Analyzing Green Finance Incentives: An Empirical Study of the Chinese Banking Sector

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Climate change is a major contemporary issue. In response, financial institutions offer green financing to fund low-carbon investments to those organizations who want to help mitigate this issue. Nevertheless, a lack of green credit remains the case. Therefore, to learn how to close this financing gap, this empirical study explores China's green finance through the lens of the Chinese banks who are the providers of such loans. Green finance has been growing rapidly in China since the Chinese government issued the Green Credit Policy. Previous studies have posited that banks have incentives in the form of credit risk management, new business opportunities, corporate reputation, and compliance risk to offer green loans. The objective of this thesis is to ascertain whether green loans provide better risk management and more business opportunities in practice.

As a part of the research, this thesis explores China's banking system and the development of, and current research into, China's Green Credit Policy. This study identifies a distinct characteristic of the Chinese banking system (i.e., heavy government involvement) and posits how the government may influence the development of green finance in China.

A dataset with a panel design was collected to perform the quantitative tests. The dataset contains financial and green finance data from 24 banks in China between 2009 and 2015. Panel regression techniques, such as Two-stage Least Square Regression Analysis (2sls) and Random-effect Panel Regression (RE), were used to examine whether the banks' green finance practices lead to better financial performance.

The results reveal that green loans grow at a faster rate than do other types of loans, and that allocating more green loans to the total loan portfolio reduces a bank's NPL ratio. The findings imply that green financing is a less risky investment with increasing demand. Through empirical evidence, this thesis contributes to the existing green finance literature and fills the literature gap on the Green Credit Policy in China through its study of the policy's implementation from the banks' perspective.

Keywords: Green Finance; Green Credit Policy; Non-performing loan; Environmental risk management; Chinese banking sector

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Chapter 1
Introduction

Greening the economy involves improving the natural environment and solving climate change issues. One of the key issues in this context is related to the financing of climate change mitigation and how to close the financing gap to fund low-carbon investments (OECD, 2017). In response to this issue, through an empirical study of green finance in China, this thesis aims to provide research into the way in which more green credit can be approved.

In 2007, China overtook the United States as the world's biggest producer of carbon dioxide, producing 30% of the global carbon dioxide emissions in 2014 (Vidal & Adam, 2007; Boden, Marland, & Andres, 2017). To control carbon emission, the Chinese government issued the Green Credit Policy in 2007, requiring banks to offer green credit toward environmental protection, emission reduction, and energy conservation projects, as well as to restrain loans to high-pollution, high-emission and overcapacity industries. Since then, sustainable and environment-friendly projects have been increasing rapidly.

Chapter 1 provides an introduction of green finance, its current problem, research question, and research methodology of the thesis.

1.1 Background of Green Finance

Since the Industrial Revolution, the increase in carbon-intensive activities is commonly seen as the main cause of rising global temperature. Banks and other lending financial institutions produce few hazardous chemicals or release toxic pollutants into the environment themselves. However, it has been increasingly recognized that banks are inextricably linked to commercial activity that harms the natural environment through their lending practices to businesses (Sarokin & Schulkin, 1991; Smith, 1994; Gray & Bebbington, 2001). In other words, banks facilitate and enable industrial activity environmental damage when they support projects that do not meet environmental standards (Thompson & Cowton, 2004).

1.1.1 Development of Green Finance

Since the early 1990s, financial institutions, governmental organizations, and NGOs have recognized the importance of sustainable development in solving the ever-growing environmental challenges. In May 1992, a small group of commercial banks, including Deutsche Bank, HSBC Holdings, Royal Bank of Canada, joined forces with the United Nations Environment Programme to issue the Statement by Banks on the Environment and Sustainable Development and to form the Banking Initiative (UNEP, 1992). The UNEP Financial Initiative publicly recognizes that sustainable development—development that meets the needs of the present without compromising the ability of future generations to meet their own needs—must rank amongst the highest priorities of banks; and that banks need to be important contributors to sustainable development. Since then, the financial sector has striven to contribute to sustainable development.

In 2003, the Equator Principles (EP) was launched to ensure that projects financed by banks be socially responsible and environmentally friendly. The EP serves as a baseline that calls on banks to consider environmental and social risks in their lending decisions when supporting new projects with a capital cost over USD 10 million, including advisory services, project finance, corporate loans, and bridge loans; and to decline projects that do not meet environmental and social standards (Equator Principles Association, 2013). The EP provides a guideline for banks in terms of responsive banking and brings responsibility out of the realm of multilateral development banks, such as the World Bank. Currently, 91 financial institutions across 37 countries have adopted the Equator Principles, representing over 70 percent of international Project Finance debt in emerging markets. The EP has the potential to influence a substantial number of projects given the number of participants, though it has received much criticism questioning its ability to deliver what it has pledged to do (i.e., enable more sustainable projects on the ground) (O'Sullivan & O'Dwyer 2009; Macve & Chen 2010).

Some other remarkable green finance principles and projects include UN Global Compact (UNGC) and UN Principles for Responsible Investment. The UNGC contains ten voluntary principles in the areas of human rights, labour, environment, and anti-corruption. It asks businesses to take a precautionary approach to environmental challenges, promote environmental responsibility, and encourage the development of environment-friendly technologies (UNGC, n.d.). UN Principles for Responsible Investment include six voluntary and aspirational investment principles that introduce possible actions for incorporating ESG issues into investment practice. The Principles have 1,750

signatories from over 50 countries, representing approximately US$70 trillion investments (UNPRI, n.d.).

Each of these initiatives has been signed by a group of banks. The initiatives help banks in increasing reputation, public recognition, and investors' favours, but may also impose challenges on stricter standards and more transparency (Bal, Faure, & Liu, 2014).

Green finance can also be used as a strategy by governments to help reduce ever-growing environmental problems. Referred as to the World's Factory, China has experienced significant economic growth for several decades, benefitting since 1978 from the economic reforms. Tags, labels and stickers inscribed with "Made in China" can be seen everywhere in the world. Most companies in attempting to catch this fast train have paid less attention to society and the environment. Many of the world's environmental problems, including water, land, and air pollution have been the tragic and very serious result of China's economic success. As a solution to reducing such increasing environmental issues, the Chinese government has put a policy in place - the Green Credit Policy - to ensure that the economy grow in a healthy and sustainable manner.

1.1.2 Green Finance in China

In 2007, the State Environmental Protection Administration (SEPA), the People's Bank of China (PBOC), and the China Banking Regulatory Commission (CBRC) published a joint policy – the Opinion on Implementing Environmental Regulations and Managing Credit Risks, which requires banks to allocate more resources towards encouraged industries; to constrain resources for restricted industries; and to withdraw support from prohibited industries. This policy is commonly known as 'the Green Credit Policy'. In response to this policy, banks have begun to offer green credit to environmental protection, emission reduction, and energy conservation projects, as well as limit loans to high-pollution, high-emission, and overcapacity (known as "two-high and one-over") industries.

Subsequently, some additional guidelines were put in place to support the development of the Green Credit Policy. In 2009, the China Banking Association issued Guidelines on corporate social responsibility, asking banks to take on environmental responsibility in supporting national industrial policies and environmental policies. The CBRC issued a formal document entitled the Green Credit Guideline in 2012. The guideline was formulated for the purpose of "encouraging banking institutions to, by focusing on green credit, actively adjust credit structures, effectively fend off environmental

and social risks, better serve the real economy, and boost the transformation of an economic growth mode and adjustment of economic structures" (CRBC, 2012). In 2014, the Chinese Banking Association along with 29 banks initiated a Green Finance Committee to organize activities such as developing a green bonds standard, facilitating environmental stress tests for the banking sector, and organizing discussions on greening China's overseas investment. In December 2015 and January 2016, the People's Bank of China (PBOC) and the National Development and Reform Commission (NDRC) released their Green Bond Guidelines, respectively, making China the first country in the world to publish official rules for the issuance of green bonds.

Since the beginning of the Green Credit Policy in 2007, green credit has been growing steadily in China. By the end of 2015, China's financial institutions provided a total of 8.08 trillion RMB (approximately 1.24 trillion USD) in green credit. 21 major banks and financial institutions contributed 7.01 trillion RMB out of the total green credit, amounting to 9% of their total outstanding loan. During a press release in September 2016, the China Banking Regulatory Commission (2016) claimed that the balance of energy-saving and environment protection projects and services of the 21 major banks' non-performing loans was 22.625 billion, or 0.41% in terms of NPL ratio, 1.35 percentage points lower than the NPL ratio of total loans. The CBRC (2016) also claimed that the overall quality of energy-saving and environment protection projects and services was excellent, and that these projects and services are saving 435 million tons of CO2 per year.

Despite the many challenges that remain in the development of green finance, the Green Credit Policy in China has enabled many environment-friendly projects that might well have been previously denied by lenders.

1.2 The Problem

Green finance is a bridge which connects environmental industries to financial institutions (Salazar, 1998). While the financial sector has taken much voluntary action, there remains a lack of loans for environment-friendly projects, such as renewable energy plants, waste treatment infrastructures, and green vehicles. Both society and the academic world are questioning green finance on its ability to deliver what it has pledged to do (i.e., enable more sustainable projects on the ground) (O'Sullivan & O'Dwyer 2009; Macve & Chen 2010). The research of this thesis takes on the question from here; that is, how to enable more green credit through the empirical study of green finance in China.

1.3 Significance of the Problem

The significance of the problem can be explained in three parts: 1) the lack of empirical studies in green finance; 2) the significance of China's Green Credit Policy; and 3) researching green finance from the banks' perspective. This study is expected to fill the knowledge gap of the problem.

Lack of empirical studies in green finance

Currently, there are many empirical studies regarding sustainability performance and financial performance. Many academic surveys have identified a positive correlation between environmental performance and financial performance from the corporate perspective (Dowell et al., 2000; Klassen & McLaughlin, 1996). Nakao et al. (2007) also found that there is a positive two-way interaction between environmental performance and financial performance in Japanese corporations, though neither studies from Margolis and Walsh (2001) or Wagner et al., (2001) show a clear positive correlation between sustainability performance and financial performance. Regardless of the results, these "Western" approaches often attempt to uncover whether better sustainability practices lead to better financial performance in returns, but these studies do not target the banking sector specifically.

Even in practice, only a few banks have used quantitative indicators to integrate environmental risks into their credit risk management (Weber, 2012). In a survey conducted by Weber, Fenchel, and Scholz (2008), only 10 out of the 42 large banks in Europe have tried to assess environmental risks quantitatively for costing analysis, mainly due to the lack of suitable instruments and awareness of environmental risks in their portfolio. A similar study found only six banks that have integrated environmental risk out of a total of 114 banks (Furrer, Hamprecht, & Hoffmann, 2012). As a result, empirical studies in green finance can determine whether the correlation between sustainability performance and financial performance also exist in the banking sector.

Significance of China's Green Credit Policy

China, to date, is the only country in the world to have organized green finance activities and standardized mandatory reporting on green loans for its banks. The Green Credit Policy is really the driving force of green finance in China. With a balance of 8.08 trillion RMB and a good number of

participants, the Green Credit Policy in China provides an excellent, practical example of green finance for an empirical study of green finance. In addition, another great characteristic of the Green Credit Policy is its standardization, as major Chinese banks have used the same guideline in providing green credit. In 2013, the CBRC identified the measuring standard for 12 types of environment-friendly projects and services, as well as the evaluation system of the Green Credit Policy, making the banks' results highly comparable. Any lesson learned from the implementation of China's Green Credit Policy could be used as a valuable reference for other regulators and banks.

In comparison, Western banks take different approaches to green finance. Western banks conduct green finance voluntarily, and the supervisory entities do not ask for mandatory participation in green finance. Unlike the Green Credit Policy in China, green finance lacks standardizations and developing mechanisms. For instance, green finance does not have a common definition among Western banks. The term is too broad and mixed with other terms (discussed in section 2.1). Principles such as UNEP, EP, and UNGC focus on developing the framework for green finance, but fail to promote the development of green finance.

In practice, Western banks' green finance activities are mostly driven by the decision-makers' awareness of sustainable development and corporate social responsibility, whereas Chinese banks participate in green finance primarily because of regulatory requirements. Regardless of the motivation of the decision-makers, green finance in China has grown from almost none to 8.08 trillion RMB in 2015. This rapid growth suggests that there must be some incentives that are motivating the banks to offer more green credit.

Studying green finance from the banks' perspective

To date there are only a limited number of studies on green finance in China, with most of the research being attentive to the Green Credit Policy from the policymaker's perspective. Moreover, the majority of these studies provide only a conceptual framework regarding the environmental risk management of commercial banks in managing and improving environmental risk (Cai, 2015; Hu & Cao, 2011; Wei, 2010). A quantitative study from Zhao (2015) tackled the Green Credit Policy from the macro level only (i.e. effect on the reduction of greenhouse gas emission). Although the Green Credit Policy mandates banks to provide green credit, the final executions are done by the banks themselves. Banks determine whether they are going to provide green credit to borrowers and how

much green credit they will allocate from their total loan based on their internal strategy. Therefore, the best way to tackle the problem is to examine green finance from the banks' perspective. Only a few scholars have attempted to utilize "Western" approaches in analyzing the financial benefit of the Green Credit Policy in the Chinese banking sector. A recent study from Weber (2016) suggests that there is a correlation between financial performance indicators and sustainability performance in Chinese banks. The study by Weber (2016) recognizes the financial benefit from sustainability activities, but it does not confirm that there are financial incentives to be gained from green credit.

Overall, this research thesis tries to fill the knowledge gap by conducting an empirical study of the financial incentives from green credit in China. The following section further breaks down the research questions and the objectives of the thesis.

1.4 Research Questions and Objectives

The research attempts to identify and examine the main incentives that encourage banks to provide more green credit.

More specifically, the two sub-questions of this research are as follows:

1. Are banks able to get new business opportunities with the development of green credit?
2. How does green credit influence the risk management of the banks?

The general objective of this research is to study the influence of green credit on financial performance from the banks' perspective through the Green Credit Policy in China.

The broad goal is to be accomplished by four specific objectives:

1. Determining the underlying incentives of implementing green finance from the financing providers' perspective;
2. Measuring green credit activities of the major banks in China;
3. Investigating whether banks' incorporation of environmental factors create a financial benefit for them;

4. Evaluating the strategic impact of green credit to financial institutions.

1.5 Research Methodology

This research uses the study from Weber et al. (2015) discussed in section 2.3 as a theoretical framework. Weber (2015) notes that banks integrate sustainable criteria into their lending business because of risk management (Weber, 2012) and of business opportunities in green-lending (Aizawa & Yang, 2010). To test whether these are the incentives for which banks conduct green finance, this study uses random-effects panel regression, Two-stage Least Square (2SLS) regression analysis, and corresponding tests to test the following hypotheses.

Three hypotheses to be tested are:

Hypothesis 1: Green credit is an expanding product or service that grows at a faster rate than total loans.

Hypothesis 2: Allocating large shares of green credit to the loan portfolio reduces credit risk (i.e., NPL ratio of the bank).

Hypothesis 3: Allocating large shares of loans to high-pollution, high-emission, and overcapacity industries to the loan portfolio increases credit risk (i.e., NPL ratio of the bank).

1.6 Structure of the Thesis

The thesis contains four main parts, followed by a conclusion:

1) **Literature Review**
   This chapter reviews the literature on green finance and introduces the conceptual framework base on the literature. Some key studies are introduced to set up the stage for the statistical model.
2) **Current Development of Green Credit in China**

This chapter starts with an introduction of the banking system in China and the Green Credit policy followed by an analysis of the current development of green finance in China. Literature regarding the Green Credit Policy is also reviewed in this chapter.

3) **Research Methodologies and Models**

This chapter introduces the data collection process and design of the quantitative models. Quantitative methodologies and the corresponding tests used in this paper are explained.

4) **Results and Findings**

This chapter presents the test results of the empirical study on green finance in China.

Chapter 2
Literature Review

The theoretical background of the statistical study is explained in this chapter. This chapter defines the boundary of the research and clarifies the terms used in this research. The literature regarding green finance is reviewed and applied to this empirical study. Furthermore, the literature that helps build the quantitative models is reviewed. This chapter concludes with a detailed explanation of the conceptual framework.

2.1 Defining Green Finance, Sustainable Banking, and Green Credit

Today, the term 'green finance' appears in many studies. However, there is no universal definition of green finance and its related terms. This section reviews the definition of 'Green Finance', 'Sustainable Banking', and 'Green Credit' from the literature, summarizes the commonly accepted elements in these definitions, and then clarifies the definition of these terms used in this research.

Green finance

The definition of green finance varies among the different studies. Some literature even interchanges the term green finance with similar terms. Meanwhile, a few core elements have been commonly accepted.

Höhne et al. (2012) suggest that "green finance is a broad term that can refer to financial investments flowing into sustainable development projects and initiatives, environmental products, and policies that encourage the development of a more sustainable economy". These financial investments may be related to greenhouse gas emissions (GHGs) reduction, industrial pollution control, or biodiversity protection.

Similarly, PricewaterhouseCoopers Consultants (PWC) (2013) define green finance as "financial products and services, under the consideration of environmental factors throughout the lending decision making, ex-post monitoring and risk management processes, provided to promote

environmentally responsible investments and stimulate low-carbon technologies, projects, industries and businesses".

Lindenberg (2014) suggests that green finance comprises: 1) financing of green investments in environmental goods and services and prevention of damages to the environment and to the climate; 2) financing of public green policies that encourage the implementation of environmental projects and initiatives; and 3) green financial system that deals especially with green investments.

In general, most studies agree that green finance is a kind of financial product or service for sustainable development projects and environmentally responsible investments. It is indeed a broad term that includes all forms of investment or lending related to sustainable development projects. The real challenge is to set boundaries in green investments and projects (i.e., what is considered as sustainable development projects or environmentally responsible investments, and what is not).

Sustainable banking

In general, sustainable banking is the integration of sustainable development into the banking sector. The idea of sustainable development was first introduced by Brundtland in 1987. It is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable banking is referred to as the strategy for achieving sustainable development of financial institutions.

Jeucken (2001) identified four phases of action that banks take for sustainability. Sequentially, the phases are defensive banking, preventative banking, offensive banking, and sustainable banking (Figure 2.1).

Figure 2.1: Jeucken's Typology of Banking and Sustainable Development

In the defensive phase, the bank stays inactive or even resists emerging environmental regulations, as its interests may be damaged directly or indirectly through its clients. The cost for environmental management can be avoided in this phase.

In the preventative phase, the bank merely integrates environmental risk management into its daily business, due to the potential for cost saving, driving force from governments and NGOs, and reputational risks.

In the offensive phase, the bank recognizes environmental concerns as a competitive opportunity in the market. Banks will develop environment-related products or services that may address those

concerns, and attempt to market them to their clients. These products and services are designed to help reach a win-win solution; however, since environmental costs are not completely integrated into the price system, this could hardly be the case.

The sustainable phase is the ideal stage of the bank. Jeucken describes this stage as, "the bank does not look for the highest financial rate of return, but for the highest sustainable rate of return, while being profitable in the long run." Meanwhile, it contradicts with the goal of a business – optimizing its profits. This strategy will cost the bank profit in the short run, meaning that it will act against the interest of the shareholders. Jeucken believes that it can work only if all banks act on a similar basis. To achieve the sustainable phase, a bank should implement the idea of sustainability into its core values and long-term strategies. Therefore, instead of looking at green credit as a product or service, it should be integrated within the business.

Sustainable banking is really about a bank's sustainable development strategy, though the actual strategy may vary among different banks. Despite the fact that some of these ideas may be obsolete by today's standards, the typology of banking and sustainable development still provides an effective theoretical framework for those financial institutions who are seeking long-term sustainable growth. The Green Credit Policy in China, for example, is designed to guide Chinese banks toward the sustainable phase.

Green Credit

Green Credit is frequently used in China. It refers to the actual green finance product and service offered by banks in China (i.e., loans related to environmental protection, emission reduction, and energy conservation projects). If green finance is considered as a solution to environmental problems and resource management (Wang, 2013; Li & Xia, 2014), then green credit is the actual bridge which connects the environmental industries with the financial institutions (Salazar, 1998). In some cases, the term is used interchangeably with the Green Credit Policy – a policy which encourages the banks to provide preferred/lower interest rates to environmental friend companies and cut down loans to polluting businesses. For the purposes of this thesis, the policy is always called the 'Green Credit Policy'; and 'green credit' is used exclusively for from Chinese banks related to environmental protection, emission reduction, and energy conservation projects.

Definition of terms used in this thesis

The boundary of this research is limited to these three areas. In this thesis, 'green finance' is used as a broad term to represent all forms of investment or lending related to sustainable development projects and environmentally responsible investments. This includes not only investments and lending that flow into sustainable development projects, but also withdrawing from projects with high pollution rates. The term 'sustainable banking' refers to the sustainable development strategy employed by decision-makers. 'Sustainable banking' emphasizes on the strategy – long-term and sustainable growth, while 'green finance' is used to describe the actual activities. 'Green credit' refers solely to loans for environmental protection, emission reduction, and energy-saving projects in China. In addition, loans to "two-high and one-over" sectors refer to such loans to high-pollution, high-emission, and overcapacity industries. The actual policy in China is termed the 'Green Credit Policy'.

2.2 Green Finance from the Banks' Perspective

In practice, decision-makers who acknowledge the importance of sustainable development are likely to engage in green finance activities. As suggested by Weber et al. (2015), banks apply sustainability criteria to their lending business for three reasons: 1) to manage their environmental risks (Weber, 2012); 2) to have business opportunities from green-lending (Aizawa & Yang, 2010); and 3) to improve their own reputation (Nandy & Lodh, 2012). In addition, banks may also conduct green finance because of 4) compliance risk. The study from Weber et al. (2015) sets up a conceptual framework for the empirical studies (introduced in Section 2.5). These possible motivations are examined to determine whether they create financial incentives for banks to participate in green financing.

2.2.1 Managing Environmental Risk

Credit risk management is the key to ensuring the business success of a bank. Those lenders that can evaluate risks will be more likely to succeed in the banking industry (Hempel et al., 1990). Banks develop environmental and sustainability credit risk assessment policies and procedures (Evangelinos & Nikolaou, 2009), and use them as a mechanism to manage credit risks resulting from environmental, social, and sustainability impacts (Coulson & Monks, 1999; Weber & Banks, 2012).

Furthermore, some lenders integrate environmental risk management throughout the phases of their credit risk management such as rating, costing, pricing, monitoring, and work-out (Weber, Fenchel, & Scholz, 2008).

