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A Study Examining Early Warning of the Legal Risk of Environmental Legislation in China

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Abstract: New environmental laws or policies bear risks for enterprises. However, this type of risk is often ignored by an enterprise. This paper analyzes the current status and characteristics of Chinese environmental laws and develops a method, known as the Risk Assessment Matrix of Environmental Legislation for possible laws, to provide early warning of the legal risk caused by new environmental laws and policies. The case study demonstrates that this method has results. This method has a good fit in countries where environmental laws are stricter day by day, and new environmental laws are enacted rapidly. An enterprise or industries can discover potential legal risk and the level of external environmental legislation.

Key words: legal risk; environmental law; risk assessment code; early warning
JEL code: M1

1. Introduction

While the enactment and revision of environmental laws has increased sharply during the past decade in China, as the analysis shows in Figure 1. The new environmental laws or policies must bring about risk for enterprises. Especially, Chinese government has devoted itself to solve environment pollution through more stringent legal regulations and cleaner production. Corporates will face more and more legal risk caused by environmental regulations. To guide Chinese corporations to control legal risk, Chinese government issued specially guidelines on corporate management of legal risk (GBT27914-2011) in February 2012. The special guidelines pointed out that Legal risk includes internal risk caused by the internal control and external risk caused by the changes in legislation. Take an example, the pollution of $PM_{2.5}$ has been found to be serious from the map of the Global satellite-derived $PM_{2.5}$ averaged over 2001-2006 (Aron van Donkelaar et al., 2010). But the Baidu research index of $PM_{2.5}$ per week is zero before the August 21th, 2011 (index.baidu.com), we can find the pollution of $PM_{2.5}$ did not draw much attention before the regulation of $PM_{2.5}$ was enacted in China. For the managers of company without the professional knowledge of air, once environmental laws are enacted, it may bring great risk for the operation of company. In addition to operation risk and financial risk, environmental risk has become another serious risk for enterprises.

Synthesizing, characterizing, and communicating the risk science information used in environmental

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decision-making depend in the first instance on the nature and quality of the technical analysis. At the same time, other important features of the risk analysis, features that require special attention to provide context for the analysis as a whole, are frequently overlooked in practice or in presentation (Pattona, 1998). The research about risk analysis of environmental legislation and legal environmental for promoting the environmental management of enterprise is less abundant. For improvement of insufficient regulations, Osman Devrim Elvan (2013) discussed the main legal regulations of environmental conservation in relation to mining activities, defined basic environmental components which form the basis of environmental conservation in relation to mining, analyzed the impact of mining on each component, and gave suggestions for the improvement of insufficient regulations. Corporate environmental risk can be divided into internal and external environmental risks. The internal environmental risk is usually caused by an unsatisfactory technology level, an unsatisfactory management level and other issues, whereas the external environment risk is usually caused by changes in environmental legislation, regional environmental pollution, consumer behavior and other factors (Du Min, 2002). Particularly, Conversely, The research regarding the external risk of environmental legislation is less abundant in China; limited papers related highly to the external risk of environmental legislation can be found. China is doing its best to promote clean production through environmental legislation. It may create unimaginable losses if enterprises do not predict possible environmental legislation and respond to it. A portion of investors and enterprises have recognized the external legal risk of environmental legislation and required consultancy services on this issue.

The purpose of this study is to develop an early warning method with which to predict the external risk caused by the environmental law changes. This paper surveys the characteristics and trends of Chinese environmental legislation and develops an early warning method named Risk Assessment Matrix of Environmental Legislation based on a specific case study. Risk Assessment Matrix of Environmental Legislation is a simple and useful method to help enterprises to predict the external legal risk of environmental legislation and respond to the risk immediately. The research of Corporate Social Responsibility is very hot since 1990s, but now the word of Social Responsibility tends to be replaced by the Sustainable and Responsible (Eurosif and US sif). Enterprise is laying more emphasis on the sustainable development in China and the global. As The Japanese Corporate Social Responsibility (CSR) change, the responsibility includes mainly the compliance, philanthropy and environmental response in the past, but at present, the big companies like MISTUI&CO. think that they emphases more on suitability which includes mainly the defense based on CSR and offense base CSR. This research just provides a proactive tool to defense environmental legislation risk.

