Citi Research

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The Great China Steel Debate: Urbanisation and Steel Intensity

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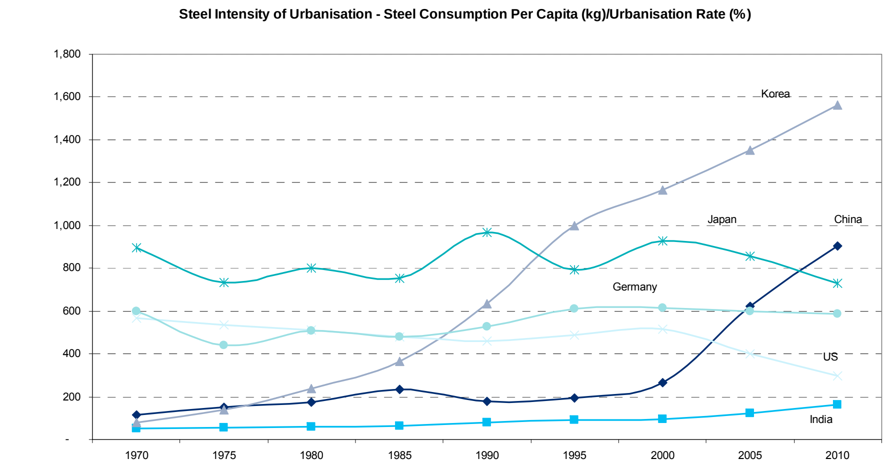
Intro

Citi is forecasting China to reach peak steel consumption by 2017 at 755mt. This is well below consensus which assumes peak consumption of over 1.1bn tonnes in the period of 2020-2025. In this note we debate the potential outcomes and highlight the importance of urbanisation in defining the level of steel consumption.

- Our economists argue that China is on the cusp of an imminent rebalancing towards consumer-led growth (*China is about to rebalance: how will EM be affected*).
- In this note we look further into this theme following up on *China Rebalance: The Impact On Steel* which focused on the sustainable level of consumption relative to GDP with a study on the intensity of steel demand relative to China's urbanisation.
- 755Mt versus 1.1bn tonnes. The sums are quite simple, to achieve an outcome of 1.1bn tonnes in the period 2020-2025 then Chinese steel consumption needs to grow at a CAGR of 4.5% (from a 2012 consumption level of 648mt and production of 697mt) or approximately at a rate of 0.5x GDP. Consensus may prove optimistic when taking into account the drivers of Chinese steel consumption.
- A correlation between steel demand and urbanisation rates. The main link between urbanisation and steel consumption is via construction (55% of Chinese demand); however, with a 0.85 correlation with GDP per capita there are also wealth benefits which subsequently generate late cycle demand (e.g. autos). According to UN figures the rate of urbanisation in China has peaked. However, with 300m people estimated to migrate into cities by 2030 urbanisation will continue to be a driver to steel consumption.
- Where consumption per capita, a key support argument for the bulls, could be wrong is in assuming that people living in Xinjiang will have the same steel intensity as people living in Shanghai. Controlling for the overall rate of urbanisation should, in our view, provide a more reliable picture of the sustainability of current demand and a guide for the future.
- Conclusion: China's steel demand remains multi-faceted and our analysis highlights that the uncertainty on forecasting is increasing. We stick to our base case bottom-up analysis that steel growth will continue, albeit at a slower pace, peaking at around 755mt by 2017.

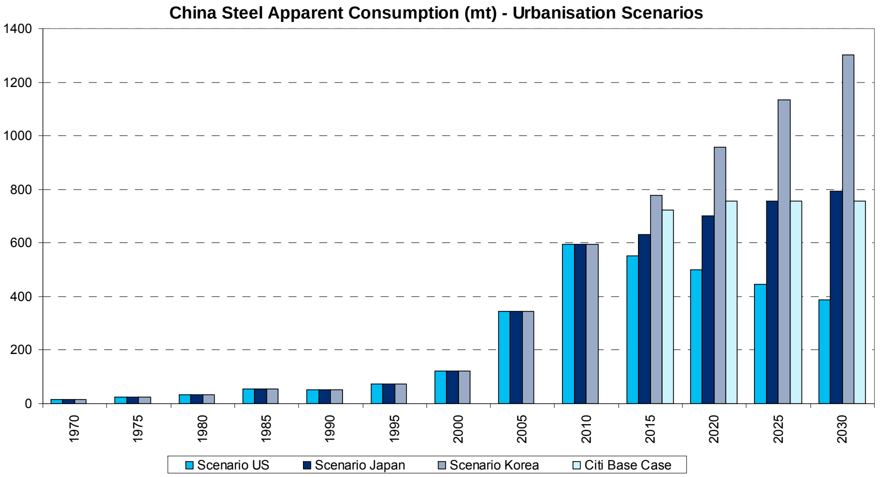
Key Charts

China's steel demand relative to urbanisation has surpassed the US/Germany and is now level with Japan



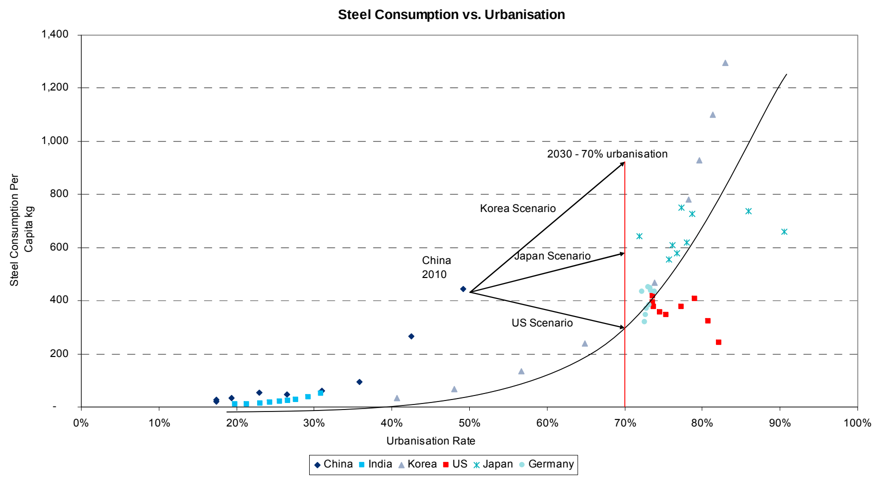
Source: World Steel, CRU, United Nations, Citi Research

Scenario analysis suggests 2020 consumption of 500-950mt, vs Citi on 750mt and consensus of >1bt by 2025



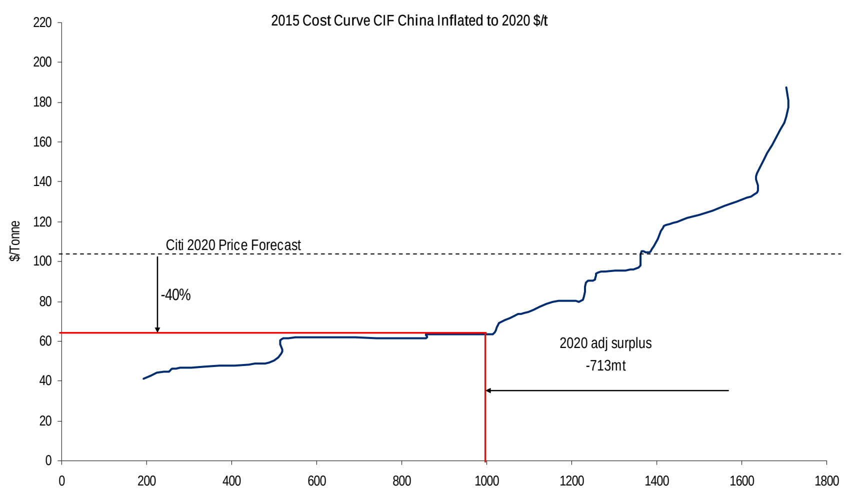
Source: World Steel, CRU, United Nations, Citi Research

