055	2,433	2,619	2,860	3,000
% change		18%	8%	9%	5%
Developed countries	3,138	3,257	3,360	3,430	3,490
% change		4%	3%	2%	2%

Source: FAO estimates

As discussed elsewhere in this report, newly rich populations are especially increasing their consumption of animal protein as part of enlarged and improved dietary intake. As a result, more beef, pork, poultry, and fish need to be raised in order to meet the burgeoning demand. And in turn, that leads to much greater grain production being directed to animal feed.

The rearing of animal protein is a very intense process, and uses a lot of resources for input. From an agricultural point of view, it takes between 2kg and 7kg of grain to feed 1kg of meat (Chart 9.4).

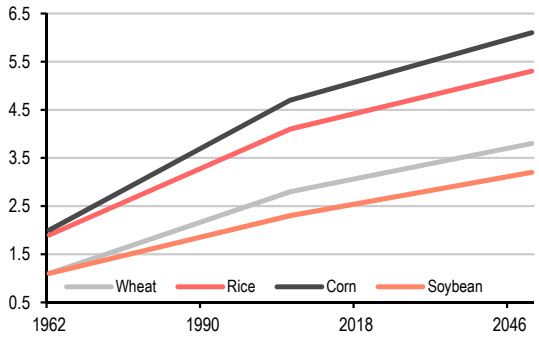
9.4) Grain consumption per kilogram of meat

Meat (1kg)	Kg of grain
Poultry	2
Pork	4
Beef	7

Source: Earth Policy Institute, HSBC

In order to match this demand, farmers will have to be able to grow increasing quantities of basic grain, both for animal consumption (more soy and corn) and human use (primarily rice, and, to a lesser extent, wheat) (Chart 9.5).

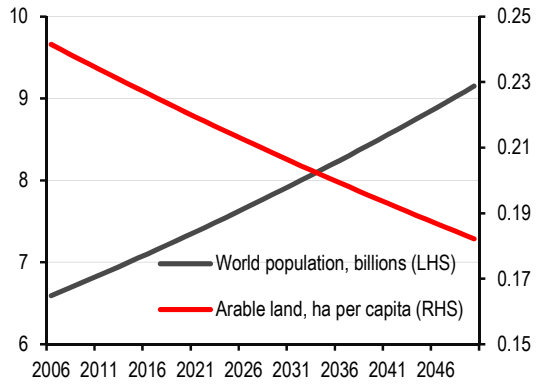
9.5) Historical and estimated required yields, tonnes/ha 1962-2050



Source: FAO estimates

The problem is there is less and less available land per capita to grow this food on. The FAO estimates that the amount of plantable area per human being will fall by c25% as the population expands by c39% during the 2006-50 period (Chart 9.6).

9.6) Hectares of arable land per capita vs. world population, 2006-50



Source: FAO and UN estimates

Higher fertiliser application rates

With less land to use, farmers are likely to turn to technology to grow enough food to meet demand. That could include higher-quality or genetically modified seeds, more crop-protection chemicals, better use of water and, importantly, more fertiliser.

Extrapolating current fertiliser use and land statistics, we forecast fertiliser application intensity (quantity of fertiliser used per ha) to rise 13-55% by 2050. This forecast is based on an estimated CAGR in total fertiliser use of 1.0-1.5%, which we deem conservative, considering the historical CAGR has been 2.3% since 1970, according to the International Fertilizer Association. We also extrapolate additions to arable land at a rate of 0.52% pa, a super-conservative figure given that the world supply of planted land is estimated by the FAO to grow at a pace of 0.10% pa until 2050 (Chart 9.7).

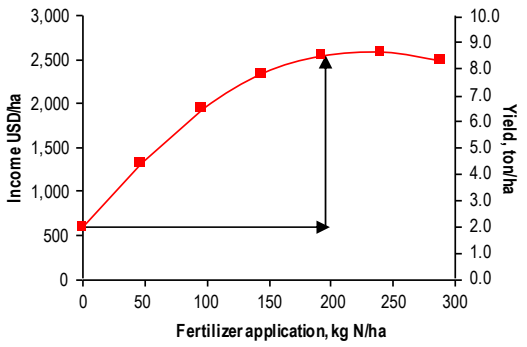
9.7) Fertiliser use projections

	Total fertiliser use, millions of tonnes	Arable land, millions of hectares (*)	Kg fertiliser used per hectare	
2005	154.1	1590	96.9	
Fertiliser use extrapolation				**Change from 2005**
2006-2030 @ 1.0% growth pa	198	1812	109.1	13%
2006-2030 @ 1.5% growth pa	224	1812	123.4	27%
2006-2050 @ 1.0% growth pa	241	2011	119.9	24%
2006-2050 @ 1.5% growth pa	301	2011	149.7	55%

Source: IFA, FAO, HSBC arable land use extrapolation estimates for 2005-30. ****Arable land growth at 0.52% pa 2005-50, which is 5 times the pace of current FAO estimate.***

The following chart illustrates the increasing gains of production from higher fertiliser application (in this case, urea).