2. Methodology

2.1 Identify the Possible Laws

Because this research aims at early warning of environmental legislation risk for enterprises, we need to elucidate the characteristics of Chinese environmental legislation and attempt to identify in advance the environmental laws or policies that will be issued or revised. In the 1970s, to control environmental pollution, the Chinese government began to enact environmental laws based on the advanced experience of other countries. Chinese environmental legislation did not stem from environmental pollution lawsuits, but it emphasized filling in the blank system structure and intent (Tang Tian-zi, 2006). Cai Shouqiu (1999) and Wang Jin (1998) pointed out that environmental laws of different countries tend to be similar. Therefore, it is viable to find the possible environmental laws or policies through comparing the environmental laws systems among different countries. To find out the environmental laws and policies that are going to be enacted in the future, it is necessary to compare the Chinese environmental laws system to that of other countries and survey the current status of environmental pollution and the process of environmental legislation in China.

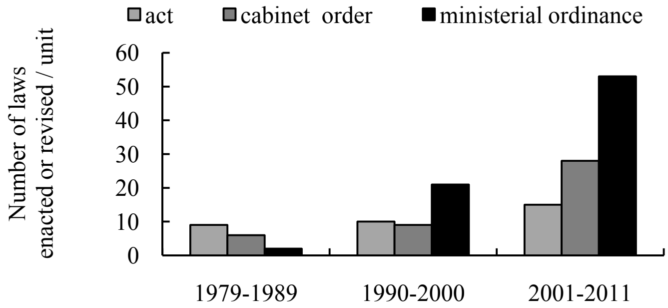

Figure 1 Number of Laws Enacted or Revised during Different Periods in China up to 2012

Source: Ministry of Environmental Protection of the People's Republic of China, law database, 2012

2.2 Develop a Risk Assessment Matrix of Environmental Legislation for Possible Laws

Once the abovementioned laws are issued or revised, it will bring environmental risk for enterprises. Enterprises may need to pay considerably higher pollutant discharge fees, even be forced to stop production, and face other risks. Many methods similar to a risk matrix are often used in environmental risk assessment. For example, the Risk Assessment Code (RAC) is utilized in water pollution risk assessment (K. P. Singh et al., 2005; C. K. Jain, 2004) and expresses risk in terms of severity and probability. An Assessment Matrix is also applied to assess the environmental responsibility of enterprises (Robert Haßler & Dirk Reinhard, 2000). Inspired by these methods, this paper developed a Risk Assessment Matrix of Environmental Legislation for possible laws ($RAMEL_n$). $RAMEL_n$ expresses the risk of a possible law n from the probability (i.e., legislation progress) and severity (i.e., intensity of environment pollution). Both aspects are divided into 4 ranks. The issue of environmental law follows this progression: first, environmental problems obtain the most attention from society or legislative departments; then the enacting or revision of relative laws is discussed by legislative departments; after they decide to enact or revise a law, the legislative departments begin to prepare for it for a long time; then they draw up the draft; and finally, legislative departments deliberate and pass the law. Therefore, according to the legislative progress, the probability codes are identified in Table 1, according to the pollution severity, the hazards severity and the difficulty of recovery; the severity codes are also shown in Table 1.

Table 1 Risk Assessment Matrix of Environmental Legislation for Possible Laws

Probability Code / Severity Code	(D) Has not received much attention	(C) Hot dispute	(B) Preparatory work is proceeding	(A) Draft and schedule have been developed
Minor (IV) Not serious pollution and not explicit hazard	5 NEGLIGIBLE	5	4	3
Significant (III) Explicit hazard, but pollution is not serious	5	4 MINOR	3	2
Critical (II) Serious pollution, explicit hazard, lead to disease, but no permanent pollution and easy to recover	4	3 MODERATE	2 SERIOUS	1
Catastrophic (I) Serious pollution, explicit hazard, lead to disease, permanent pollution and difficult to recover	3	2	1	1 CRITICAL

$RAMEL_n$ levels are identified by a numerical scale of 1-5, with $RAMEL_n$-1 being the most critical and requiring immediate response, to $RAMEL_n$ -5, which is the least critical. $RAMEL_n$ is annotated by the $RAMEL_n$ Number, followed by the Frequency and Severity. Examples of $RAMEL_n$ annotations are 1(A)(I) for a $RAMEL_n$-1 that has catastrophic consequences and the immediate issuance of laws. The possible laws with $RAMEL_n$-1 will bring a critical risk for some industries.

