Stress Testing on Impact of Environmental Factors on Commercial Banks' Credit Risk in Steel Industry

ICBC Green Finance Research Group

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中国工商银行

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Abstract

This paper is a study of the likely changes to credit risk for commercial banks once stricter environmental standards are imposed on the steel industry. It was undertaken by the Industrial and Commercial Bank of China (ICBC) in cooperation with China Lianhe Equator Environmental Impact Assessment Co., Ltd. and China-ASEAN Environmental Cooperation Center. This project considered stress scenarios and stress transfers. In analyzing stress transfers, firms were divided into small- and medium-sized enterprises (SMEs) and large enterprises. In researching stress factors, pollution treatment and pollution discharge were considered. Pollution treatment was studied for three processes – sintering, iron making and steel making. Pollution emissions ware split into gas emissions and solid waste. This study found that stricter environmental standards will impact the solvency of steel companies to an extent but the overall risk can be controlled. This paper also puts forward some policy suggestions.

Key words

Environmental factors, Risk qualification, Steel industry, Credit risk, Commercial banks

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The steel industry is a key sector of China's national economy. It requires a large amount of funds, resources, energy and labor and is currently operating at over-capacity. It also has a heavy environmental footprint. ICBC studied the likely credit risks for commercial banks once the steel industry is required to comply with stricter environmental standards. This study is titled, "Credit Risk Stress Testing on the Impact of Stricter Environmental Protection Requirements on the Steel Industry for Commercial Banks." It also provides policy suggestions. This study was conducted in conjunction with China Lianhe Equator Environmental Impact Assessment Co., Ltd. and China-ASEAN Environmental Cooperation Center.

1 An Overview of the Chinese Steel Industry

As the steel industry phased out excess production capacity and market demand rose post-2016, steel prices have picked up amid fluctuations, helping the sector turn losses into gains. This report defines the steel industry as the ferrous metal smelting and rolling industry. According to China's Ministry of Industry and Information Technology, in 2016 steel companies made sales worth RMB2.8 trillion, down 1.8% year-on-year. Total profits grew by more than RMB100 billion to RMB30.378 billion over the same period last year when the sector made a loss of RMB77.938 billion. In the first quarter of 2017, steel continued to grow profits, making RMB23.284 billion, compared with a loss of RMB8.748 billon in the same period of last year.

i. The steel industry's main features

With both production and consumption on the rise, Chinese crude steel output was the highest in the world in 2016, indicating the enormous scale of the sector. Nationwide, crude steel output in 2016 was 808 million tons, up 1.2% year-on-year. Domestic consumption reached 710 million tons, up 1.3% year-on-year, marking the first increase in two years. Steel output (including recycled steel) posted 1,138 billion tons, up 2.3% year-on-year or 1.7 percentage points faster than last year. China's crude steel output accounted for 49.6% of the world's total, up 0.2 percentage points. From January to March 2017, nationwide crude steel output rose 4.6% year-on-year. In March, daily

output hit 2,322,500 tons, a record high.

But with rising domestic steel prices and growing international trade protectionism, China's steel exports slipped slightly. In 2016, the country exported 108 million tons of steel (billets), down 3.5% year-on-year; it imported 13.5 million tons of steel (billets), up 3.2% year-on-year, meaning the net export volume of crude steel was 98.55 million tons, down 4.4% year-on-year, accounting for 12.2% of China's total output. From January to March 2017, the volume of steel exports slipped to 20.73 million tons, down 25% year-on-year.

The de-capacity policy continued to drive down fixed-asset investment in the sector. In 2016, RMB416.1 billion was invested in China's ferrous metal smelting and rolling sector, down RMB 9.36 billion or 2.2% year-on-year. Investment in Chinese steel has been falling for three consecutive years since 2014. From January to March 2017, investment totaled RMB58.4 billion, down 10.1% year-on-year or 7 percentage points more than the same period last year.

ii. Major obstacles facing the development of the steel industry

First, the industry remains largely unconcentrated and excess production capacity is still a major problem. Baoshan Iron and Steel Group (Baosteel) and Wuhan Iron and Steel Group merged to form the Baowu Steel Group, helping to make the sector more concentrated. As a result, CR10 climbed to 35.9%, up 1.7% year-on-year and CR4 increased to 21.7%, up 3.1% year-on-year. But more can be done in this regard since just 305 steel complexes have been recognized by the Ministry of Industry and Information Technology with a production capacity over 1 million tons, Meanwhile, there are more than 2,000 single-operation steel mills. Even though de-capacity efforts have achieved some periodic success; the problem has not fundamentally been solved. Capacity utilization rate is around 71%. In 2017, China should reduce capacity by about 50 million tons and remove all substandard steel production before the end of June. De-capacity will continue to face challenges.

