TOWARDS SUSTAINABLE PROPERTY INVESTMENT: PERSPECTIVE FROM ASIAN EMERGING MARKETS

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DECLARATION

I hereby declare that this thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis.

This thesis has also not been submitted for any degree in any university previously.

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SUMMARY

Despite the growing academic and industry interests in sustainable property investment, a good grasp of its market performance is still void. As opposed to the West where the sustainable property investing practice was initiated, the public awareness and academic research are sparse in Asia. Against this backdrop, this thesis seeks to provide the first in-depth exploration of financial economic merits related to property investments based on environmental sustainability principle in Asia.

The first essay is featured with a comparative analysis across some key Asian economies, e.g., China, Hong Kong, and Singapore, to identify the ongoing best practices to promote sustainable property investment via certification system, regulatory framework, and economic instruments. Importantly, Singapore is found to lead the region thanks to its well-established environmental policy and market structure, and only in Singapore, property companies committing to green building practice are significantly positively valued as opposed to other markets.

With the above finding and severe data limitation of other markets, the thesis proceed to exclusively focus on Singapore, aiming to provide insightful implications to other Asian markets[1]. Presently, emerging literatures on green building economics is greatly dominated by commercial sector in the western context. To enrich the literature body, the second essay serves as the first study in Asia to examine the topic in Singapore housing market. Consistent with existing studies, it documents a significant green price premium in Singapore private housing market.

Nonetheless, existing studies merely focus on higher market premium, leaving the net financial consequence of or market return to sustainable property investment largely untapped. As such, the third essay intends to shed some light on the net financial benefit by focusing on the financial performance of real estate operating companies (REOC) in Singapore[2] committing to green building investment, with the hope to tackle the market hurdle of "Vicious Circle of

[1] Given its advanced economy, Singapore is hardly taken as "Emerging" market. However, as far as the extent of the public awareness and academic research of environmental sustainability is concerned, Asia as a whole lags behind the west. Thus, the term of "Emerging Asian" in the title is employed here to reflect the fact of the lagging but fast growing environmental sustainability in the region

[2] Focus on real estate operating companies (REOCs) rather than real estate investment trust (REITs), mainly due to their inherent differences in earnings distribution, corporate taxation, and more importantly the shunning of development activities of REITs in Singapore.

Blame[3]. It argues that if developers who are first movers in green property are further rewarded, the projected wider adoption of sustainable property practices would in turn enhance the awareness of demand side, eventually resulting in the market norm of green real estate. It concludes a significant role of underlying environmental institution in understanding the net financial result of sustainable property investment.

[3] Simply speaking, it refers to that key market players blame each other for their hesitation to go green in a loop (Cadman, 2000)

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CHAPTER ONE

INTRODUCTION

This PhD thesis bundles three empirical essays on the topic of sustainable property investment in Asia, aiming to help understand the financial economic merits of environmental sustainability and the broader concept of corporate social responsibility (CSR) [4] in real estate industry, from both investors and developers' perspective.

Although the CSR principles have been growingly integrated into property investment decision-making given the rising awareness of climate change and resource scarcity among academia and practitioners, whether investing in environmental sustainability and energy efficiency in real estate industry aligns with fiduciary responsibilities remains largely unaddressed. Especially in Asia, public awareness of environmental sustainability and sophisticated academic research still lag behind its counterparts in the West. Thus, this thesis seeks to provide the first in-depth research in Asia of financial merits associated with different types of property investments based on environmental sustainability principles, and ultimately contributes to the extant literatures of green building economics.

1.1 **Social Responsibility**

Spurred by anecdotal industrial revolutions since the 19th century, human society has evolved dramatically and modern technology has continuously progressed. However, the material prosperity comes at the expense of the earth ecosystem: it is not only being fatally damaged, but human activity has been leading to irreversible losses of critical ecosystem functions, which together threaten the survival of human being. To address it, a new way to achieve sustainable economic development without compromising the nature was called upon throughout the globe. Against this backdrop, decades of efforts leads to the universally accepted principle of sustainability, i.e., "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

[4] It refers to that companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. (Renneboog et al., 2008).

(Brundtland, 1987). The sustainability principle essentially balances between the anecdotal "zero growth" argument and others favoring the pure economic growth, seeking to harmonize the co-existence of the economy and the nature.

People integrated the principle into their business areas thereafter. The corporate social responsibility (CSR) and socially responsible investing (SRI) had become increasingly popular over the past decades, especially among resource-intensive organizations, investors and companies dedicating themselves to primarily tackle the environmental, social, and governance (ESG) issues. CSR, being a transparent business practice based on ethical values and respect for all stakeholders, is designed to deliver sustainable value to society at large and impact on all business activities including investment policies as well Notably, such investment policies can be grouped under the term of SRI characterizing the behavior of investors, i.e., not only focus on economic gain but also follow ethical principles and take into account environmental and social aspects[5].

1.2 **Sustainable Property Investment**

The issue of social responsibility becomes appealing worldwide as ignoring environmental and/or social concerns by investment decision-makers can be financially risky, which is particular the case for real estate industry. It shows that the built environment is responsible for around 25-40% of total energy use globally, 30% of raw material use, 30-40% of global greenhouse gas emissions, and 30 to 40% of solid waste generation (RICS, 20005). Also, people spend almost 90% of their life inside buildings. Thus, this industry significantly matters to human health and well-being (OECD, 2003 and UNEP, 2006). Furthermore, the shifting consumer behavior, tightened building mandate, increasingly expensive material inputs and scarce resource, and greater pressure from stakeholders all converge to make it both financially risky to ignore and financially beneficial to address the ESG issues in the process of real

[5] Such investors either avoid investments into particular companies and products or they systematically select and support other companies and products through their investment.

estate investing. Hence, the contribution of property sector to sustainable development is immense[6], and the potential of the built environment to mitigate its related negative externality is substantial.

The notion of sustainability and social responsibility has already emerged on property investment agendas. The past decades has witnessed a growth of similar concepts, e.g., responsible, and sustainable property investing. Specifically, both encompass the goal of maximizing positive and minimizing negative effects of property investment on society and the natural environment (Pivo and McNamara, 2005), but the former (responsible) allows for an investment strategy to be considered responsible even if the maximization of positive effects and the minimization of negative effects take place within the tight boundaries set by financially-oriented and short-term investor goals, while the latter (sustainable) goes one significant step further since the investor lays down appropriate conditions so that all his (or her) actions are aimed at being sustainable. For the sake of brevity and consistency, sustainable property investment will be the lead terms in this thesis, which is defined as the property investment in pursuit of sustainability, as well as the well-being and economic benefit measured in terms of financial, natural and social capital (e.g., Lorenz et al., 2008).