Risk management

The goal of every business is to make a profit and so, by extension, the goal of every strategy should be to move that business towards optimal profitability. Banks take deposits and channel the capital into lending activities. A commercial bank earns revenue from interest on outstanding loans and service charges, pays variable costs that include the cost of holding capital and the loss from bad debt as well as the various fixed costs associated with the provision of banking services. The simplified profit model of a bank can be expressed as a function of:

Profit = Interest Income + Service Charges – Bad Debt – Capital Holding Costs – Fixed Costs

While capital cost is largely influenced by the macroeconomic environment and fixed costs being stable, the ability to minimize bad debt is what can be managed to increase the profit of a bank. Typically, this requires the lenders to keep track of a borrower's capital stock, earnings, liquidity, etc. Those factors are often recognized as counterparty credit risks which influence the borrower's ability to repay the loan (i.e. the default risk of a borrower) (Saunders, 1999; Caouette et al., 1998; Fitch, 1997). Recently, environmental risk is recognized as one of the most important factors that can influence credit risk.

Environmental risk

Sustainability performance is suggested to have a positive influence on future financial earnings (Aerts, Cormier, & Magnan, 2008; Weber, 2016). Some studies find a positive correlation between sustainability performance and borrowers' credit risk (Bauer & Hann 2010; Goss & Roberts 2011; Weber, 2016). In general, banks are not interested in playing the role of environmental regulators (Coulson & Monks, 1999), or environmental policemen (Thompson, 1998). In practice, banks are more aware of environmental consequences of their lending decisions, as the environment in return can pose serious risks to a bank's business. Per Thompson (1998), there are three types of

environmental risks resulting from a bank's lending decisions – direct risk, indirect risk, and reputational risk.

Direct risk occurs when a bank takes over possession of the land that was being used as collateral for a loan. When pollution has contaminated the land, the lender who has taken it as a security will find that the land has decreased in value. With increased legislation, the lender will also find himself being treated as the responsible party, hence resulting fin his being held liable for remediation costs (Dawson, 1996). These remediation costs can be substantial, even to the point of exceeding the original value of the loan (Case, 1996).

Indirect risk emerges when environmental cost is incurred, thus impairing a borrower's ability to repay the loan. A business may be exposed to many costs due to causing damage to the environment, such as the cost of cleaning up contaminated sites, the cost of complying with increased environmental legislation, and losing customers due to its bad reputation. Eventually, banks can be affected as well when the business is not able to pay back its loans. In such a series of events, this type of risk could end up with a bank losing its loans.

Lastly is reputational risk. A bank's lending to environmentally irresponsible companies might infuse reputational risk when receiving negative comments from the public, such as customers, media, pressure groups, and governmental bodies (Buxton, 1997). Reputational risk is considered different from the other two risks by Thompson (1998), as it might hurt banks over a long period of time rather than from sudden losses. Banks may lose their ability to attract new customers, lose interest from investors, and eventually suffer financial loss. Thus, it is more difficult to gauge its financial consequences.

These three types of risk may co-exist to create a serious burden on a bank. As such, it gives banks plenty of reason to consider environmental issues in their lending decisions. Fear of losing their loans (indirect risk) and getting a bad reputation (reputational risk) as well as being held responsible for the clean-up of the contaminated site(s) (direct risk) are the main reason why banks take environmental information into consideration before making the final lending decision. Thompson and Cowton (2004) stated that "the consideration of environmental issues in bank lending operations is prompted mainly by a concern to manage risk rather than to exploit lending opportunities or as a means of fulfilling their social responsibilities". They argued that "banks are not so much interested in the impact of bank lending upon the environment as in the impact of the environment (as filtered by regulators, etc.) upon bank lending."

2.2.2 Business Opportunities

A bank's fundamental goal is to achieve optimal profits. Green credit is a service that targets businesses in the environment-friendly sector. Many financial services and products have been developed by a rapidly evolving banking sector to serve the needs of specific groups of customers. Banks are now seeing green entrepreneurs as a target group to whom they can expand their market. And, with incentives from the government, businesses are seeing the case for the environment-friendly sector (Aizawa & Yang, 2010; Wei, 2009). Aizawa and Yang (2010) mentioned that "banks in developed and developing markets are becoming increasingly interested in financing energy-efficiency and renewable-energy projects, and to become involved in carbon financing, in a concerted effort to address climate change and make profits, a win-win scenario".

Management and marketing theories may explain how and why banks adopt sustainability. The first-mover advantage (FMA) means a financial benefit for the business that first adopts a strategy. This is also valid for the financial sector (Weber, 2014b).

Meanwhile, the question regarding the priority between new opportunities and risk controls has been controversial. Fulton (2008) believes that environmental problems come behind profits – the fundamental interests of a bank, so the incentives and subsidies from the government are very important in the development of green credit. However, Thompson (1998) argues that although considering environmental issues in the business world offers banks opportunities (green market) for gaining financial benefits, banks focus more on risks than possible profits. Businesses often try to weigh the trade-off between financial return and sustainability (Delmas et al., 2010; Hahn et al., 2010; Keele & DeHart, 2011) rather than seeing a win–win situation in both (Schaltegger & Wagner, 2011).

2.2.3 Improving Reputation

Banks also conduct green finance in hopes of increasing their reputation. As mentioned before, banks try to improve reputation through sustainable banking with the goal of reducing reputational risk (Thompson, 1998). Some scholars suggest that reputational risk could affect the financial performance of a bank (Scholtens et al., 2008). Much reputational risk can come from the stakeholders. Stakeholders are becoming more aware of the need for sustainable development and often put pressure on the organization. For example, due to reputational risk, banks started to investigate their financed emissions after NGOs, such as Banktrack and Rainforest Action Network,

started to track emissions caused by the banks' loans to their clients. However, banks are often criticized for being reactive rather than proactive regarding sustainable development (Weber, 2014b).

In addition, Simpson and Kohers (2002) found a positive correlation between corporate social responsibility and financial performance in the financial sector. Similarly, Anderson and Sullivan (1993) found that customer satisfaction could generate customer loyalty, which effectively helps the banks to expand their business in a cost beneficial way. Weber (2016) also found a causal correlation between CSR performance and financial performance in Chinese banks. Banks also attempt to increase their reputation by reducing the direct environmental impact from their daily operations (Babiak & Trendafilova, 2011), though the direct environmental impact is relatively small for service sectors like the banking industry.

Corporation reputation is recognized as a company's intangible asset. This research will not attempt to analyze the effect of reputation due to toughness and lack of inaccuracy in quantifying the value of reputation.

2.2.4 Compliance risk

The Basel Committee defines compliance risk as "the risk of legal or regulatory sanctions, material financial loss, or loss to reputation a bank may suffer as a result of its failure to comply with laws, regulations, rules, related self-regulatory organization standards, and codes of conduct applicable to its banking activities" (Basel Committee, 2005). Basel III, for example, has increased the core tier one capital ratio from 2% to 4.5%, and requires banks to further increase the ratio to 7% by 2019. Banks whose core tier one capital ratio falls within the buffer zone (4.5% to 7%) will face restrictions on paying dividends and discretionary bonuses. As a result, being compliant with environmental policies has also become very important to financial institutions. For instance, Chinese banks are increasing their green credit to be compliant with the Green Credit Policy.

Managing compliance risk is about dealing with future regulations. Non-compliance usually does not cause immediate losses. Most regulations, laws, and standards provide a transition period for corporations. Nevertheless, if no action is taken ahead of time, transitions are much harder to achieve within a limited amount of time. For this reason, organizations may act ahead of time if they see new regulations forthcoming.

Moreover, corporate compliance risk can also affect financial institutions indirectly. Businesses that have failed to comply with environmental regulations may suffer financial loss, thus negatively influencing the ability to repay their loans. Therefore, financial institutions should apply sustainability criteria in their lending decisions.

Compliance risk is not studied in this research as the effect of this type of risk is mostly reflected in future financial performances.

To summarize, it is not hard to find that the reason for conducting green finance is interconnected. Implementing green finance helps banks to better manage their environmental risk and compliance risk, thus improving their reputation and eventually helping to expand their business.

2.3 Application of green finance literature to China

Theoretically, the literature from section 2.2 can also be applicable to China. Chinese banks should conduct green finance activities for the following four reasons.

First, Chinese banks, in providing more green credit, are being compliant with the Green Credit Policy. Currently, the Green Credit Policy does not set a quota on the amount of green credit a bank should supply, but there is no telling whether the China Banking Regulatory Commission (CBRC) will set stricter standards in the future. The CBRC has been asking banks to report their key performance indicators (KPI) on green credit since 2014. This might indicate that the CBRC will require that banks meet certain performance standards. Forward thinking decision-makers would be wise to make early moves towards managing potential risks in the future.

Nevertheless, compliance risk is not the only reason why Chinese banks should engage in green finance activities. In China, there is a large demand for curbing pollution and energy consumption (Aizawa & Yang, 2010), and building corresponding infrastructures would require a significant amount of funding. Many banks are seeing these business opportunities and trying to grow their business by financing these developments. Taking advantage of these opportunities can eventually enhance the financial performance of the banks through the increase in interest income.

With the Chinese central government striving for sustainable economic growth, high-pollution, high-emission, and overcapacity (“two-high and one-over”) projects are exposed to environmental

risks. Meanwhile, environment-friendly projects have very limited exposure to environmental risks. As a result, Chinese banks are shifting their loans from “two-high and one-over” industries to environment-friendly industries to reduce the environmental risk in their loan portfolios.

Finally, many Chinese banks are attempting to grow their business globally. As a result, they may find that corporation reputation is very important in becoming successful worldwide. Customers pay close attention to a business’ reputation when dealing with it for the first time.

Overall, theories from previous studies have advanced the possible incentives that encourage banks to provide more green credit and fewer loans to “two-high and one-over” industries. These possible incentives are justified by the quantitative models.

2.4 Non-Performing Loan (NPL) and NPL Ratio

To help build the quantitative models, the literature regarding credit risk is reviewed here. Credit risk is the risk of default on a debt due to the borrower’s non-payment of the principal or interest on the loan. There are many theoretical models of credit risk measurement, but these models often only focus on the measuring or estimating. For the nature of this study, an explanatory model is used.

Non-performing loan (NPL) and NPL ratio, on the other hand, are good indicators of how much risk a bank takes at a specific moment. A non-performing loan refers to a loan in which the debtor fails to make scheduled payments for at least 90 days. An NPL is either in default or close to being in default of repayment. Typically, once a loan is considered non-performing, the odds that it will be repaid in full are substantially low. The NPL ratio is the amount of non-performing loans over total loans, expressed as a percentage. It is a good indicator of how well a bank manages its default risk.

Many scholars have tried to investigate the determinants of NPLs, and some have found that in fact both macroeconomic and bank-specific determinants can affect the NPL ratio of a bank (Ghosh, 2015; Klein, 2013).

Macroeconomic factors (systematic risks)

In fact, most empirical studies examine NPLs from a macroeconomic perspective, despite the fact that systemic credit risk represents about half of the total bank credit risk (Li & Zinna, 2014). NPLs of banks in Central, Eastern, and South-Eastern Europe (CESEE) were found to respond to

macroeconomic conditions, such as GDP growth, unemployment, and inflation in the period of 1998–2011 (Klein, 2013). Also from banks in CESEE, Jakubik and Reininger (2013) confirmed that domestic economic activities, stock indices, and currency exchanges can have a sizeable impact on NPL ratio. NPLs are highly sensitive to real interest rates and unemployment rates according to the Nordic banking system (Berge & Boye, 2007). Quagliarello (2007) found that NPLs of Italian banks were affected by the business cycle over the period of 1985 to 2002.

As all Chinese banks operate under a similar macroeconomic environment (except for some local influences), this study does not implement macroeconomic factors.

Bank-specific factors (unsystematic risks)

Most of the literature on bank-specific determinants follow in the footsteps of Berger and DeYoung (1997). This strand of literature examines the distinctive features and the policy choices of each bank to find the factors that influence NPLs of banks. These factors are generally endogenous since they are often related to the management quality of a bank.

In their seminal paper, Berger and DeYoung (1997) drew attention to the links among problem loans, cost efficiency, and financial capital. They investigated four hypotheses from a sample of US commercial banks between 1985 to 1994:

'Bad luck' hypothesis: External events cause an increasing number of NPLs. External events, such as a local plant closing, can create problem loans for banks. Therefore, banks are supposed to make additional managerial effort and expense to deal with problem loans. This hypothesis was supported by the data – increases in NPLs are typically followed by decreases in cost efficiency, suggesting that banks are forced to increase spending on monitoring and selling off of these loans.

'Bad management' hypothesis: NPL is negatively associated with cost efficiency. The justification is that subpar managers have poor skills in credit scoring, appraisal of collaterals pledged against the loans, and monitoring covenants. Moreover, managers in these banks do not keep their operating expenses under control.

'Skimping' hypothesis: Increases in measured cost efficiency generally precede increases in non-performing loans. Under this hypothesis, there is a trade-off between short-term operating costs and future loan performances. Allocating more resources to screening loan applicants, appraising pledged

collateral, and monitoring loans after issuance ensure better loan performance in the future, but impose more costs in the short run. Conversely, reducing effort to monitoring loans saves operating costs in the short run, but may increase the risk of running into loan performance problems.

'Moral hazard' hypothesis: Banks with low capital ratios generally have more non-performing loans. Under this hypothesis, bank managers with incentive contracts attempt to increase performance by taking riskier loans. It is a classic problem when one party gets involved in a risky event knowing that the other party will incur the cost.

It is worth noting that Berger and De Young (1997) employed Granger-causality analysis to all four hypotheses, suggesting there are intertemporal relationships among problem loans, cost efficiency, and financial capital. They also suggest that each of these results has a relatively small effect on banks, but may have a substantial effect when all four hypotheses affecting the same bank at the same time.

Louzis et al. (2012) extended Berger and DeYoung's study by incorporating several additional hypotheses in their study of NPLs in the Greek banking sector. Their study confirmed 'bad management' (as well as 'bad management II'), but rejected 'skimping' and 'moral hazard'. In addition, they also found that: 1) increase in sovereign debt causes NPLs to rise; 2) large banks take excessive risks under the presumption of 'too-big-to-fail'; therefore, larger banks have more NPLs; and, 3) performance outcome is negatively related to increases in future NPLs.

In a study of US banks, Ghosh (2015) built his research on Berger and DeYoung's (1997) and Louzis et al.'s (2010) studies, as well as others. The results from Ghosh's (2015) study confirmed the 'bad management', 'skimping', 'moral hazard', and 'too big to fail' hypotheses from these previous studies. In addition, he found that: 1) ensuring better quality credit and reducing illiquid loans in banks' asset portfolios will reduce NPLs; and, 2) high profits will lead to more prudent lending. In addition, the lack of significance of bank diversification in the US banking industry matches that of the Greek banking industry (Louizis et al., 2012).

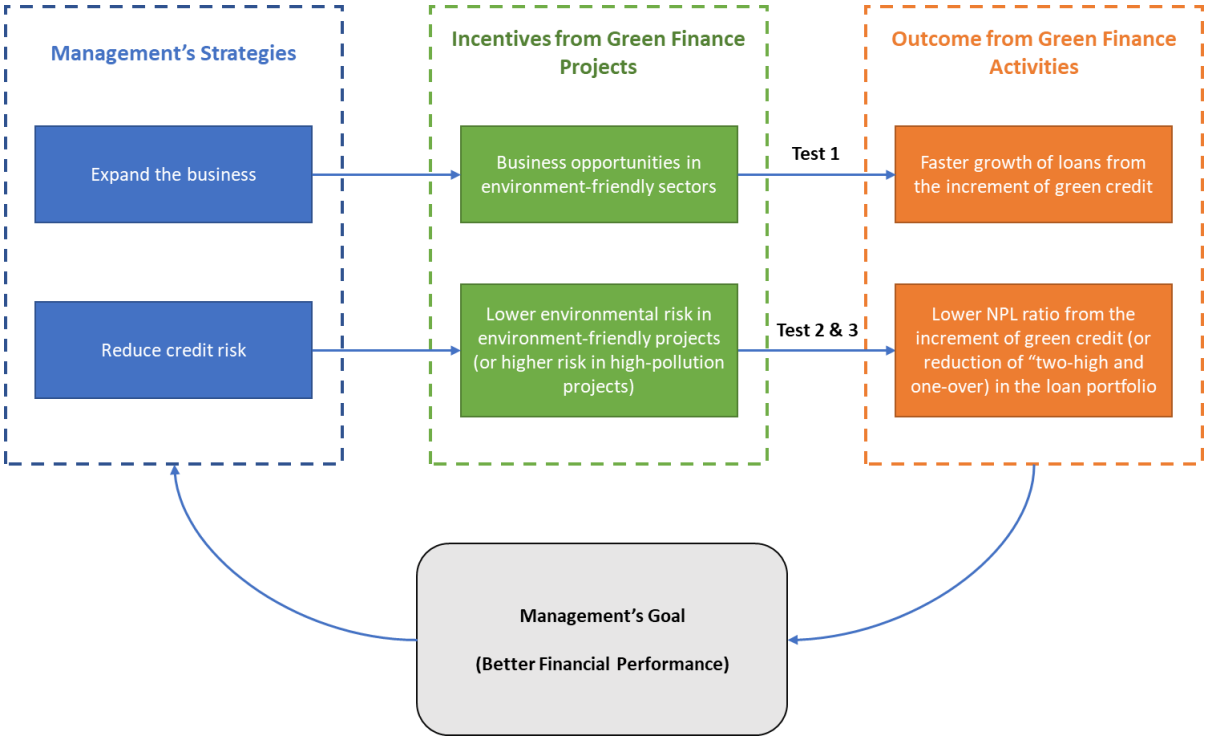
In another strand of study, Micco and Panizza (2004) found that public banks are exposed to more risk than other banks since they play an important role in the facilitation of credit policies. Similarly, the case of Tunisia also showed that public ownership increases banks' credit risk (Zribi & Boujelbène, 2011). De Nicolo (2001) and Iannotta et al. (2007) have suggested that state-owned banks typically exhibit higher risk than do other types of banks.

2.5 Conceptual Framework

The degree of participation in green finance is really management's decision. According to Koch et al. (2014), the decision-making from a bank's perspective involves managing: 1) bank performance; 2) securities and interest rate risks; 3) liquidity & capital; 4) loans & credit; and, 5) investments, globalization, & technology. The purpose of this study is to examine whether the commitment in green finance can achieve the expected outcome for the decision-makers.

The conceptual framework (Figure 2.2) is built based on the study from Weber et al. (2015). As mentioned in Section 2.2, banks engage in green finance because of: 1) credit risk management (Weber, 2012); 2) new business opportunities (Aizawa & Yang, 2010); 3) corporate reputation (Nandy & Lodh, 2012); and, 4) compliance risk. This study only focuses on the first two incentives, as the other two cannot be measured directly.

Figure 2.2: Conceptual Framework



When a bank seeks better financial performance, one of the best ways is to provide more loans without having excessive leverage. Historically, banks have developed many products, such as credit cards, personal mortgage loans, etc., to generate more profits. Much of the literature suggests that green finance may bring new business opportunities (Aizawa & Yang, 2010; Weber, 2014b). Test 1 essentially examines whether green credit is a rapidly growing product or service that expands faster than other types of products. It would be hard to assume that the growth from green credit would have a large impact on the profitability of the entire organization as banks also rely on other sources of income (i.e., non-interest incomes). Moreover, green credit only represents a low fraction of the total loans.

Therefore, the first hypothesis is as follows:

Hypothesis 1: Green credit is an expanding product or service that grows at a faster rate than total loans.

As suggested by Thompson and Cowton (2004), the consideration of environmental issues is mainly motivated by the concern of risk management. In addition, some scholars find a correlation between sustainability performance and credit risks of borrowers (Bauer & Hann, 2010; Goss & Roberts, 2011). This study attempts to study whether the incentive of offering more green credit exists (Test 2), and whether a bank will have more default risk when taking too much high-polluting, high-emission, and overcapacity projects (Test 3).

This concept translates into the following hypotheses:

Hypothesis 2: Allocating large shares of green credit to the loan portfolio reduces credit risk (i.e., NPL ratio of the bank).

Hypothesis 3: Allocating large shares of loans to high-pollution, high-emission, and overcapacity industries to the loan portfolio increases credit risk (i.e., NPL ratio of the bank).

The actual quantitative models and related methodologies are explained in Chapter 4.

Chapter 3
Current Development of Green Credit in China

This chapter introduces the current development of green finance in China to help better understand the background of this empirical study. This chapter begins with an introduction of the Chinese banking system. A summary of major Green Credit Policies and an explanation of Green Credit products and services are provided, followed by a description of the current development of Green Credit in China. Additional literature regarding the Green Credit Policy is reviewed at the end of the chapter.

3.1 Banking System in China

Chinese banks play a very important role in the global financial industry. The "big four" state-owned commercial banks ICBC, BOC, CCB, and ABC are among the largest banks in the world. Nonetheless, there are many difference between banking industry in Western countries and banking industry in China. For example, the government and supervisory entities play important roles in China's banking industry. Therefore, the general background of the Chinese banking sector, especially the political background, is provided to ensure better understanding of China's Green Credit Policy.

3.1.1 History of the Banking Industry in China

In 1948, the People's Bank of China was established and given sole representation of the nation's financial assets. Since then, China's financial system entered the era referred to as the "grand unification" (i.e., the PBOC worked as the central bank, the ministry of finance, and as commercial banks towards the country's national goal within the planned economy).

The "grand unification' lasted until 1978 when the Chinese banking system started to commercialize after the Economic Reform. The process began in 1979 and was mostly completed in the late 1990s. In 1984, the Industrial and Commercial Bank of China (ICBC) became the spin-off of the commercial service of the PBOC. The PBOC no longer provided corporate and personal services

from that point. From the mid-1980s, the existing BOC, CCB, and ABC transformed into commercial banks to serve foreign business, infrastructure investment, and the agriculture industry, respectively. The ABC, BOC, CCB, and ICBC are referred to as the "big four". In the mid-1980s, joint-stock commercial banks began to surface with the Bank of Communications becoming the first joint-stock commercial bank in 1987. The China Merchant Bank was established by the China Merchant Group soon afterwards.