Second, there is more friction within the global steel trade and low-end products have become less competitive. The contradiction between a weak demand for crude steel across the world and overcapacity in the industry has encouraged a resurgence in trade protectionism and intensified international competition. A number of Chinese steel companies have added micro-alloy into ordinary steel models and exported them as alloy steel. This has disrupted the steel market at home and abroad. In 2016, a total of 117 anti-dumping and anti-subsidy investigations (also known as "dual-anti

investigations") were launched against China, of which 49 involved the steel industry, (or 42% of the total). As a result, Chinese steel exports dropped 3.5% year-on-year. In the first quarter of 2017, China saw its steel exports slump 25%. In February, it dropped to 5.75 million tons, the lowest single-month level since February 2014. Steel exports are expected to be confronted with more challenges in the second half of the year.

iii. Pollution from China's steel industry

Pollution from the steel industry has three main characteristics – that is there are multiple sources, pollutants are complex, and the pollution is very difficult to treat. By the end of 2016, the sector produced 9.5% of all industrial SO2 pollution, 6.3% of NOx pollution, 9.35% of smoke dust, and 20.7% of dust emissions. It tops the three most polluting sectors (metallurgical, chemical and light industry) and the six industries (steel, oil refining, thermal power, chemical engineering, non-ferrous metal smelting, and papermaking). Most pollution from the steel industry is air pollution[1] , which is in the form of dust and smoke dust, while sintering releases enormous amounts of SO_2. Water pollution is a less serious issues in the steel sector, and is mostly coking phenolic wastewater and wastewater from steel rolling[2] .

1. Flue gas discharged from the steel industry mainly consists of particulate matter and SO2. Particulate matter comes from sources and processes such as stock yards, sintering, iron making, steel making, coking, and roasting. SO2 is mainly produced from sintering. NOx is also largely a byproduct of sintering, iron making, coking, hot rolling and other processes. Other pollutants connected with the steel industry are HF and Dioxin. Most HF comes from sintering and cold rolling while a smaller amount is emitted from special steel pickling and electroslag melting. Dioxin is emitted during sintering and electric steelmaking.

2. The main water pollutants associated with the steel industry are COD, petroleum, ammonia nitrogen and heavy metals. COD and petroleum pollution is connected with coking, hot rolling and cold rolling, ammonia nitrogen comes from coking, while heavy metals are released from cold rolling. Coking also produces phenol and cyanogens.

2 Environmental Protection Policies for the Steel Industry

i. Major environmental protection standards on China's steel industry have been made significantly stronger

In 2005, emission standards for China's steel industry dated from the 1990s and were well behind those in developed countries. China started drawing up new emission standards in 2003 and these were finally introduced on October 1, 2012. In these 10 years, eight new standards were made, including the *Emission Standards of Pollutants from the Mining and Mineral Processing Industry and the Emission Standards of Air Pollutants from Sintering and Pelletizing in the Iron and Steel Industry* [3], which were much stricter than the previous standards. The special emission caps introduced on January 1, 2015 were called the "harshest-ever" emission standards to date. Some pollution emission caps were as low as one tenth of the old standards. Chinese water pollution standards on suspended matter and hexavalent chromium are now almost as strict as international standards, but those on CODcr, total chromium, and total lead fall behind (for more details, please see Table 1 below). China's air pollution standards on iron making, steel making, ferroalloys and other processes are actually stricter than those in developed countries, such as the US, Germany and Japan (for more details, please see Table 2).

3. Emission Standards of Pollutants from the Iron Mining Industry (GB28661-2012); Emission Standards of Air Pollutants from Sintering And Pelletizing in the Iron and Steel Industry (GB28662-2012); Emission Standards of Air Pollutants from the Iron Smelting Industry (GB28663-2012); Emission Standards of Air Pollutants from the Steel Smelting Industry (GB28664-2012); Emission Standards of Air Pollutants from the Steel Rolling Industry (GB28665-2012); Emission Standards of Air Pollutants from the Ferroalloy Smelting Industry (GB28666-2012); Discharge Standards of Water Pollutants from the Iron and Steel Industry (GB13456-2012); Emission Standards of Pollutants from the Coking Chemical Industry (B16171-2012).