2.3 Assessment Method of Legal Risk for Industries

To evaluate the legal risk for specific industries, it is necessary to analyze the environment impact of industries and the rules of environmental laws. Some environmental laws stipulate terms for pollutants, rules for industries, or rules for pollutants at first glance, but they may specifically stipulate rules for industries. The latter two types of laws affect 100% of the industries for which they stipulate rule; thus, they will absolutely bring risk for those industries; for the former type of laws, the legal risk of industries depends on the amount of pollutant emissions. The more pollutants an industry discharged, then the more seriously it polluted the environment and the more likely it is to be impacted seriously by the possible related laws. Therefore, the quantification of pollutants is necessary. Some pollutants are difficult to measure; for example, dioxins and dioxin-like compounds are a diverse range of chemical compounds. We need to analyze pollutant causes and use the amount of seasonable material to speculate the pollutant amount. To quantify the intensity of environmental effects for industries, we use the Pollution Code to identify it, as shown in Table 2. Similar to RAC, we can assess the risk level $RAMEL_{nm}$ of an environmental law n for a specific industry $m,$ as shown in Table 3. $RAMEL_{nm}$-i is the most critical risk brought about by law n to industry m and $RAMEL_{nm}$-vii is the least critical risk brought about by law n to industry m.

Table 2 Risk Assessment Matrix of Environmental Law n for Specific Industry m

Pollution Code / $RAMEL_n$ Number	(e) Rarely	(d) Less	(c) Moderate	(b) More	(a) Much or stipulate rule on this industry
5 Negligible	**vii GMOs[a]**	**vii**	**Vi**	**v**	**iv**
4 Minor	**vii**	**vi**	**V**	**iv**	iii
3 Moderate	**vi**	**v Offensive odor[b]**	**Iv**	iii	ii **Dioxins[c]**
2 Serious	**v**	**iv**	Iii	ii	i
1 Critical	**iv**	iii	Ii	i	i **PM 2.5,[d] Groundwater[e] and Soil[f]**

Note: (a) GMO_S is used to replace Act on safety of Genetically Modified Organisms (GMO_S) in this table.

(b) Offensive odor is used to replace the Law Concerning Protection of Groundwater in this table.

(c) Dioxins is used to replace the Law Concerning Special Measures against Dioxins in this table.

(d) $PM_{2.5}$ is used to replace the Regulation on Control of $PM_{2.5}$ (Particles Less Than 2.5 Micrometers in Diameter).

(e) Groundwater is used to replace the Law Concerning Protection of Groundwater in this table.

(f) Soil is used to replace the Soil Contamination Countermeasures Act in this table.

3. Case study

3.1 Identify Possible Laws

This research began in March 2012, and aimed at predicted the risk caused by the possible environmental legislation for a company in Smelting and Pressing of Ferrous Metals. As mentioned above, it is viable to find the possible environmental laws or policies through comparing the environmental laws systems among different countries. It is well known that Japanese environmental law system is complete. To find out the possible environmental laws, this study compared the environmental law system of China and Japan, and identified the possible laws to be enacted in the future, as shown in Table 3.

Table 3 Laws Issued or Revised Possibly in the Future in China

Topic	Name of law
Air and noise	Regulation on Control of Particles Less Than 2.5 Micrometers in Diameter ($PM_{2.5}$)
	Offensive Odor Control Law
Water and soil	Soil Contamination Countermeasures Act
	Law Concerning Protection of Groundwater
Chemicals	Law Concerning Special Measures against Dioxins
Nature and resources	Act on safety of Genetically Modified Organisms (GMOs)

Source: Ministry of Environmental Protection of China, Ministry of Environment of Japan, by March 2012.