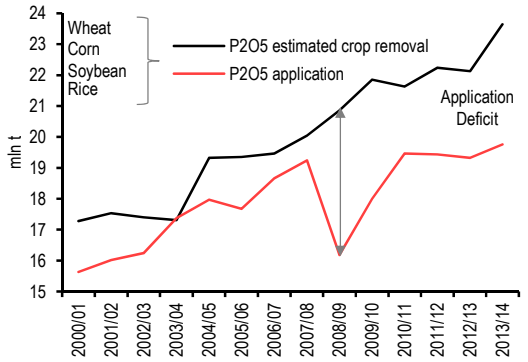
9.8) Yield response (monetary value) to N fertilizer rate for wheat



Source: YARA, HSBC estimates

In addition, as planted area increases and agricultural practices become more sophisticated, larger harvests are recorded, the depletion of nutrients in the soil increases, requiring greater application of fertiliser in order to maintain an optimum balance for plants to thrive.

9.9) Insufficient application of phosphate fertilizer creates significant room for growth



Source: USDA, IFA, IPNI, PhosAgro

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What needs to change?

In order for the theoretical gains of fertiliser use to be realised in practice, farmer behaviour needs to change. The shift needed is greater for agriculture in developing markets such as India, China, and the former Soviet Union, where the focus of many farmers is still sustenance farming using antiquated methods. In more advanced agricultural regions, such as Brazil, North America and Europe, farming methods are much more up to date with the latest scientific and technological advances.

Farmer sophistication: This is a combination of education and farm size. Education improves the overall level of agricultural techniques, as well as giving specific emphasis to the benefits of fertilisers (see balanced application, below, as well). Considering the investment of time, money, and equipment, in following better farming practice, the scale of activity at each farm would need to provide enough return to justify the effort. This means materially increasing the size of plots, and consolidating family-run farms into larger units. Implicitly, this hints at further waves of migration from the countryside to cities, as fewer people work in agriculture, and the developing economies' workforce distribution begins to mimic those of developed economies, in which only a very small proportion of the population is involved in growing food.

Balanced application: The predominant fertiliser in the world is nitrogen urea, accounting for roughly two-thirds of overall volume use. However, because it is relatively cheap, and because its effects (mainly increased height of the plant) are visible to the eye, developing farmers overuse nitrogen to the detriment of phosphates and potash. A clear example of this is India, which through a subsidy system encourages the application of almost double the amount of nitrogen needed, but not nearly enough phosphate and potash. This abuse of urea leads to soil degradation as P and K are not replenished, and this limits the possible gains in crop yield.

Including more micronutrients such as sulphur, zinc, and magnesium in the fertiliser mix will also increase agricultural output.

Delivery methods: Most fertiliser today is applied directly to the ground in pure form, i.e., three separate or one combined spreading of N, P, and K. But there are ways to improve the utility of the product being used. By testing the soil and studying individual plant needs, customised blends of nitrogen, phosphate, and potash fertiliser can be developed to meet the specific needs of a given crop in a given location. Such blends are called NPK, and usually carry the ratio of each nutrient within the mix.

A generic example of this is 15:15:15, which contains 15% N, 15% P and 15% K. A more customized example would be 20:10:10 or 10:26:26, the first of which would be used in instances where more N is needed, while the second has more effect in P and K. Custom blends are more relevant to growers of fruits, vegetables and other niche crops, as the nutrient needs of the main commodities like corn, soy and wheat are straight forward and well-known.

Another innovative delivery system is called 'fertigation', in which fertiliser is mixed with water used in irrigation, to deliver nutrients more directly to the root systems. This can also be formulated to be absorbed through plant leaves as well, and calls for highly water soluble fertiliser formulations.