Table 1 Comparison of discharge standards of water pollutants for the steel industry at home and abroad

Pollutant (Unit: mg/l)	1992 standards, level 1	Stage 2 of the current standards	Advanced level abroad
Suspended matters	70	30	10-30
CODcr	100	50	18-43
Ammonia nitrogen	10	5	—
Volatile phenol	0.5	0.5	—
Total zinc	2	2	—
Total copper	—	0.5	—
Total arsenic	—	0.5	—
Hexavalent chromium	0.5	0.5	0.1
Total chromium	—	1.5	0.3-2.0
Total lead	—	1	0.263
Total nickel	—	1	—
Total cadmium	—	0.1	—
Total mercury	—	0.05	—

Once stage-2 caps listed in the current standards went into effect, COD discharge fell about 61,000 tons (53%) during the 12th Five-Year Plan period (2011-2015) from 2009 (and accounting for 0.47% to the total reduction of pollution); ammonia nitrogen emissions fell some 6,000 tons (69%) over the same period (accounting for 0.49% of total pollution reduction).

Table 2 Comparison of emission standards of air pollutants for the steel industry at home and abroad

Pollutant (Unit: mg/m^3)	Production facility		Stage 2 of the current standards	1996 standards	US	Germany	Japan
Particulate matters	Mining and dressing		20	120	11.45	—	—
	Sintering	Sintering (pelletizing) equipment	50	100	13.7—41.2	50 (currently)	150
		Other production equipment	30	120	11.4-57.2		—
	Iron making	Air heating furnace, heating furnace	20	100	—	10	100
		Blast furnace discharge yard	25	100	6.9	10	—
		Raw materials, pulverized coal system	25	120	11.45	10	—
	Steel making	Primary flue gas of rotating furnace	50	100	22.9	—	—
		Secondary flue gas of rotating furnace	20	100	11.9	—	—
		Electric furnace	20	100	11.45	5 (newly built)	20
		Various dedusting systems relating steel rolling	20	100—200	—	20	20
	Ferroalloy	Semi-closed furnace, open furnace, finery	50	100	50	5	—
		Other production facilities	30	120	35	5	—
Other gas (SO_2, NOX, Dioxin)	Sintering	SO2	200	2000	500	—	320m^3/h
		NOx	300	—	400	—	451 (220ppm)
		Dioxin	0.5	—	0.1~0.4	—	—
		SO2	100	2000	350	250	250m3/h
	Air heating furnace for iron making	NOx	300	—	350	35	200—350 (100—170ppm)
	Electric furnace for steel making	Dioxin	0.5	—	0.5	0.5	5
	Heat treating furnace for rolling mill	SO2	150	2000	≤150		
		NOx	300	—	250—400		

Once the stage-2 caps listed in the current standards went into effect, particulate matter emissions fell about 760,000 tons (56%) over the 12th Five-Year Plan period from 2009; SO2 emissions dropped 1.02 million tons (about 60%) and accounting for 4.5% of the drop in total emissions. The sintering (pelletizing) industry saw air pollution fall by 1 million tons. NOx emissions fell 200,000 tons (about 23%) and accounting for 1.2% to the drop in total emissions.

ii. Scenario design and cost analysis for the impact on the steel industry from environmental protection policies

Environmental protection policies will impact the steel industry on a number of fronts including pollution treatment and pollution emissions costs, water use rights, energy use rights, and carbon emission trading. Currently, the trading of energy use rights, carbon emission trading, and water use rights are undergoing top-level design and preparatory work on a trial basis, so they will not exert any immediate impact in the short term. However, the impacts from pollution treatment and pollutant emissions have emerged recently and these form the key considerations for this study's stress test modeling (Please refer to Chart 1).

1. Stress factors

These fall into two categories, stress from treating pollution and stress from reducing emissions. This study has simplified the stress model for pollution treatment by only analyzing the major processes that consume significant amounts of resources and energy. Sintering (pelletizing), iron making and steel making were used as the major pollution emission sources. Costs were calculated for emissions of smoke dust, industrial dust, SO2, NOx, and VOC. Currently, China's steel industry is now able to recycle all wastewater, therefore water pollution costs have been excluded from this study.

2. Stress scenarios

(1) Pollution treatment stress scenarios: Scenarios were based on three standards – those on newly built enterprises, special emission caps, and companies graded at international leading levels as listed in the Emission Standards of Air Pollutants for Sintering and Pelletizing of the Iron and Steel Industry (GB28662-2012) (with reference to emission standards on air pollutants for the steel industries in regions and countries such as the EU and Germany as well as the requirements for emissions prescribed by level 1 standards from the Evaluation Index System of Cleaner Production in the Steel Industry).