The government made a second wave of reform to the financial system in the 1990s. National joint-stock commercial banks were established by the government to offer banking services to households and firms across the nation. Unlike state-owned banks, which were fully owned by the State at that time, SOEs were the majority shareholders in joint-stock banks (Jia, 2009). In 1994, three policy banks were established to accomplish political missions. The China Development Bank was established to help develop infrastructure; the Export-Import Bank of China took over the policy business of international business; and the Agricultural Development Bank of China took over the policy business of rural finance. In addition, part of the reform was to create four state-owned asset management companies to tackle the problem of the accumulating non-performing loans from state-owned banks. Many SOEs were on the verge of bankruptcy due to their lack of competitiveness after the economic transformation. As a result, state-owned banks had to absorb large amounts of non-performing loans, and 1.4 trillion RMB of non-performing loans were eventually transferred to asset management.

A third wave of financial reforms took place in the late 1990s. Foreign banks were permitted to operate in China and acquire up to a 25% stake in joint-stock banks. Both state-owned and joint-stock banks could file for initial public offerings (IPOs). By the end of 2015, 33 banks were publicly listed in mainland China, Hong Kong, or co-listed on both. City commercial banks and rural commercial banks were transformed from local credit unions. Many city credit unions were established from the late-1970s to 1993. The government decided to reorganize the system and to set up city commercial banks based on credit unions. There were over 5000 city credit unions, some of which were eventually closed, with the remaining 2000 credit unions becoming city commercial banks. Up until the end of 2009, there were 140 city commercial banks. Rural commercial banks were also developed in the same way.

By the end of 2015, the Chinese banking system was composed of the PBOC, three policy banks, six state-owned banks (including the Postal Savings Bank of China), 12 joint-stock commercial

banks, more than 100 city commercial banks, and many rural commercial banks and rural credit unions.

During the 30 years of reformation, the State gradually took a step back from allowing public ownership in all banks. As a result, financial institutions are more vulnerable to the discipline of the marketplace in the conduct of their business. Risk management is becoming more important to banks with the increase of public exposure and market competition, as both investors and depositors focus more on a bank's risk profile when making their decisions (Wu & Bowe, 2012).

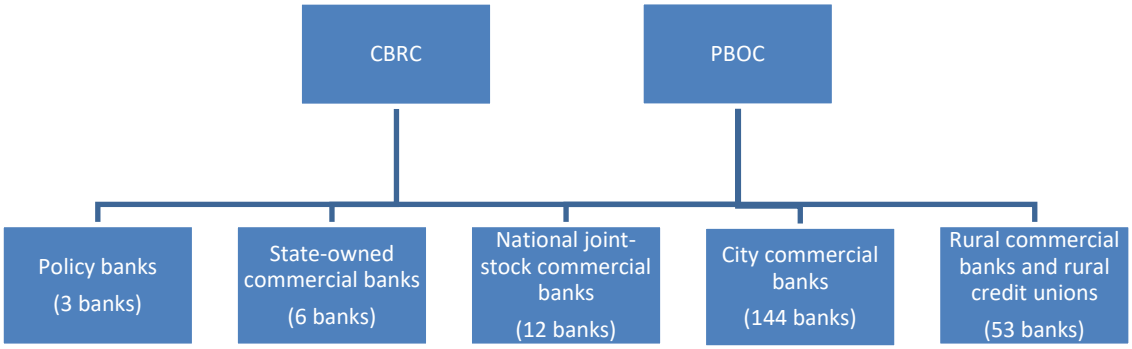
3.1.2 Supervisory Entities

The People's Bank of China (PBOC) and the China Banking Regulatory Commission (CBRC) are the two supervisory entities that oversee financial institutions in China. The structure of the Chinese Banking Industry is illustrated in Figure 3.1.

The PBOC is China's central bank, which formulates and implements monetary policy. The PBOC also maintains the banking sector's payments, clearing and settlement systems, and monitors official foreign exchange and gold reserves. It is also the issuer of the Renminbi – the official currency in China.

Triggered by the accession to the World Trade Organization in 2001, the China Banking Regulatory Commission (CBRC) was established to act as the independent banking regulator of China. The CBRC formulates supervisory rules and regulations that governs all banking institutions. As the supervisor of the banking industry, the CBRC focuses on conducting consolidated supervision to monitor and mitigate the risks of each banking institution. At the same time, the CBRC also strives to protect the interests of consumers, promote financial stability, and maintain market confidence through prudential supervision.

Figure 3.1: Structure of Chinese Banking Industry



3.1.3 Government's Influence on Commercial Banks

As mentioned before, state-owned banks were commercialized to serve the financial needs of the people. All the traditional state-owned commercial banks and the Postal Savings Bank of China were once entirely owned by the government. Although all the state-owned banks went public, State and state-owned entities still own a large percentage of the total shares in these banks. State and state-owned entities have the majority of shares/controlling interest (over 50%) in ABC, BOC, CCB, and ICBC (Table 3.1). Although the State does not have controlling interest in BOCOM, the Ministry of Finance (MOF), which represents the State, is still the largest shareholder of the bank. Moreover, State or state-owned shareholders control 100% of the policy banks. Having majority shares means the banks may act in the best interest of the country – the major shareholders of the company.

Some scholars suggest that the lending policies and practices of state-owned commercial banks may potentially be an extension of the country's overall social policy to help achieve its main economic agenda (Lardy, 2008; Zhang et al., 2011). In other words, state-owned banks may be very responsive to the country's policies and strategies. Of course, the Green Credit Policy is one of the many policies.

Table 3.1: Major State or State-Owned Shareholders in State-Owned Commercial Banks

Banks	Major state or state-owned shareholders	Percentage of total ordinary shares	Total state ownership
ABC	1. Central Huijin Investment Ltd.	40.03%	84.52%
	2. Ministry of Finance (MOF)	39.21%	
	3. Social Security Fund (SSF)	3.02%	
	4. China Securities Finance Co., Ltd.	1.57%	
	5. Central Huijin Asset Management Co., Ltd.	0.39%	
	6. Wutongshu Investment Platform Co., Ltd.	0.30%	
BOC	1. Central Huijin Investment Ltd.	64.02%	67.58%
	2. China Securities Finance Co., Ltd.	2.53%	
	3. Central Huijin Asset Management Co., Ltd.	0.61%	
	4. Wutongshu Investment Platform Ltd.	0.36%	
	5. Guotai Junan Securities Co., Ltd.	0.06%	
BOCOM	1. MOF	26.53%	37.67%
	2. Social Security Fund (SSF)	4.42%	
	3. China Securities Finance Co., Ltd.	1.99%	
	4. Capital Airports Holding Company	1.68%	
	5. Shanghai Haiyan Investment Management	1.09%	
	6. Wutongshu Investment Platform Ltd.	1.07%	
	7. China FAW Group Corporation	0.89%	
CCB	1. Central Huijin Investment Ltd.	57.03%+0.28%	60.18%
	2. China Securities Finance Co., Ltd.	1.00%	
	3. Baosteel Group	0.80%+0.02%	
	4. State Grid	0.64%	
	5. Yangtze Power	0.41%	
ICBC	1. Central Huijin Investment Ltd.	34.71%	71.22%
	2. Ministry of Finance (MOF)	34.60%	
	3. China Securities Finance Co., Ltd.	1.23%	
	4. Wutongshu Investment Platform Co., Ltd.	0.40%	
	5. Central Huijin Asset Management Co., Ltd.	0.28%	

To further break down the ownership, some of the key shareholders that make multiple appearances are introduced.

Central Huijin Investment Ltd. (Huijin) is a wholly state-owned subsidiary of China Investment Corporation Limited. Huijin was founded to hold equity interests in state-owned financial institutions in accordance with the Chinese State Council, and to exercise its legal rights and assume obligations as an investor on behalf of the PRC Government. Huijin was established to achieve the goal of preserving and increasing the value of state-owned financial assets. Hui also does not engage in other commercial activities or operations of the company in which it invests.

Some of the other state-owned enterprises, such as the Social Security Fund (SSF), China Securities Finance Co., and the Ministry of Finance (MOF) are all established to serve their own purpose, literally. By contrast, Wutongshu Investment Platform Ltd. is entirely owned by the State Administration of Foreign Exchange (SAFE).

Table 3.2: Companies Directly Held by Huijin

No.	**Company name**	**Huijin's shareholding percentage (%)**
1	China Development Bank Corporation	34.68%
2	Industrial and Commercial Bank of China Limited	34.71%
3	Agricultural Bank of China Limited	40.03%
4	Bank of China Limited	64.02%
5	China Construction Bank Corporation	57.11%
6	China Everbright Group Ltd.	55.67%
7	China Everbright Bank Company Limited	21.96%
8	China Export & Credit Insurance Corporation	73.63%
9	China Reinsurance (Group) Corporation	71.56%

10	New China Life Insurance Company Limited	31.34%
11	China Jianyin Investment Limited	100%
12	China Galaxy Financial Holdings Company Limited	78.57%
13	Shenwan Hongyuan Group Co., Ltd.	25.03%
14	China International Capital Corporation Limited	28.45%
15	China Securities Co., Ltd.	40.00%
16	China Investment Securities Co., Ltd.	100%
17	Jiantou CITIC Asset Management Co., Ltd.	70.00%
18	Guotai Junan Investment Management Co., Ltd.	14.54%
19	Central Huijin Asset Management Co., Ltd.	100%

Three policy banks, ADBC, CDB, and EIBC were established to take over government-directed spending from the four state-owned commercial banks. These banks are responsible for their designed purposes, respectively. ADBC provides funds for agricultural development in rural areas; CDB specializes in infrastructure financing, and EIBC specializes in trade financing and development.

By contrast, national joint-stock commercial banks may be owned by entities of a different nature. The major shareholders and their ownership structures also vary. For example, China Merchants Bank (CMB) has China Merchants Group as their largest shareholder (26.78%); China CITIC Bank has CITIC Group as their largest shareholder (67.13%); and China Industrial Bank has Fujian Provincial Department of Finance as their largest shareholder (17.86%). Nevertheless, most of the major shareholders are also state-owned enterprises (SOEs), such as regional governments, financial investment companies, and development companies, though these SOEs are typically less directly influenced by the government.

City commercial banks and rural commercial banks focus more on regional development. City commercial banks can be found in better developed regions and provide funds for development in cities. Rural commercial banks are established in rural areas and specialize in rural development.

Typically, the top 10 shareholders of both city and rural commercial banks are corporation-established by their corresponding governments.

Overall, the government of PRC has ownership in almost all the commercial banks through different forms. The State and state-owned shareholders (mostly SOEs) own a 100% share of the policy banks, the majority interest in state-owned commercial banks and national joint-stock banks, and non-controlling interest in city commercial banks. The difference between state-owned banks and national joint-stock banks is that the State has more shares in state-owned banks while state-owned shareholders have more shares in national joint-stock banks. With State and state-owned shareholders having controlling interest, banks are more likely to obey government strategy and instruction to act in the State's best interest. For instance, the type of banks with more State or state-owned shareholders has a greater proportion of green credit to total loans than those with less (Table 3.3). State-owned banks have a greater proportion of green credit than national joint-stock banks because national joint-stock banks have more SOEs as shareholders. Even though SOEs are owned by the State, they still function as normal businesses which generate profit. The State's interest may come in second place.

Table 3.3: Average Proportion of Green Credit Sorted by Type of Bank (with estimation)

Year	Policy	State-owned	National joint-stock	City
2009	8.95%	4.12%	1.60%	1.09%
2010	10.99%	4.02%	1.84%	1.15%
2011	11.91%	4.25%	2.04%	1.27%
2012	13.17%	4.10%	3.84%	1.58%
2013	12.51%	4.95%	4.03%	1.70%
2014	18.08%	4.98%	4.61%	2.24%
2015	17.05%	5.80%	4.90%	2.56%

3.2 Major Green Credit Policies

Table 3.4 summarizes a list of major macroeconomic policies in green finance in China. In 1995, the Ministry of Environmental Protection of the People's Republic of China (MEP), formerly the State Environmental Protection Administration (SEPA), and the PBOC issued policies respectively regarding credit policy for environment protection, providing a foundation for the Green Credit Policy. Since then, there has been many major events in the development of the Green Credit Policy.

In 2005, the State Council took the idea further and integrated sustainable economic development into the development strategy of the nation. The Green Credit Policy was officially announced in 2007. Subsequently, the SEPA, the International Finance Corporation (IFC), the China Banking Association (CBA), and the CBRC issued guidelines respectively to provide sound practice and guidance. In 2012, the Guidelines on Green Credit was issued by CBRC, representing another milestone in the development of the Policy. The Guidelines defined banks' roles and responsibilities in environmental protection and sustainable social and economic development and required full disclosure of Green Credit information. Recently, the PBOC and NDRC issued guidelines for green bonds, providing a routine for the development of green bonds.

The Green Credit Policy requires banks to shift loans away from high-pollution, high-emission, and overcapacity industries to environmental protection, emission reduction, and energy saving industries. The Policy can be broken down into three components. First, financial institutions are required to take borrowers' environmental performance into consideration before extending loans or granting new loans. Furthermore, banks should restrict or even take back loans from those enterprises in violation of environmental law. Second, the Green Credit Policy attempts to create environmental information sharing platform between financial institutions and environmental authorities. Information regarding environmental violators are shared between banks and environmental authorities, so that both parties can better monitor the environmental performance of borrowers/polluters. Third, banks are hold responsible for environmental violations. Sanctions will be imposed on financial institutions if they grant loans to polluting enterprises or environmental violators. Overall, the goal of this policy is to guide loans away from polluting industries to environment-friendly industries.

Table 3.4: Macroeconomic Policies in Green Finance

Time	Policy	Department	Remark
February 1995	Notice on using credit policy in environment protection	SEPA	Foundation of the Green Credit Policy
February 1995	Notice on implementing credit policy with environment protection	PBOC	Foundation of the Green Credit Policy
December 2005	Decision on implementing Scientific Outlook on Development and improving environment protection	State Council	Integrated sustainable development into national development policies
July 2007	Opinions on preventing credit risks and implementing policy for environmental protection	MEP PBOC CBRC	The official issuance of the Green Credit Policy
January 2008	Green credit and environment protection guidelines	SEPA IFC	Introduced Equator Principal in China
January 2009	Guidelines on corporate social responsibility for Chinese banking sector	CBA	Took environmental responsibility in supporting national industrial policies and environmental policies
February 2012	Guidelines on Green Credit	CBRC	Defined banks' roles in environmental protection and sustainable development and required full disclosure of Green Credit information
June 2014	Notice of the China Banking Regulatory Commission on Key Performance Indicators of Green Credit Implementation	CBRC	Required banks to conduct self-assessment in green credit implementation and submit results to CBRC

December 2015 January 2016	Green Bond Guidelines	PBOC NDRC	Issued by both departments separately

3.3 Types of Green Credit

Currently, there are many types of Green Credit offered by banks. In the "Notice of the China Banking Regulatory Commission on Key Performance Indicators of Green Credit Implementation", the CBRC categorizes Green Credit into two general types – "Credit to projects and services of environmental protection and emission reduction" and "Credit to emerging strategic industries of energy saving & environmental protection, and new energy, new energy automobile" (CBRC, 2014), separating existing technologies and emerging technologies. However, banks often introduce more detailed products and services to meet the specific demands of their customers. The actual classification of Green Credit products varies among banks. Shanghai Pudong Development Banks, for example, has a comprehensive list of their offering in Green Credit products and services (Table 3.5).

Table 3.5: Types of Green Credit Products and Services Offered by Shanghai Pudong Development Bank (SPD, 2016)

Number	Categories	Sub-Categories
1	Green agricultural projects	
2	Green forestry projects	
3	Industrial energy and water conservation and environmental protection projects	
4	Nature protection, ecological restoration and disaster prevention projects	

5	Resource recycling projects	
6	Waste disposal and pollution prevention and treatment projects	
7	Renewable and clean energy sources projects	1. Solar power projects 2. Wind power projects 3. Biomass power generation projects 4. Hydroelectric projects 5. Other renewable and clean energy sources projects 6. Smart electrical grid projects
8	Rural and urban water projects	1. Rural drinking water safety engineering projects 2. Small-scale irrigation and water conservation facility construction projects 3. Urban water conservation projects
9	Energy-saving or green-building construction projects	1. Green transformation of existing building projects 2. Green building construction, development, operation, and maintenance projects
10	Green transportation projects	1. Railway transportation projects 2. Waterway management and vessel purchasing projects 3. Urban public transportation projects 3.1 Urban public passenger transportation projects 3.2 Urban rail transport projects 4. Transportation environmental protection projects
11	Energy-saving and environmental protection services	1. Energy-saving services 2. Environmental protection services

		3. Water conservation services 4. Circular economy (cyclical resource utilization) services

As a part of the Green Credit Policy, financial institutions are also required to reduce their Credit to industries related to "high-pollution, high-emission and overcapacity", excluding loans to technology transformation. Although the CBRC does not have a guideline for industries included in the Green Credit Policy in their "KPIs for implementing Green Credit" (CBRC, 2014), banks often have mutual agreements in the categorization of these industries (Table 3.6). Typically, high-pollution and high-emission industries are those involved in carbon-intensive activities and toxic waste. Meanwhile, overcapacity industries come in a wide variety. Construction materials, namely, steel, cement, and flat glass, are all considered overcapacity industries. This may be a result of a reduction in infrastructure and real estate development.

Table 3.6: Industries Related to "High-Pollution, High-Emission, and Overcapacity" Projects

High-Pollution and High-Emission Industries	**Overcapacity Industries**
Non-metallic mineral product manufacturing (e.g., cement)	Steel
Ferrous metal smelting and rolling industry (e.g., iron and steel)	Cement
Raw chemical materials and chemical product manufacturing industry	Flat glass
Non-ferrous metal smelting and rolling industry (e.g., aluminum)	Coal chemical, calcium carbide
Rubber and plastic products	Ship-building
Coking and petroleum processing	Polysilicon

3.4 Development Status of the Green Credit Policy

According to the CBRC, the total balance of green credit is 8.08 trillion RMB (approximately 1.24 trillion USD). 21 major banks (i.e. policy banks, state-owned banks, joint-stock banks, and postal saving banks) contributed 7.01 trillion RMB, which represents 9% of their total loan.

The sample from this study (see Chapter 4) finds that the green credit balance has been growing for the last seven years. Figure 3.2 provides a clearer picture of the overall trend of green credit development in China. The total green credit balance (Y-axis on the left side) from the sample banks (if available) has been increasing steadily. The growth rate has maintained around 25% (from 2010 to 2013), ranging from 28.21% (2010) to 23.10% (2013). The growth rate of green credit balance saw a boost in 2014, increasing by 5.58% to 28.68%, the fastest growth during the last six periods. Conversely, the growth rate dropped by 9.40% to 19.28% in 2015, the lowest growth rate of all the periods in this study.

Figure 3.2: Total Green Credit Balance and Year-over-Year (YOY) Growth

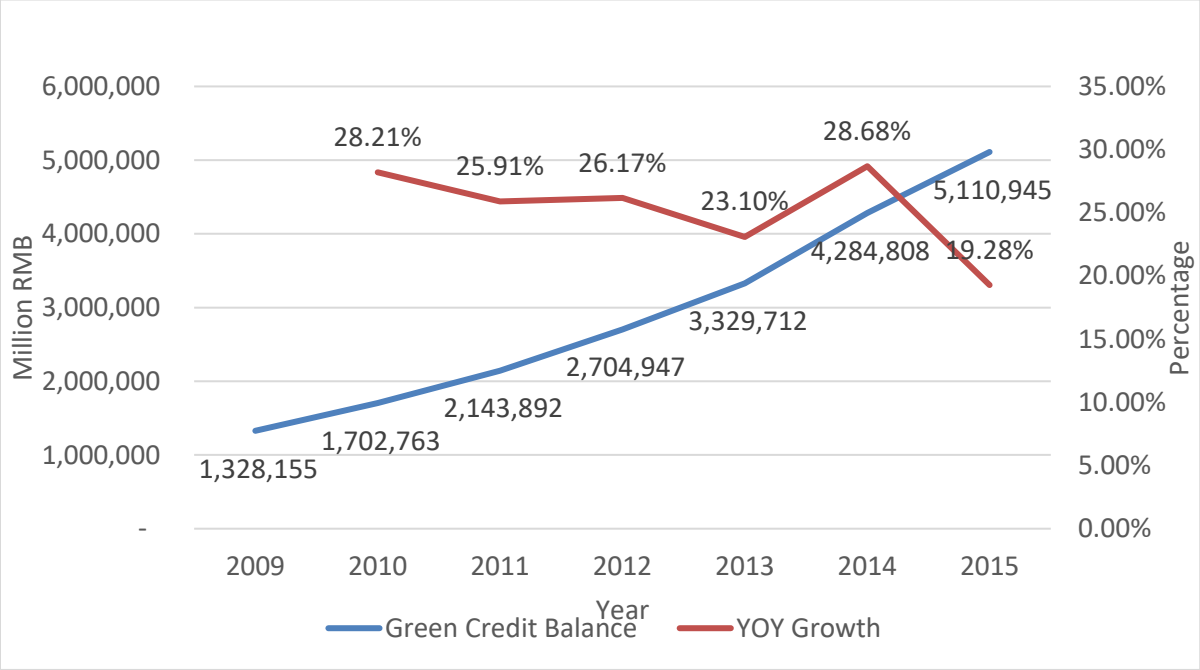
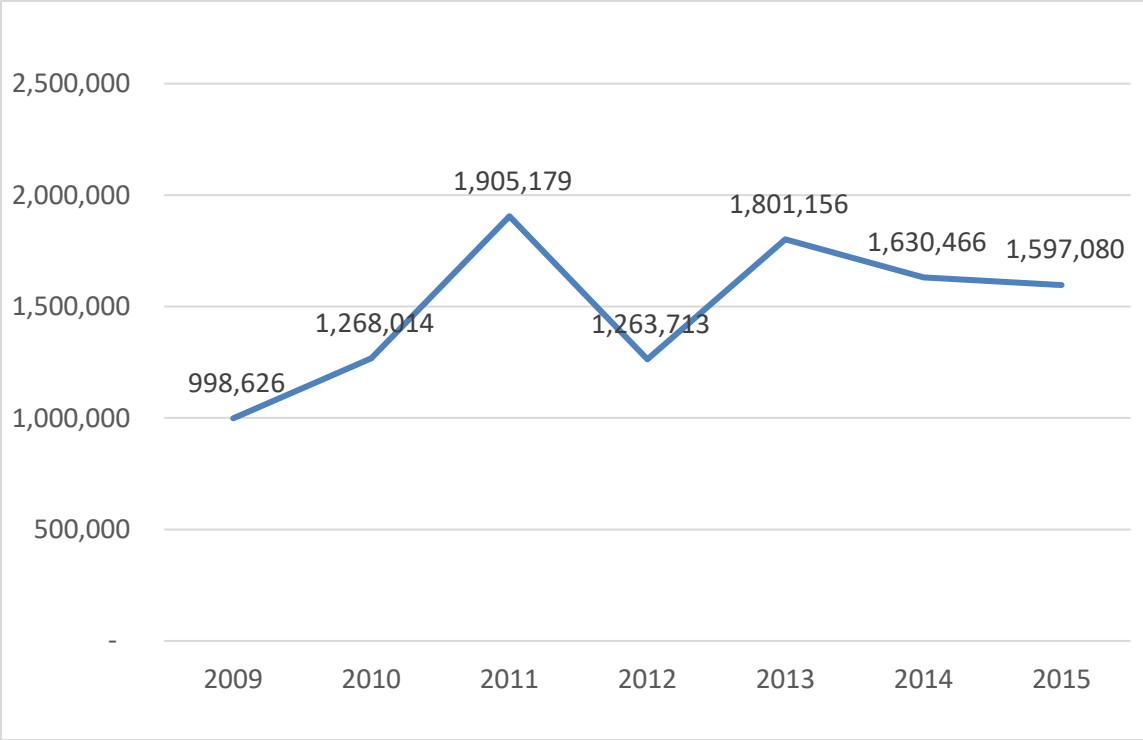


Figure 3.3 presents the total loans to "two-high and one-over" projects. The drop of balance in 2012 is largely due to missing data from the Industrial and Commercial Bank of China (ICBC) and the Agricultural Bank of China (ABC), which had 142,975 and 624,733 "two-high and one-over" loans, respectively. Therefore, the actual balance should be no more than 2,031,421 given the fact that the balance from both banks dropped after the missing period. This figure also shows that banks paid less attention to controlling loans to "two-high and one-over" industries until around 2011 and 2012, confirming the importance of the "Guidelines on Green Credit" in 2012.