The reduction in intensity to levels similar to the US simply suggests a return to trend



Source: World Steel, CRU, United Nations, Citi Research

500mt of steel demand in China in 2020 could see iron ore at c.$60, 40% below our forecasts

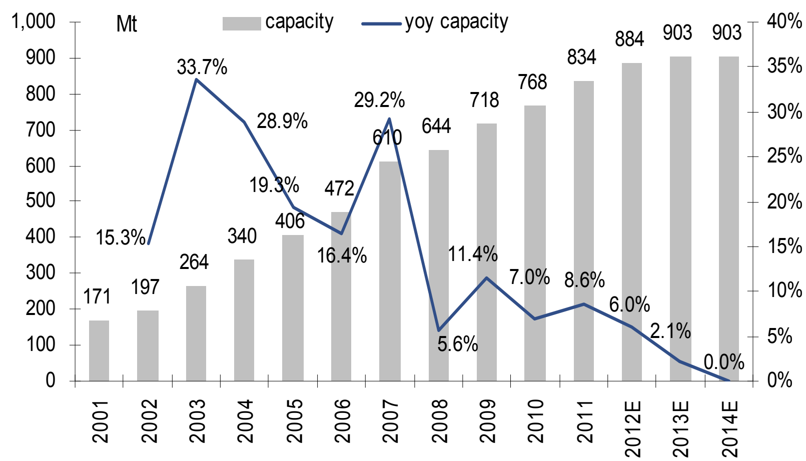


Source: Citi Research

Citi Steel Base Case

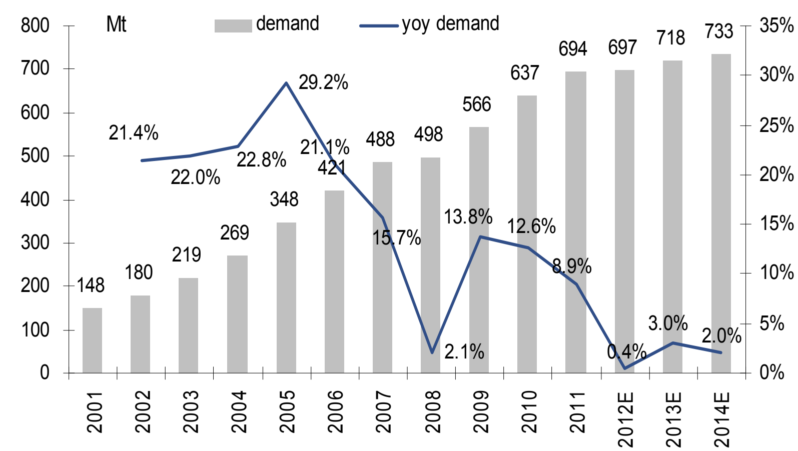
Citi base case is for 648mt of Chinese steel consumption in 2012 rising to 722mt in 2015 and 755mt in 2020

Chinese Crude Steel Capacity Forecast



Source: WIND, CEIC, Citi Research

Chinese Steel Demand Forecast



Source: WIND, CEIC, Citi Research

Regional Crude Steel Production (mt)

Regional Production - Crude Steel	2009	2010	2011	2012e	2013e	2014e	2015e
EU (15)	116	144	150	146	147	147	147
Other Europe	48	54	60	64	64	66	66
CIS	96	107	112	116	121	121	121
NAFTA	81	111	118	123	125	131	131
Central/South America	38	44	50	57	65	76	81
% change Y-o-Y	-21%	16%	14%	15%	14%	17%	6%
China	566	637	694	697	718	733	777
% change Y-o-Y	14%	13%	9%	0%	3%	2%	6%
Japan	88	110	108	111	111	114	111
India	56	66	72	78	90	106	112
Other Asia/Pacific	80	95	104	116	116	118	120
Africa/Middle East	32	36	34	48	55	57	57
Global Production	1,203	1,405	1,502	1,555	1,610	1,669	1,722
Estimate Production Excess/(Deficit)	4	46	63	96	107	125	109
Finished Steel Production	1143	1335	1427	1478	1529	1585	1636

Source: IISI, Citi Research

Regional Finished Steel Demand (mt)

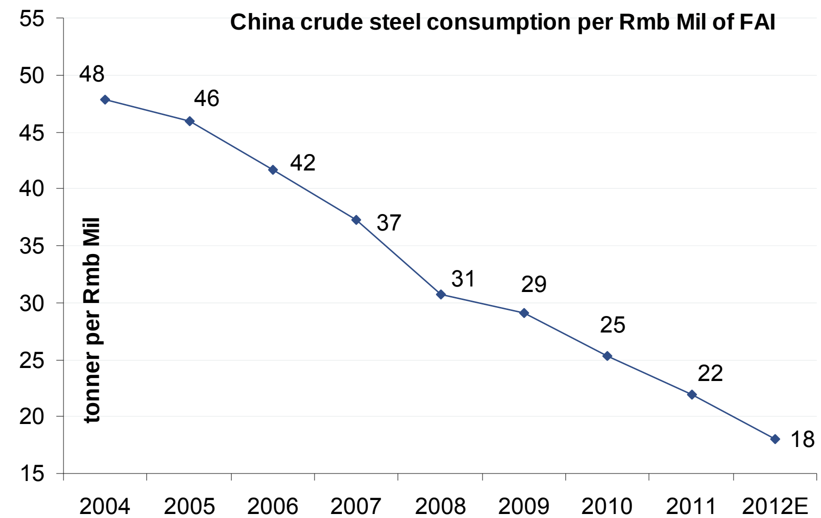
Regional Demand - Finished Steel	2009	2010	2011	2012e	2013e	2014e	2015e
EU (15)	102	122	125	124	125	127	129
Other Europe	34	43	44	44	45	45	46
CIS	38	48	51	52	54	56	58
NAFTA	77	103	111	114	116	120	124
Central/South America	31	38	39	41	42	44	45
China	558	596	645	648	667	681	722
Japan	66	84	81	82	83	85	86
India	55	59	63	67	73	78	85
Other Asia/Pacific	112	129	132	137	142	148	154
Africa/Middle East	67	68	70	73	75	77	79
Global Demand	1,139	1,289	1,363	1,382	1,422	1,460	1,527
Global Finished Steel Production	1,143	1,335	1,427	1,478	1,529	1,585	1,636
Estimate Production Excess/(Deficit)	4	46	63	96	107	125	109

Source: CRU, Citi Research

Citi Steel Base Case – Limited impact of stimulus

Steel consumption intensity to FAI spending has fallen 40% since 2009, from 29 tonnes per Rmb million to 18. The recent stimulus measures announced by the NDRC are unlikely therefore to materially increase steel demand; we forecast an incremental uptick of 3%.

- In early September the NDRC announced Rmb1 trillion (~$157bn) approvals on 25 rail projects worth $110bn.
- While this could boost sentiment in the near term there is likely to be limited incremental demand impact on commodities due to:
- Lower intensity to FAI spending; steel intensity has fallen by almost 40% since 2009 on our calculations (see top chart).
- Steel overcapacity – steel production capacity totalled 718mt in 2009 but has since grown 23% to 884mt on our estimates
- Given 2-3 years construction periods we think demand impact could be less than 1%
- We therefore think the incremental steel demand from the project approvals could reach around 18mt or 3% of current demand.