(2) Pollution emission stress scenarios: Scenarios employed standards adopted by Hebei Province (including VOCs). In the light scenario (Scenario 1), the pollution

equivalent is charged at a rate of RMB2.4; in the medium scenario (Scenario 2), RMB4.8; and the severe, (Scenario 3), RMB6.0.

(3) Classification of steel companies: Steel companies have different production capacities and equipment. To meet the same environmental protection requirements, they will need to meet widely varying costs, so the companies were divided into two categories: steel companies ranked average (annual crude steel output of 3 million tons) and companies ranked large (annual crude steel output exceeding 10 million tons).

3. Stress costs

Please see Table 3 below for stress scenarios and increase in costs per unit:

Table 3 Total predicated cost of different steel companies under different scenarios

Unit: RMB/ton of steel

Increased unit cost	Scenario 1		Scenario 2		Scenario 3	
	Pollution treatment expenses	Pollution discharge expenses	Pollution treatment expenses	Pollution discharge expenses	Pollution treatment expenses	Pollution discharge expenses
Steel companies with annual output of 3 million tons	24.95	15.67	41.14	28.45	83.29	14.89
	40.62		69.59		98.18	
Steel companies with annual output of 10 million tons	2.47	9.42	17.81	16.48	33.98	10.74
	11.89		34.28		44.73	

3 Stress Testing Analysis and Suggestions

i. Model

Steel companies of different sizes (average and large) show different increases in costs under the stress scenarios.

A "bottom-up" method was used to investigate how more stringent requirements for environmental protection will affect the financial positions of the steel companies. This study estimated new increased costs under the stress scenarios and used ICBC's existing rating model to calculate how that would affect their credit rating and PD (probability of default) (for details, please refer to Chart 2).

ii. Results

Higher environmental costs will impact steel companies' financial position to an extent but the effect can be controlled.

iii. Policy suggestions

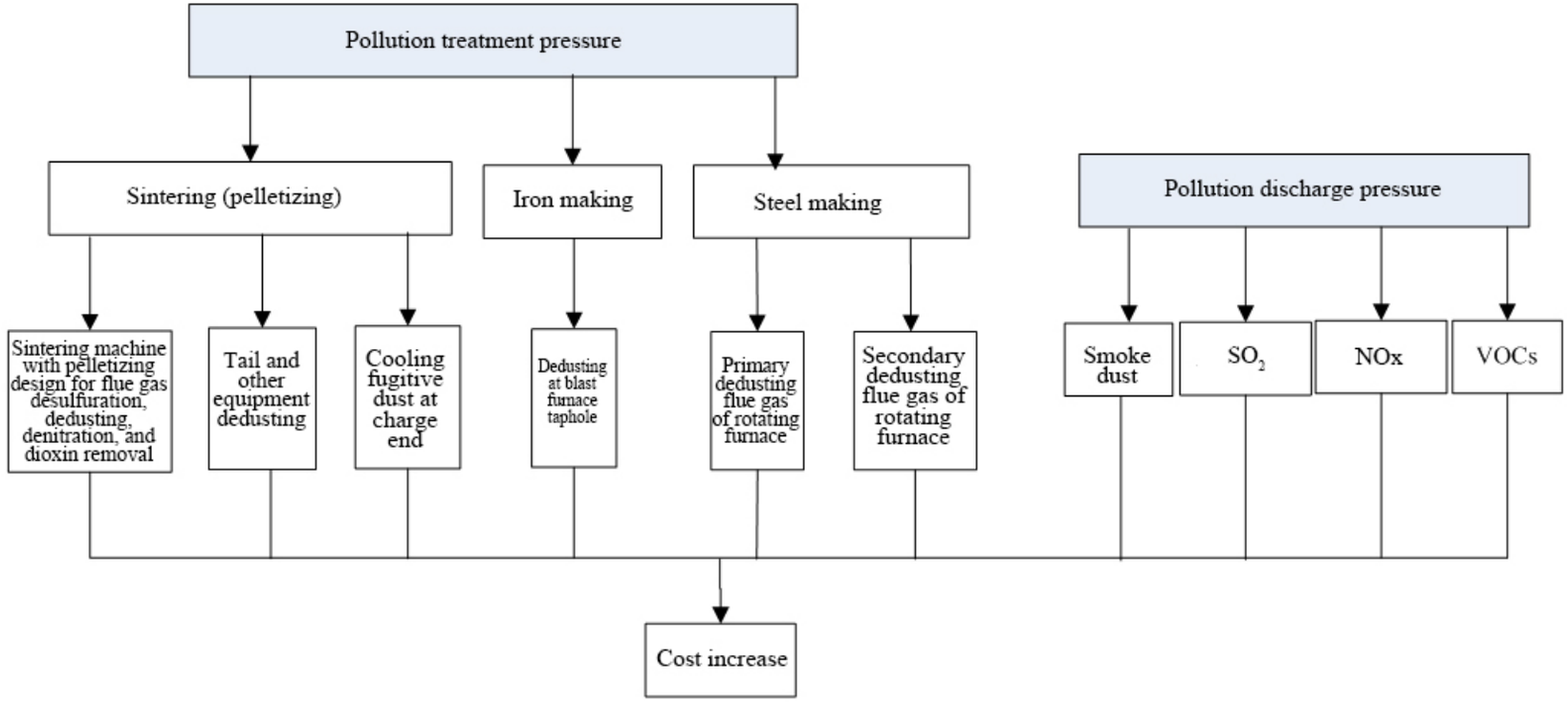
1. General industry estimates: The steel industry is showing signs of recovery; its total size will fall slightly without compromising stability going forward. However, as the de-capacity drive and reforms on the supply side take effect, the industry should become more concentrated, with leading firms able to gain a considerable space for further development. First, effective supply will keep rising. New manufacturing models such as flow-based intelligent manufacturing, internet-based coordinated manufacturing, large-scale custom manufacturing, and remote operation and maintenance are expected to be picked up by the steel industry. Structural steel will gain in popularity. Driven by demands from many fields as diverse as hi-tech shipping, maritime engineering, advanced rail transit, and power generation, key steel models will be able to make breakthroughs and grow into independent sectors. Second, more mergers and extensive reorganization is predicted. The merger of Baosteel and Wuhan Iron and Steel Group sets a good precedent in this regard. In the future, M&A that focus on improving quality/brand awareness and integrating