Figure 3.3: Total Loans to "Two-High and One-Over" Projects



3.5 Literature on China's Green Credit Policy

While green finance is growing rapidly, there is limited literature on this discipline, especially in the case of China – the Green Credit Policy. Currently, most research on the Green Credit Policy are still in the stage of concept development. Many scholars choose to study the Green Credit Policy from the

policy-maker's perspective. For instance, Cai (2015) argues that there are possibly five reasons for the weak performance of the Green Credit Policy:

1. Lack of a unified executive standard: There is no joint assessment rules among the banks. It is not clear what types of corporations are considered high-polluting, and what types of corporations are considered environment-friendly. What is more, the environmental protection administration's penalty on corporations' polluting behavior is also vague and unclear. Commercial banks chose to execute a green credit policy that would benefit themselves, based on their understanding of the policies. CIB, for example, focused on innovation in green credit products and achieved good outcomes. Though a little behind, four large state-owned banks began to offer green credit, and did not have a mature system within them overall. Likewise, most small rural commercial banks and city commercial banks have not begun to offer green credit services.
2. Poor communication of environment information between banks and corporations: The Green Credit Policy requires a deep understanding of a corporation's environmental management process. Incomplete information disclosure interferes with a bank's decision-making. Therefore, banks are not able to make the best decisions according to the information they have. There is yet a perfect environmental risk management system in place.
3. Over-intervention by the regional government: Under slower economic growth, regional governments wish to achieve more growth in GDP and financial income, but ignore environmental consequences. The problem with city commercial banks is that most of their large clients are local businesses and/or related to local governments. By restricting the development of certain industries, especially those regions that rely on high-polluting industries, regional governments may encounter increasing unemployment rates, reduction in tax base, etc.
4. The need for more awareness in banks of CSR: Commercial banks focus more on making profit than managing risks. They tend to treat green credit as normal loans. Moreover, there is no special recommendation or development of green credit services.
5. Lack of new green credit products due to lack of talent: China has limited talented professionals in the finance sector, and as a result this causes difficulties in green credit product innovation.

In addition, Ye and Li (2014) pointed out that the development of green credit needs to be backed up with policies such as the stimulus binding mechanism, risk compensation, and guaranteed funding.

The Green Credit Policy focuses more on restriction and constraint, but it lacks subsidized policies (i.e., financial and tax compensation to reduce the cost of green credit (Ma, 2015; Chen, 2016). Similarly, Wang and Zhang (2014) suggested that low interest income (generated by green credit) and high risk associated with environmental protection and emission reduction projects should be compensated.

Regarding the advantage of the Green Credit Policy, some believe it helps commercial banks in managing and improving environmental risk (An, 2008; Chang, Wang, & Li, 2008; Hu & Cao, 2011; Wei, 2010). Zhao (2015) found that the Green Credit Policy has a positive effect on energy-saving, emissions reduction, and economic development. It is also believed that the Green Credit Policy can provide help to environment-friendly industries on pollution reduction, environmental protection, and renewable energy projects (Zhang & He, 2010).

Chapter 4
Research Methodology and Models

This chapter introduces the methodology used for this research. The dataset used in the empirical study is explained, as well as the statistical methods and appropriate tests for the hypotheses.

4.1 Dataset

Due to the lack of available databases in the field, the dataset used in this study was built from scratch. The dataset used for quantitative analyses was designed to be longitudinal, also known as panel data, that involves repeated observations of different individuals over a period of time. This would help analyze how different banks develop green credit during the period.

4.1.1 Sample Selection

The sample was selected based on two criteria: a) considered as “major banks”; b) being publicly listed. The term “major banks” can be found in many official press releases from the CBRC, new reports, and other financial resources. There are 21 “major banks”, including all the policy banks, state-owned commercial banks, and national joint-stock commercial banks, with the addition of Postal Savings Bank of China. Since this dataset relies solely from publicly available information, publicly listed banks were also included given that they must disclose financial statements and other requirements set by the China Securities Regulatory Commission (CSRC). As of September 2016, there was a total of 33 banks that traded on either the Shanghai Stock Exchange (SSE) or the Shenzhen Stock Exchange (SZSE) to Chinese investors and Qualified Foreign Institutional Investors (QFII); on the Hong Kong Stock Exchange (SEHK) to global investors; or on both the SSE/SZSE and the SEHK.

Initially, 39 banks met at least one of these two criteria in China. The sample is composed of three policy banks, five state-owned commercial banks, 12 national joint-stock (three unlisted), one postal savings bank, 14 city commercial banks, and four rural commercial banks. The sample was shortlisted to 24 due to the availability of data (further discussed in section 4.2).

Table 4.1: Summary of Banks in the Sample

Type of banks	Total number of banks	Number of publicly traded banks	Number of banks included in the initial dataset	Number of banks in the final dataset
Policy banks	3	0	3	1
State-owned commercial banks	5	5	5	5
National joint-stock commercial banks	12	9	12	10
Postal savings banks	1	1	1	0
City commercial banks	144	14	14	8
Rural commercial banks and rural credit unions	53	4	4	0

4.1.2 Source of Data

All publicly available information was used to build the dataset. The dataset for quantitative analyses predominately referred to two types of reports. Annual data were collected for both types of data.

Financial data and indicators

The financial performances of all the publicly listed banks are available from many official sources. As a general requirement of the China Securities Regulatory Commission (CSRC) and the Securities and Futures Commission (SFC) of Hong Kong, stock issuers are asked to disclose their financial statements on a regular basis. Period reports can be found on the stock exchanges' website, official websites of the banks, as well as many other financial data providers' websites. According to basic listing requirements for equities from the CSRC and SFC, companies are required to have a

trading record of no less than three financial years. Therefore, publicly listed banks have their past three years' financial statements ready for investors' review, though most banks provided a record of five years instead. Many unlisted banks also make their financial information available on their websites, though some only provide a summary of financials. Overall, financial data and indicators from the sample are mostly available for the past 10 fiscal years, while few only publish information for three years. Although most key financial data and indicators were available quarterly, only annual data were collected as green finance data were not available quarterly.

Green finance data

Banks rarely discuss green finance or green credit in their annual reports. Therefore, green finance data were collected mostly from CSR or sustainability reports issued by the banks. Typically, banks would discuss their responsibility to the economy, environment, and society. In some cases, banks with specialization in a specific sector would also discuss their responsibility to the sector. For instance, the Agricultural Bank of China also included discussion regarding agricultural development. The dataset relied heavily on the environment section. Although most banks have adopted Global Reporting Initiatives (GRI) version 4.0, the actual report often varies among different banks and sometimes changes across time. Thus, the availability of data from each report also varies.

The dataset uses "Notice of the China Banking Regulatory Commission on Key Performance Indicators of Green Credit Implementation" as a guideline when building the dataset for green finance data. All nine core indicators on "Support and Limited Loan" were included, as well as three optional indicators – "Carbon emission (tons) per employee generated during business activities; "Average power consumed by employee (kw-h)"; and "Hours of green credit training per employee in a year". In addition, some banks also reported reduction in greenhouse gas emissions from their green credit, number of green loans, as well as loans to industries with high pollution, high energy consumption, and overcapacity. These data were categorized as "environmental benefits from green finance", "number of loans to environmental protection, emission reduction, and energy saving projects"; "business data for industries with high pollution, high energy consumption, and overcapacity", respectively.

Table 4.2: Green Finance Indicators

Type of indicator	Name of indicator
Core indicators	1. Credit to projects and services for environmental protection and emission reduction
	2. Credit to emerging strategic industries for energy-saving & environmental protection, new energy, and new-energy vehicles
	3. Total amounts of said two items
	4. Credit to industries related to "high-pollution, high-emission and overcapacity" (excluding loans to technology transformation)
	5. Credit to enterprises related to obsolete industry capacity
	6. Credit to enterprises violating laws and regulations on environmental protection
	7. Credit to enterprises violating safety production
	8. Emission Reduction of CO2 equivalent to every RMB 100 million loan
	9. Development of main e-banking business
Optional indicators	10. Carbon emission (tons) per employee generated during business activities
	11. Average power consumed by employee (kw-h)
	12. Hours of green credit training per employee in a year
Additional indicators	13. Environmental benefits from green finance
	14. Number of loans to environmental protection, emission reduction, and energy saving projects

	15. Business data for industries with high pollution, high energy consumption and overcapacity

4.2 Data Processing

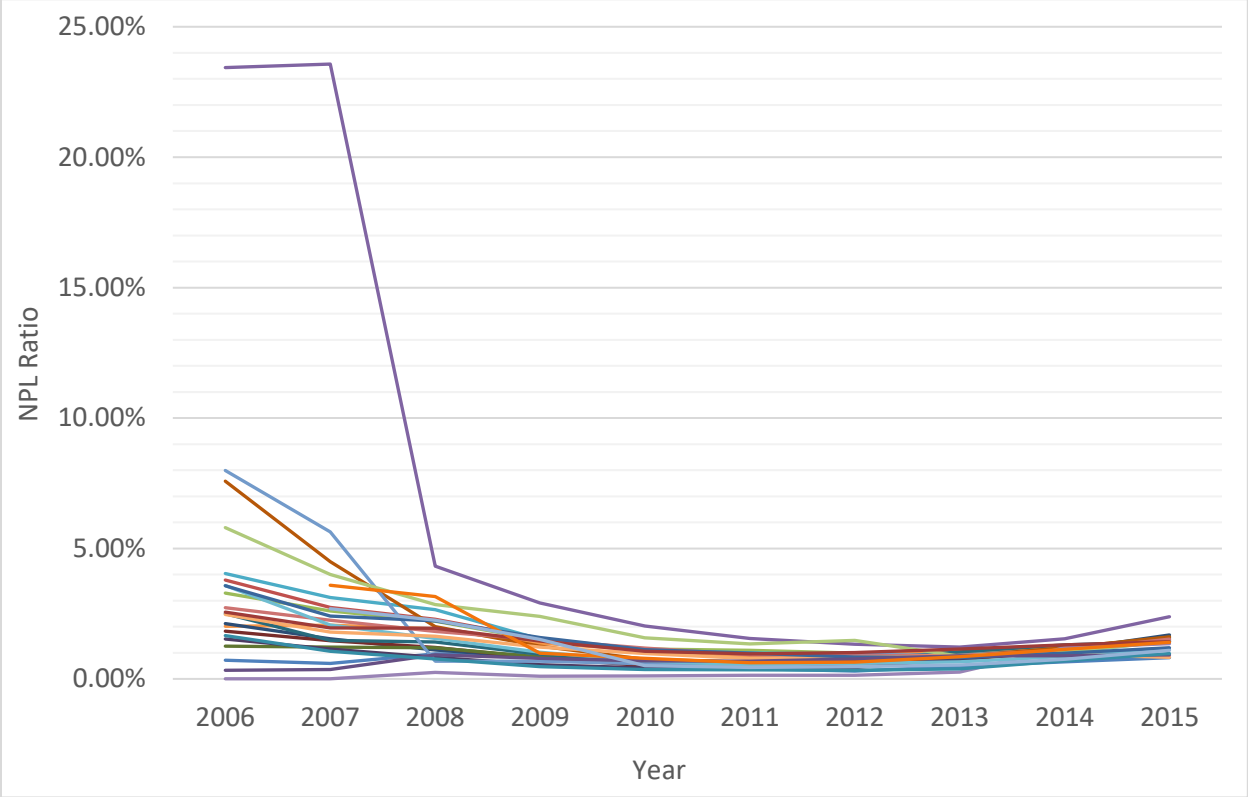
After the raw data were gathered, the dataset was processed to increase reliability. The problem of heavy-tailed distribution and missing data were dealt with during data processing. In the beginning, some basic data calculations and transformations were performed because some of the data were not readily available. For instance, some banks only published a proportion of their green credit in terms of total loans. This ratio is transformed to the amount of green credit outstanding after being multiplied by total loan outstanding.

4.2.1 Unusual observations due to special event

During the initial data collecting stage, both green finance data and financial data were collected for a range of 10 years. After looking at the distribution of the data, the first three years of data were dropped due to a special event taking place in the 2010s. Dropping these data may help reduce the biasness from external factors.

The NPL ratio appears to improve suddenly after the first three years of data. After a thorough investigation, the decision was made to exclude the first three years of data from the dataset. Figure 4.1 shows that the average NPL ratios of the banks during 2006-2008 are significantly higher than 2009 onward. As the NPL ratio is the most important element of this research, a careful examination is performed to determine if this sudden “improvement” can be backed up with proper reasons.

Figure 4.1: NPL Ratio from 2006 to 2015 (24 Sample Banks)



The outcome of the examination is that this improvement in NPL ratio is mostly a result of dumping non-performing assets. Chinese banks had been carrying a high NPL ratio for a long period of time and right up until the late 2000s. Years of government-directed lending had created large numbers of NPLs. Central Bank reported that NPLs accounted for 21.4% to 26.1% of total lending of the "big four" state-owned banks in 2002. In 1999, four asset management companies (AMC) were established to take over the NPLs from the banks. The AMCs repackaged these NPLs into viable assets and to sell them to risk-loving investors. Banks had been selling NPLs to AMCs since the AMCs were founded.

In fact, to show more attractive financial statements to investors, banks were more active in selling NPLs before going public. For example, Agricultural Bank of China (ABC), which launched the Initial Public Offering (IPO) of its stock to the investing public on the SSE and SEHK simultaneously in July 2010, had NPL ratios of 23.43% and 23.57% in 2006 and 2007, respectively, before dropping to 4.32% in 2008. Similarly, China Everbright Bank's (CEB) NPL ratios were at 7.58%, 4.49%, and

2.00% from 2006 to 2008 before decreasing to 1.25% in 2009. CEB went public in 2010. However, there were some exceptions. For example, Ping An Bank, which launched its IPO to global investors on the SZSE back in 1991, improved its NPL ratio from 7.99% in 2006 to 0.68% in 2008 without additional IPO on the SEHK. In addition, the descriptive data in Table 4.3 show that the mean and median of NPL ratios from 2009 onward are much closer, meaning that the distribution of the data is more symmetrical.

Table 4.3: Descriptive Data of NPL Ratio from 2006 to 2015

Year	Mean	Median	SD	Count
2006	3.85%	2.53%	4.83%	22
2007	3.08%	2.06%	4.56%	24
2008	1.76%	1.73%	0.92%	24
2009	1.20%	1.12%	0.60%	24
2010	0.85%	0.72%	0.41%	24
2011	0.72%	0.64%	0.33%	24
2012	0.76%	0.76%	0.31%	24
2013	0.83%	0.87%	0.23%	24
2014	1.07%	1.11%	0.20%	24
2015	1.39%	1.43%	0.33%	24

4.2.2 Data Imputation of Green Credit Data

The biggest challenge in this research is the availability of green credit data. Because many banks did not provide their green credit data in their annual reports and sustainability reports, there is, as a result, a large amount of missing data on green credit balance. To deal with the missing data, this study estimated the missing green credit balance and loan to "two-high and one-over" projects based on the compound annual growth rate (CAGR) from the data available. The estimation involves two steps. The first step is to calculate the compound annual growth rate (CAGR) of green credit (or "two-high and one-over") from the available periods.

$$CAGR = \left(\frac{Ending\ value}{Beginning\ value}\right)^{\left(\frac{1}{Number\ of\ years}\right)} - 1$$

The second step is to estimate the missing data with the CAGR. The formula to estimate missing data before the beginning period and the missing data after the ending period are:

$$Estimated\ value\ of\ year_{t-1} = \frac{Value\ of\ year_t}{(1 + CAGR)}$$

$$Estimated\ value\ of\ year_{t+1} = Value\ of\ year_t \times (1 + CAGR)$$

The compound annual growth rate makes sense for this type of estimation because the green credit balance accumulates over time. The drawback of this method is that the growth rate of the green credit balance delivers less meaningful information now because the growth rates of those estimated periods are the same as the compound growth rate. Therefore, only original data were used to test hypothesis 1.

Samples with less than three years of green credit balance available were excluded, since relying on growth rate between two years would increase inaccuracy. Therefore, 13 of the 39 banks which only reported their green credit of two or fewer years were excluded. Also, Agricultural Development Bank of China (ADBC) and Bank of Guiyang were excluded due to the lack of financial data. The remaining 24 banks reported the green credit balance for at least three periods, but only 14 of which provided the balance of loans to "two-high and one-over" for at least three periods. The statistical tests related to "two-high and one-over" loans had to settle with only 14 samples.

For the remaining 24 samples, 50% do not require estimation, 33% had a green credit balance available for five or six periods, requiring estimations for only one or two periods, and only 17% needed estimations for three or four periods (Table 4.4). The actual data after the data imputation is included in Appendix A.

Table 4.4: Data Availability of Included Samples

Number of years available / **Variable**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Total**
Green credit balance	12	5	3	3	1	0	0	0	24

"Two-high and one-over"	3	6	3	2	0	0	2	8	24

A comparison of the data before and after imputation (Table 4.5) was conducted to check the quality of data imputation. The mean of the green credit balance was reduced by about 20,000 million RMB because the early years with a lower green credit balance were added to the dataset. The minimal green credit balance shows quite a significant reduction from 33 million RMB to 2.28 million. In fact, this is an estimation of the same banks in the earlier years. The banks began to offer green credit at relatively late, but increased the green finance balance significantly. This fast growth rate was used to estimate the green credit balance in the earlier years, thus creating a very significant drop.

Table 4.5: Data Imputation – Before and after Comparison

Variable name	**Obs**	**Mean**	**SD**	**Min**	**Max**
Green credit balance (before)	144	143,092	254,828	33	1,570,000
Green credit balance (after)	168	123,052	240,895	2.28	1,570,000
Loan to "two-high and one-over" projects (before)	90	120,901	167,780	533	669,160
Loan to "Two-high and one-over" projects (after)	109	122,107	171,103	553	669,160

4.3 Test for Hypothesis 1

To test hypothesis 1, statistical tests were designed to learn whether growth of the green credit balance increases the growth rate of total loans.

Hypothesis 1: Green credit is an expanding product or service that grows at a faster rate than total loans.

4.3.1 Test Methodologies

Hypothesis 1 is tested through two techniques – descriptive analyses and random-effects GLS panel regression.

Descriptive Analyses

Descriptive analyses are commonly used in all types of statistical studies. Descriptive statistics of the "difference between growth rate of green credit to growth of total loans", including mean, standard deviation, skewness, and kurtosis, were calculated to analyze the distribution of the sample. The mean of this indicator tells whether the difference between the growth rate is significantly larger than 0%. The standard deviation (SD) can show the range of this indicator, assuming the data has a normal distribution. Skewness and kurtosis provide a measurement of symmetry (or lack of symmetry) and tail-heaviness of the sample. Overall, descriptive analyses provide a quick view of the indicator.

Random-Effects Panel Regression vs Fixed-Effects Panel Regression

The data used in this study were collected on 24 banks over time periods from 2009 to 2015, as both time and individual difference among banks are important factors. Time is an important factor because the idea is to analyze the effect on outcomes when the inputs change over time. Studying multiple targets allow for individual-specific factors to be built into the model.

The panel regression is a two-dimensional analysis (Madalla, 2001) which estimates outcomes from multiple target banks (i) across time horizon (t). This comprehensive methodology provides an overall view on green credit of the entire banking sector.

$$Y_{it} = \beta 0_{it} + \beta 1 X_{it} + u_{it}$$

With panel/longitudinal data, the most commonly estimated models are fixed-effects and random-effects models. In a fixed-effects model, it is assumed that there are some omitted variables that are

correlated with explanatory variables in the model. The fixed model provides a mean for controlling omitted variable bias. These omitted variables must be time-invariant (such as state-owned or city commercial banks), meaning that they should not be correlated with other individual characteristics. The idea is that the effects the omitted variables have on the subject at one point in time will also cause the same effect at a later point in time (Allison, 2009). In fixed models, the error term and the constant must not be correlated with other variables. Moreover, a fixed-effects model can be biased because of the incidental parameters problem (Neyman & Scott, 1948; Lancaster, 2000).

In contrast, a random-effects model is preferred because it analyzes two sources of variance – variance between subjects and variance within the subject over time (Kahane, 2007). The random-effects model assumes that differences across entities have an influence on the dependent variable, and omitted or unobserved variables are not correlated with the observed variables (Allison, 2009). Random-effects models are often measured via Generalized Least Squares (GLS). Greene (2012) suggests that the crucial distinction between fixed- and random-effects models is whether the unobserved individual effect contains elements that are correlated with the independent variables, not whether these effects are random.

Durbin-Wu-Hausman Test

The Durbin–Wu–Hausman test (Hausman, 1978), also known as the Hausman test, is a statistical hypothesis test in econometrics commonly used to decide between fixed- or random-effects models in the panel regression. The Hausman test evaluates the consistency of an estimator when compared to an alternative estimator which is already known to be consistent (Greene, 2012). The Hausman test investigates the null hypothesis – the random-effects model is preferred when compared to the fixed-effects model.