Source: CEIC, Citi Research

Steel Intensity to FAI spend 2009 vs. 2012

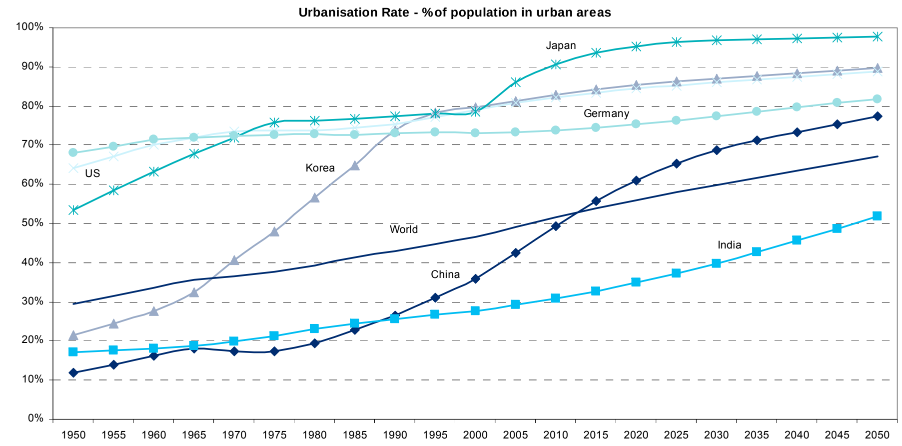
2009 stimulus generated steel demand of 116 Mt, or 25.5% of 08 demand	
2009 stimulus in Rmb mil	4,000,000
Tonne of crude steel per 1 Mil Rmb by 2009	29
Extra steel demand in Mt	116
Crude steel demand 2008 in Mt	455
Extra demand from potential stimulus	25.50%
2012 stimulus to generate steel demand of 18 Mt, or 2.8% of 12 demand	
2012 stimulus in Rmb mil	1,000,000
Tonne of crude steel per 1 Mil Rmb by 2012	18
Extra steel demand in Mt	18
Crude steel demand 12E in Mt	652
Extra demand from potential stimulus	2.80%

Source: Citi Research

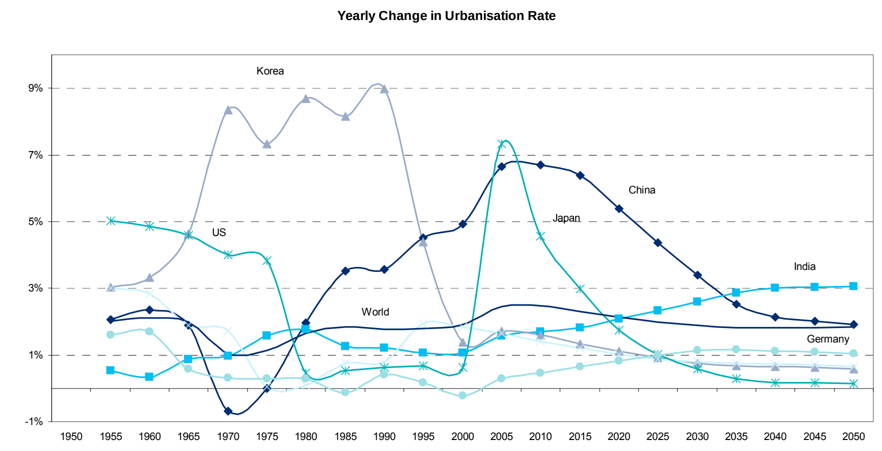
China’s urbanisation trend

While the rate of urbanisation in China has peaked, UN forecasts suggest a further 300m Chinese will leave the countryside for the cities by 2030.

- Based on UN data China’s 2010 urbanisation rate stood at c.50% and is set to rise to 70% by 2030 and 77% by 2050.
- Since 1975 the proportion of Chinese in cities has risen by 4pps on average every 5 years.



- While this rate has clearly now peaked as more migrant workers return home to the countryside this forecast still implies a further 300m people are set to permanently settle in urbanised areas over the next 20 years.
- This has long been a fall-back for commodity bulls as this suggests significant structural support for steel and related early cycle metals including iron ore



Source: United Nations, Citi Research, *2015-2050 forecasts

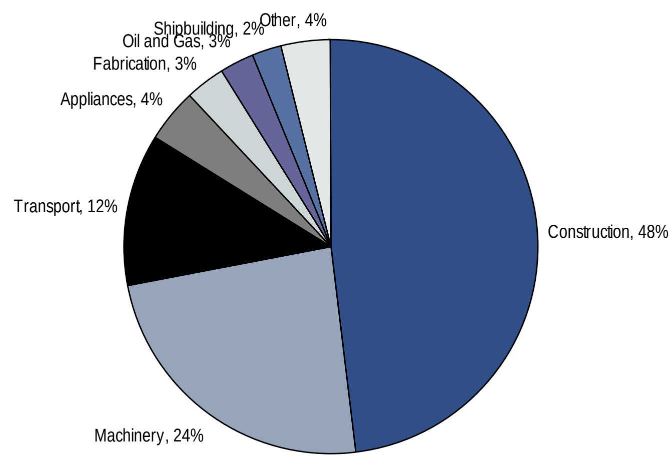
Urbanisation is a key driver of steel consumption

Steel demand flows from not only construction but the network effects that surround urban areas including transport and communication.

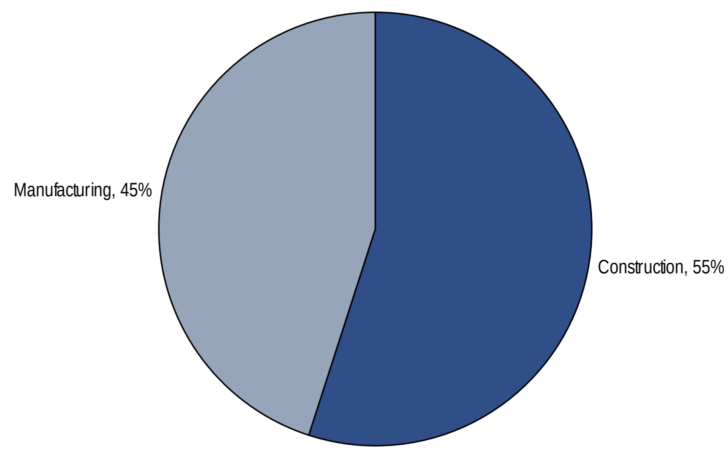
- On a global basis construction, the most direct link between urbanisation and steel demand, constitutes c.50% of consumption. However transport (12%) and machinery (24%) are also significant.

- The rapid pace of growth in fixed asset investment in China has led to a more construction-intensive demand profile than the global average. Construction represents 55% of steel demand on our estimates.