regional resources will secure substantial progress, thereby making the steel industry more concentrated. Third, steel consumption will decrease slightly and stabilize, and reach an optimal rate. As the Chinese economy settles into a medium-high growth rate rather than its previous rapid rate, the sector will begin to enjoy intensive growth that focuses on quality and efficiency. Demand for steel from traditional manufacturing, real estate and other industries will decrease slightly but demand from high-end manufacturing and emerging industries will pick up.

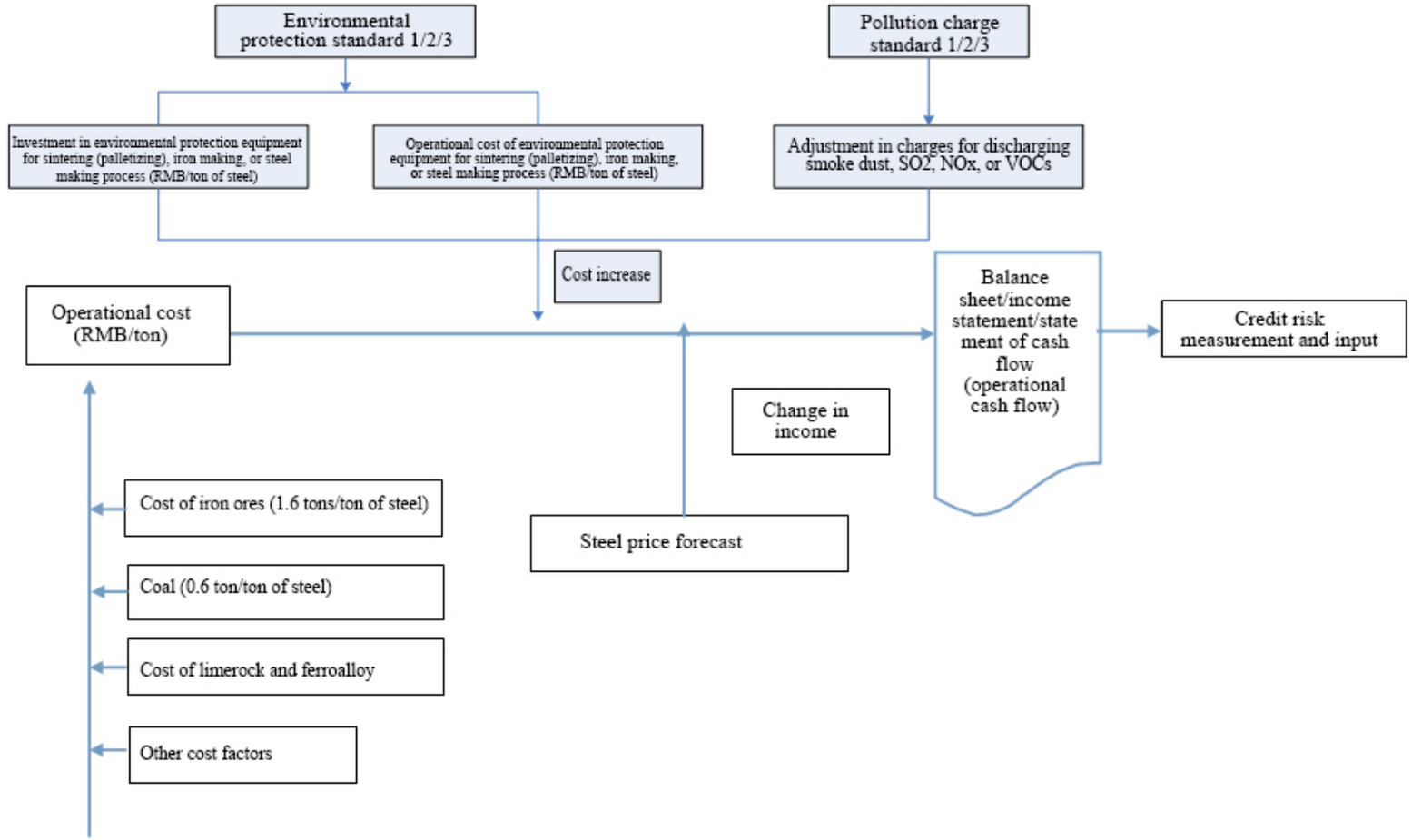
2. Commercial banks should continue differentiated credit policies and seize more market opportunities. First, commercial banks should ensure they have put risk under control, and give preferential support to the key players in the industry. As the sector begins to show sign of recovery, commercial banks should continue their differentiated credit policies. Second, they should look out for opportunities for high-quality steel companies offered by environmental protection requirements. Between 2005 and 2015, China's major steel companies spent more than RMB130 billion on treating environmental pollution. In the future, Chinese steel companies will work harder at overcoming technological bottlenecks and become more innovative in treating multiple pollutants from sintering flue gas, desulfurization and denitrification of coking flue gas, and others. They should also pursue green development in mining, procurement, logistics, manufacturing, products and industry, and invest more in environmental protection equipment, eco-friendly technologies, intelligent operations and technological development. Commercial banks are advised to spot business opportunities in this area and jump in and offer support.

3. Although large-sized major steel companies can withstand significant cost increases from environmental protection requirements, de-capacity and supply-side reform are areas that still require close attention. Efforts must be made help them take better risk prevention measures. The core message delivered at the Central Economic