3.2 Identify the $RAMEL_n$ Number for Every Possible Law

3.2.1 Regulation on $PM_{2.5}$

The regulation for controlling $PM_{2.5}$ was still not enacted in March 2012. $PM_{2.5}$ is believed to pose the largest health risks. Because of their small size, fine particles can lodge deeply within the lungs and even deeper within the blood and, thus, the health damage is lasting. Health studies have shown a significant association between exposure to $PM_{2.5}$ and premature mortality (Pope C. A. et al., 2002; Krewski D. et al., 2009; Yang C. et al., 2012). The important effects include aggravation of the respiratory system, cardiovascular disease, lung disease, decreased lung function, asthma attacks, damage of the immune system, nervous system disease, and damage to DNA (Guo X. B. & Wei H. Y., 2013). global information about $PM_{2.5}$ concentrations were offered by satellite observations(Aron van Donkelaar et al., 2010), from the map of the Global satellite-derived $PM_{2.5}$ averaged over 2001-2006, we can find the $PM_{2.5}$ concentration in northern, eastern and central China was as high as approximately 80 μg/m^3. The Word Health Organization (WHO) thinks that a concentration of $PM_{2.5}$ below 10 μg/m^3 is safe. Clearly, the $PM_{2.5}$ concentration of these areas of China is much higher than the safe standard. However, the concentration of $PM_{2.5}$ can be reduced by wind or rain. Therefore, people can reduce $PM_{2.5}$ rapidly by removing the pollutant sources or through artificial rainfall and other methods. From the above analysis, the Severity Code for the regulation of $PM_{2.5}$ should be II.

China has not enacted any laws to mandatorily monitor and disclose information about $PM_{2.5}$ as of March 2012. The revision of the Quality Standard of Environment Air in 2011 specified the monitoring of $PM_{2.5}$ will be developed step by step from 2013. The new Quality Standard of Environment Air will come into force by 2016. Consequently, the Probability Code is identified as A. The RAMEL of $PM_{2.5}$ is 1(A)(II).

3.2.2 Offensive Odor Control Law

To implement the Atmospheric Pollution Prevention and Control legislation, China issued the Emission Standard for Odor Pollutants GB14554-93 in 1993, in which eight odor substances and the measurement of odor pollutants were stipulated, while Japan stipulated 22 odor substances. In recent years, odor pollution is still serious, as odor complaints in Guangzhou and Tianjin were higher than all other types of complaints in the 2000s. With the development of society, the traditional pollutant industries still exist and, meanwhile, the boom of industrial parks creates more complex odor pollution. Moreover, the increasing municipal waste also causes odor pollution.

Experts appealed to revise the regulation of odor pollution (Lou Zhengang et al., 2009; Wang Gen & Wang Zongshuang, 2012). The damage of offensive odor is affected by the concentration of the odor substance and the duration of pollution. Odor mainly causes mental disgust. Complaints about odor will decline rapidly once the concentration declines with an increase in wind speed. In contrast, the countermeasures for odor are various and easy. Thus, the Severity Code of the offensive odor control law is III. The China Ministry of Environment Protection collected advice for revising the standard of odor in 2010. However, the standard has not been drafted for comment, so the Probability Code is B. The RAMEL of the Offensive Odor Control Law is 3(B)(III).

3.2.3 Soil Contamination Countermeasures Act

Since 1949, a great mass of forests have been cut down, domestic animals have been feed on grassland, vegetation has been destroyed, and hills have been reclaimed to be land for food. All these actions lead to water and soil erosion. The legislation about soil focused mainly on preventing water and soil erosion during this period. In recent years, the soil pollution in China has become severe. According to a survey, 20 million hm^2 of arable land (approximately 1/5 of total arable land) has been polluted by heavy metals and 13-16 million hm^2 of arable land has been polluted by organic compounds such as pesticides (Mei Zuming et al., 2010). According to a preliminary estimate, the pollution of grain by heavy metals is up to 1.2 million tons per year; heavy metals remain in the human body and cause diseases (Chen Demin & Xue Jingyuan, 2008). In contrast, agricultural mulch is another important soil pollutant. Unlike air and water pollution, soil pollution cannot recover by itself, as it is difficult for soil pollution to diffuse and dilute. The recovery of soil pollution is difficult and needs a long time (Mei Zuming et al., 2010). Thus, the Severity Code is I.