Breusch-Pagan Lagrange Multiplier (LM) Test for random-effects

The Breusch-Pagan Lagrange multiplier (LM) test is used to test whether a random-effects regression should be chosen over a simple OLS regression (Breusch & Pagan, 1979). The null hypothesis in the LM test is that variances across entities is zero (i.e., no panel effect). In other words, there is no significant difference across banks.

4.3.2 Test Model (Test 1)

Hypothesis 1 uses the following model for the GLS random effect panel regression test:

$$Y_{it} = \beta 0_{it} + \beta 1 X_{it} + u_{it}$$

Y_{it} represents the growth rate of total loan of each individual bank from 2009 to 2015. This dependent variable is calculated by:

$$Growth\ rate\ of\ total\ loans\ (t) = \frac{Total\ outstanding\ loans\ \ (t)}{Total\ loan\ outstanding\ (t-1)}$$

X_{it} represents the growth rate of the green credit of each individual bank from 2009 to 2015. This independent variable is calculated by:

$$Growth\ rate\ of\ \ green\ credit\ (t) = \frac{Total\ balance\ of\ \ green\ credit\ (t)}{Total\ balance\ of\ \ green\ credit\ (t-1)}$$

The expected outcome of the study is that the growth rate of green credit will increase the growth rate of total loans. This is supported by the literature mentioned in section 2.5.2 entitled, "Business opportunities".

4.4 Test for Hypotheses 2 and 3 – Two-Stage Estimation Model in Predicting Conceptual Model (Tests 2 and 3)

A Two-stage Least Square (2sls) estimation model is used to test hypothesis 2 and hypothesis 3.

Hypothesis 2: Allocating large shares of green credit to the loan portfolio reduces credit risk (i.e., NPL ratio of the bank).

Hypothesis 3: Allocating large share of loans to high-pollution, high-emission, and overcapacity industries to the loan portfolio increases credit risk (i.e., NPL ratio of the bank).

4.4.1 Test Methodologies

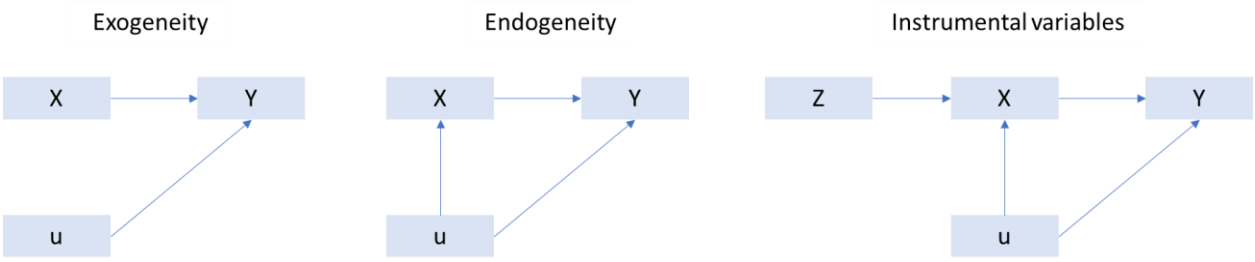
The statistical models incorporate Two-stage Least Square regression analysis with Granger causality (Granger, 1969). The Durbin-Wu-Hausman test (Hausman, 1978) is performed to test whether the 2sls model is more efficient than the random-effect model.

Two-stage Least Square Panel Regression

Many economic models involve endogeneity where a theoretical relationship does not fit into a Y-on-X regression (Wooldridge, 2013). Endogeneity can arise because of: 1) model misspecification or omitted variables; 2) measurement error; or 3) simultaneity (Wooldridge, 2013). The issue of endogeneity can cause a correlation between the explanatory independent variable and the error terms of the dependent variable (Greene, 2012), and render the test result (i.e., coefficient) a bias estimation. The conceptual framework suggests that it is the management's decision on green finance that influences final financial performance. Therefore, there might be some other sustainability practices that influence performance. However, these sustainability indicators are impossible to quantify and may not be directly related to performance.

The Two-stage Least Square (2sls) regression model is commonly used to deal with endogeneity through the use of instrumental variables. The instrumental variables must be correlated with the endogenous variables, but not correlated with the error term (Wooldridge, 2013).

Figure 4.2: Problem of Endogeneity



Two-stage least squares models are used when the dependent variables in the first and second stage models are continuous. The 2sls starts with replacing the endogenous variable with a predicted

version, formed by regressing this variable on all exogenous variables and the instrumental variables. The predicted endogenous variable is then used to regress the dependent variables. The actual regression is performed by Stata®.

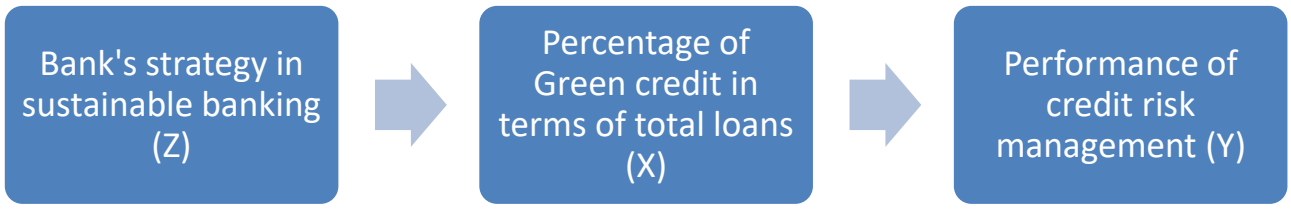
The basic 2sls model can be represented as:

$$\textit{First stage:} \quad \hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$$

$$\textit{Second stage:} \quad Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u \qquad \textbf{(Model 2)}$$

In this study, the first stage predicts what kind of characteristics related to sustainability (Z) a bank with a higher percentage of green credit (or loans to "two-high and one-over" industries) in terms of total loan (X) has. The second stage analyzes the effect of green credit (X) on the performance of credit risk management (Y). The advantage of this model is that it considers the percentage of green credit as an explanatory variable while keeping all other proven variables as exogenous variables. This may better test the effect of green credit on the performance of credit risk management.

Figure 4.3: Two-Stage Least Square Estimation Model



The 2sls model has been developing since the 1950s in econometrics in the context of simultaneous equation models (Basmann, 1957). It has been used in many studies related to voluntary environmental programs (e.g., Khanna & Damon, 1999; Rivera & De Leon, 2005; Lin, 2012).

Durbin-Wu-Hausman test for endogeneity

Two-stage estimation models are not always better than linear models in determining correlation between two variables because of inefficiency problem (Greene, 2012). The Durbin-Wu-Hausman test is used here to determine whether 2sls models are better than the alternative (i.e., random-effects model). The Hausman test examines whether the endogeneity for two-stage models is present. If the endogeneity does not exist, then the two-stage model is considered unnecessary, and a random-effects model (Model 1) should be used. Correspondingly, the Breusch-Pagan Lagrange multiplier (LM) test is used to validate the random-effects model.

$$Y_{it} = \beta 0_{it} + \beta 1 X_{it} + u_{it} \qquad \textbf{(Model 1)}$$

Granger causality

Some studies suggest that there is a delay between sustainability performance and financial performance (Weber, 2016). Louzis et al. (2012) and Ghosh (2015) also found the persistence of a lagged effect on NPL ratios. In fact, all loans (including green loans) are unlikely to default during the same year of issuance. Therefore, a lag between green finance and NPL ratio are used to analyze Granger causality (Granger, 1969). To reduce the complexity, only the lagged effect of independent variables (proportion of green credit in test 2 and proportion of loans to "two-high and one-over" industries in test) are tested. Independent variables in year t-1 (Model 3), year t-2 (Model 4), and year t-3 (Model 5) were used, respectively, to measure the dependent variables in year t.

4.4.2 Variables and Test Models (Tests 2 and 3)

The 2sls model used in the test for hypotheses 2 and 3 can be represented as:

First stage: $\hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$

Second stage: $Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u$ **(Model 2)**

$\hat{X}$ represents the predicted management's decision on the proportion of green credit in terms of total loans (or proportion of loans to "two-high and one-over" industries in test 3).

Y represents the NPL ratio of the bank.

Z represents the instrumental variables.

W represents the exogeneous variables. There are multiple exogeneous variables. Each variable has its corresponding coefficient.

The basic 2sls estimation model is composed of the dependent variable (Y), endogenous variables (X), instrumental variables (Z), and exogeneous variables (W). The test models utilized research from Berger and DeYoung (1997), Louzis et al. (2010), and Ghosh (2015), adding green credit into their concepts. The actual variables are explained as follows:

A. Dependent variable

NPL ratio

The "NPL ratio" is the dependent variable of this model. Year-end NPL ratio is used to reflect the financial performance at a fixed point of time.

The NPL ratio is calculated as $NPL\ ratio = \frac{NPL\ (year-end)}{Total\ loan\ oustanding\ (year-end)}$

B. Endogenous variables

Proportion of green credit to total loans (Test 2 only)

The endogenous variables – the proportion of green credit (POGC) to total loans is also the explanatory variable for the dependent variable. The POGC is the predicted management's decision on the proportion of green credit in terms of total loans based on their strategy in sustainable banking. The POGC is expected to negatively influence the NPL ratio given that green credit has minimal environmental risks.

$$POGC = \frac{Green\ credit\ balance\ (year-end)}{Total\ outstanding\ loans(year-end)}$$

Proportion of "two-high and one-over" loans to total loans (Test 3 only)

Proportion of "two-high and one-over" (POTO) represents a bank's loan to non-environment-friendly industries. A large percentage denotes that a bank has less intention in "going green". These loans have more exposure to environmental risk. Therefore, having a large number of "two-high and one-over" loans raises the NPL ratio.

$$POTO = \frac{\text{"Two} - \text{high and one} - \text{over balance"}\ (year - end)}{Total\ outstanding\ loans(year - end)}$$

C. Instrumental Variables (IV)

Type of bank

The type of bank matters due to government influence. Managers who act on the best interests of their shareholders implement shareholders' orders. As explained in section 3.1.3, those banks that have strong connections with the government are more responsive to the Green Credit Policy than those that do not (Table 3.3). Apparently, policy banks are anticipated to help with policies. Their sole purpose is to complement the nation's development plan. National joint-stock banks are also influenced by the government to a certain degree. City commercial banks are even less responsive to the Green Credit Policy. Over interventions from local governments (Cai, 2015) render green credit less favorable to their local customers. The Postal Savings Bank of China and rural commercial banks, on the other hand, have different specializations, though green agriculture is emerging as one of the green credit products. Nevertheless, bank type does not evidently influence NPL ratios. Therefore, the type of bank is coded as an instrumental variable on an ordinal scale of 1 to 5 (Table 4.6). The higher the code, the more attention management pays to the green credit. However, the ordinal scale suggests that the actual effect is not as large as the difference in scale.

Table 4.6: Coding of Bank Type

Type of Bank	Coding	Number in the sample
Policy banks	5	1
State-owned commercial banks	4	5
National joint-stock commercial banks	3	10
Postal Savings Bank	2	0
City commercial banks	1	8
Rural commercial banks	0	0

D. Exogenous Variables

Credit quality

The credit quality (or 'loan loss provision-to-total loans') indicator reflects a bank's credit quality. The theory for this indicator is the 'moral hazard hypothesis'. This hypothesis was first introduced by Keeton and Morris (1987) who argued that moral hazard, such as incentives, would increase the riskiness of the loan portfolio. The indicator is proven to have a significant positive influence on NPL ratio (Ghosh, 2015; Louzis et al, 2012).

$$CQ_{it} = \frac{Loan\ loss\ provision_{it}}{Total\ loans_{it}}$$

Return on assets (ROA)

According to Berger and DeYoung's (1997) 'bad management' hypothesis, managers with poor skills often do no monitor their loans very well. In fact, having less NPL means keeping more profits. Higher ROA is expected to be found in banks with a lower NPL ratio.

$$ROA_{it} = \frac{Net\ profits_{it}}{Total\ equity_{it}}$$

Inefficiency

The cost efficiency effect is controversial. The 'skimping hypothesis' and 'bad management hypothesis' (Berger and DeYoung, 1997) both apply to this indicator. The 'skimping hypothesis' demonstrates that banks with fewer resources to monitor loans are more cost-efficient. Conversely, the 'bad management hypothesis' argues that substandard managers often give out low quality loans. These two effects offset each other, so the overall effect is ambiguous.

$$INFF_{it} = \frac{Operating\ expenses_{it}}{Operating\ income_{it}}$$

Solvency

The solvency ratio measures a bank's leverage. It represents a bank's attitude towards risk. Similarly, banks suffering a 'moral hazard' issue typically have low-capitalization as the manager attempts to provide more loans while ignoring the riskiness of the loans (Berger & DeYoung, 1997). Reluctantly providing loans increases the asset and liability simultaneously, but the shareholder's equity is not increased. This ultimately increases the bank's leverage. Therefore, the solvency ratio is used to reflect the bank's leverage, as a low solvency ratio indicates a 'moral hazard' issue.

$$SOLR_{it} = \frac{Total\ equity_{it}}{Total\ assets_{it}}$$

Size

The 'too-big-to-fail hypothesis' underlines the importance of this indicator. In larger markets, banks commonly take excessive risks as they may seek government protection in the case of failure (Stern & Feldman, 2004). Therefore, this indicator is expected to influence the NPL ratio positively.

$$SIZE_{it} = \frac{Total\ assets_{it}}{\sum_{i=1}^{24} Total\ assets_{it}}$$

Table 4.7: Summary of Variables and Expected Results

Variables	Description	Expected results
NPL ratio	$NPLR_{it} = \frac{Green\ credit\ balance_{it}}{Total\ loans_{it}}$	Dependent variable
POGC **(Test 2 only)**	$\boldsymbol{POGC_{it} = \frac{Green\ credit\ balance_{it}}{Total\ loans_{it}}}$	**'Environmental risk' (-)**
POTO **(Test 3 only)**	$\boldsymbol{POTO_{it} = \frac{Two - high\ and\ one - over_{it}}{Total\ loans_{it}}}$	**'Environmental risk' (+)**
Credit quality	$CQ_{it} = \frac{Loan\ loss\ provision_{it}}{Total\ loans_{it}}$	'Moral hazard' (+)
Return on assets	$ROA_{it} = \frac{Net\ profits_{it}}{Total\ equity_{it}}$	'Bad management II' (-)
Inefficiency	$INFF_{it} = \frac{Operating\ expenses_{it}}{Operating\ income_{it}}$	'Bad Management' (+) 'Skimping' (-)
Solvency ratio	$SOLR_{it} = \frac{Total\ equity_{it}}{Total\ assets_{it}}$	'Moral hazard' (-)
Size	$SIZE_{it} = \frac{Total\ assets_{it}}{\sum_{i=1}^{24} Total\ assets_{it}}$	'Too-big-to-fail' (+)
Type of bank	Ordinal scale of 1 to 5	Government influence (+)

In **Test 2**, **Model 1** (regular panel regression), **Model 2** (2sls), and **Models 3, 4, 5** test whether banks with a larger proportion of green credit have a lower NPL ratio. In **Model 1**, preferably the random-effects panel regression is used to compare against the two-stage model (**Model 2**). **Models 3, 4, 5** test whether the green credit has a significant lagged effect.

Table 4.8: Statistical Test Model for Hypothesis 2

	Model 1 Random-effects (RE)	Model 2 2sls	Models 3, 4, 5
Equation	$Y_{it} = \beta_{it} + \beta 1 X_{it} + u_{it}$	$\hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$ $Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u$	$\hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$ $Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u$
Dependent variable	NPLR	NPLR	NPLR
Independent variables (RE) / Endogenous variables (2sls)	POGC	POGC	POGC in year t-1, year t-2, and year t-3
Instrumental variables	N/A	Type of bank	Type of bank
Control variables	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size

In Test 3, all the models remain the same, expect that the independent variables or endogenous variables are replaced with POTO.

Table 4.9: Statistical Test Model for Hypothesis 3

	Model 1 Random-effects (RE)	Model 2 2sls	Models 3, 4, 5
Equation	$Y_{it} = \beta_{it} + \beta 1 X_{it} + u_{it}$	$\hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$ $Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u$	$\hat{X} = \gamma 0 + \gamma 1 Z + \gamma 2 W + u$ $Y = \beta 0 + \beta 1 \hat{X} + \beta 2 W + u$
Dependent variable	NPLR	NPLR	NPLR
Independent variables (RE) / Endogenous variables (2sls)	POTO	POTO	POTO in year t-1, year t-2, and year t-3
Instrumental variables	N/A	Type of bank	Type of bank
Control variables	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size	Credit quality, ROA, inefficiency, non-interest ratio, solvency, size

Chapter 5
Results and Findings

This chapter presents the test results of the statistical model as well as the descriptive statistics.

5.1 Test Results of Hypothesis 1

The descriptive statistics and regression models both confirm *"Hypothesis 1: Green credit is an expanding product or service that grows at a faster rate than total loans".*

Descriptive statistics

The descriptive statistics of the "difference between growth of green credit to growth of total loans" (mean, standard deviation, skewness, kurtosis, and count) of the banks in the sample are presented in table 5.1. The "difference between growth of green credit to growth of all loans" is calculated by growth of green credit minus growth of total loans, if both data are available for the same year.

The descriptive statistics suggest that green loans grow at a faster rate than the total amount of loans in the sample. However, the high standard deviation suggests that the actual difference between the growth rate varies widely among banks – green credit grows rapidly compared to total loans in some banks while green credit may grow slower in other banks. The positive skewness above 1 suggests that the data is positively skewed, or right-hand tailed. Meanwhile, the positive kurtosis suggests that the data is peaked, meaning that the data have more weight in the tails.

If the data is broken down based on a bank's type, the data reflects that state-owned banks and city commercial banks enjoy more growth from green credit than joint-stock commercial banks. The joint-commercial has a slow-down trend in 2014 and 2015. City commercial banks, on the other hand, were very slow in the development of green credit pre-2012, but then caught up quickly. In fact, the difference between the green credit growth and the growth of total loans of city commercial banks was at its largest in 2014 and 2015.

Table 5.1: Descriptive Statistics for Difference Between Growth of Green Credit and Total Loans

	YEAR	MEAN	SD	SKEWNESS	KURTOSIS	COUNT
ALL	2009	73.60%	141.83%	1.677	1.591	8
	2010	4.70%	56.58%	1.872	6.367	13
	2011	4.40%	22.12%	-0.549	0.692	17
	2012	86.70%	185.91%	2.413	5.690	20
	2013	25.06%	66.02%	2.916	10.214	23
	2014	24.98%	70.91%	3.008	11.032	23
	2015	18.70%	57.05%	3.725	15.953	23
STATE-OWNED (5 IN TOTAL)	2009	-5.59%	5.60%	N/A	N/A	2
	2010	-5.14%	13.79%	0.423	-2.183	5
	2011	11.36%	14.72%	1.023	0.184	5
	2012	4.86%	30.82%	1.960	3.988	5
	2013	37.91%	54.70%	0.590	-2.971	5
	2014	2.09%	17.63%	1.392	1.944	5
	2015	19.81%	17.21%	-0.250	-2.173	5
JOINT-STOCK (10 IN TOTAL)	2009	154.01%	172.28%	0.476	-3.301	4
	2010	12.66%	93.26%	1.363	2.996	5
	2011	-0.90%	28.23%	-0.270	-0.250	8
	2012	136.12%	245.13%	1.728	2.118	10
	2013	28.75%	91.28%	2.832	8.354	10
	2014	6.39%	21.45%	0.856	0.766	9
	2015	-2.91%	19.70%	0.955	0.525	9
CITY (8 IN TOTAL)	2009	-8.32%	N/A	N/A	N/A	1
	2010	-2.10%	38.04%	N/A	N/A	2
	2011	4.95%	20.99%	1.393	N/A	3
	2012	84.08%	127.27%	1.589	2.366	4

	2013	14.98%	32.48%	0.295	-0.213	7
	2014	57.15%	114.06%	1.644	2.988	8
	2015	45.47%	90.03%	2.466	6.437	8

Figure 5.1 converts the data from Table 5.1 into a graph. The difference in growth peaked in 2009 and 2012 and remained relatively steady after 2013, which coincides with the timeline of the major Green Credit Policies – Guidelines on CSR for the Chinese banking sector in 2009, Guidelines on Green Credit in 2012, and the KPI of Green Credit Implementation in 2014 (see Table 3.3 for reference). This indicates that banks were responding to these policies when they were issued. Figure 5.2 compares the sum of green credit balance and the sum of total loans using an index of 100 based on year 2009. The indexed figure enables direct comparison between the accumulated rates of green credit and total loans. The growth rate of total loans is quite steady during this period, but the growth rate of green credit balance is much faster. This is also the reason why the spread between the index gets wider in the end.

Overall, the descriptive data show faster growth of green credit when compared to the growth of total loans. The difference between the growth rate is within 25% to 50% over the seven-year period, but the spread is decreasing during this period (Figure 5.2).