1.3 **Research Background**

Amidst the global proliferation of green building rating systems[7] assessing buildings' environmental and energy performance, environmental sustainability and energy efficiency are giving rise to the green transformation of the real estate industry, from which investors can benefit from investing in the sustainable property assets. Meanwhile, the improved availability and transparency of sustainable (green) property data makes it possible to conduct empirical research in Asia where academic research has been long sparse.

[6] The contribution of products and services to sustainable development is usually described and evaluated by an assessment of both their ability to meet current and future requirements as well as their capability of keeping current and future impacts, expenses and risks within certain limits or boundaries. If the assessment results are positive, such products and services are commonly called 'sustainable'. This also applies for buildings and constructed works (Lorenz et al., 2008). Buildings and the investments in buildings have the potential to contribute to sustainable development (Lützkendorf and Lorenz, 2005). For the purpose of this paper, the terms 'sustainable building' and 'sustainable property investment' are used for simplicity instead of the term 'buildings and investments that contribute to sustainable development in this paper.

[7] The term sustainable building is usually used interchangeably with green building, whose purpose is to reduce the adverse human impacts on the natural environment, while improving our quality of life and economic well-being (Ministry for the Environment , New Zealand, 2005)

It is crucial, however, to recognize that the mainstreaming of sustainable property investment is still deterred by the "Vicious Circle of Blame" (Cadman, 2000), i.e., the misalignment between supply and demand for occupation and investment in sustainable property assets. For example, developers complain about the lack of demand for green space, and concurrently environmentally conscious occupiers can barely find green space at all.

Arguably, the circle can be broken up by providing market participants with hard evidence on both the improved environmental performance of buildings, and more importantly its superior financial performance. Also suggested by the classic economic assumption of "rational agent", one should invest in sustainable property not only because this is the good thing to do, but a good investment deal. Ultimately, increasing economic return, sustaining the natural environment and protecting social values are not incompatible. Therefore, the market barrier can be tackled by offering both business cases for companies and investment cases for investors that it pays to be green.

Regardless of recent public and private initiatives to promote sustainable property investment, the signals from marketplace remain obscure, as developers and investors are understandably uncertain about how far to go in investing in real estate sustainably due to the lack of sufficient evidence of financial benefits (Eichholtz et al., 2010). While sustainable investing practices in Asia still lag behind the west, it is attracting more and more interest.

Essentially, several stylized facts can justify the necessity of conducting such a research in Asian property market: Firstly, the fast economic growth is always accompanied with the severe negative environmental impact. Projected trends in urbanization put much pressure on urban capacity, leading to considerable infrastructure projects that will have implications for resource consumption. If China's per capita greenhouse gas emissions rose to U.S. levels, then global carbon emissions would increase by more than 50 %. Besides, according to the World Health Organization (WHO) estimates, two-thirds of diseases attributable to air pollution worldwide occur in emerging Asia which is particularly vulnerable to rising temperatures and sea levels, and the physical risks of climate change.

Secondly, in the western society, civilians have pressured companies and regulators towards sustainability initiatives in the 'bottom-up' approach. In contrast, civil society activity is limited in Asia, and sustainability movement is mostly promoted by public sector in the 'top-down' approach; Thirdly, there are several unique governance issues in Asian capital market which may contribute to the low acceptance and performance of CSR strategy, such as the lack of transparency, limited regulation/enforcement, and concentrated shareholder structures and family ownership.

1.4 State of The Art

The debate of CSR and its impact on corporate financial performance (CFP) has been long studied in management science and financial economics domain, whilst it is under-researched in real estate area. As CSR is a multi-disciplinary concept (Carroll, 1979), different disciplines can be employed and also different perceptions can be anticipated. Scholars and practitioners in real estate industry have recently borrowed from other disciplines to justify the greening of real estate industry. For instance, using the conceptual corporate environmental responsiveness framework (Bansal and Roth, 2000) with a real estate dimension added, Eichholtz, Kok and Quigley (2011b) systematically analyze why companies occupy green office space in the U.S.

Two competing theoretical arguments dominate: on the one hand, those criticizing CSR rely on the neoclassical microeconomics that the costs associated with CSR improvement are likely to outweigh the financial benefits, which is as opposed to the underlying principle of shareholder wealth maximization (e.g., Friedman, 1962). Understandably, environmental activities involve much of corporate resources, but the potential benefits of such measures could be in the distant future, if any. Thus, it argues that there is no role for CSR and that firms should only care about their shareholders' profit (Friedman, 1962). Indeed, real estate investors used to hold that social or environmental issues should be taken care of by government and not of direct concern to their investment practices.

On the other hand, advocates for CSR may also be rooted in the neoclassical microeconomics in that CSR may help address the agency problems and the external costs. Heal (2005) finds that the government does not fully resolve all

problems with external effects. In this regard, CSR activities can substitute missing markets and reduce conflicts of interest among stakeholders. Also, both the stakeholder theory and resource-based view of firm favor meeting all stakeholders' expectations, rather than only shareholders', by engaging CSR activities. Throughout the thesis, it is in support of the argument of the positive association between CSR, or more specifically environmental sustainability in real estate industry, and financial performance both at property asset market and public market.

In terms of real estate-related CSR aspects, environmental sustainability appears the major focus, whereas less emphasis is placed on social and community concern. In addition, anecdotal CSR literatures can be well applied to its subsets, i.e., particularly corporate environmental performance (CEP) in this thesis.

1.5 Research Statement & Contribution

Several features underpin the contributions of this PhD thesis. To begin with, I provide the first cross-country analysis in Asia in Chapter 2 to identify the currently best practices to direct the built environment towards environmental sustainability, and explore whether and how sustainable property investment is valued. Although the concept stems from the West, it is an open question whether or not the reported evidence of financial benefits of sustainable property investment is sample-specific and subject to the underlying environmental institution. I attempt to address these issues in Asia where the uniqueness of institutional set-up, cultural background, and market structure allow governments in the region to promote sustainable property investment via a top-down approach.