In the Suggestion about the Soil Pollution Prevention issued by the Environment Ministry in 2008, the law system of soil pollution control was expected to be established by 2015. Thus, the Probability Code is A. The RAMEL of the Soil Contamination Countermeasures Act is 1(A)(I).

3.2.4 Act on Groundwater Pollution

The Chinese groundwater level has been descending seriously and the groundwater has been polluted by heavy metals and toxic organics. According to one groundwater survey (Yin Yafang et al., 2012), 90% of the groundwater and 64% of cities have been polluted severely and groundwater withdrawal was increasing by 2.5 billion ton per year by 2009. Pollutants include organic pollutants and inorganic pollutants. Organic pollutants, such as phenol and other chemical substances, are carcinogenic; heavy metals tend to accumulate in the food chain and they can result in disease and death (Wang Qiong et al., 2012). Unlike surface water, recycling of groundwater requires a long time; the water in a deeper aquifer may need more than thousands of years to recycle. Therefore, the recovery of groundwater is difficult and needs a long time. The Severity Code is identified as I.

The Water Law (2002) and the Water Pollution Prevention Law of the People's Republic of China (2008) stipulated little regulatory responsibility and countermeasures about pollution prevention of groundwater. However, this situation has drawn the attention of China; the Environment Ministry issued the Decade Planning of Groundwater Pollution Control (2011-2020) in October 2011. This law planned to master the basic pollution situation of groundwater, launch a pilot project for recovery of groundwater and preliminarily prevent the continual deterioration of groundwater by 2015; it also planned to master completely the pollution situation, improve groundwater quality in places of concern and establish a prevention system for groundwater pollution by 2020. Although issuing the specific law on the prevention of groundwater pollution is not on schedule, the administrative order and work plan of the ministry will be enforced soon. Consequently, the Probability Code rank is A. The RAMEL of the Act on groundwater pollution is 1(A)(I).

3.2.5 Regulation of Dioxins

Dioxins and dioxin-like compounds, a diverse range of chemical compounds that are known to exhibit "dioxin-like" toxicity, are known as persistent organic pollutants. Experiments have shown that they affect a number of organs and systems. Once dioxins have entered the body, they will exist a long time because of their chemical stability and ability to be absorbed by fat tissue, where they are then stored in the body. In the environment, dioxins tend to accumulate in the food chain. The higher in the animal food chain one goes, the higher the concentration of dioxins. Short-term exposure by humans to high levels of dioxins may result in skin lesions, such as chloracne and patchy darkening of the skin, and alter liver function. Long-term exposure is linked to impairment of the immune system, the developing nervous system, the endocrine system and reproductive functions. Chronic exposure of animals to dioxins has resulted in several types of cancer (WHO, 2010). All groups of dioxin-like compounds are persistent in the environment (Claes Bernes, 1998). Neither soil microbes nor animals are able to break down effectively the PCDD/Fs with lateral chlorines. This causes very slow elimination. Dioxins are unwanted by-products of various industrial processes (e.g., smelting, chlorine bleaching of paper pulp and the manufacturing of some herbicides and pesticides) and combustion activities (e.g., burning household trash, forest fires, and waste incineration). The highest levels of these compounds are found in some soils, sediments and food, especially dairy products, meat, fish and shellfish. Very low levels are found in plants, water and air. In China, high levels of PCNs pollution were recorded in northern China (Yan Lina et al., 2013) and the Pearl River Delta atmosphere (Y. Wang et al., 2012), particularly in an e-waste site. Higher levels of PCNs were observed from megacities than from town and countryside sites (Yan Lina et al., 2013). However, the dioxin pollution of China was not so serious, as the dioxin concentration in 5 air samples out of a total of 93 samples in northern China is comparable or better than the highest limit (0.6 pg/m^3) (Yan Lina et al., 2013). Food pollution incidents of dioxins have not occurred in China. Therefore, the Severity Code is III.

In October 2010, the Ministry of Environmental Protection of the People's Republic of China and 8 other ministries were required to enforce the management of dioxins and issued instructions on dioxins prevention. However, the draft of dioxin measurement has not been written. Therefore, the Probability Code is B. Its RAMEL is 3(B)(III).