Global Steel Demand By Industry 2011



China Steel Demand By Industry 2011

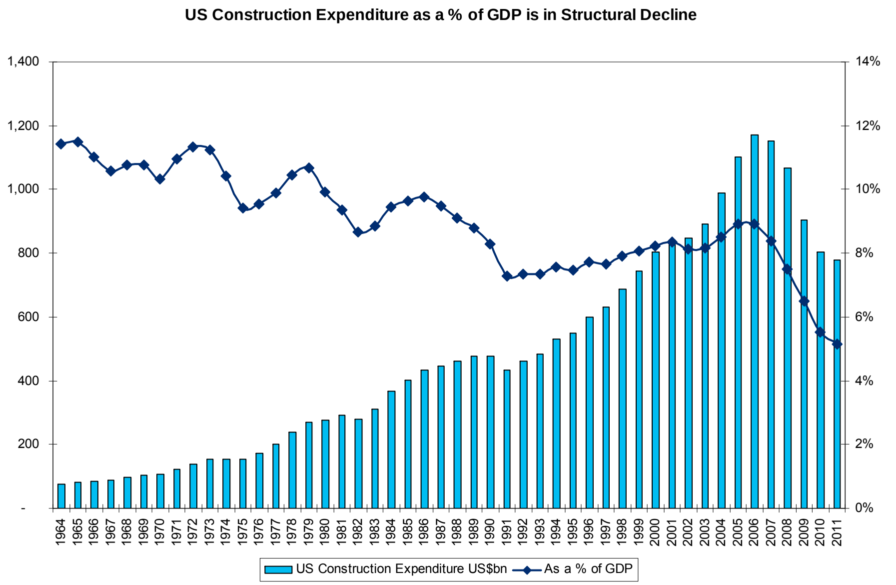


Source: CRU, Citi Research

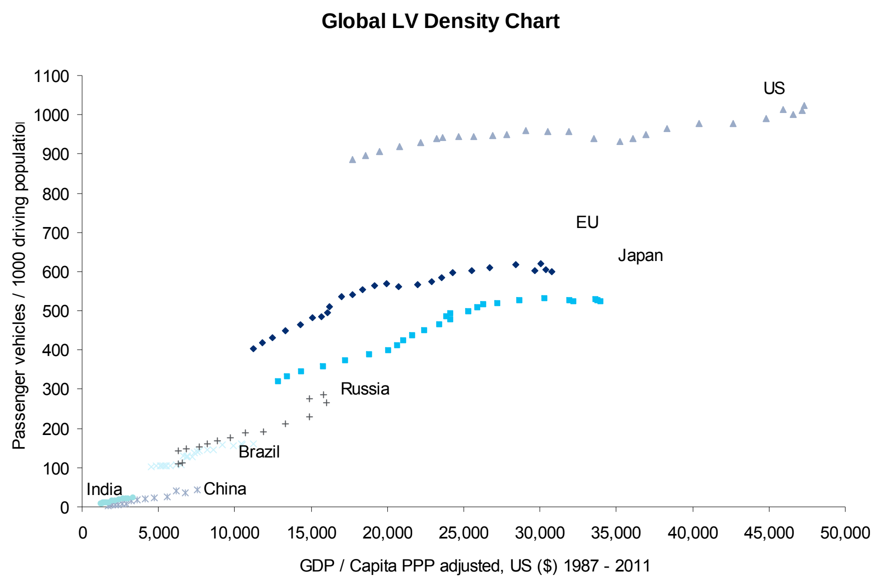
Driving GDP growth and offsetting trends in steel demand

Over time urbanisation drives increasing wealth and therefore late cycle demand. To this extent early cycle investment intensive sectors such as construction are likely to be partially offset by later cycle demand such as autos.

- GDP/capita tends to increase over time as urbanisation levels rise. Production of both manufacturing and services is more efficient when concentrated in business districts of cities. Firms operating in close proximity gain from information spillovers, cost savings and more efficient labour markets. Academic studies put the simple correlation coefficient of urbanisation and GDP per capita at 0.85[1].
- Increasing wealth generates demand for late cycle products including autos and white goods. Arguably this may not be as supportive for steel demand in China as the development of other countries given the structural trend to lighter vehicles and substitution for aluminium into cars.
- In turn early cycle construction and infrastructure investment decrease in their intensity.



Source: Datastream, World Bank, Citi Research



Source: JD Power, Citi Research

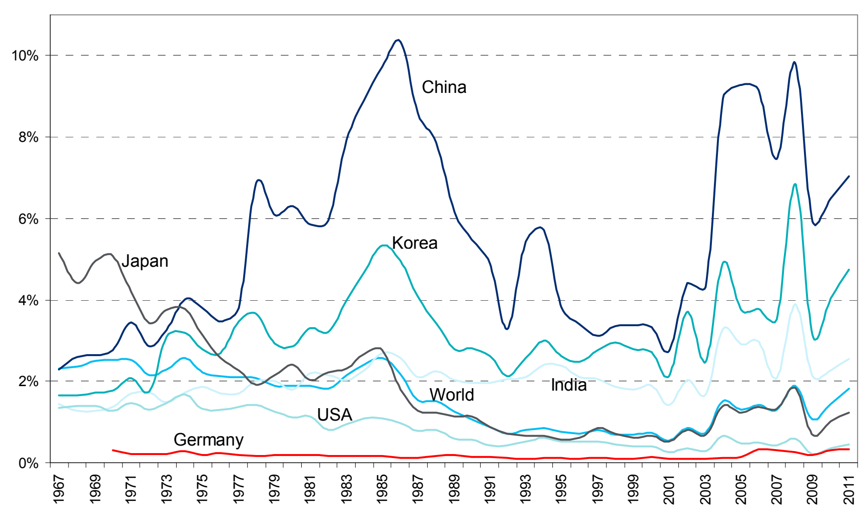
1: Henderson (2003)

China may be consuming beyond its requirements…

China is consuming steel at an extremely elevated rate. The stimulus package in 2009 served to artificially prolong the longevity of this 'spike', boosting construction and averting a decline to more sustainable levels

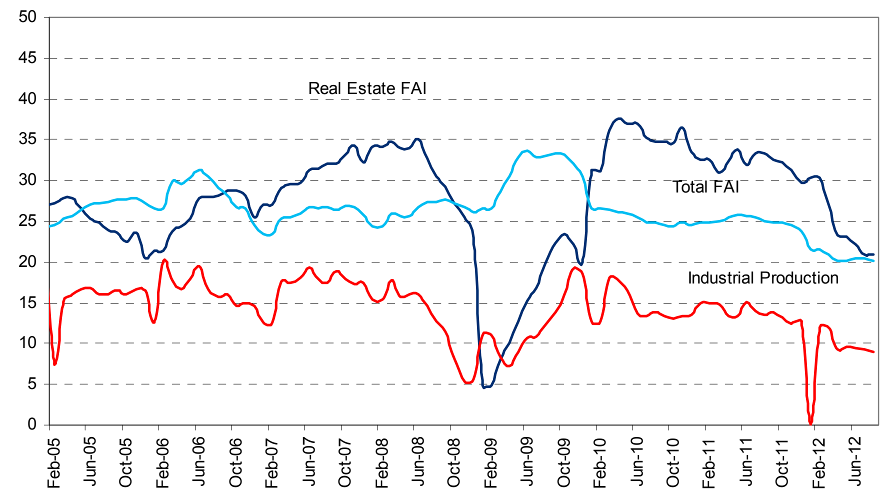
- The bullish urbanisation thesis does not account for the impact on future demand stock from the unprecedented levels of Chinese steel consumption which has grown from c.140mt in 2001 to c.690mt in 2011.
- As we have highlighted in previous reports since 2004 China has spent on average 8% of its GDP on steel. This is in excess of both Korea and Japan during their rapid growth phases. As the below chart shows Korea's demand peaked at 7% of GDP in the 1980s. While we do not have steel data to capture Japan's post war 'miracle years' investment/GDP only reached 36.4% in 1973 vs. China's current 50% record suggesting a lower steel intensity.
- This demand has been driven by surging investment in fixed asset investment and in particular construction. Real Estate FAI has outpaced broader FAI in 2 of every 3 years since 2005.