Given the data richness, employing two types of environmental sustainability measurements sheds some light on the appropriateness of the environmental screening for sustainable property investment. To mitigate the reverse causality issue, the "Instrumental Variable" (IV) regression is applied to the empirical analysis. It documents an initial evidence of a positive relation between environmental performance and firm value. More importantly, it suggests that the extent to which individual market values the environmental sustainability of real estate is significantly different, depending on both the underlying environmental policy and market structure. Essentially, only in Singapore where underlying

environmental institution is well established and strictly implemented, property companies with superior environmental performance enjoys higher market value than its counterparts.

The aforementioned dependency of CEP-CFP relation in Asian real estate industry on the market structure and environmental policy warrants further studies at market level. Due to the severe data scarcity in other markets, the thesis proceeds to exclusively center on the financial consequence of investing in environmental sustainability in Singapore real estate. In line with the conventional property investment, sustainable property investment may take several forms[8]: Ones could invest in individual or a portfolio of properties certified as environmental sustainably by the globally proliferated green building rating schemes, e.g., Energy Star, Green Mark; or they may invest in publicly traded real estate companies making environmental sustainability a key part of their corporate strategy.

Chapter 3 and Chapter 4 subsequently contribute to a detailed investigation on the economic pay-off of sustainable property investment in Singapore at asset market and capital market, respectively. Previous literatures on the financial performance of sustainable properties are either from engineering perspective, being an *ex ante* predictions for policy implementation (Jacobsen and Kotchen, 2009). With the improved data availability, empirical studies have recently reported the alignment between better environmental and energy efficiency performance and improved financial gains for both new and existing properties. For example, Eichholtz et al., (2010), Fuerst and MacAllister (2011a and 2011b), and Kok, Miller and Morris (2012) report significant green premiums associated sale price and rent for the U.S. office market. Brounen and Kok (2011) find that consumers seem to capitalize the energy information into house prices in Dutch residential market. Further, the energy labels command significant higher rents and selling price to certified office buildings in Dutch as well (Kok and Jennen, 2011).

However, few systematic analyses on the "green price premium" in the housing market have been performed, especially in Asia. Hence, I fill out this gap by assessing the private return of sustainable dwelling units in Singapore, namely, whether or not the green certified dwelling units in multifamily housing projects yield higher asset values

[8] There are other real estate investment forms as well. However, given the data limitation and research objectives of the thesis, the aforementioned two types of sustainable property investments are of primary interest and are believed to be most relevant to Asian market players.

than non-green ones (Chapter 3). The "Green Mark" rating system launched in 2005 makes Singapore a unique test-bed to provide an Asian insight into green building's financial performance at asset market. The propensity score matching (PSM) approach is employed to reduce any influencing impact of housing attributes. With some matched 37,000 transactions in the Singapore private housing market during 2000 and 2010, it analyzes the private returns to green building investments by evaluating the premium in asset values they command in the marketplace. Estimate results show that the green price premium relative to conventional dwelling units is significant even controlling for the broadest number of hedonic characteristics. Remarkably, this is one of the first analyses of the economics of green building in the residential sector. The results may provide insight about the operation of the housing market in one country, but the policy implications about the economic returns to sustainable investments in the property market can have broader applications for markets in emerging Asia.

Despite the emerging evidence of financial benefits of sustainable property investment at asset market, the market adoption of sustainable property remains sluggish. Plausibly, it may be attributed to several reasons: (1) the "Vicious Circle of Blame" featured by the misaligned response between demand and supply side of sustainable property market. Eichholtz et al (2011b) apply a conceptual management model with the real estate dimension to explore the green office rental decision. Importantly, it suggests that corporate tenants may occupy green space for the competitive advantage, legitimation or environmental responsibility, depending on the nature of individual industry. Yet, their study is only focused on the demand side of property market, without reference to supply side. Also, some contextual dimension of the association between corporate incentives and environmental strategy, e.g., capital market's scrutiny, is ignored; (2) anecdotal studies just consider the benefits without costs of sustainable property investment, leading to no convinced cost-benefit conclusion[9] and thus the uncertainty of the net financial performance of such investments.

As the financial performance of property companies that are directly involved in property development and investment is the eventual consequence of the interplay between the cost and benefits of green buildings, examining this interplay can shed some light on the net financial consequence of investment in sustainable properties. Also, it believes that if property companies are further rewarded, the projected wider adoption of sustainable property practices would in turn

[9] Except for some pilot projects and case studies that yield inconclusive results on the net benefits.

enhance the awareness of demand side, eventually resulting in the market norm of green real estate. Against this background, an exploration of the association between property companies' financial performance and their environmental performance in Chapter 4 both sheds some light on the net benefits of going green and contributes to the full picture of market responsiveness of the greening of real estate industry.

Besides, the fact that the minimum environmental sustainability performance has been mandated in Singapore as of 2008 enables a further investigation of the important role of environmental institution in understanding the financial consequence of environmental sustainability in real estate investment industry. A dynamic dataset of green property portfolios of all public property companies is Singapore are developed. Empirically, sub-period analysis is robust to alternative estimation method and concludes that only under stringent environmental policy regime do property companies committing to sustainable property practice in Singapore outperform the market peers.

Taken as a whole, the three empirical essays systematically examine economics of (direct and indirect) sustainable property investment in Asia, thus aiming to convince the market participants of the financial benefits of the greening of real estate industry. Empirical results may be not only informative to real estate markets' practitioners keen to integrate environmental information into corporate strategies and investment criteria, but the policy implications about the economic pay-off to sustainable property investments can have broader application for markets in emerging Asia, in which the sparkling economic growth is accompanied with the severe environmental deterioration, fast-growing urbanization, the 'top-down' approach to promote sustainability, and the concentrated shareholder / family ownership capital structure (Zheng et al., 2009; Cheung et al., 2010).

1.6 Organization of the Thesis

This thesis is organized as follows. Chapter Two presents the first essay, titled "*The Greening of Asian Real Estate Industry*" It examines the emerging market recognition of environmental sustainability in Asian real estate investment industry. The economic price premium of investing in energy efficiency and sustainability in housing markets in Singapore is investigated in Chapter Three, titled "*Does It Pay To Go Green? Evidence from Singapore Housing*

Market". Chapter Four presents the third essay, titled "*The Financial Implication of Green Building Investment: Evidence from Singapore Property Companies"*. This chapter explores the financial consequence of property companies in Singapore committing to environmental sustainability, moderated by the dynamic underlying environmental policy. The final chapter concludes the thesis, highlights the limitations of the study, as well as offer recommendations for further research.