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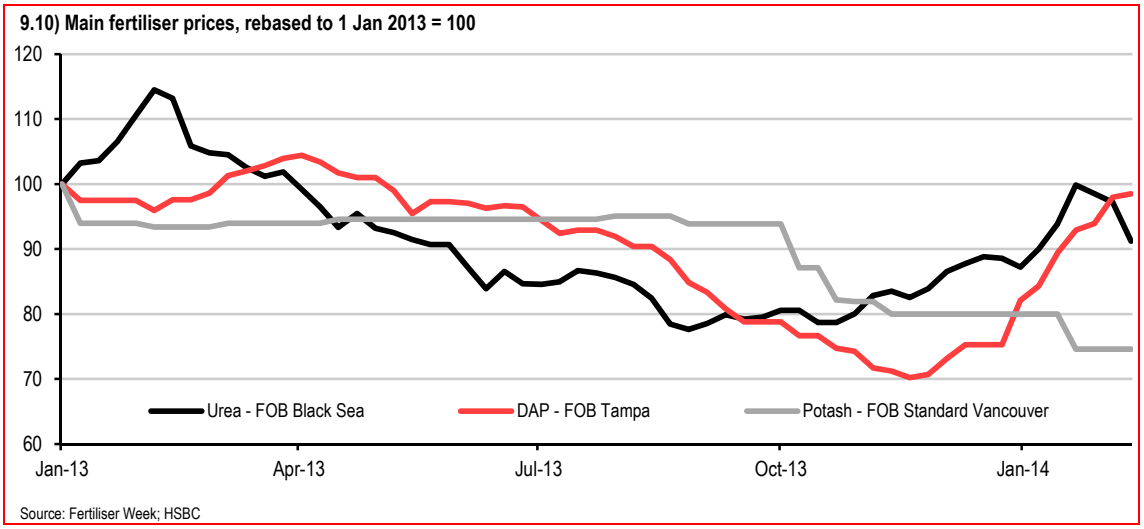
Current state of play in the fertiliser industry

The long-term case in favour of greater fertiliser use is well known, but short-term factors have had a much more visible impact on prices and demand for N, P and K, in the past year.

Urea started off 2013 with reasonable demand and prices of above USD400/t. During the year, China began selling volumes of cheap product, as input costs in the country (coal, as opposed to the natural gas used to make urea elsewhere around the world) dropped. This brought urea prices to a trough of cUSD290/t in 3Q13. At the same time, cold weather in the US during 4Q13 and the anticipation of further price drops caused demand to weaken in the Northern Hemisphere (US, Canada, Europe) during the last months of 2013. Urea had a much better start to 2014; deferred application last year means higher farmer needs this year in both the US and Europe. In addition, the possible increase in corn planting (versus previous expectations) could also boost demand. Prices are now ranging around USD370/t, although if coal costs in China stay relatively low for the year, urea prices could once again fall during 2Q14 and 3Q14, the main Chinese export window.

DAP saw a big drop in price during 2013, as Indian demand weakened drastically and inventories rose, while Chinese producers liquidated high amounts of inventory. The weather during the US spring of 2013 impeded application, leading to inventory build-up in this region as well. Prices fell from cUSD530/t at the start of the year to a trough of USD370/t in November. At such a low price, many small or semi-integrated producers were near or even below their breakeven profit point. Similar to urea, there has been a swift rebound in price. Logistics difficulties in Morocco, and unexpected purchases from Brazil and Europe, pushed DAP to almost USD500/t in the space of eight weeks in the spot market. Supporting this move is the quarterly phosphoric acid contract between India and Morocco, which was signed in early February at levels implying a DAP price of UD460/t (Chart 9.10).

There was chaos in potash in 2013. The year opened up with a Chinese supply contract signed at USD400/t, a drop of USD70/t from the previous contract of June 2012. The falling price was a symptom of declining discipline amongst large producing groups, as skirmishes over market share increased, and sellers began compromising on price to achieve volume. Then Uralkali announced a radical shift in commercial strategy in July 2013; it abandoned the BPC export group, and stated its goal of full production and willingness to sell product at whatever price the market would bear. This had no precedent in the potash market in at least the previous decade. Buyers froze activity for a month, but then returned for more purchases towards the end of the year. Spot prices fell to cUSD300/t, and in January 2014, a new Chinese contract at USD285/t (net of rebates) has likely marked the floor for prices. During this time, Uralkali has changed both CEO and owners, and is slowly abandoning the free-pricing strategy announced in mid-2013. Demand is looking reasonable, and there are indications that prices could begin to rise once again, but not in the same order of magnitude experienced by urea and DAP.