Work Conference was that the steel industry must phase out overcapacity in 2017. According to the Ministry of Industry and Information Technology, the steel industry is still suffering from overcapacity and has a weak foundation for price pickup and profit recovery. The sector is also struggling with not being sufficiently concentrated; it also faces increasingly intense international trade frictions and a number of other pressing issues such as too much substandard steel and a problematic market environment. So, while supporting the sector's development, commercial banks should also improve their risk awareness, tighten credit approval procedures, and place equal importance on quality and benefits.

Attached Chart 1 Basic structure of environmental stress testing of steel industry



Attached Chart 2 Stress transfer routes for changes in steel industry policy



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Urban Finance Research Institute of ICBC, which was established in 1993, is the strategy research and planning department of ICBC Head Office. As well as providing intellectual support for top decision-making of ICBC, the Institute sets up the development vision of building "The Think-Tank for Chinese Financial Industry", devoting itself to make contribution to healthy and sustainable development of Chinese financial system. The major responsibilities of the Institute are as follows: formulating medium-to-long term development planning and strategies; analyzing the macro-economic situations & outlooks, development of banking industry and business tactics; focusing on prospective study on green finance as well as international and domestic cooperation, exploring the methodology of environmental risk quantification, conducting environmental factors stress-testing and ESG rating; editing and publishing two journals named CHINA URBAN FINANCE and FINANCE FORUM respectively; taking charge of daily operation and organization of China Urban Finance Society; taking charge of daily operation of ICBC Post-Doctoral Research Center; compiling the history of ICBC.

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