CHAPTER TWO

THE GREENING OF ASIAN REAL ESTATE INDUSTRY*

ABSTRACT

Although it is growingly recognized that the greenness of real estate industry has great potential to tackle the climate change issue, academic research and public awareness in Asia has lagged behind its counterpart in the west, due largely to the data constraint. Against this backdrop, this essay seeks to conduct the first Asia-focused comparative analysis to identify the best practices to direct the built environment towards environmental sustainability, as well as initially evaluate how environmental sustainability in real estate is valued financially. Tobin's Q is used to measure the intangible asset of firm value, while the use of two types of environmental performance proxies can shed light on the appropriateness of environmental screening for sustainable property investment. Empirically, the "Instrumental Variable" (IV) regression is employed to in part alleviate the reverse causality issue.

This essay concludes Singapore as the regional leader in greening its built environment via a good combination of environmental institution and market structure. Importantly, it documents that whether or not environmental sustainability in real estate is valued relies on the underlying institutional frameworks and market structure in the sense that only in Singapore, property companies committing to green buildings enjoy a higher value, as opposed to other markets. Implications can be substantial to other emerging Asian economies eager to promote environmental sustainability in the built environment.

* This chapter is a modified version of "Towards sustainable property investment: Evidence from Asia" by Zhiliang Li and Yongheng Deng, which was initially presented at the symposium of Harvard Kennedy School titled "The Societal Function of Investment Asset Class: Implication for Responsible Investment", Oct 2012, Cambridge.

2.1 Introduction

Environmental sustainability[10] has become the central theme of corporate social responsibility (CSR) nowadays, not only reflecting the public concern about climate change but also the shifting taste amongst consumers and investors (Stern, 2008). In particular, institutional investors with real estate exposure are facing broad societal pressure to assess and improve the environmental performance of their real estate investments (Bauer et al., 2011). Accordingly, the extent that real estate entities incorporate environmental sustainability into their business strategy now becomes a matter of great interest to market participants.

To meet the non-financial information needs of investors, several private and public initiatives have been shaped, e.g., the Carbon Disclosure Project (CDP) and the United Nations Global Compact (UNGC). Also, public entities are eager to exhibit their environmental awareness and responsible activities through CSR reporting, engaging third-party CSR rating, or the inclusion into sustainability indices, and so forth[11].

What is more relevant to the real estate industry is the global emergence of green building rating systems[12], being a critical step towards promoting investment in sustainable real estate and private provision of environmental public goods (Kotchen, 2006). Properties certified as 'green' are not only marketed as having better energy and environmental performance, but also aligned with significant market premium (e.g., Eichholt, Kok and Quigley, 2010 and 2011a; Fuerst and MacAllister, 2011a and 2011b; Brounen and Kok, 2011; Kok and Jennen, 2011; and Deng, Li and Quigley, 2012). It will also help publicize property companies' strong commitment to environmental sustainability stewardship (Eichholtz et al., 2010).

Nonetheless, the mainstreaming of sustainable property investment is still stagnant. Some attribute it to the lack of sufficient information on the financial performance (Pivo, 2008). Indeed, there has been so far no publicly available

[10]Since the Brundlandt report in 1987, environmental sustainability has been widely accepted as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
[11]For example, KLD, SAM and Innovest are independent third-party CSR or sustainability rating agencies; Dow Jones Sustainability index, Domini 400 Social index, and FTSE KLD 400 Social index.
[12]LEED and Energy Star in the U.S., BREEAM in the U.K., Green Mark in Singapore, Green Star in Australia, and HKBEAM in Hong Kong

evidence on the financial consequences of committing to environmental sustainability at firm level, leading investors and property owners largely reluctant to allocate more green property into their investment portfolio. Against this background, this paper aims to fill this gap by examining whether or not, and to what extent does corporate environmental performance (CEP) relate to corporate financial performance (CFP) in the real estate industry.

There is abundance of literature on the CSR/CEP-CFP debate. One intriguing question has been the source of this controversy - can firms' environmental performance be aligned with the added-value? On the one hand, skeptics perceive that CSR is too expensive to comply with the shareholder value-maximization principles (Friedman, 1962; Henderson, 2002); on the other hand, CSR has been increasingly embraced within the business community due to its perceived tangible and intangible benefits (e.g., Shrivastava, 1995; Turban and Greening, 1996). Several decades' research has yielded mixed results, mainly attributed to the measurement problem of environmental screening (Waddock et al., 1997), methodological inconsistencies (Ulman, 1985; Griffin et al., 1997), or endogenity issues (e.g., Nogareda et al., 2006). This paper extends the existing literature and provides evidence that there is a positive relationship between firms' environmental and financial performance in the real estate industry, and the association depends on the underlying environmental policy and market structure.

Given the intangible nature of CSR-related benefits (Turban and Greening, 1996), Tobin's Q, measuring market expectation of future profitability, is used to measure firm valuation. Arguably, it is adequate to reflect the intangible reputation effect, investor trust, and investor risk[13] (e.g., Guenster et al., 2011; Dowell et al., 2000; Konar and Cohen, 2001). Empirically, I employed two sets of environmental sustainability proxies: (1) the environmental dimension of "Asian Sustainability Rating" score, which is a disclosure-based proxy developed by the "Responsible Research"; (2) the binary variable indicating concrete green property commitments of real estate firms. The empirical results of this study can shed light on the appropriateness of the environmental screening for sustainable real estate investment[14].

[13]Plausibly, using this variable may avoid the bias of manipulation of some accounting-based variables.

[14]Pivo (2005) pointed out that one screening process is needed for investors to determine whether director indirect sustainable property investment products meet their needs. He suggests that in the real estate industry, green building certification is more appropriate than the conventional social screening. As such, by using the two types of environmental screening approach this study allows us to identify which type is materially applicable to the context of sustainable real estate investment.

To address the potential endogenity problem and omitted variable bias, an instrument variable (IV) approach is employed to examine the CEP-CFP link in the sample countries from 2010 to 2011. Notably, Asian economies are at different stages of economic development and thus have different levels of environmental awareness. The uniqueness of institutional and cultural background allows some governments among these Asian economies to promote sustainable real estate investment via a top-down approach. Such unique institutional variations allow us to test whether the debated CEP-CFP relation may vary across markets, depending on the underlying institutional frameworks to encourage environmental sustainability in the built environment.