9.10) Main fertiliser prices, rebased to 1 Jan 2013 = 100
120
110
100
90
80
70
60
Urea - FOB Black Sea
DAP - FOB Tampa
Potash - FOB Standard Vancouver
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Source: Fertiliser Week; HSBC

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Notes

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Notes

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Disclosure appendix

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Issuer of report
HSBC Bank Australia Limited
Level 32
HSBC Centre
580 George Street
Sydney, NSW 2000, Australia
Telephone: +61 2 9006 5888
Fax: +61 2 9255 2205
Website: www.research.hsbc.com

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HSBC

Economics, Climate Change & Clean Technology and Equities Research Team

Economics Research Team

Paul Bloxham
Chief Economist, Australia and New Zealand
+612 9255 2635 paulbloxham@hsbc.com.au

Adam Richardson
+612 9006 5848 adamrichardson@hsbc.com.au

Global Climate Change & Clean Technology Team

Climate Change Centre of Excellence
Zoe Knight
Director, Climate Change Strategy
+44 20 7991 6715 zoe.knight@hsbcib.com

Wai-Shin Chan
Director, Climate Change Strategy - Asia-Pacific
+852 2822 4870 wai.shin.chan@hsbc.com.hk

Clean Technology
Ravi Jain
+1 212 525 3442 ravijain@us.hsbc.com

Equities Research Team

Consumer Brands & Retail
Christopher Leung
Analyst
+852 2996 6531 christopher.k.leung@hsbc.com.hk

Alice Chan
+852 2996 6535 aliceptchan@hsbc.com.hk

Thilan Wickramasinghe
Analyst
+65 6658 0609 thilanw@hsbc.com.sg

Food & Beverage
Lauren Torres
Analyst
+1 212 525 6972 lauren.torres@us.hsbc.com

Diego T Maia
Analyst
+55 11 33718192 diego.t.maia@hsbc.com.br

Agricultural Products
Alexandre Falcao
Analyst
+55 11 3371 8203 alexander.p.falcao@hsbc.com.br

Ravi Jain
Analyst
+1 212 525 3442 ravijain@us.hsbc.com

Chemicals
Yonah Weisz
+972 3 710 1198 yonahweisz@hsbc.com

Paul Bloxham
Chief Economist, Australia & New Zealand
HSBC Bank Australia Limited
+612 9255 2635
paulbloxham@hsbc.com.au

Paul Bloxham joined HSBC in late 2010 as chief economist for Australia and New Zealand. Prior to this, he spent almost 12 years working as an economist at the Reserve Bank of Australia. During his time there, he held a range of roles in the economic analysis department, including heading up the overseas economies and financial conditions sections, and working in the domestic forecasting and prices areas. Paul has published a number of papers, including on housing and household finances, as well as on asset prices and monetary policy. Paul holds a master's degree in public financial policy from the London School of Economics.

Adam Richardson
Economist
HSBC Bank Australia Limited
+612 9006 5848
adamrichardson@hsbc.com.au

Adam Richardson joined HSBC in 2013 as an economist, covering Australia and New Zealand. Prior to this, he worked as an economist for six years at the Reserve Bank of New Zealand in a number of roles including analysing domestic and international financial markets, as well as forecasting and modelling of the New Zealand economy. He holds a bachelor's degree in economics with honours from the University of Otago, and is a CFA charterholder.

Zoe Knight
Director, Climate Change Strategy
HSBC Bank plc
+44 20 7991 6715
zoe.knight@hsbcib.com

Zoe Knight joined HSBC in 2010 as a senior analyst. She has been an investment analyst at global financial institutions since 1997, initially focusing on Pan-European small-cap strategy and subsequently moving into socially responsible investing, covering climate change issues. Throughout her career, she has been ranked in Extel and II. She holds a BSc (honours) economics from the University of Bath.

Wai-Shin Chan
Director, Climate Change Strategy, Asia-Pacific
The Hongkong and Shanghai Banking Corporation Limited
+852 2822 4870
wai.shin.chan@hsbc.com.hk

Wai-Shin Chan joined HSBC in 2011 as Director for Climate Change Strategy in Asia Pacific. In this role, he helps clients position their portfolios for climate change and consults internally for the bank's various business functions. Previously, Wai-Shin worked as a fund manager, as which he was responsible for integrating environmental social governance (ESG) issues into the investment decision-making process. He has also worked as an executive director at the Association for Sustainable and Responsible Investment in Asia and as an ESG equity analyst for Asia at an investment bank. Wai-Shin holds a degree in mathematics and physics from Durham University (first class honours) and is a CFA charterholder.