Figure 5.1: Difference between Growth of Green Credit and Growth of Total Loans

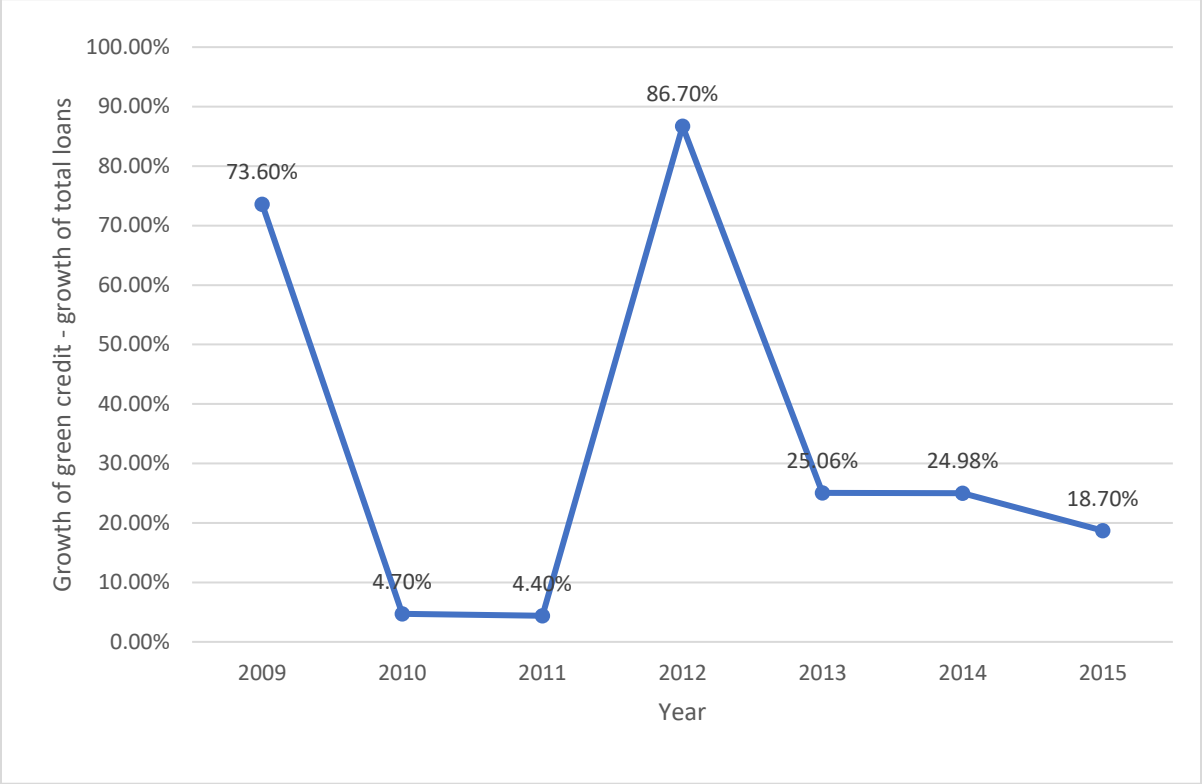
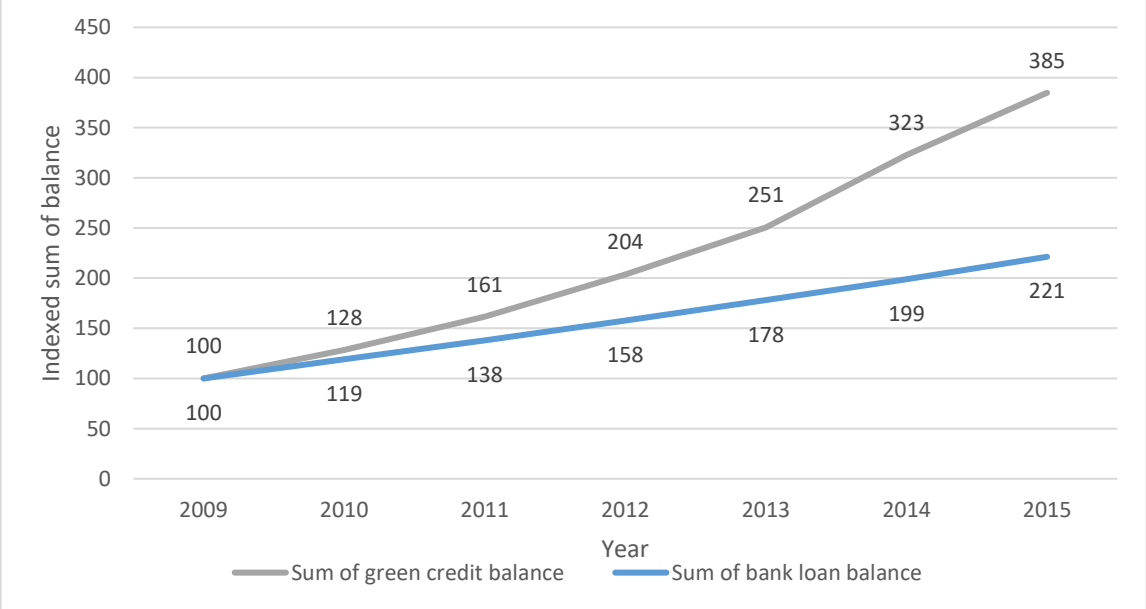


Figure 5.2: Indexed Sum of Balance (24 Banks)



Regression Analysis for Hypothesis 1 (Test 1)

Generalized least squares (GLS) panel regression is employed to test hypothesis 1. The model is built to find the relationships between growth of total loans (dependent variable) and growth of green credit (independent). The results of the test may help to justify the observations from the descriptive statistics.

$$Y_{it} = \beta_{it} + \beta 1 X_{it} + u_{it}$$

where Y_{it} represents the growth rate of total loans and X_{it} represents the growth rate of green credit.

H_0: There is no statistically significant correlation between the growth of green loans and the growth of total loans.

The test results from the GLS random-effects panel regression (Table 5.2) show that a 1% increase in green credit increases the total loans by 0.014% at a significance level of 5.4%. Although the significance level is fairly close to 5%, the results from this model are not sufficient to confirm that the increase in the growth rate of green credit will increase the growth rate of total loans. Alternatively, other regression methodologies are viewed to see whether there is a better statistical model for Test 1.

Table 5.2: Test Results of Panel Regression Analysis for Hypothesis 1 (Test 1)

Growth of total loans	**Coefficient**	**SD**	**P>z**
Growth of green credit	0.014	0.007	0.054
Constant	0.172	0.008	0.000*
R-sq Sig	0.0313 0.0541		

Coefficient significance: *P<0.05

The results of the Hausman test (Table 5.3) are in favor of the random-effects model over the fixed-effects model. The p-value is 0.2580, which is much larger than 0.05. However, the result from the

LM test (Table 5.4) suggests that there is no evidence of a significant difference across banks. Therefore, a pooled Ordinary Least Square (OLS) regression (Table 5.5) is sufficient for this test.

Table 5.3: Hausman Test Results for Random-Effects Model

Coefficients	(b)	(B)	(b-B)	Sqrt (diag(V_b-V_B))
	Fixed	Random	Difference	S.E.
Growth of green credit	0.0101866	0.0136874	-0.0035008	0.0033589
b = consistent under Ho and Ha; obtained from xtreg				
B = inconsistent under Ha, efficient under H_0; obtained from xtreg				
Test: H_0: difference in coefficients not systematic				
chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)= 1.09				
Prob>chi2 = 0.2973				

Table 5.4: Breusch and Pagan Lagrangian Multiplier (LM) Test for Random-Effects

Growth of total $loans_{it}$ = Xb + u_i + e_{it}		
Estimated results	Var	SD=Sqrt(Var)
Growth of total loans	0.0064919	0.0805723
e	0.0061269	0.0782748
u	0.0002305	0.0151823
Test: Var(u) = 0		
chibar2(01) = 0.07		
Pro>chibar2 = 0.3971		

Table 5.5: Test Results of OLS Regression Analysis for Hypothesis 1 (Test 1)

Growth of total loans	**Coefficient**	**SD**	**P>z**
Growth of green credit	0.014	0.007	0.047*
Constant	0.172	0.008	0.000*
R-sq Sig	0.0313 0.0467		

Coefficient significance: *P<0.05

Conversely, the more effective pooled OLS regression (Table 5.5) finds a significant effect of the growth of green credit. In fact, the OLS model has an identical coefficient and standard deviation with the random-effects panel regression, but the OLS model shows a slightly stronger level of significance. The result from the OLS model also suggests that a 1% increase in green credit increases the total loans by 0.014%, but at a significance level under 5%.

The result from the OLS model confirms that an increase in the growth rate of green credit will lead to a faster growth rate of total loans. Combining the results from the OLS model and the descriptive data, these results demonstrated that green credit is a fast-growing product or service which increases growth rate of total loans for the banks.

5.2 Test Results for Hypothesis 2

The results from the preferred 2sls panel regression models confirm *"Hypothesis 2: Allocating large shares of green credit to the loan portfolio reduces credit risk (i.e., NPL ratio of the bank).* The descriptive statistics and correlation matrix of the data was conducted before running the test models (Tables 5.6 and 5.7).

Table 5.6: Descriptive Statistics for Test 2

Variable	Obs	Mean	SD	Min	Max
NPL ratio	168	0.0097327	0.0042845	0.001	0.0291
POGC	168	0.0342357	0.0371159	0.0001	0.2215
Credit quality	168	0.0239427	0.005936	0.011001	0.045258
ROA	168	0.010947	0.0022033	0.0029	0.0167
Inefficiency	168	0.4292731	0.1110364	0.284463	0.938463
Solvency	168	0.0593432	0.0105749	0.033294	0.087589
Size	168	0.0416195	0.0520565	0.0007034	0.1950136
Type of bank	168	2.625	1.255825	1	5

Table 5.7: Correlation Matrix of Variables Related to Test 2

Variable	1	2	3	4	5	6	7	8
1.NPL ratio	1.000							
2.POGC	-0.021	1.000						
3.Credit quality	0.543*	0.288*	1.000					
4.ROA	-0.151*	0.065	-0.003	1.000				
5.Inefficiency	-0.006	-0.207*	-0.053	-0.430*	1.000			
6.Solvency	0.068	0.185*	0.148*	0.530*	-0.306*	1.000		
7.Size	0.347*	0.363*	0.326*	0.291*	-0.154*	0.295*	1.000	
8.Type of bank	0.201*	0.484*	0.160*	-0.098	-0.076	0.081	0.706	1.000

Coefficient significance: *P<0.05

Regression analysis for Hypothesis 2 (Test 2)

Test 2 uses a series of regression analysis techniques to test the following hypothesis:

H_0: Allocating more green credit to the loan portfolio does not have a significant impact on the NPL ratio of the banks.

Test results from both Model 1 random-effects model (RE) and Model 2 two-stage least square model (2sls) find significant effects of the POGC (Table 5.8). That is, banks with a larger POGC have a lower NPL ratio. Thus, Hypothesis 2 is confirmed – allocating large share of green credit to the loan portfolio reduces the NPL ratio of the banks.

Table 5.8: Test Results of Hypothesis 2 (Test 2)

	Model 1 (RE)	**Model 2 (2sls)**	
	NPLR	First stage (POGC)	Second stage (NPLR)
POGC	**-0.022(0.010)****		**-0.076(0.038)****
Type of bank (IV)		0.015(0.004)***	
Credit quality	0.326(0.053)***	1.904(0.375)***	0.416(0.085)***
ROA	-0.950(0.158)***	0.261(1.211)	-1.041(0.177)***
Inefficiency	-0.008(0.004)**	-0.061(0.028)**	-0.012(0.005)***
Solvency	0.052(0.028)*	0.243(0.206)	0.067(0.032)**
Size	0.029(0.008)***	-0.086(0.093)	0.039(0.012)***
Constant	0.012(0.003)***	-0.038(0.028)	0.013(0.004)***
Model significance	P=0.0000	P=0.0000	
R-sq	0.4196	0.4061	
Obs	168	168	

Coefficient significance: *P<0.10, **P<0.05, ***P<0.01

The results of the Hausman test (Table 5.9) provide the existence of endogeneity. Therefore, the 2sls model (Model 2) should be used over the random-effects model. The 2sls model shows that a 1% increase in the POGC will reduce the NPL ratio of the bank by a 0.00076 percentage point at a significance level of 5%.

Table 5.9: Hausman Test Results for Random-effects Model

Coefficients	(b)	(B)	(b-B)	Sqrt (diag(V_b-V_B))
	2sls	RE	Difference	S.E.
POGC	-.0761466	-0.0219975	-0.0541491	0.027024
Credit quality	0.4158093	0.3258913	0.089918	0.0377025
ROA	-1.040637	-0.0949626	-0.0910114	.
Inefficiency	-0.0124764	-0.0079633	-0.0045132	0.0005863
Solvency	0.0674108	0.0516749	0.0157359	.
Size	0.0393245	0.0291683	0.0101561	0.0027789
b = consistent under Ho and Ha; obtained from xtivreg				
B = inconsistent under Ha, efficient under H_0; obtained from xtreg				
Test: H_0: difference in coefficients not systematic				
chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)= 3.82				
Prob>chi2 = 0.7008 (V_b-V_B is not positive definite)				

Finally, in order to test whether Granger causality (Granger, 1969) exists between POGC and NPL ratio, the dependent variables (NPL ratio) was measured by using POGC in year t-1, t-2, and t-3 in Model 3, 4 , and 5 resptively. The results reveled no significance in Models 3, 4 and 5 (Table 5.10). Therefore, POGC is not a granger cause of NPL ratio. Green credit is unlikely to default during the same year of issuance. The addition of non-default loans to the total loan portfolio dilutes the NPL ratio in the same year with corresponding effects. Therefore, the increment in the POGC should have the strongest influence on the NPL ratio in the same year. Nonetheless, the most efficient model – 2sls model (Model 2) - confirms that allocating more green credit to the loan portfolio reduces the NPL ratio of the banks.

In addition, most exogenous variables are found to have a significant effect on the NPL ratio of the banks. This confirms the validity of the models, as well as most findings in previous literature. In Model 2, the effects of ‘credit quality’, ‘ROA’, ‘size’, and ‘type of bank’ are all aligned with the expected results; the positive result from ‘inefficiency’ suggests that the effect of ‘bad management’ is greater than the effect of ‘skimping’; but the result from ‘solvency’ is contradictory to the expected results.

Table 5.10: Test Results of Hypothesis 2 Con't: Lagged Models (Test 2)

	Model 3 t-1 (2sls)		**Model 4 t-2 (2sls)**		**Model 5 t-3 (2sls)**	
	First stage (POGC)	Second stage (NPLR)	First stage (POGC)	Second stage (NPLR)	First stage (POGC)	Second stage (NPLR)
$POGC_{t-1}$		**-0.050**				
$POGC_{t-2}$				**-0.032**		
$POGC_{t-3}$						**-0.033**
Type of bank (IV)	0.013***		0.012***		0.011***	
Credit quality	1.730***	0.392***	1.270***	0.358***	1.224***	0.284***
ROA	-0.677	-0.937***	-0.235	-0.832***	-0.284	-1.025***
Inefficiency	-0.052*	-0.013***	-0.036	-0.008**	-0.019	-0.007*
Solvency	0.370*	0.139***	0.469**	0.158***	0.549**	0.193***
Size	-0.040	0.022*	-0.039	0.014	-0.023	0.014
Constant	-0.035	0.008**	-0.045	0.004	-0.056*	0.006
Model significance	P=0.0000		P=0.0000		P=0.0000	
R-sq	0.4191		0.3807		0.3703	
Obs	144		120		96	

Coefficient significance: *P<0.10, **P<0.05, ***P<0.01

5.3 Test Results for Hypothesis 3

Exactly the same statistical tests as Test 2 were run on the Proportion of "two-high and one-over" (POTO) (Table 5.11 and 5.12). None of the models show a significant effect of POTO on the NPL ratio. In fact, the increment in POTO without lag and with a 1-year lag reduces the NPL ratio, while incremental in POTO with 2-year and 3-year increases in NPL ratio. This may suggest that loans to "two-high and one-over" industries are likely to default after two to three years. Nonetheless, none of the models show enough evidence that allocating fewer loans to "two-high and one-over" industries will reduce the NPL ratio of the bank.

Table 5.11: Test Results of Hypothesis 3 (Test 3)

	Model 1 (RE)	**Model 2 (2sls)**	
	NPLR	First stage (POGC)	Second stage (NPLR)
POTO	**-0.011(0.009)**		**-0.048**
Type of bank (IV)		0.007(0.005)	
Credit quality	0.315(0.045)***	-0.925(0.483)**	0.278(0.084)***
ROA	-1.305(0.163)***	0.477(1.890)	-1.321(0.178)***
Inefficiency	-0.002(0.002)	-0.034(0.029)	-0.004(0.005)
Solvency	0.084(0.036)**	-1.696(0.362)***	0.020(0.126)
Size	0.026(0.006)***	0.096(0.088)	0.033(0.014)**
Constant	0.013(0.003)***	0.159(0.040)***	0.020(0.014)
Model significance	P=0.0000	P=0.0000	
R-sq	0.6455	0.5951	
Obs	109	109	

Coefficient significance: *P<0.10, **P<0.05, ***P<0.01

Table 5.12: Test Results of Hypothesis 3 Con't: Lagged Models (Test 3)

	Model 3 t-1 (2sls)		**Model 4 t-2 (2sls)**		**Model 5 t-3 (2sls)**	
	First stage (POGC)	Second stage (NPLR)	First stage (POGC)	Second stage (NPLR)	First stage (POGC)	Second stage (NPLR)
$POTO_{t-1}$		**-0.111**				
$POTO_{t-2}$				**0.015**		
$POTO_{t-3}$						**0.029**
Type of bank (IV)	0.014		0.011*		0.016**	
Credit quality	-2.194***	0.054	0.780	0.337***	1.031	0.357***
ROA	-0.470	-1.241***	1.976	-0.970***	4.833**	-1.085***
Inefficiency	0.104**	-0.003	-0.052	-0.002	-0.034	-0.002

Solvency	-1.300***	0.047	-1.347***	0.266***	-1.58***	0.339***
Size	0.108	0.048	-0.087	-0.002	-0.173	-0.012
Constant	0.105*	0.025	0.098	-0.003	0.060	-0.007
Model significance	P=0.0000		P=0.0000		P=0.0022	
R-sq	0.3304		0.6322		0.5608	
Obs	92		77		61	

Coefficient signifiance: *P<0.10, **P<0.05, ***P<0.01

Chapter 6
Conclusion

This section further discusses the results from this study. The justification, implications, and limitations of the results are explained. Furthermore, future research opportunities are suggested.

6.1 Summary of Results and Justification

This thesis researched the topic of green finance from the banks' perspective while specifically studying the Chinese banking sector, a rapid growing market of green finance. The financial performance and green finance performance of 24 banks from 2009 to 2015 were collected and tested with panel regression techniques such as Two-stage Least Square Regression Analysis (2sls) and Random-effect Panel Regression (RE).

The results justify that there are financial incentives for banks to continue to provide green credit. The results of the regression analyses indicate that: 1) green credit is an expanding product or service that grows at a faster rate than total loans; and 2) allocating large shares of green credit to the loan portfolio can reduce credit risk (i.e., NPL ratio of the bank). However, the study failed to confirm that allocating fewer shares of loans to high-pollution, high-emission, and overcapacity industries can decrease NPL ratio.

The result of the first test demonstrates that an increase in the growth rate of green credit has a positive effect on the growth rate of total loans, and that for every 1% increase in green credit, total loans grow by 0.014%. In addition, the descriptive statistics show that the growth rate of green credit is always faster than the growth rate of total loans for the period of 2009 to 2015. This result implies that green loans can create opportunities for banks to grow their loan business.

This result is in line with study from Aizawa and Yang (2010). Aizawa and Yang (2010) suggested that there are business opportunities for the banking sector in renewable energy projects and carbon financing. Banks are willing to offer credit, especially in the early years of a business to gain the first mover advantage (FMA) (Weber, 2014b). With these new business opportunities, banks can achieve a win–win situation in both financial and sustainability performance (Schaltegger & Wagner, 2011). In

fact, the findings are in line with the objective of the Green Credit Policy; namely, having commercial banks offer more green loans as a proportion of their total loans. The test results confirm that the Green Credit Policy is an effective policy which accomplishes positive outcomes through its implementation.

Although the Chinese government has been making efforts to solve environmental issues, the nation still needs more infrastructure for environmental protection. This creates a huge demand for green loans, and the banks, in turn, benefit through these opportunities to grow their loan business.

The result of the second test demonstrates that an increase in green credit to total loans has a negative effect on NPL ratio (i.e., the increase reduces NPL ratio). This finding suggests that banks can accomplish better risk management performance by adding more sustainable or environment-friendly investments into their loan portfolio.

The test results are in line with other empirical studies which find a positive correlation between sustainability performance and borrowers' credit risk (Bauer & Hann 2010; Goss & Roberts 2011; Weber, 2016). The test results are also in line with the suggestion by Weber et al. (2015), though the results cannot directly confirm that the banks are able to achieve better risk management performance because of lower environmental risk (Thompson, 1998).

In China, subsidies and stimulus packages are offered to encourage projects for energy conservation, emission reduction, and ecological environmental protection, as this will reduce the risk of the investment dramatically. For instance, the transmission cost of renewable energy is typically very high, so electricity suppliers are less willing to take on these renewable energies. However, the National Grid, a state-owned enterprise, has been forced to purchase from these renewable energy generators at a decent price. With subsidies like this, green loans are even less likely to fail. Some scholars have questioned the business model of renewable energy projects, as the government may withdraw the subsidies, often without any advanced notice. However, with expectations of higher cost of thermal power and lower cost of renewable energy, renewable energy projects are likely to be more competitive even without subsidies.

The third test shows the effect on NPL ratio of allocating more high-pollution, high-emission, and overcapacity loans to the total loan portfolio. The idea for this model is also derived from the standpoint of environmental risk (Thompson, 1998). While the result from Test 2 confirms that having more environment-friendly projects can lower the NPL ratio of the bank, there is no empirical

evidence, however, to show that an increase in the number of polluting projects will increase the NPL ratio.

The test results are in contrast with the studies that found a positive correlation between sustainability performance and financial performance (Bauer & Hann 2010; Goss & Roberts 2011; Weber, 2016). The results also deny the role of environment risk (Thompson, 1998) in polluting industry investments.

In practice, loans to "two-high and one-over" industries do not necessarily have a greater chance to default. High-pollution and high-emission corporations may choose to install pollution treatment plants to be compliant with regulations. The installation of additional treatment plants may require funding and increase the cost of doing business, but consequently, corporations are unlikely to become bankrupt. Corporations in the overcapacity industries are anticipated to make transitions. They could either divert their business into other fields, or simply cut down their outputs. In fact, good financial performance can still be achieved with proper management. As a result, carrying more "two-high and one-over" loans may not necessarily increase NPL ratio.

In addition, the instrumental variable (type of banks) has a significant effect on how much green credit a bank allocates. Banks with large amounts of shares controlled by the State and SOEs, such as policy banks and state-owned commercial banks, are more willing to allocate a large proportion of green credit, according to the test results in the two-stage model. This is in line with suggestions from Lardy (2008) and Zhang et al. (2011) – stated owned commercial banks may be an extension of the country's policy in helping achieve the main economic target.

In contrast to previous studies on NPL by Louzis et al. (2012) and Ghosh (2015), as well as study on the correlation between sustainability performance and financial indicators by Weber (2016), this study did not find a lagged effect between green credit performance, including both green credit and "two-high and one-over" and NPL ratio. The lagged effect happens to normal loans because they are unlikely to default during the same year of issuance. The non-existence of the lagged effect may suggest that green loans are less likely to default even after several years of borrowing. It turns out that the addition of non-default loans to the total loan portfolio dilutes the NPL ratio in the same year, but has no further effect in later years. Therefore, the increment in proportion of green credit should have the strongest influence on NPL ratio in the same year.