A positive association between real estate companies' environmental performance and firm valuation is reported, though marginally. It documents the firm value differential across markets, subject to both environmental set-up and market structure. Essentially, only in Singapore where underlying environmental institution is well developed and strictly implemented, a real estate company committing to green building practices enjoys higher market value. Moreover, results are in favor of green building practice as the environmental screening measure for future research given its visibility to the market.

Implication can be substantial to multiple parties: it will ease corporate managers' concern to go green without compromising financial objectives, which is consistent with the existing literature (e.g., King and Lenox, 2002); For those interested in sustainable real estate investment in Asia, results suggest investing where a proper combination of stringent environmental policy and incentive program has been well established and rigorously implemented; Lastly, it will give rise to the policy instrument to guide the built environment towards environmental sustainability.

The rest of the paper proceeds as follows: Section 2 conducts a literature review on CSR and its effect on CFP; Section 3 discusses institutional difference; Data collection and analysis are presented in Section 4, followed by the empirical analysis in Section 5; Section 6 concludes and discusses some limitations and further research.

2.2 Literature Review on CSR

In recent years, CSR and its subsets, e.g., CEP in this study, have become societal focus that requires the business community to take on responsibility towards environmental, social and government issues in general (Orlizky, 2001). Among different perspectives of CSR, McWilliams and Siegel (2001), for example, defines it as actions furthering social good beyond the interest of the firm and what is required by law. Others (e.g., Heal, 2005) consider CSR as being able to avoid social distributional conflicts and thus reduce the externality. Notably, there has been a wide divide in the theoretical argument on the CSR-CFP debate (Griffin and Mahon, 1997).

2.2.1 Opponents for CSR

Above all, those criticizing CSR rely on the neoclassical microeconomics that the costs associated with CSR improvement are likely to outweigh the financial benefits, which is inconsistent with the underlying principle of shareholder wealth maximization (e.g., Friedman, 1962 and 1970; Telle, 2006). Understandably, environmental activities involve much of corporate financial resources, but the potential benefits of such measures are mostly in the distant future, if any (e.g., Henderson, 2002; Walley and Whitehead, 1994). Thus, it argues that there is no role for CSR and that firms should only care about their shareholders' profit (Friedman, 1962). Further, McWilliams et al., (2006) and McWilliams & Siegel (2001) report that the overall effect of CSR is neutral in equilibrium.

The criticisms of CSR may also be rooted in the arguments of stakeholder theory and corporate governance. According to Freeman (1984), managers need to balance the interests of all stakeholders, rather than shareholders' interests only, to the extent that the aggregate welfare is maximized (Renneboog et al. 2008). And yet, it fails to address the problem of how to aggregate welfare and how to make the tradeoff amongst stakeholders. Also, in a competitive market, firms pursuing social or environmental objectives by lowering their economic profits may not survive the competition (e.g., Renneboog et al., 2008; Baumol, 1991). Shleifer (2004) even argues that competitive pressure from markets, to some extent, encourages unethical corporate behavior.

In the meantime, from the corporate governance viewpoint, only if internal control structures and managerial incentive are properly established, would managers choose to maximize stakeholders' wealth. It appears, however, that the objective function of managers in the CSR domain is not clearly defined and thus their performances are unaccountable, probably generating more conflict of interest and agency cost (e.g., Jensen, 2001; Tirole, 2006). Moreover, the multi-task nature of managers to achieve both financial and social goals greatly weakens their incentives to pursue high risk-adjusted returns and may be used for entrenching their own utility (Tirole, 2001), again resulting in additional agency problems.

2.2.2 Proponents for CSR

Advocates for CSR can also be rooted in the neoclassical microeconomics in that CSR may help address the agency problems and the external costs. As is assumed in the social welfare theorem, there is no conflict between a company's shareholder value and social value maximization in a competitive and complete market[15], and the resource allocation is Pareto-optimal and the social value is maximized accordingly (Renneboog et al., 2008). However, in the presence of externalities[16], shareholder profit-maximizing behavior does not necessarily imply social welfare-maximizing outcomes (Jensen, 2001). Heal (2005) finds that the government does not fully resolve all problems with external effects. In this regard, CSR activities can substitute missing markets and reduce conflicts of interest among stakeholders. Based on Ghatak's (2006) model where only those who care about CSR attributes are willing to buy ethical goods, CSR can create a Pareto improvement for the entire economy and thus maximize wealth. Consequently, the reduced agency cost enhances corporate profits and financial performance at least in the long term.

Additionally, the stakeholder theory is gaining momentum in the modern organizational structures to overcome the externality (Barnett and Salomon, 2006). Essentially, the stakeholder theory suggests that management must satisfy the expectations and demands of several groups (e.g., shareholders, employees, customer, and government) that have some interests in a firm and can influence its outcome or can be influenced by firms (Freeman, 1984; McWilliams et al., 2006). Furthermore, it can be embedded into the resource-based view of firm (e.g., Barney, 1991; Hart, 1995) that

[15]Social value is defined as the sum of the value generated for all stakeholders.
[16]The costs and benefits of an agent's action are affected by or affect others' actions in the economy.

corporate economic success and competitive advantage evolves from internal resources and capabilities.

Notably, only proactive environmental governance that is valuable, rare, and difficult to imitate by competitors is a source of financial benefits which is intangible in nature (e.g., King and Lenox, 2001; Derwall et al., 2011), such as stakeholder relationships and brand images (e.g., Davis, 1973; Derwall et al., 2010). Likewise, CSR may be rationalized to mitigate asymmetric information by signaling firms' reputation or product quality (e.g., Fombrun and Shanley, 1990; Barnea and Rubin, 2006). In addition, investors may view companies with poor environmental reputation as risky to invest in and thus demand a higher risk premium (e.g., Hamilton, 1995). Also, firms with a good reputation of environmental sustainability could attract a qualified workforce, as an improved corporate environmental reputation makes talent recruitment and retention easier than poor performers. Beyond the above benefits, in this paper, sustainable real estate can lead to enhanced employee health and productivity, which ultimately increases CFP (see Hoffman et al., 1993; Wargocki et al., 2004; Bauer et al., 2009).