Alexandre Falcao*
Analyst
HSBC Bank Brasil SA – Banco Múltiplo
+55 11 3371 8203
alexandre.p.falcao@hsbc.com.br

Alexandre Falcao joined HSBC in January 2013 as a senior vice president covering the LatAm agribusiness, transport and capital goods sectors. In this role, Alex covers the agribusiness, fast-growing transport, infrastructure, and industrials. Alex has 12 years of LatAm financial markets experience. Most recently, he worked as a banker in equity capital markets and served as a portfolio manager. Previously, he was a sell-side analyst at two major firms, covering LatAm mid- to small-caps. Alex holds a bachelor's degree in mechanical engineering from the University of Sao Paulo.

Ravi Jain
Associate
HSBC Securities (USA) Inc
+1 212 525 3442
ravijain@us.hsbc.com

Ravi Jain has been on HSBC's New York equity research team for LatAm food, agribusiness, and alternative energy since June 2010. He joined HSBC's mid-cap equities team based in Bangalore, India, in December 2007. Previously, Ravi was employed by a major audit, advisory, and tax services firm in Bangalore. He is designated as a chartered accountant by the Institute of Chartered Accountants of India and holds a bachelor's degree in commerce and accounting from Bangalore University.

Thilan Wickramasinghe*
Analyst
The Hongkong and Shanghai Banking Corporation Limited,
Singapore Branch
+65 66580609
thilanw@hsbc.com.sg

Thilan Wickramasinghe covers the broad agri-commodities sector including the supply chain managers. He was previously with a European stock brokerage, where he covered Singapore banks and financials, commodity supply chain managers and land transport. Thilan has over 10 years of equity research and consulting experience, including coverage of the Malaysian banking sector. He holds a BA in accounting and financial management from the University of Sheffield, UK.

Christopher Leung*
Analyst
The Hongkong and Shanghai Banking Corporation Limited
+852 2996 6531
christopher.k.leung@hsbc.com.hk

Christopher Leung joined HSBC in June 2010. Prior to this, he worked as an equity analyst with a leading US research house for six years, covering the small-cap and consumer sectors in Asia. Christopher also worked as a corporate finance analyst at i-CABLE Communications Limited for two years. He holds a bachelor's degree from York University and a postgraduate diploma in corporate finance from Hong Kong Polytechnic University.

Yonah Weisz*
Analyst
HSBC Bank plc
+972 3 710 1198
yonahweisz@hsbc.com

Yonah Weisz has been with HSBC since 2005, and has covered the agricultural and fertiliser markets since 2008. His bi-annual Fertile Crescent report offers a global, top-down view on soft commodities and fertilizers, as well as local, bottom-up insight into producers across the Middle East, Europe, Russia, and North America. Prior to joining HSBC, Yonah worked for three years at a global investment bank, covering technology and industrial companies. He holds a bachelor of commerce and economics degree from McGill University in Montreal, Canada.

Alice Chan*
Analyst
The Hongkong and Shanghai Banking Corporation Limited
+852 2996 6535
aliceptchan@hsbc.com.hk

Alice Chan joined HSBC in August 2013 as a consumer analyst. Prior to this, she worked for a Sino-foreign JV broker in Shanghai, covering major A-share consumer companies. She has also previously worked as a consumer staples analyst for a Korean brokerage firm and as a research assistant at a major broker in Hong Kong. Alice is a CFA charterholder, and holds a bachelor of science degree with honours in mathematics and a master of science degree in mathematics, both from the University of British Columbia.

Diego Maia*
Analyst
HSBC Bank Brasil SA – Banco Múltiplo
+55 11 3371-8192
diego.t.maia@hsbc.com.br

Diego Maia has been with HSBC as an analyst covering the LatAm food and agribusiness sector since April 2008. Prior to this, he had covered the utilities, oil and gas, and food sectors on the sell side since 2006. Diego has a BS in business administration from Ibmec Sao Paulo University.

Lauren Torres
Analyst
HSBC Securities (USA) Inc
+1 212 525 6972
lauren.torres@us.hsbc.com

Lauren Torres joined HSBC in April 2005 and has covered the beverage sector since 2002. Prior to joining HSBC, she was a generalist in equity research and high-yield research. Lauren has been voted a top analyst in various surveys, including Institutional Investor, StarMine and Wall Street Journal's Best on the Street. Most recently, she was ranked third among stock pickers in the US across all industries by StarMine. Lauren earned her MBA in finance from Stern School of Business, New York University, and her BA in English from University of Scranton.

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