With respect to the study on the Green Credit Policy in China, the major contribution of this paper is that it closes the literature gaps in empirical studies from the banks' perspective. Most studies, including Cai (2015), Hu and Cao (2011), and Wei, (2010) to name a few, have focused on policy analyses, but have not looked at the policy from the lenders' perspective. A quantitative study from Zhao (2015) analyzed the benefit of the Green Credit Policy at a macro level only. This study broadens the literature by adding empirical evidence that green loans can create financial benefit for banks in China.

6.2 Implications

This case study of the Chinese banking sector has looked at green finance from the banks' perspective. The conceptual framework (Figure 2.2) suggests that managers who seek better financial performance may choose to grow their loan business and minimize default risk. As green loans offer new business opportunities and come with lower risks, managers are encouraged to issue more green loans because of these financial incentives. Ultimately, the issuance of green loans increases the growth of business and reduces the default risk of the loan portfolio, thus achieving the stronger financial performance that managers look for.

While financial incentives and risk management are proven to be the reason why banks participate in green finance activities, it would be crucial to understand how this finding might be used to achieve the goal of the research. That is, to find out how to enable more green loans globally. In fact, the findings may be implied in two different ways.

First, green finance is proven to have financial benefits to banks, but not all bank managers have come to realize this. As mentioned by Cai (2015), some banks treat green loans as they would normal loans (but only for environment-friendly projects). Many managers do not choose to integrate environmental risk management into their daily business, because they fail to recognize the importance of environmental risk management. Other banks in developing countries might not have realized the opportunities from green economy transition. Environment issues are simply not creating concerns in these countries, so banks are less aware of the potential opportunities. Therefore, promoting the financial benefits of green loans to banks managers would potentially encourage more banks to participate in green finance activities.

Second, the rapid growth of green finance in China has been achieved through the issuance of the Green Credit Policy, and other related regulations and incentives. This may also imply that the outcome of these policies, regulations and incentives is proving positive. After all, the banking sector is not the pioneer of green finance in China. Effective policies, regulations, and incentives are the main reason why this successful framework is in place. Therefore, instead of waiting for financial institutions to take action, policy-makers may also consider utilizing the policies, regulations and incentives that have proven effective outcomes in China.

6.3 Limitations

While the greatest effort has been made to ensure that the best results are presented, there are still some limitations in this research.

One major limitation is the availability of data. As explained in Section 4.2.2, the lack of green finance data created the biggest challenge to this study. Despite the fact that the most relevant estimation method is used for data imputation, the results are still based on a few estimated variables. It is not a true presentation of the reality, rather it is the closest presentation. Moreover, only few a KPIs of green credit implemented are available. Even for those banks that published the data, the data were only available for several financial periods. Therefore, this thesis is not able to perform a comprehensive analysis based on different KPI on green finance implementation. For example, green credit data based on project types are not available, so this thesis is not able to see if providing more green credit to certain sectors would create an even lower NPL ratio.

Although NPL ratio is a good indicator of how much credit risk a bank is taking, it may still be biased because the sale of non-performance loans can reduce the NPL ratio. Even though the period when banks dumped their NPLs to asset management companies had passed after 2009, there still might be some selling of NPLs on a small scale. These artificial changes in NPL ratio are likely to have some influence on the outcome of the study, though the influence is expected to be minimal.

The last limitation is the implication of the study. This research used the Chinese banking sector as a case study, but may not be directly applicable to other markets. The Chinese banking industry is a unique system which has different banking regulations and macroeconomic environment than do other countries. As mentioned in section 3.1.3, State and state-owned enterprises own majority shares in major banks in China. This ownership structure is very different from those in other countries.

Therefore, the financial benefits of green loans in other markets should be conducted before telling whether the finding exists in the respective market.

6.4 Future research

Future studies on the topic of green finance can be pursued in various ways.

As mentioned in the last section, one of the limitations of this study is the lack of data. It would be interesting to study this case again when more green finance data are available. Finding significant outcomes over longer periods will also produce even more convincing results. In addition, doing a case study for other regions may be useful in finding out whether the incentives to participate in green finance activities are also applicable to other markets.

Another opportunity for further research is to revisit policy analysis. As mentioned in section 3.5, most policy analyses are still theoretical. Currently, there is no study that attempts to value the presence of the Green Credit Policy. If the Green Credit Policy is proven to be the driving force of green finance activities in China, then adapting a perfected policy globally will quickly solve the shortage in green loans. Moreover, the Green Credit Policy has encountered many issues, such as conflict of interest (Cai, 2015). Further studies are needed to explore how to solve these issues.

Bibliography

Adkins, R., & Paxson, D. (2016). Subsidies for renewable energy facilities under uncertainty. *The Manchester School, 84*(2), 222-250.

Aerts, W., Cormier, D., & Magnan, M. (2008). Corporate environmental disclosure, financial markets and the media: An international perspective. *Ecological Economics, 64*(3), 643-659.

Aizawa, M., & Yang, C. (2010). Green Credit, Green Stimulus, Green Revolution? China's Mobilization of Banks for Environmental Cleanup. *The Journal of Environment & Development, 19*(2), 119-144.

Allison, Paul. (2009). *Fixed Effects Regression Models*. Sage publications.

An, W. (2008). *Lv se jin rong de nei han, ji li, he shi jian chu tan.* [A probe into the connotation, mechanism and practice of green finance]. *Economic Survey, 5049.*

Anderson, E., & Sullivan, M. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science*, *12*, 125–143.

Babiak, K., & Trendafilova, S. (2011). CSR and environmental responsibility: Motives and pressures to adopt green management practices. *Corporate Social - Responsibility and Environmental Management, 18*(1), 11-24.

Bal, Y., Faure, M., & Liu, J. (2014). The role of China's banking sector in providing green finance. *Duke Envtl. L. & Pol'y F., 24*, 89.

Basel Committee. (2005). Compliance and the compliance function in banks. Basel Committee on Banking Supervision.

Basmann, R. (1957). A Generalized Classical Method of Linear Estimation of Coefficients in a Structural Equation. *Econometrica, 25*(1), 77-83.

Bauer, R., & Hann, D. (2010). Corporate environmental management and credit risk. *ECCE Working Paper*. University Maastricht: The European Centre for Corporate Engagement.

Berger, A., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking and Finance, 21*(6), 849-870.

Berge, T.O., & Boye, K.G. (2007). An analysis of bank's problem loans. *Norges Bank Economic Bulletin 78*, 65–76.

Boden, T.A., Marland, G., and Andres, R.J. (2017). National CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy. Doi 10.3334/CDIAC/00001_V2017.

Breusch, T. S., & Pagan, A. R. (1979). A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica, 47*(5), 1287-1294. Doi:10.2307/1911963.

Brundtland, G.H. (1987). Our common future. Oxford: Oxford University Press.

Buxton, A. (1997). Business ethics: getting on the right track. *CIB News*, February, 1–4.

Cai, H. (2015). *Xin chang tai xia wo guo lv se xin dai fa zhan lu jing you hua.* [The optimization of China's Green Credit Policy development path under the "new normal"]. *Finance and accounting monthly, 2015,* 5.

Caouette, J. B., Altman, E. I., & Narayanan, P. (1998). *Managing credit risk: the next great financial challenge* (Vol. 2). John Wiley & Sons.

Case, P. (1996). Land, lending and liability. *Chartered Banker* 2 (4), 44–49.

CBRC. (2012). *Notice of the CBRC on Issuing the Green Credit Guidelines.* Retrieved from http://www.cbrc.gov.cn/EngdocView.do?docID=3CE646AB629B46B9B533B1D8D9FF8C4A

CBRC. (2014). *Notice of the China Banking Regulatory Commission on Key Performance Indicators of Green Credit Implementation. General Office of the China Banking Regulatory Commission Document, 2014,* 186.

CBRC. (2016). *Yin hang ye lv se xin dai zhu li jing ji jie gou tiao zheng he chan ye zhuan xing sheng ji.* [Green Credit in helping the adjustment of economic structure and the upgrade in industry transformation]. *CBRC press release*, 2016 September 2nd.

Chang, M., Wang, S., & Li, D. (2008). *Lv se xin dai de shi shi ji chu - Yin hang ye huan jing feng xian guan li ti xi.* [The basis for implementation of green credit - banking environment risk management system]. *Environmental economics, 7,* 32-35. Beijing, China: Tsinghua University.

Chen, Y. (2016, Aug 30). *Lv se jin rong huo si da tu po, ding ceng she ji geng qing xi*. [Four major break-throughs of green finance, design gets clear at high-level]. *Journal of the Chinese People's Political Consultative Conference*, 005.

Coulson, A., & Monks, V. (1999). Corporate environmental performance considerations within bank lending decisions. *Eco-Management and Auditing, 6*(1), 1-10.

Dawson, A.W. (1996). Pollution and the uncertainty principle. *Chartered Secretary,* September.

De Nicolo, G. (2001). Size, charter value and risk in banking: An international perspective. Board of Governors of the Federal Reserve System. *International Finance Discussion Paper*, P. 689.

Delmas, M., Blass, V., Hahn, Tobias, Figge, Frank, Pinkse, Jonatan, & Preuss, Lutz. (2010). Measuring corporate environmental performance: The trade-offs of sustainability ratings. *Business Strategy and the Environment, 19*(4), 245-260.

Dowell, G., Hart, S., & Yeung, B. (2000). Do corporate global environmental standards create or destroy market value? *Management Science 46*(8): 1059–1074.

Equator Principles Association. (2013). The Equator Principles (EP III).

Evangelinos, K.I., & Nikolaou, I.E. (2009). Environmental accounting and the banking sector: A framework for measuring environmental–financial risks. *International Journal of Services Sciences 2*(3/4): 366.

Fitch, T.P. (1997). *Dictionary of banking terms*. Barron's Educational Series Inc. Hauppauge: New York.

Fulton, M. (2008). Climate change investment strategies: How a universal bank is leading investments in a low carbon economy. *Research report*, 115-141.

Furrer, B., Hamprecht, J., & Hoffmann, V. H. (2012). Much ado about nothing? How banks respond to climate change. *Business & Society, 51*(1), 62–88.

Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states, *Journal of Financial Stability*, Elsevier, vol. 20(C), pages 93-104.

Goss, A., & Roberts, G. S. (2011). The impact of corporate social responsibility on the cost of bank loans. *Journal of Banking and Finance, 35*, 1794-1810.

Granger, C. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica (pre-1986), 37*(3), 424.

Gray, R., & Bebbington, J. (2001). Accounting for the environment, second ed. Sage: London

Greene, W. (2012). Econometric analysis (7th ed.). Boston: Prentice Hall.

Hahn, T., Figge, F., Pinkse, J., & Preuss, L. (2010). Trade-offs in corporate sustainability: You can't have your cake and eat it. *Business Strategy and the Environment, 19*(4), 217-229.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica (pre-1986), 46*(6), 1251-1271.

Hempel G.H., Colema, A.B., & Simonson, D.G. (1990). Bank Management. Wiley: New York.

Höhne, N., Khosla, S., Fekete, H. & Gilbert, A. (2012). Mapping of green finance delivered by IDFC members in 2011, Cologne: Ecofys.

Hu, N., & Cao, D. (2011). *Lv se xin dai yu shang ye yin hang huan jing feng xian guan li.* [Green-Credit Policy and Environmental Risk Management of Commercial Banks]. *On Economic Problems, 3*: 103-107

Iannotta, G., Nocera, N., & Sironi, A. (2007). Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance, 31*(7), 2127-2149.

Jakubík, P. & Reininger, T. (2013). Determinants of nonperforming loans in Central, Eastern and Southeastern Europe. *Focus on European Economic Integration, 3*, 48-66.

Jeucken, M. (2001). *Sustainable finance and banking: The financial sector and the future of the planet*. London; Sterling, VA: Earthscan Publications.

Jia, C. (2009). The effect of ownership on the prudential behaviour of banks – the case of China. *Journal of Banking and Finance* 33, 77–87.

Kahane, L. H. (2007). Regression basics: Sage publications.

Keele, D., & DeHart, S. (2011). Partners of USEPA Climate Leaders: An Event Study on Stock Performance. *Business Strategy and the Environment, 20*(8), 485-497.

Keeton, W., & Morris, C. (1987). Why do banks' loan losses differ? *Economic Review - Federal Reserve Bank of Kansas City,72*(5), 3.

Khanna, M., & Damon, L.A. (1999). EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic Performance of Firms. *Journal of Environmental Economics and Management, 37*(1), 1-25.

Klassen, R., & Mclaughlin, C. (1996). The impact of environmental management on firm performance. *Management Science, 42*(8), 1199-1214.

Klein, N., (2013). Non-performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance. *International Monetary Fund Working Paper*, 13/72.

Koch, T.W., MacDonald, S.S., Edwards, V., & Duran, R.E. (2014). *Bank management: A decision-making perspective.* CENGAGE Learning Asia.

Lancaster, T. (2000). The incidental parameter problem since 1948. *Journal of Econometrics, 95*(2), 391-413.

Lardy, N.R. (2008). Financial repression in China. Policy Brief No. 08-8. Peterson Institute for International Economics, Washington, DC.

Li, J., & Zinna, G. (2014). On bank credit risk: systemic or bank specific? Evidence for the United States and United Kingdom. *Journal of Financial and Quantitative Analysis, 49*(5-6), 1403-1442.

Li, X., & Xia, G. (2014). *Zhong guo lv se xin rong bao gao.* [China green finance report]. China Finance Press: Beijing.

Lin, H. (2012). Cross-sector Alliances for Corporate Social Responsibility Partner Heterogeneity Moderates Environmental Strategy Outcomes. Journal of Business Ethics, 110(2), 219-229.

Lindenberg, N. (2014). Definition of Green Finance. DIE mimeo. Retrieved from: SSRN: https://ssrn.com/abstract=2446496.

Louzis, D.P., Vouldis, A.T., & Metaxas, V.L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking and Finance, 36*(4), 1012-1027.

Ma, J. (2015). *Lun gou jian zhong guo lv se jin rong ti xi*. [On the construction of China's green finance system]. Finance Forum, 5: 18-27.

Madalla, G.S. (2001). *Introduction to Econometrics*. New York: Wiley.

Margolis, J.D. & Walsh, J.P. (2001). People and Profits? The Search for a Link Between a Company's Social and Financial Performance. Mahwah, NJ: Lawrence Erlbaum Associates.

Macve, R., & Chen, X. (2010). The "equator principles": A success for voluntary codes? *Accounting, Auditing & Accountability Journal, 23*(7), 890-919.

Micco, A., & Panizza, U. (2004). Bank ownership and lending behaviour. Inter-American developement. bank. Research Department, Working Paper no. 520. *Nationalbank, issue 3*, pages 48-66.

Nakao, Y., Amano, A., Matsumara, K., Genba, K., & Nakano, M. (2007). Relationship between environmental performance and financial performance: An empirical analysis of Japanese corporations. *Business Strategy and Environment 16*(2): 106–118.

Nandy, M., & Lodh, S. (2012). Do banks value the eco-friendliness of firms in their corporate lending decision? Some empirical evidence. *International Review of Financial Analysis, 25*, 83-93.

Neyman, J., & Scott, E. (1948). Consistent estimates based on partially consistent observations. *Econometrica, 16*(1), 1-32.

O'Sullivan, N., & O'Dwyer, B. (2009). Stakeholder perspectives on a financial sector legitimation process: The case of NGOs and the Equator Principles. *Accounting, Auditing & Accountability Journal, 22*(4), 553–587.

OECD. (2017). Green financing: Challenges and opportunities in the transition to a clean and climate-resilient economy. *OECD Journal*: Financial Market Trends. Retrieved from http://dx.doi.org/10.1787/fmt-2016-5jg0097l3qhl.

Pricewaterhouse Coopers Consultants (PWC) (2013). Exploring Green Finance Incentives in China, PWC.

Quagliariello, M. (2007). Banks' riskiness over the business cycle: A panel analysis on Italian intermediaries. *Applied Financial Economics, 17*(2), 119-138.

Rivera, J., & De Leon, P. (2005). Chief executive officers and voluntary environmental performance: Costa Rica's certification for sustainable tourism. *Policy Sciences, 38*(2-3), 107-127.

Salazar, J. E. (1998). Environmental Finance: Linking Two Worlds, Paper presented at a workshop on Financial Innovations for Biodiversity. 10th Global Biodiversity Forum, Bratislava, Slovakia, 1-3 May 1998: 15 pp.

Sarokin, D., & Schulkin, J. (1991). Environmentalism and the right-to-know: Expanding the practice of democracy. *Ecological Economics, 4*(3), 175-189.

Saunders, A. (1999). Credit risk measurement: new approaches to value at risk and other paradigms. Wiley: New York

Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: Categories and interactions. *Business Strategy and the Environment, 20*(4), 222-237.

Scholtens, B., Zhou, Y., Cerin, Pontus, & Hassel, Lars. (2008). Stakeholder relations and financial performance. *Sustainable Development, 16*(3), 213-232.

Shanghai Pudong Development Bank. (2016). 2015 SPD Bank Corporate Social Responsibility Report.

Simpson, W. G., & Kohers, T. (2002). The Link Between Corporate Social and Financial Performance: Evidence from the Banking Industry. *Journal of Business Ethics, 35*(2): 97–109.

Smith, D.R. (1994). Environmental risk: Credit approaches and opportunities: An interim report. United Nations environment. McGraw Hill: Geneva.

Stern, G.H., & Feldman, R. (2004, January 27). Big Banks, Big Bailouts. *Wall Street Journal*, p. A.14.

Thompson, P. (1998). Bank lending and the environment policies and opportunities. *International Journal of Bank Marketing 16*(6): 243–252. Doi: 10.1108/02652329810241384.

Thompson, C. & Cowton, P. (2004). Bringing the environment into bank lending: Implications for environmental reporting. *The British Accounting Review, 36*(2), 197-218.

United Nations Environmental Program (UNEP). (1992). Statement by Banks on the Environment and Sustainable Development. UNEP: Rio de Janeiro.

United Nations Global Compact (UNGC). (n.d.). The Ten Principles of the UN Global Compact. Retrieved from: https://www.unglobalcompact.org/what-is-gc/mission/principles

United Nations Principles for Responsible Investment. (n.d.) About the PRI. Retrieved from: https://www.unpri.org/about

Vidal, J. & Adam, D. (2007, June 19). China overtakes US as world's biggest CO2 emiter. *The Guardian.*

Wagner, M., Schaltegger, S., & Wehrmeyer, W. (2001). The relationship between the environmental and economic performance of firms. What does theory propose and what does empirical evidence tell us? *Greener Management International, 34(Summer)*: 95–108.

Wang, Y. (2013). *Lv se xin dai yan jiu yu fa zhan zong shu.* [Research in Green Credit Policy and development summary]. Times Finance, 7: 224-225.

Wang, Y., & Zhang, J. (2014). *Lv se xin dai zheng ci de yan jin, ying xiang ji fa zhan*. [Evolution, impact and development of the Green Credit Policy]. China National Conditions and Strength, 9: 45-47.

Weber, O., Fenchel, M., & Scholz, R. (2008). Empirical analysis of the integration of environmental risks into the credit risk management process of European banks. *Business Strategy and the Environment, 17*(3), 149-159.

Weber, O. (2012). Environmental Credit Risk Management in Banks and Financial Service Institutions. *Business Strategy and the Environment, 21*(4), 248-263.

Weber, O. (2014a). Environmental, Social and Governance Reporting in China. *Business Strategy and the Environment, 23*(5), 303-317.

Weber, O. (2014b). The financial sector's impact on sustainable development. *Journal of Sustainable Finance & Investment, 4*(1), 1-8.

Weber, O. (2016). The Sustainability Performance of Chinese Banks: Institutional Impact. Toronto, ON: University of Toronto Press.

Weber, O., & Banks, Y. (2012). Corporate sustainability assessment in financing the extractive sector. *Journal of Sustainable Finance & Investment 2*(1): 64–81. Doi:10.1080/20430795.2012.702501.

Weber, O., Hoque, A., & Ayub Islam, M. (2015). Incorporating environmental criteria into credit risk management in Bangladeshi banks. *Journal of Sustainable Finance & Investment, 5*(1-2), 1-15.

Wei, G. (2010). *Guan zhu huan jing feng xian, jian she lv se xin dai yin hang.* [Concern for the environment risk and the construction of green credit bank]. *The Chinese Banker, 4*, 27-31.

Wei, J. N. (2009, Sep 14). *Si wa yi tou zi ji hua lv se xin dai de ji yu yu tiao zhan*. [$4 trillion stimulus package: Opportunities and challenges to the green credit policy]. Securities Daily.

Wooldridge, J. M. (2013). Introductory econometrics: A modern approach (Fifth ed.). Mason, OH: South-Western Cengage Learning.

Wu, Y., & Bowe, M. (2012). Information disclosure and depositor discipline in the Chinese banking sector. *Journal of International Financial Markets, Institutions and Money*, 22(4), 855-878.

Ye, Y., & Li, X. (2014). *Gou jian Zhong guo lv se xin dai zheng ce zhi du ti xi.* [Building the regulation system for Green Credit Policy in China]. *China Banking, Z1*: 70-74.

Zhang, B., Yang, Y., & Bi, J. (2011). Tracking the implementation of green credit policy in China: Top-down perspective and bottom-up reform. *Journal of Environmental Management, 92*(4), 1321-1327.

Zhang, X., & He, D. (2010). *Huan jing jin rong fa zhan de cai shui zheng ce ji li: Guo ji jing yan ji qi shi*. [Financial and tax incentive polices for environmental finance development: Experience and revelation from the globe]. *Public Finance Research, 5*: 78-80.

Zhao, Chaoxia. (2015). Shang ye yin hang lv se xin dai shi jian ji qi dui jing ji lv se zhuan xing de tui dong [Commercial banks' practice in Green Credit and their influence in green economic transformation]. *Finance and accounting monthly, 32*, 023.

Zribi, N. & Boujelbène, Y. (2011). The factors influencing bank credit risk: The case of Tunisia. *Journal of Accounting and Taxation, 3*(4): 70-78.