Taken as a whole, when these (intangible) benefits are financially relevant, it can be anticipated that CSR-related activities tend to positively affect companies' financial performance.

2.2.3 Capital Market Response to CSR

Capital-market participants have increasingly incorporated the Environmental, Social and Governance (ESG) aspects into their investment decision-makings (e.g., Groysberg et al., 2011). For example, mutual funds that invested in socially responsible firms by 2007 have assets under management of more than $2.5 trillion and $2 trillion dollars in the United States and Europe, respectively (Ioannou and Serafeim, 2011).

Apart from the prior economics and managerial advocates of CSR, financial economists add important perspectives on its benefits in terms of risk-adjusted return to investors, risk-sharing opportunities, and the market segment of social (green) investors (see Moskowitz, 1972; Merton, 1997; Hamilton, Jo and Statman, 1993; Heinkel et al., 2001; Derwall et al., 2011). Importantly, whether investors gain by holding responsible companies depends on how capital market

values CSR (Guenster et al., 2011).

Despite early studies reporting that the market does not value CSR (e.g., Luther et al., 1992; Luther and Matatko, 1994; Bauer, Derwall, and Otten, 2007), recent studies tend to document a learning process that CSR information is gradually incorporated into asset pricing, e.g., Gompers et al. (2003), Derwall et al. (2005), Bauer et al. (2006), Derwall et al. (2010), and Ghoul et al. (2010). Meanwhile, others document favorable business cases for the significant effect of CSR on CFP.

For example, Spicer (1978) and Shane and Spicer (1983) argue that CSR activities reduce the threat of litigation risk. Karpoff et al. (2005) claim that investors 'price-protect' against lawsuit risks from environmentally irresponsible activities. Also, Hong and Kacperczyk (2007) find that litigation risk associated with socially contentious companies has become more relevant to investors expecting to earn premium from holding those stocks. Moreover, CSR activities matter to other idiosyncratic risks as well, such as reputation, investor trust, and customer loyalty, which lay further basis for eschewing environmentally controversial companies (e.g. Vandermerwe and Oliff, 1990; Russo and Fouts, 1997).

2.3 Institutional Difference in Asia

Having reviewed and analyzed general arguments on the CSR & CFP relation, it is possible that the aforementioned association may run in another direction under different underlying policy regimes (Ziegler et al., 2011). Porter et al (1995) contend that social benefits arising from environmental policies come at the expense of private cost and the direction of this balance depends on the underlying policy regimes. Under appropriately designed environmental standards, innovation can be spurred to lower production cost and enhance resource productivity, ultimately achieving the mutual interests of environmental improvement and competitiveness. As such, how CSR, or CEP, affect firms' financial performance depends on the structure of the market that determines the interplay between social costs and benefits (e.g., Cheung et al., 2010).

According to Ziegler et al. (2011), the stakeholder theory is likely to be reinforced under stringent institutions where social climate also demand better corporate responses to environmental issues such that good stakeholder relationships enable companies to be largely free from regulatory or market risks. Therefore, a good reputation of environmental performance seems to be a more important intangible resource under such circumstance. In contrast, the criticisms of CSR (e.g., Friedman, 1970) may be weakened if stringent regulation leads to higher non-compliance costs when firms do not react. Heinkel et al. (2001) argue that environmental polluters opt for reforming when the cost of pollution exceeds the reform cost. Overall, both the strengthening of the stakeholder theory and the weakening of the cost argument can benefit environmentally sustainable companies in the real estate industry.

Nowadays, Asian markets are at the different stages of economic cycles and urbanization process, as well as different levels of environmental awareness, naturally leading to distinct approaches to promote investment towards sustainable property. Keep in mind that the impact of institutional factors on the CSR-CFP linkage is of major focus in the paper, the following contributes to discussing and analyzing the institutional frameworks and market structure to promote sustainable real estate investment in China, Hong Kong and Singapore[17].

2.3.1 Green Certification System

Established by Akerlof (1970) and Jensen and Meckling (1976), the asymmetric information regarding the quality standards may make property market participants either stick to producing conventional buildings, or misuse the concept of green property as a (deceptive) marketing tool (Zheng et al., 2011). As such, to address the information asymmetry, scholars argue that a rating system providing credible and transparent energy and environmental performance of buildings is required to serve as a direct push to promote investment towards and activate the market of sustainable real estate (e.g., Qian and Chan, 2008; Lee and Yik, 2004).

The Singapore Green Mark (GM) rating scheme was launched in 2005 by the Building and Construction Authority (BCA), which essentially assess buildings' environmental and energy performance. Since its inception, the number of

[17]Only these three markets that take up over 80% of sample data have green certified properties, while other markets are of minor interest in this respect.

green certified projects has significantly increased from 17 in 2005 to over 1,000 in 2011.

In contrast, Hong Kong rely more on the private sector to voluntarily promote green properties. In particular, the HK-BEAM[18] rating system was launched in 2002 by private developers, such as Swire properties. As of October 2009, up to 37% of commercial space and nearly 28% of dwellings have been certified green. So far, China has yet to adopt a well-functioning green rating standard for its real estate sector. Since 2007, the Ministry of Housing and Urban-Rural Development (MOHURD) has been seeking to create a nationwide program called the "China Green Building Evaluation Label". Nonetheless, green buildings in China are still rare. The very low market penetration of green certification may be attributed to the lack of public recognition of the program, and insufficient institutional and financial mechanism to reward those who achieved higher scores for energy efficiency (Zheng et al., 2011).

2.3.2 Regulatory Instrument

Government intervention is said to be one of the most effective ways to promote sustainable properties (e.g., Varone and Aebischer, 2000). Still, it is debatable how governments can supplement the market for green building adoption, for each government has its own concerns and policy instruments. While some favor economic tools to correct externalities due to the subsidized private cost (e.g., Chan, 2000; Jaffe et al., 2002), others argue that legislation and regulations remain superior (e.g., Rivers and Jaccard, 2006). Eyre (1997) holds that a mix of economic and regulatory instruments could be more appropriate for internalizing environmental externalities. Notably, regulatory instruments may deter opportunistic behaviors in an imperfect market and create a level playing field for all competitors in the green property market (Chan et al., 2009).