Value of Steel Consumption as % of GDP



Source: World Steel, CRU, World Bank, IMF, Citi Research

YoY Real Estate FAI, Total FAI and Industrial Production in China



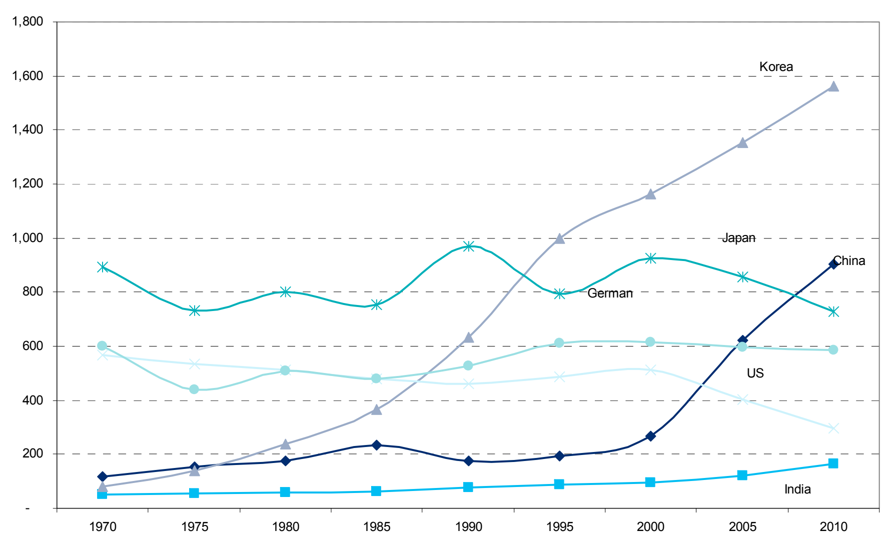
Source: Bloomberg

Driving rapid growth of steel consumption relative to urbanisation

From 2000-2010 the ratio of annual steel consumption to urbanisation has risen from 266 to 904 suggesting China's steel intensity of urbanisation has risen c.4x taking it past both the US and Germany, level with Japan

- There is an intuitive link between the amount of steel consumed per person and the rate of urbanisation as more people enter cities increasing both personal and workplace accommodation requirements.
- As you would expect in established societies this ratio tends to remain fairly constant with Japan for example oscillating around 800, consistently more intensive than the US or Germany which sit at 400-600.
- China's Steel Intensity of Urbanisation or the ratio of steel consumption per capita to the urbanisation rate has risen dramatically from 266 in 2000 to 904 in 2010 implying a 4x increase in intensity taking it past the US and Germany and level with Japan. While this surge in steel demand has been driven by a number of factors including cheap energy and rapid growth in exports, in our view urbanisation trends represent an important long-term anchor.

Steel Intensity of Urbanisation - Steel Consumption Per Capita (kg)/Urbanisation Rate (%)



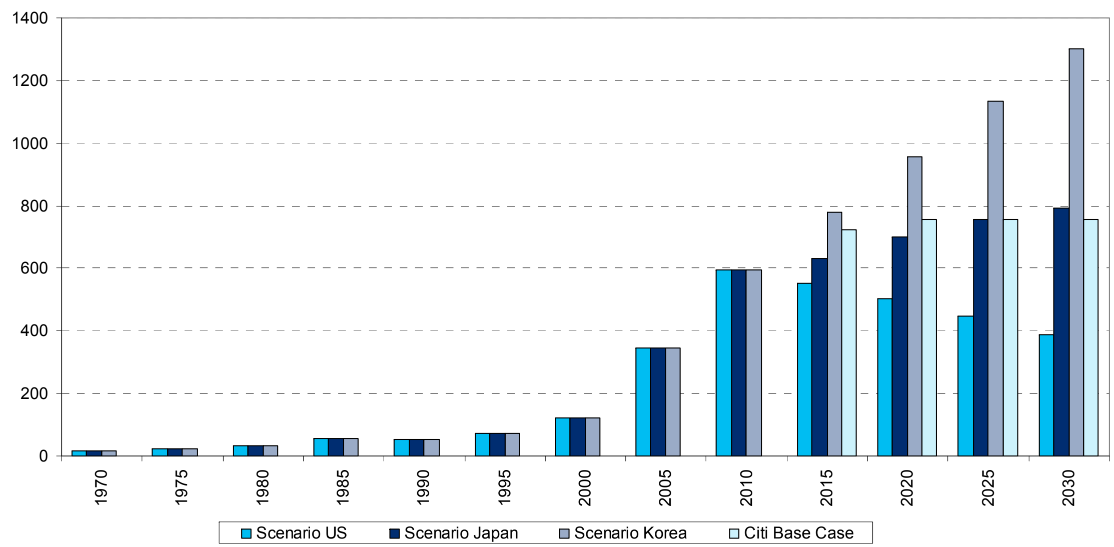
Source: World Steel, CRU, United Nations, Citi Research

What could peaking intensity mean for future demand?

Our analysis suggests 2020 consumption of 500-950mt vs. Citi base case of 750mt and 2011 levels of 645mt. In order to meet industry forecasts of >1.1bt in 2020-2025 China's demand would have to push on beyond Japanese intensity levels towards those of Korea

- We have run three scenarios where the intensity of China's steel demand relative to its urbanisation rate (904 in 2010) trends to similar levels to that of the US (~400), Japan (~800) and Korea (~1,400) by 2030
- Given an expected population of 1.4bn in 2030 we find:
- US scenario: Chinese consumption 552mt in 2015, 502mt in 2020 and 387mt in 2030
- Japan scenario: Chinese consumption 631mt in 2015, 701mt in 2020 and 793mt in 2030
- Korea scenario: Chinese consumption 777mt in 2015, 957mt in 2020 and 1,302mt in 2030

China Steel Apparent Consumption (mt) - Urbanisation Scenarios

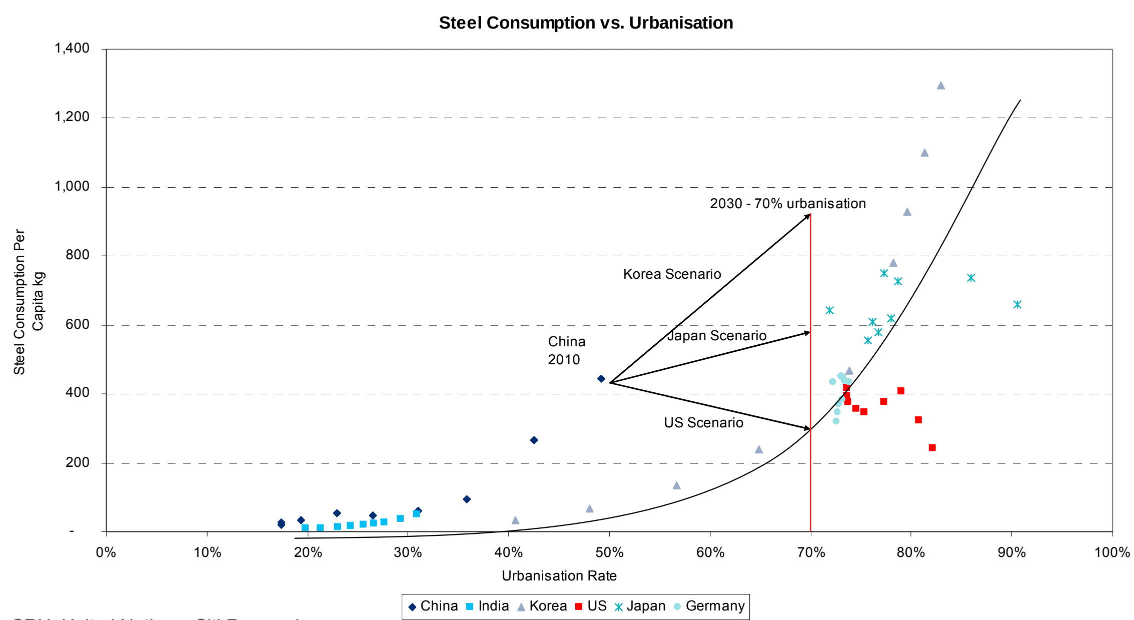


Source: World Steel, CRU, United Nations, Citi Research

Rebalancing suggests reversion to trend

A reduction in the Steel Intensity of Urbanisation to levels similar to the US would simply be a reversion to trend. Neither Korean nor Japanese intensity trajectories suggest the kind of downshift required from a concerted, policy enhanced, rebalancing away from an investment-led economy.