3.2.6 Act on Safety of Genetically Modified Organisms (GMOs)

The highest level law on GMOs is the Cabinet Order of Safety of Agricultural Genetically Modified Organism, issued in 2001. The Ministry of Agriculture, the Ministry of Health, the General Administration of Quality Supervision, the State Forestry Administration and the Ministry of Science and Technology enforced 8 ministerial ordinances. Scholars appealed to enact a specific and comprehensive act on the safety of GMOs (Meng Yu, 2013; Li Yiding & Chen Haiou, 2011). At present, the hazard of genetically modified organisms still is in dispute, so the Severity Code is IV. China tried to issue one act about the safety of GMOs. However, the issuance of this act faces many difficulties (Liu Xuxia et al., 2012), so it is impossible that the act on the safety of GMOs will come into effect in the short term. Therefore, the Probability Code is C. The RAMEL of the GMOs act is 5(C)(IV).

3.3 Quantify Pollution Code and Results

After evaluating the $RAMEL_n$ Number, the subsequent work rationally quantifies the Pollution Score. The instructions for dioxin prevention being issued by 9 China ministries noted that the Smelting and Pressing of Ferrous Metals industry needs to attach much attention; therefore, the Pollution Code of dioxin should be (a) for the Smelting and Pressing of Ferrous Metals industry. Smelting and Pressing of Ferrous Metals has almost no relationship to GMOs. The act on GMOs will not bring about a risk for the Smelting and Pressing of Ferrous Metals industry, as the Pollution Code was identified as (e). Smelting and Pressing of Ferrous Metals discharges $PM_{2.5}$ and odor, as well as pollutes groundwater and soil. The main sources of $PM_{2.5}$ are fuel burning, industry dust and automobile exhaust emissions (Li Delin et al., 2005). We identify the Pollution Code by the emission of industry waste gas (i.e., from fuel burning and the production process). Chemical fertilizer, pesticide and agricultural mulch are the main pollution sources of soil contamination in China, taking a large part of all polluted soil; heavy metals are the main pollution source of industrial pollution for soil, which comes into soil mainly through wastewater irrigation (Chen Demin et al., 2008). Because the chemical fertilizer, pesticide and agricultural mulch primarily are derived from agricultural behavior, this paper uses the amount of heavy metals discharged in industrial wastewater by industries to identify the Pollution Code. In China, the main pollutants of groundwater pollution coming from industries are petroleum and heavy metals. We use the emission amounts of heavy metals and petroleum from the industry to identify the Pollution Code. The statistical data for waste gas, Odor Index, heavy metals and petroleum for the Smelting and Pressing of Ferrous Metals industry can be collected from the Chinese Statistics Bureau. According to the above analysis, a risk assessment matrix is drawn in Table 2. We can find the $RAMEL$ of laws on $PM_{2.5}$, groundwater and soil contamination for Smelting and Pressing of Ferrous Metals is (i), which means the laws for $PM_{2.5}$, groundwater and soil contamination may bring about considerable risk for this industry. Conversely, the Smelting and Pressing of Ferrous Metals industry may face higher legal risk from laws on dioxins control, lower risk from laws on offensive odor and negligible legal risk from the law on GMOs. As of 2014, the law on $PM_{2.5}$ has been enacted, the Smelting and Pressing of Ferrous Metals industry of China is affected heavily by it, and this consult provided a satisfactory service for the early warning of legal risk by the Risk Assessment Matrix of Environmental Legislation. This proves that the Risk Assessment Matrix of Environmental Legislation delivers results. The risk of the law on water and soil contamination is not as obvious as the risk of $PM_{2.5}$, but the Smelting and Pressing of Ferrous Metals industry must take a measurement to avoid legal risk from both these laws.

4. Conclusions

Environmental protection benefits greatly from policies and laws. Increasing numbers of environmental laws and policies will be enacted to protect the environment in the future. The legal risk caused by environmental legislation will often affect enterprises in the future. The Risk Assessment Matrix of Environmental Legislation developed by this search has proven to deliver results, which can help enterprises predict legal risk in advance. Meanwhile, the environmental conservation industries may identify a new market opportunity by this method. This method is better fit to the enterprise that is located in the country where the new environmental laws are enacted rapidly or environmental laws become stricter.

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