As mandated by the 2nd green building Master-plan[19], all new government buildings in Singapore with over 5,000 m^2 must achieve top green ratings and existing ones with over 10,000 m^2 will be at least green mark gold-plus level[20]. Also, 80% of building must be green by 2030[10]. Remarkably, thanks to the revised building control act in 2008,

[18]It refers to Hong Kong Building Environmental Assessment Method Society
[19]http://www.bca.gov.sg/GreenMark/others/gbmp2.pdf
[20]There are four levels of the Green Mark certification, i.e., Platinum, Gold-plus, Gold, and Certified, based on total score gained for each building project.

Singapore becomes one of the few countries in the world to set minimum environmental sustainability performance for buildings, namely, all eligible new building projects must fulfill a level that is on par with the Green Mark Certified standard. That way it explicitly creates a product market for green real estate.

In contrast, regulations on green property are still in the infancy in Hong Kong and China. Compulsory mandates on buildings' energy efficiency are still pending in Hong Kong. Yet, it affirms that the environmental performance of all newly built government buildings with a floor area of over 10,000 m^2 must be certified as green by either LEED or HK-BEAM. In anticipation that aggregate energy demand will rise sharply in China, the 11th "Five Year Plan Guidelines" contains a target of 20% reduction in China's energy intensity, 40% of which should come from energy conservation in buildings. New buildings will be more affected by new design standards mandating 50% energy savings compared to the1980s standards by the end of the 2010s.

2.3.3 Economic Instruments

Sustainable properties involving an array of innovative construction techniques is perceived to have higher upfront costs than conventional ones (OECD, 2003), lifting the green property market entry barrier. Thus, either cost savings or increased valued, or both, is necessary to make sustainable real estate attractive to stakeholders. Some argue that monetary or fiscal incentives may leverage the higher capital expenses, as they are both efficient and effective means to economize buildings' energy consumption (e.g., Jaffe et al., 2002; Dennis, 2006). Others hold that the greater availability of green technologies and human capital, the lower the threshold of green property investment (e.g., Prakash, 2002). Also, market economic force, e.g., energy price, matters to sustainable real estate, since increased life-cycle cost will make green properties favorable (e.g., Lee and Yik, 2004).

To ease the financial burdens of going green, a wide range of monetary incentive schemes are released, e.g., the US$20 million cash subsidy for new buildings (GMIS-NB), a US$100 million for existing buildings (GMIS-EB), and the gross floor area scheme (GM-GFA), coupled with the "Building Retrofit Energy Efficiency Finance" (BREEF) scheme entitling building owners bank loans to retrofit their buildings to a greener standard. Also, Singapore

strengthens R&D input to build up expertise in green building design and technologies as well as to develop industry capability to ensure sufficient supply of green building professionals. Moreover, recent evidence of sale price premium associated with Singapore green housing projects (Deng, Li and Quigley, 2012) corroborates a societal attitude towards environmental concern that can be translated into demand for green buildings and further affect supply-side behavior. Lastly, electricity price are adjustable periodically to incentivize energy conservation.

In Hong Kong, government launched a US$57 million funding program as of April 2009 to encourage private sector to make their facilities more energy efficient, which is relatively smaller in scale than Singapore. Traditionally, local government injects little investment into R&D. The institutional environment in Hong Kong, i.e., the lack of markets for innovations in the building sector led to a low entry barrier to the conventional building market. Accordingly, key market players have little incentives to venture into new business of sustainable real estate (Chiang et al., 2001; Chan et al., 2009); As for China, to attain energy efficiency in building sector, subsidies of 20% of the total investment costs are proposed for projects saving between 15% and 25% on energy, while projects with a rate above 25% can apply for up to 30% investment subsidy. However, the progress towards maturing green building technology and cultivating green professionals is in the early stage. Besides, China government keeps electricity price low, which could have been another direct incentive to conserve energy (Zheng et al., 2011).

2.4 Data Collection &Analysis

2. 4.1 Environmental Data

Prior studies have advised a number of measures of CSR/CEP: forced-choice survey instruments (Aupperle, 1991), self-reported toxic release inventory (TRI) (e.g., Konar and Cohen, 2001), or CSR rating score (e.g., KLD, Innovest). And yet, little contextual and geographic considerations are given to the Asia. One exception could be the CLSA (Credit Lyonnais Securities Asia) used by Cheung et al. (2010), Klapper and Love (2004) and Durnev and Kim (2005). However, this indicator is constructed with subjective responses to 57 questions and merely reflects corporate governance dimension of CSR.

Given the data richness in this essay, two types of environmental measures in real estate are used. The first is the disclosure-based CSR rating score – the "Asian Sustainability Rating" (ASR)[21] by "Responsible Research", a leading provider of independent ESG research in Asia[22]. One advantage of it is its comprehensiveness in capturing the full picture of ESG factors through a set of 100 proprietary sustainability indicators representing nearly all of the most realistic assessment of achievable best sustainability practices specifically for companies[23]in MSCI AC (All Country) Asia ex Japan[24]. Importantly, the ASR score can be disaggregated into four sub-groups, of which its environmental dimension is used to measure CEP in this paper:

- *General*: Assessment of the presence and comprehensiveness of overall sustainability reporting.
- *Environment:* Assessment of environmental policy and reporting on resource usage and carbon emission. Importantly, this dimension assesses both transparency on resource consumption information and the extent of environmental responsiveness (See Appendix 2.1 for details)
- *Social*: Assessment of engagement with community, supplier, employees and customers.
- *Governance*: Assess governance policy, reporting, systems, financial control, board quality and independence, audit quality and so forth.

- Insert Appendix 2.1 Here -

Another advantage of the ASR is its in-depth understanding of local markets by having analysts with local market expertise and language skills (e.g., Mandarin, Cantonese, Korean, Hindi and English). ASR aims at accurately reflecting the strategic sustainability of Asian companies by giving a half point score if the data is only in the local language without English version[25].To explicitly control for the lack of transparency and high family ownership in

[21]It has been so far the first comprehensive CSR rating exclusively for Asian listed companies.
[22]In 29 June 2012, It was acquired by the "Sustainalytics BV", a Amsterdam-based responsible investment research, lead to the discontinuation of the ASR rating score.
[23]To make sure that the resulting findings are as unbiased as possible, there is neither engagement and questionnaire nor the highly subjective elements in the methodology. Thus, all ASR assessments are done in-house and based on publicly available information such as annual reports, sustainability or CSR reports, press releases and website information
[24]Despite the mature and liquid property market, Japan is excluded in the current universe mainly because of the language barrier which impedes the access to the quality data of both Japanese enterprises and property market.
[25]Scoring for each criterion is binary and a full point can only be achieved if submissions are in English reflecting the fact that this is the

Asian capital markets (Cheung et al., 2010), listed subsidiaries are treated as separated investable entities from holding companies in the sense that information declared by the holding company is not considered sufficient for developing an understanding of the subsidiary's sustainability practices. Moreover, all data point used are collected from public source without direct engagement with companies, e.g., stock exchanges filings, annual financial and/or CSR reports, company or NGO websites. That way ASR is not immune to the assumption that reporting is a proxy of performance[26], which plagues most studies using disclosure as the proxy for CSR performance.