- China is consuming well above trend. A decline in intensity levels to those of the US returns the relationship between steel consumption and urbanisation to historical trend levels.
- Sustaining intensity at current levels, similar to Japan, implies a reduction in the rate of growth of steel consumption but still substantially higher than Korea at this stage of urbanisation. With China already spending 8% of its GDP on steel this continued growth in intensity implied by a continuation of Japanese intensity does not correspond, in our view, to a shift away from investment.
- To attain a similar levels of intensity as Korea would require China to maintain the same steel demand growth rate in the next 18 years as it produced during the super-cycle period from 2002-2008



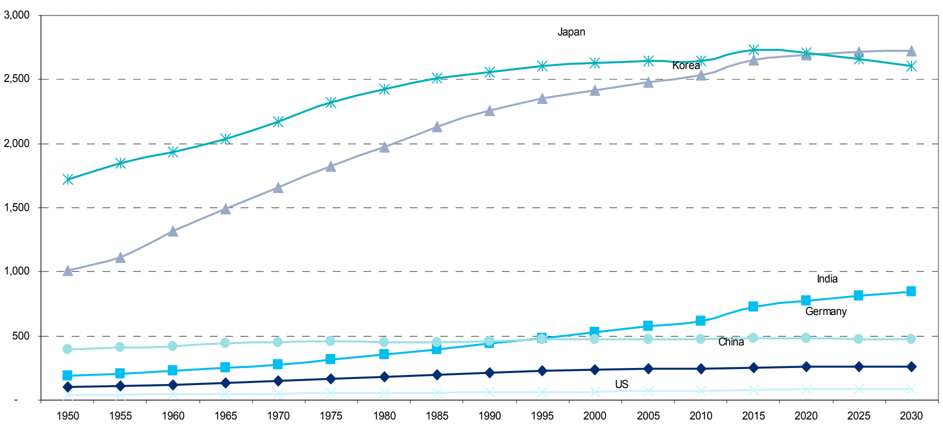
Source: World Steel, CRU, United Nations, Citi Research

While Korea and Japan are special cases

Without either country's geographic limitations or in the case of Korea, elevated export skew, China is likely to struggle to sustain Japanese, or push towards Korean, Urban Intensity levels.

- Both Korea and particularly Japan are severely restricted in their ability to build outwards from urban areas with habitable land only 19% and 13% respectively. As a result they must build upwards resulting in more steel-intensive urbanisation.
- China in contrast has 56% of land available for habitation, closer to the US (44%) and similar in size at c.9m km^2. Adjusting population density for these limitations suggests population pressures on habitable land in Korea and Japan are c.3x greater than China.

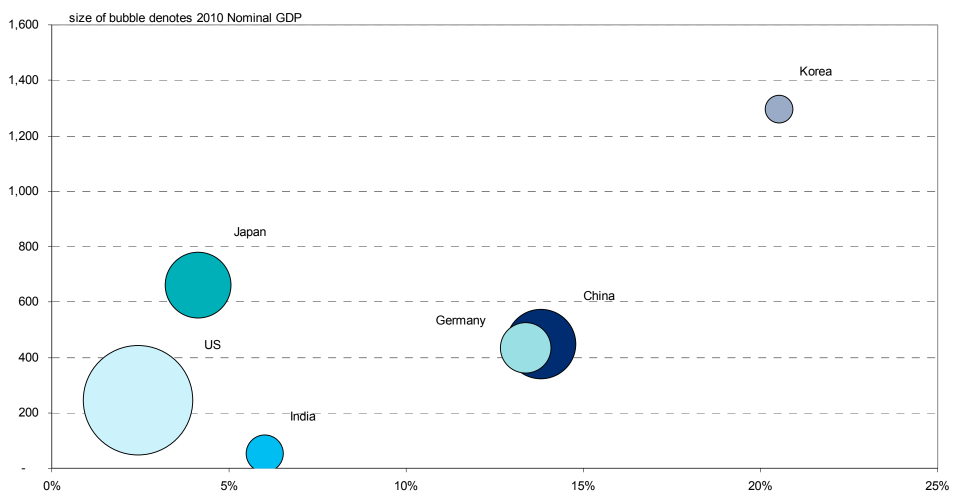
Population Density Adjusted for Habitable Land 1950-2030 (pple per kmsq)



Source: United Nations, World Bank, Citi Research

- Korea not only has the highest export contribution to GDP of the countries in this report (52% vs. average 30%) but its GDP composition is significantly weighted towards manufacturing (39% vs. average 31%) implying a relatively high share of steel-intensive exports.
- For China to reach similar intensity levels of steel consumption to Korea would require a seismic shift in global trade dynamics.

Exports as % of GDP adj for Manufacturing Share of GDP vs. Steel Cons per capita (kg)



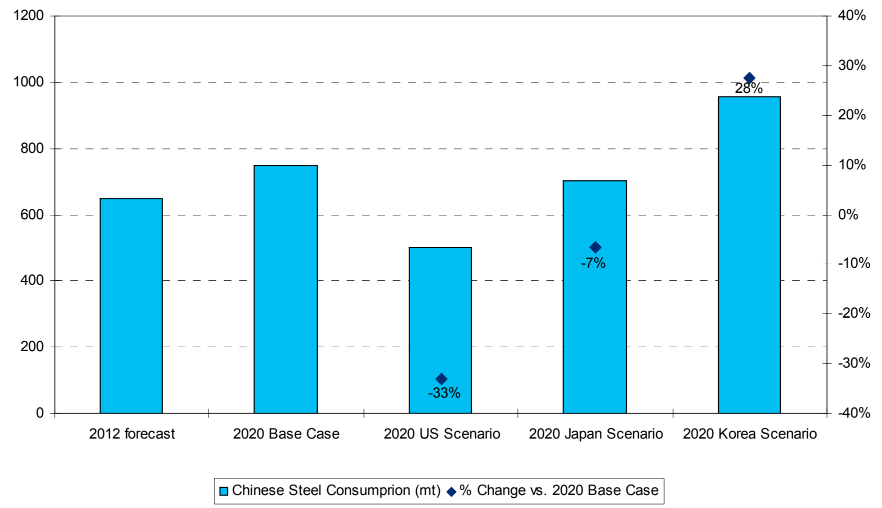
Source: World Bank, CIA World Fact book, Citi Research

Therefore a decline to US intensity may be more base than bear

Difficulties in attaining Korean and sustaining Japanese intensity levels suggest downside risk to our conservative base case of 750mt of Chinese demand in 2020 while consensus expectations for >1.1bt by 2025 are highly improbable in our view.