Appendix A

Data Used for Hypotheses Testing

(Bold indicates an estimation of variable)

Bank	Year	NPLR	POGC	POTO	Credit quality	ROA	Inefficiency	Solvency	Size	Type of bank	Growth of green credit	Growth of total loan
China Development Bank (CDB)	2009	0.94%	8.95%		1.92%	0.76%	58.12%	5.35%	0.0751	5	20.17%	27.94%
	2010	0.68%	10.99%		2.22%	0.77%	56.15%	6.08%	0.0716	5	49.37%	21.61%
	2011	0.40%	11.91%		2.52%	0.80%	54.25%	6.37%	0.0748	5	32.83%	22.53%
	2012	0.30%	13.17%		2.82%	0.92%	52.42%	6.77%	0.0775	5	28.41%	16.14%
	2013	0.48%	12.51%		3.05%	1.02%	41.84%	6.95%	0.0760	5	5.82%	11.39%
	2014	0.65%	18.08%		3.43%	1.06%	42.61%	6.60%	0.0848	5	60.51%	11.10%
	2015	0.81%	17.05%		3.71%	0.90%	47.28%	8.48%	0.0914	5	9.35%	15.93%
Industrial and Commercial Bank of China (ICBC)	2009	1.54%	7.12%	2.27%	2.54%	1.20%	39.05%	5.76%	0.1950	4		25.30%
	2010	1.08%	7.47%	1.93%	2.46%	1.32%	36.63%	6.11%	0.1885	4	24.38%	18.54%
	2011	0.94%	7.58%	1.84%	2.50%	1.44%	36.04%	6.19%	0.1851	4	16.35%	14.70%
	2012	0.85%	6.74%	**1.63%**	2.50%	1.45%	35.86%	6.43%	0.1805	4	0.51%	13.03%
	2013	0.94%	6.03%	1.45%	2.43%	1.44%	35.26%	6.76%	0.1753	4	0.78%	12.71%
	2014	1.13%	5.94%	1.22%	2.34%	1.40%	34.44%	7.46%	0.1694	4	9.58%	11.13%
	2015	1.50%	5.89%	1.00%	2.35%	1.30%	33.02%	8.11%	0.1609	4	7.26%	8.23%
China Construction Bank (CCB)	2009	1.50%	3.76%		2.63%	1.24%	39.04%	5.81%	0.1592	4	17.49%	27.04%
	2010	1.14%	3.45%		2.52%	1.32%	37.25%	6.48%	0.1514	4	8.12%	17.62%
	2011	1.09%	3.37%		2.64%	1.47%	36.19%	6.65%	0.1468	4	11.88%	14.59%
	2012	0.99%	3.19%		2.69%	1.47%	36.99%	6.80%	0.1438	4	9.39%	15.64%
	2013	0.99%	5.69%		2.66%	1.47%	36.82%	6.99%	0.1424	4	103.80%	14.35%
	2014	1.19%	5.14%		2.66%	1.42%	35.20%	7.48%	0.1377	4	-0.27%	10.30%

	2015	1.58%	7.00%		2.40%	1.30%	33.21%	7.88%	0.1329	4	50.61%	10.68%
Agricultural Bank of China (ABC)	2009	2.91%	1.45%	14.10%	3.06%	0.82%	48.99%	3.86%	0.1470	4		33.48%
	2010	2.03%	1.20%	13.50%	3.40%	0.99%	43.83%	5.25%	0.1448	4	-0.15%	19.78%
	2011	1.55%	1.56%	11.08%	4.08%	1.11%	41.43%	5.56%	0.1396	4	47.65%	13.78%
	2012	1.33%	2.37%	**8.64%**	4.35%	1.16%	43.02%	5.67%	0.1363	4	72.62%	14.07%
	2013	1.22%	4.57%	7.36%	4.46%	1.20%	42.64%	5.80%	0.1349	4	117.10%	12.30%
	2014	1.54%	5.83%	6.44%	4.42%	1.18%	42.72%	6.46%	0.1313	4	42.98%	12.09%
	2015	2.39%	6.10%	6.02%	4.53%	1.07%	41.75%	6.81%	0.1289	4	14.96%	10.03%
Bank of China Limited (BOC)	2009	1.52%	3.06%	**11.07%**	2.30%	1.09%	46.00%	6.23%	0.1448	4	47.34%	48.97%
	2010	1.10%	3.39%	**9.51%**	2.17%	1.15%	44.14%	6.46%	0.1465	4	27.80%	15.28%
	2011	1.00%	3.93%	8.40%	2.20%	1.17%	42.77%	6.40%	0.1414	4	29.82%	12.05%
	2012	0.95%	3.31%	7.62%	2.25%	1.19%	43.62%	6.79%	0.1305	4	-8.79%	8.23%
	2013	0.96%	3.40%	6.76%	2.21%	1.23%	42.28%	6.93%	0.1286	4	13.75%	10.82%
	2014	1.18%	3.55%	5.87%	2.22%	1.22%	38.96%	7.76%	0.1254	4	16.34%	11.51%
	2015	1.43%	4.51%	5.60%	2.20%	1.12%	39.12%	8.07%	0.1218	4	36.96%	7.69%
Bank of Communications (BOCOM)	2009	1.36%	5.20%	3.95%	2.05%	1.01%	39.25%	4.97%	0.0548	4		38.44%
	2010	1.12%	4.57%	3.94%	2.08%	1.08%	40.62%	5.66%	0.0554	4	6.99%	21.62%
	2011	0.86%	4.82%	3.21%	2.20%	1.19%	39.02%	5.92%	0.0551	4	20.77%	14.52%
	2012	0.92%	4.89%	2.83%	2.30%	1.18%	39.44%	7.23%	0.0543	4	16.59%	15.05%
	2013	1.05%	5.08%	2.52%	2.24%	1.11%	40.44%	7.07%	0.0552	4	15.14%	10.83%
	2014	1.25%	4.44%	2.15%	2.24%	1.08%	41.01%	7.56%	0.0515	4	-8.08%	5.06%
	2015	1.51%	5.50%	1.83%	2.35%	1.00%	41.83%	7.52%	0.0518	4	34.35%	8.46%
China Merchants Bank (CMB)	2009	0.82%	3.36%	**11.16%**	2.02%	1.00%	51.16%	4.49%	0.0342	3		35.62%
	2010	0.68%	3.23%	**8.71%**	2.05%	1.15%	45.87%	5.58%	0.0337	3	16.15%	20.71%
	2011	0.56%	3.11%	7.17%	2.24%	1.39%	42.61%	5.90%	0.0334	3	10.23%	14.64%
	2012	0.61%	5.75%	6.86%	2.16%	1.46%	42.77%	5.88%	0.0351	3	114.87%	16.05%
	2013	0.83%	5.30%	5.52%	2.22%	1.39%	40.92%	6.62%	0.0372	3	6.23%	15.37%

	2014	1.11%	6.00%	3.78%	2.59%	1.28%	36.88%	6.61%	0.0392	3	29.71%	14.42%
	2015	1.68%	5.54%	3.29%	3.00%	1.13%	33.59%	6.61%	0.0397	3	3.69%	12.35%
Shanghai Pudong Development Bank (SPD)	2009	0.80%	1.88%	10.40%	1.98%	0.90%	44.71%	4.20%	0.0269	3	41.68%	33.16%
	2010	0.51%	1.87%	11.04%	1.95%	1.01%	40.51%	5.63%	0.0307	3	22.71%	23.43%
	2011	0.44%	1.92%	10.16%	2.19%	1.12%	36.31%	5.57%	0.0321	3	18.89%	16.13%
	2012	0.58%	9.73%	9.54%	2.31%	1.18%	36.66%	5.71%	0.0324	3	489.27%	16.01%
	2013	0.74%	8.61%	8.10%	2.36%	1.21%	33.41%	5.63%	0.0341	3	1.16%	14.43%
	2014	1.06%	7.71%	6.62%	2.65%	1.20%	30.23%	6.27%	0.0345	3	2.81%	14.76%
	2015	1.56%	7.65%	5.49%	3.30%	1.10%	28.45%	6.32%	0.0365	3	9.86%	10.70%
China Minsheng Banking (CMBC)	2009	0.84%	1.01%	**6.69%**	1.73%	0.98%	48.86%	6.23%	0.0236	3	264.27%	34.12%
	2010	0.69%	0.28%	5.65%	1.88%	1.09%	46.56%	5.77%	0.0256	3	-67.35%	19.77%
	2011	0.63%	0.19%	5.21%	2.23%	1.40%	43.13%	6.02%	0.0267	3	-19.22%	13.96%
	2012	0.76%	0.09%	4.54%	2.39%	1.41%	41.70%	5.25%	0.0331	3	-46.89%	14.88%
	2013	0.85%	0.31%	5.94%	2.21%	1.34%	39.59%	6.33%	0.0299	3	294.23%	13.70%
	2014	1.17%	**0.49%**	3.46%	2.12%	1.26%	40.06%	6.17%	0.0330	3		15.14%
	2015	1.60%	0.56%	3.08%	2.46%	1.10%	37.84%	6.85%	0.0327	3		12.99%
Industrial Bank (CIB)	2009	0.54%	2.36%	**8.88%**	1.37%	1.13%	44.02%	4.47%	0.0220	3	401.91%	40.49%
	2010	0.42%	5.60%	8.13%	1.38%	1.16%	39.62%	4.97%	0.0259	3	188.66%	21.77%
	2011	0.38%	7.58%	7.32%	1.46%	1.20%	39.12%	4.82%	0.0288	3	55.73%	15.09%
	2012	0.43%	9.16%	7.02%	2.00%	1.23%	33.29%	5.25%	0.0335	3	51.06%	25.01%
	2013	0.76%	13.12%	3.91%	2.68%	1.20%	33.88%	5.47%	0.0341	3	58.16%	10.40%
	2014	1.10%	18.58%	3.44%	2.76%	1.18%	31.07%	5.93%	0.0362	3	66.20%	17.40%
	2015	1.46%	22.15%	3.42%	3.07%	1.04%	29.98%	5.99%	0.0384	3	33.00%	11.69%
China Citic Bank (CNCB)	2009	0.95%	1.41%	10.16%	1.42%	0.94%	46.68%	6.03%	0.0294	3	61.86%	45.90%
	2010	0.67%	1.27%	9.04%	1.44%	1.13%	40.17%	5.98%	0.0292	3	7.46%	18.64%
	2011	0.60%	1.28%	7.88%	1.62%	1.27%	36.81%	6.46%	0.0331	3	13.57%	13.43%
	2012	0.74%	1.14%	5.69%	2.12%	1.10%	38.99%	6.86%	0.0305	3	3.61%	15.96%

	2013	1.03%	1.07%	4.48%	2.13%	1.20%	38.58%	6.34%	0.0337	3	9.51%	16.73%
	2014	1.30%	1.15%	3.36%	2.36%	1.07%	37.49%	6.46%	0.0340	3	21.23%	12.71%
	2015	1.43%	0.94%	2.92%	2.39%	0.90%	34.77%	6.24%	0.0371	3	-5.87%	15.58%
China Everbright Bank (CEB)	2009	1.25%	**0.20%**	3.59%	2.59%	0.75%	46.89%	4.02%	0.0198	3		38.52%
	2010	0.75%	**0.29%**	4.28%	2.35%	0.95%	42.15%	5.49%	0.0208	3		20.01%
	2011	0.64%	0.45%	4.06%	2.36%	1.12%	39.59%	5.55%	0.0207	3		14.25%
	2012	0.74%	3.15%	3.69%	2.53%	1.18%	37.76%	5.02%	0.0235	3	699.63%	14.99%
	2013	0.86%	2.80%	3.38%	2.07%	1.14%	40.40%	6.34%	0.0224	3	1.50%	13.99%
	2014	1.19%	2.68%	2.32%	2.16%	1.12%	38.10%	6.56%	0.0225	3	6.38%	11.42%
	2015	1.61%	2.56%	**2.10%**	2.52%	1.00%	34.65%	7.07%	0.0229	3	11.33%	16.48%
Ping An Bank	2009	0.68%	**1.07%**	**9.11%**	1.10%	0.94%	49.02%	3.44%	0.0097	3		26.71%
	2010	0.58%	1.21%	9.59%	1.58%	0.95%	48.32%	4.57%	0.0102	3		13.32%
	2011	0.53%	0.85%	9.29%	1.70%	1.04%	48.45%	5.99%	0.0150	3	6.66%	52.35%
	2012	0.95%	1.53%	7.70%	1.74%	0.94%	47.99%	5.28%	0.0165	3	109.83%	16.13%
	2013	0.89%	1.52%	7.13%	1.79%	0.87%	48.56%	5.92%	0.0175	3	16.67%	17.55%
	2014	1.02%	1.50%	1.34%	2.06%	0.97%	43.80%	5.99%	0.0180	3	19.32%	20.94%
	2015	1.45%	1.42%	1.08%	2.41%	0.93%	38.25%	6.44%	0.0182	3	12.42%	18.68%
Hua Xia Bank (HXB)	2009	1.50%	**2.60%**	**13.83%**	2.50%	0.44%	52.20%	3.58%	0.0140	3		21.03%
	2010	1.18%	**2.62%**	**9.63%**	2.48%	0.61%	50.00%	3.41%	0.0146	3		22.71%
	2011	0.92%	2.79%	**7.11%**	2.82%	0.74%	48.92%	5.14%	0.0149	3		15.82%
	2012	0.88%	5.08%	5.16%	2.82%	0.87%	47.15%	5.02%	0.0153	3	18.25%	17.78%
	2013	0.90%	4.21%	3.39%	2.73%	0.98%	46.15%	5.14%	0.0155	3	-5.28%	14.30%
	2014	1.09%	4.20%	2.57%	2.54%	1.02%	45.04%	5.51%	0.0152	3	13.79%	14.19%
	2015	1.52%	3.74%	2.25%	2.55%	0.98%	42.37%	5.86%	0.0146	3	1.32%	13.74%
China Guangfa Bank (CGB)	2009	2.40%	**1.36%**	**4.72%**	3.74%	0.56%	57.09%	3.33%	0.0110	3		22.19%
	2010	1.58%	1.03%	3.99%	3.30%	0.84%	48.55%	5.27%	0.0114	3		22.57%
	2011	1.34%	1.09%	3.95%	3.10%	1.11%	47.62%	5.74%	0.0110	3	22.25%	15.71%

	2012	1.48%	0.75%	3.19%	2.52%	1.08%	49.23%	5.44%	0.0120	3	-21.97%	13.99%
	2013	0.87%	0.66%	2.97%	1.56%	0.88%	51.12%	4.99%	0.0136	3	2.55%	16.07%
	2014	1.04%	0.53%	2.59%	1.77%	0.77%	45.59%	5.31%	0.0135	3	-11.71%	10.67%
	2015	1.43%	0.39%	2.43%	2.16%	0.52%	40.45%	5.31%	0.0133	3	-17.97%	9.60%
China Bohai Bank (CBHB)	2009	0.10%	**0.77%**		1.20%	0.29%	64.74%	4.46%	0.0019	3		100.68%
	2010	0.11%	0.97%		1.51%	0.41%	58.58%	3.55%	0.0037	3		32.55%
	2011	0.14%	1.17%		1.70%	0.64%	51.67%	5.28%	0.0037	3	47.75%	21.76%
	2012	0.14%	2.05%		1.85%	0.85%	45.79%	4.20%	0.0049	3	120.00%	25.71%
	2013	0.26%	2.66%		2.21%	0.88%	41.05%	4.26%	0.0053	3	54.00%	18.68%
	2014	1.20%	3.23%		2.46%	0.81%	41.21%	4.42%	0.0055	3	48.54%	22.31%
	2015	1.35%	4.08%		2.77%	0.79%	38.73%	4.65%	0.0055	3	68.51%	33.70%
Bank of Beijing (BOB)	2009	1.02%	0.91%		2.21%	1.19%	34.25%	7.04%	0.0088	1	33.33%	41.65%
	2010	0.69%	0.70%		2.13%	1.07%	37.34%	5.81%	0.0103	1	-6.60%	22.40%
	2011	0.53%	0.63%		2.35%	1.06%	33.54%	5.27%	0.0114	1	9.85%	21.17%
	2012	0.59%	2.01%		2.67%	1.13%	32.84%	6.40%	0.0115	1	290.18%	22.46%
	2013	0.65%	1.88%		2.74%	1.10%	32.82%	5.86%	0.0124	1	9.76%	17.74%
	2014	0.86%	2.67%		3.05%	1.09%	31.85%	6.31%	0.0125	1	63.86%	15.46%
	2015	1.12%	3.35%		3.54%	1.00%	31.39%	6.33%	0.0134	1	42.22%	14.82%
Bank of Nanjing	2009	1.22%	**1.28%**		2.12%	1.28%	38.51%	8.14%	0.0025	1		66.82%
	2010	0.97%	**1.60%**		2.27%	1.25%	36.92%	8.56%	0.0031	1		25.16%
	2011	0.78%	**2.03%**		2.53%	1.29%	37.68%	7.74%	0.0034	1		22.54%
	2012	0.83%	2.60%		2.64%	1.28%	36.95%	7.22%	0.0035	1		21.85%
	2013	0.89%	2.78%		2.66%	1.16%	39.09%	6.19%	0.0040	1	25.10%	17.32%
	2014	0.94%	5.44%		3.06%	1.12%	35.87%	5.72%	0.0047	1	132.84%	18.86%
	2015	0.83%	4.93%		3.57%	1.02%	31.72%	6.51%	0.0058	1	30.45%	43.80%
	2009	1.59%	0.50%	1.59%	2.68%	0.87%	88.15%	4.62%	0.0077	1		37.47%
	2010	1.12%	0.60%	1.18%	2.80%	0.97%	86.47%	5.20%	0.0079	1	46.75%	21.96%

Bank of Shanghai (BOS)	2011	0.98%	0.59%	1.31%	2.71%	0.95%	93.43%	5.38%	0.0078	1	9.64%	12.12%
	2012	0.84%	0.55%	1.27%	2.39%	1.02%	93.85%	5.17%	0.0084	1	7.71%	16.72%
	2013	0.82%	0.75%	**1.21%**	2.39%	1.04%	90.05%	5.76%	0.0091	1	54.68%	13.05%
	2014	0.98%	0.56%	**1.20%**	2.54%	1.05%	81.18%	6.26%	0.0098	1	-17.31%	9.75%
	2015	1.19%	0.67%	**1.17%**	2.82%	0.99%	76.37%	6.41%	0.0105	1	32.14%	10.73%
Bank of Jiangsu	2009	1.45%	**1.03%**		2.30%	0.94%	45.40%	4.55%	0.0055	1		44.14%
	2010	1.06%	**1.27%**		2.22%	1.10%	42.49%	5.27%	0.0060	1		23.65%
	2011	0.96%	1.58%		2.54%	1.24%	40.49%	5.41%	0.0061	1		21.41%
	2012	1.01%	1.67%		2.67%	1.21%	40.26%	5.25%	0.0067	1	27.48%	21.11%
	2013	1.15%	1.70%		2.58%	1.16%	39.12%	6.27%	0.0071	1	19.59%	16.89%
	2014	1.30%	2.87%		2.69%	0.97%	36.63%	5.40%	0.0085	1	99.46%	18.66%
	2015	1.43%	4.33%	1.00%	2.74%	0.82%	36.47%	5.08%	0.0093	1	73.57%	15.00%
Bank of Ningbo	2009	0.79%	**0.35%**	**10.37%**	1.34%	1.09%	47.92%	5.96%	0.0027	1		66.54%
	2010	0.69%	0.38%	**6.53%**	1.36%	1.09%	46.74%	6.03%	0.0037	1		24.08%
	2011	0.68%	0.47%	4.22%	1.63%	1.24%	43.76%	7.18%	0.0031	1	49.49%	20.84%
	2012	0.76%	0.76%	1.97%	2.10%	1.29%	40.81%	5.98%	0.0038	1	89.88%	18.63%
	2013	0.89%	0.93%	1.54%	2.27%	1.16%	40.91%	5.52%	0.0043	1	43.07%	17.56%
	2014	0.89%	0.77%	1.49%	2.53%	1.11%	37.83%	6.17%	0.0046	1	1.83%	22.71%
	2015	0.92%	0.67%	0.75%	2.85%	1.03%	39.54%	6.29%	0.0052	1	6.61%	21.72%
Bank of Chongqing	2009	0.47%	**4.10%**		1.80%	1.28%	43.08%	4.99%	0.0013	1		46.75%
	2010	0.36%	**4.11%**		1.91%	1.16%	39.92%	4.61%	0.0015	1		25.35%
	2011	0.35%	**4.27%**		1.87%	1.26%	40.63%	5.07%	0.0015	1		20.87%
	2012	0.33%	**4.49%**		1.80%	1.36%	40.82%	5.29%	0.0016	1		19.70%
	2013	0.39%	4.78%		2.06%	1.28%	38.86%	6.52%	0.0019	1		18.10%
	2014	0.69%	4.97%		2.19%	1.17%	37.48%	5.79%	0.0023	1	22.27%	17.62%
	2015	0.97%	5.48%		2.37%	1.07%	37.13%	6.66%	0.0023	1	29.22%	17.21%
Harbin Bank	2009	0.99%	**0.56%**		1.59%	1.08%	44.85%	4.65%	0.0014	1		29.37%

	2010	0.79%	**0.54%**		1.53%	1.17%	38.27%	4.17%	0.0018	1		24.09%
	2011	0.62%	**0.52%**		2.14%	1.12%	41.61%	5.58%	0.0025	1		26.76%
	2012	0.64%	0.49%		2.25%	1.20%	39.24%	6.27%	0.0028	1		27.42%
	2013	0.85%	0.76%		2.29%	1.14%	42.03%	6.19%	0.0030	1	87.82%	21.40%
	2014	1.13%	0.46%		2.35%	1.15%	43.24%	8.75%	0.0028	1	-29.05%	16.98%
	2015	1.40%	0.51%	0.37%	2.43%	1.14%	39.66%	7.61%	0.0032	1	32.16%	19.97%
Bank of Zhengzhou	2009	1.51%	**0.01%**		2.81%	0.59%	39.50%	5.01%	0.0007	1		24.69%
	2010	0.51%	**0.02%**		2.17%	1.26%	40.95%	4.80%	0.0008	1		32.66%
	2011	0.44%	**0.04%**		1.84%	1.47%	36.78%	8.76%	0.0008	1		39.58%
	2012	0.47%	0.07%	6.32%	2.01%	1.67%	30.52%	7.39%	0.0011	1		34.10%
	2013	0.53%	0.05%	6.17%	2.24%	1.50%	32.42%	6.39%	0.0014	1	-5.71%	25.48%
	2014	0.75%	0.18%		2.26%	1.39%	33.46%	5.58%	0.0017	1	327.27%	23.90%
	2015	1.10%	0.57%		2.85%	1.43%	28.66%	6.71%	0.0019	1	281.56%	20.91%