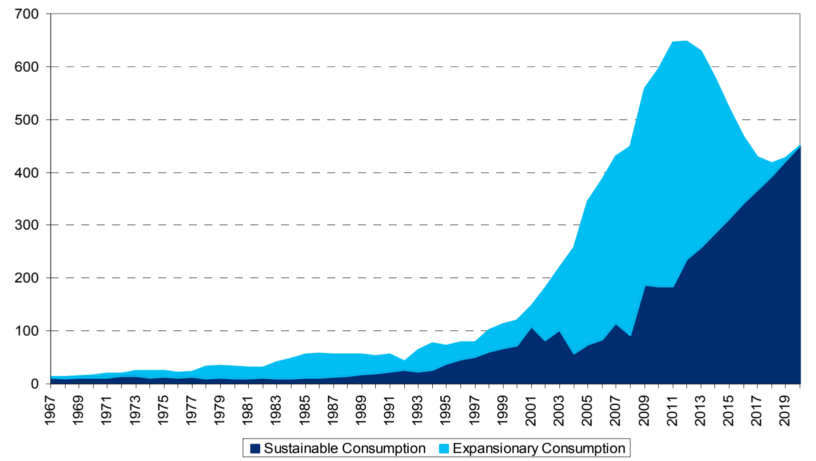
- Under a scenario where Chinese steel consumption reverts over the course of 18 years to levels commensurate with its urbanisation rate demand could fall c.30% below our 750mt base case to 500mt.
- To get near Citi forecasts requires the maintenance of Japanese intensity levels which we regard as challenging.
- Consensus of >1.1bt can only be achieved if China develops into a manufacturing intensive exporter which we do not think can be supported by current trade dynamics.
- Furthermore, the US scenario confirms the finding of our recent report on the sustainable level of Chinese steel consumption relative to GDP. With China rebalancing away from an investment-driven economy demand should trend over time to 'maintenance' levels.
- History suggests economies can sustain spending c.2% of GDP which would imply Chinese demand of 450mt in 2020.

Chinese Steel Consumption Forecasts vs. Urbanisation Scenarios



Source: Citi Research

Chinese Consumption at 2% of GDP Sustainable Levels (mt)

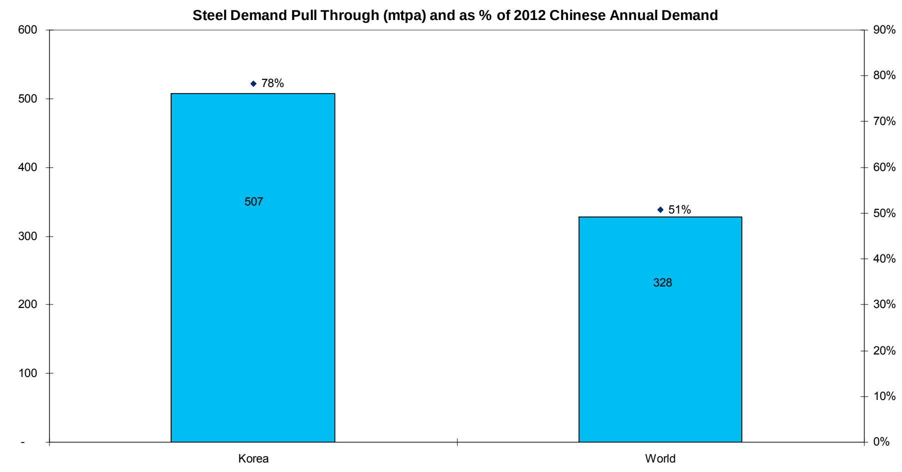


Source: World Steel, CRU, World Bank, IMF, Citi Research

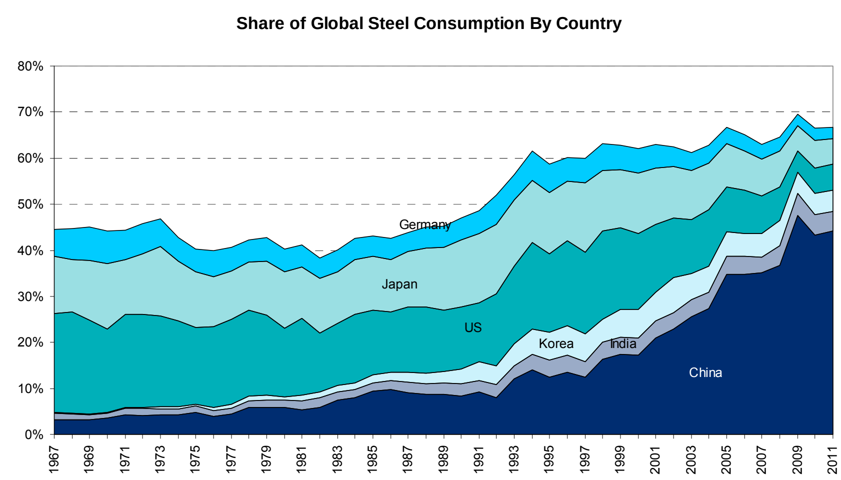
Pull-through creates the vacuum for correction

A correction to levels commensurate with urbanisation trends could be driven by the vacuum from the pull-through of the last 10 years' excess demand

- Based on a comparison of other consumers at 50% urbanisation rates we calculate China has pulled through between 300mt and 500mt of future demand since 2000. This represents 50-70% of China's 2012 annual consumption.
- This suggests a significant hollowing out of future demand and the creation of a potential vacuum which could support a demand correction.
- Any correction is likely to be facilitated by official commitment to active policy promotion of rebalancing.
- Steel-intensive investment has run ahead of the requirements of the urban populace creating a false base demand level.
- With China now representing 45% of global demand the impact is likely to have a profound effect not only on global steel market dynamics but iron ore pricing where Chinese imports represent 65% of seaborne demand.



Source: Citi Research



Source: World Steel, CRU, Citi Research

A game changer for iron ore?

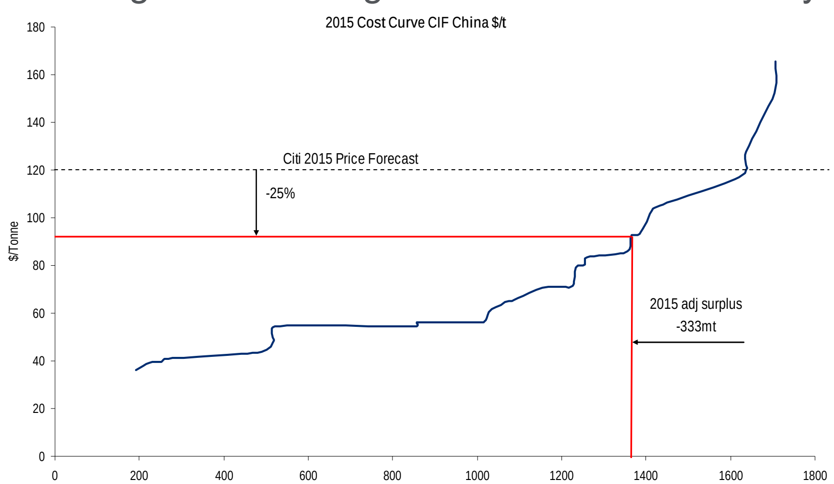
The re-alignment of the Steel Intensity of Urbanisation to fundamental support has the potential to represent a game-changer for iron ore. Should we see 500mt of Chinese steel demand in 2020, 40% of the cost curve would be surplus to requirements. Pricing would also be likely to trend to marginal cost rather than incentive pricing.

• A correction in Chinese steel demand to 550mt in 2015 and 500mt in 2020 would represent a shortfall vs. Citi's iron ore demand base case of 200mt and 470mt respectively.

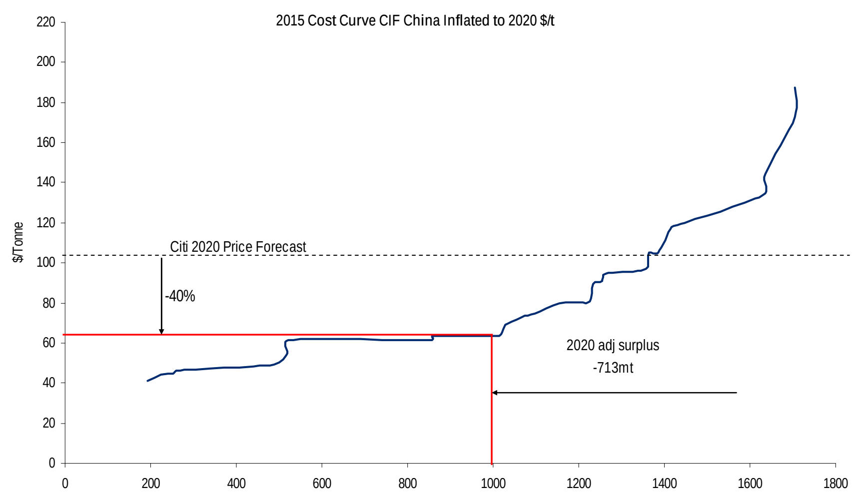
• Combined with existing surplus expectations of 137mt in 2015 and 246mt in 2020, this creates net excess capacity of c.330mt and c.700mt respectively. In reality such a surplus is unlikely to develop given pricing weakness by 2015, rendering higher cost capacity uneconomic and causing project cancellations.

• Based on our 2015 global CIF cost curve marginal cost support would therefore sit at $90/t, 25% below our $120/t forecasts. Inflating this curve to 2020 (implying no new supply additions, not unrealistic given the pessimistic scenario) suggests price support at $64/t. This compares to our 2020 long-run assumption of $105/t or $80/t real.

• In a surplus of this magnitude incentive pricing, the basis for consensus long-run forecasts, would be meaningless and marginal cost would be the only support.



Source: Citi Research



Source: Citi Research

What does this mean for the miners?

Removing high cost capacity on this scale would result in a dramatic flattening of the cost curve from 2.8x on our 2015 base case to 1.8x while 2020 would fall to 1.5x. ROCE could compress by up to 10pps.

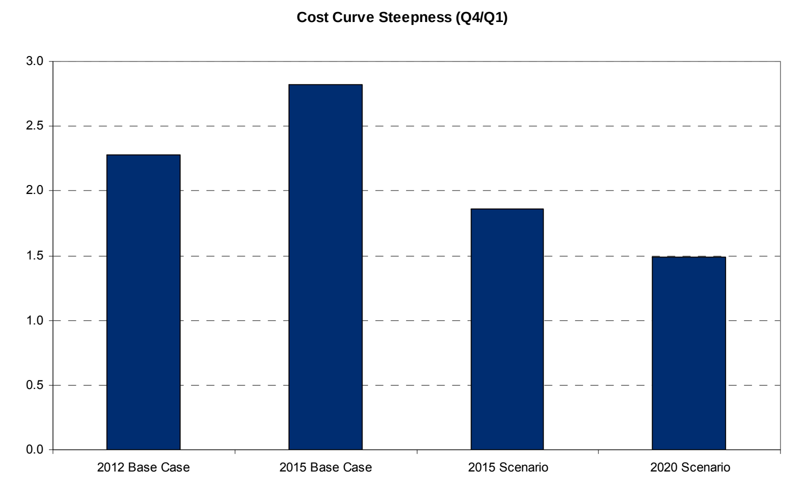
- The resulting loss of capacity in a rebalancing scenario would result in the cost curve flattening from 2.8x on our 2015 base case to 1.9x with a further fall to 1.5x in 2020. This represents a 34% reduction in steepness in 2015 and 47% in 2020 vs. our 2015 forecast base case.

- Prior analysis suggests the relative steepness of the curve is a key driver of returns (See *Quality of Resource Companies – 5th March 2012*).

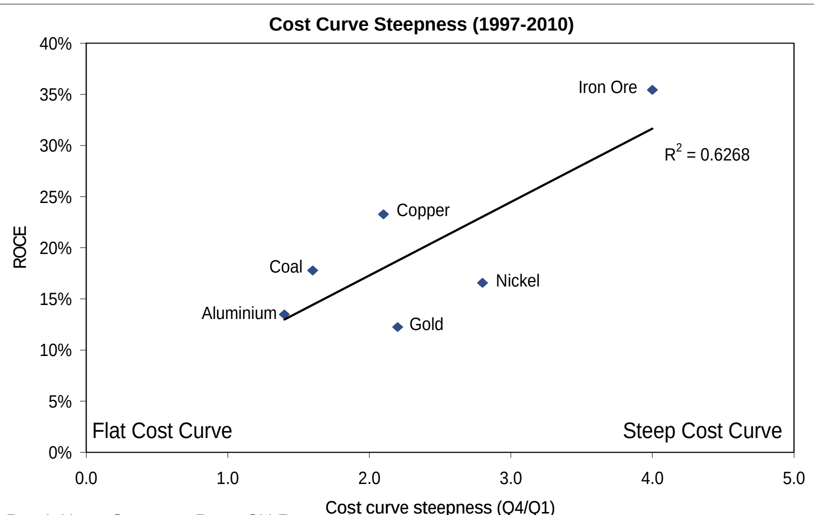
- The steeper the curve the greater the protection provided by high-cost producers to the rest of the curve insulating margins.

- With the ratio between the fourth and first quartiles falling to 1.5x, in line with Aluminium, ROCE could reduce to reflect this by as much as 10pps vs. our forecasts and 20pps compared to historical margins as shown in the chart to the side.

- In this scenario mid-cost producers look vulnerable while the requirement for additional greenfield capacity is called into question.



Source: Citi Research



Source: Brook Hunt, Company Data, Citi Research

Conclusions

Our analysis of urbanisation rates suggests rapid growth in Chinese steel demand may have resulted in a significant pull-through in consumption beyond that supported by population drivers. This potentially implies sizeable downside to consensus forecasts for both steel and iron ore.

- We find China's Steel Intensity of Urbanisation (steel consumption per capita/urbanisation rate) has risen by 4x since 2000 and is now level with Japan and well beyond the rate of the US and Germany.
- A reversion to a trend ratio of steel consumption to urbanisation would suggest demand in China has peaked with demand in 2020 potentially 500mt vs. 645mt in 2011. This corroborates the findings in our analysis of China's GDP where we derived 450mt in 2020 and compares to Citi base case demand of 750mt and consensus of >1.1bt in 2020-2025.
- To achieve >1.1bt of demand in 2020-2025 requires Chinese intensity to continue to increase to that of present day Korea implying the same growth rate in steel consumption per capita in the next 13 years as we have seen during 2002-2008.
- Since 2000 China may have pulled through c.300-500mt of future demand, driven by a surge in construction, equating to c.50-80% of 2012 annual consumption. This in turn has created a potential demand vacuum which, in combination with active policy pressure, could result in a sizeable adjustment to lower consumption levels swamping structural demand support from sectors such as autos.
- Under a rebalance scenario we could see 330mt of excess global iron ore capacity in 2015. Based on Citi's 2015 cost curve this implies a price of $90/t, 25% below Citi forecasts.
- By 2020 this iron ore surplus could rise to 700mt removing 40% of the cost curve. In a world awash with iron ore there would be no need for incentive pricing and we could see $64/t nominal in 2020 vs. consensus long-run pricing of c.$100. Given prices tend to settle at the 90th percentile we could in fact see realised prices closer to $80/t in 2015 and sub $60 in 2020.
- This suggests a) that both high and low cost Chinese capacity could be knocked out by 2015; b) both mid and high cost producers worldwide could be potentially loss-making; c) there is little requirement for additional greenfield iron ore capacity; d) the resultant flattening in the cost curve could reduce ROCE by 10pps.
- Despite the bearish implications of both our urbanisation analysis and our previous GDP work China's steel demand remains a multi-faceted moving feast presenting significant uncertainties in forecasting. Given the lack of visibility on policy-making, the limited comparative datasets and our conservative forecasts relative to consensus we continue to use our bottom-up base case estimates.

Appendix A-1

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