Similar with the Kinder, Lyndenberg and Domini (KLD) dataset, each data point is equally-weighted to reckon the aggregated and disaggregated ASR scores. Up to date, literature has not drawn a theoretically derived ranking of importance for the various stakeholder groups a guide for empirical work (Cheng et al., 2011), whilst some use differential weights based on either subject academic opinion (Graves and Waddock, 1994) or analytic hierarchy process to derive weights (Ruf et al., 1993). Mitchell et al (1997) even hold that finding a universally accepted ranking is impossible theoretically. Therefore, this paper follows prior studies (e.g., Waddock and Graves, 1997; Hillman and Keim, 2001; Waldman et al., 2006) by assigning equal weights to each of data point of ASR. Presumably, the distinct materiality of sub-dimension of ASR can be partly measured by the different number of data points within each category.

To ensure that the largest and most influential companies domiciled and listed in Asian countries are covered in the ASR[27], several approaches and criteria are applied to form the ASR company universe (See Appendix 2.2 for details). In total, a universe of 542 and 750 publicly listed companies are included for the ASR 2010 and the ASR 2011, respectively[28], of which 40 real estate entities (4 REITs and 36 REOCs) are for ASR 2010 and 62 (11 REITs and 51 REOCs) are for ASR 2011. There are 37 companies rated twice over the sample period.

language companies must use if they are to successfully and responsibly communicate with the global investment community.

[26]Though the ASR team acknowledges that it is challenging to report on all activities being undertaken, it is vital that companies prioritize the communication of their internal practices in order to better inform investment decisions.

[27]Banking, Real Estate, Telecoms and Utilities are considered the high impact sectors for which several sector specific indicators are developed.

[28]ASR analysts compile information and benchmark companies at the beginning of each year and the ASR report will usually be released to the public every September. Noticeably, the ASR review companies' sustainability performance of the past fiscal year. Thus, the ASR 2010 and ASR 2011 proxy for the corporate sustainability performances for the FY 2009 and FY 2010, respectively.

- Insert Appendix 2.2 Here -

To mitigate concerns about the symbolic nature of disclosure-based CSR rating (see Patten, 1991; Gray and Bebbington, 2007; Cormier et al., 2011), another variable –"*Green Building*" measuring a concrete and substantive environmental sustainability practice in real estate industry is considered. This binary variable has the value of 1 if a listed real estate company develops, operates or owns green properties certified by the Green Mark, HKBEAM or LEED labeling program; and value of 0 otherwise[29]. Its usage is justified by that green real estate is not only marketed for its ability to reduce resource usage, but also helps identify property companies with strong commitment to environmental sustainability (Eichholtz et al., 2010; Deng, Li and Quigley, 2011).

Given the inherent distinction between the two types of environmental proxies, different capital market responses are possible and different empirical results are thus anticipated.

2.4.2 Dependent Variable

Previous literatures imply CSR benefits are mostly intangible in nature, if any (e.g., Turban and Greening, 1996; Waddock and Graves, 1997; Gardberg and Fomburn, 2006). Hence, Tobin's Q is used in this paper, as it is widely understood as an indicator of intangible value (e.g., Dowell et al., 2000; Konar and Cohen, 2001). Also, Guenster et al (2011) argue that the use of Tobin's Q is sufficient particularly when analyzing CSR, as it reflects reputation effects and investor trust. Also, in contrast with accounting-based measures, i.e., ROA and ROE, using this variable can avoid backward-looking bias and data manipulation.

Typically, a firm's market value is based on the present value of future profitability discounted at financial market risk perception of the firm (Fama, 1970). Following prior studies (e.g., Lindenberg and Ross, 1981; Jaffe, 1986; Konar and

[29] Favorably, the fraction of green building in each portfolio may account for the intrinsic behavior of property companies. However, given the severe data limitation on the total number of property portfolio in Asia property sector, the current binary variable is instead to proxy for the environmental performance of property companies.

Cohen, 2001), Tobin's Q increases with the intangible asset value of firms (for details, please refer to Appendix 2.3).

- Insert Appendix 2.3 Here -

In this paper, due to the missing data on the replacement cost of corporate tangible assets for most firms, I follow the way Kaplan and Zingales (1997) and Guenster et al. (2011) compute Tobin's Q. In essence, it is the ratio of the market value of assets to the book value of assets[30].Though there are other more sophisticated methods e.g., Perfect and Wiles (1994), this type of calculation appears the most efficient and applicable approximation to ensure data richness for my sample.

2.4.3 Independent Variables

I match the ASR data to the "Compustat" and "Bloomberg" database by ticker, company name and GVKEY number[31]. Since the ASR is released in each September, all financial information is matched to appropriate year-end to mitigate the look-ahead bias (Baquero et al., 2005; Jaffe et al., 1989). To account for firms' heterogeneities, several control variables, such as firm size, leverage, sale growth, profitability, and firm age, are considered[32].

Following the seminal work of Waddock and Graves (1997), firm size and leverage are included: size is measured by the natural logarithm of book value of total asset, and leverage is proxied by the ratio of long-term debt to asset. To condition on any difference in corporate characteristics relevant to firm value, I include past 1-year sale growth (e.g., Schmalensee, 1989; Hirsch, 1991). Profitability measured by return on asset (ROA) is included as suggested by Derwall et al. (2010). Besides, firm age, i.e., the difference between the first trading day on the "Factset" dataset and the respective ending date of analysis is calculated. Presumably, firm age could yield reputation effect benefiting firm performance. However, due to the in-transparency, business scandal, and family ownership featuring Asian financial

[30] The market value of assets is defined as the sum of the book value of assets and the market value of common stock outstanding minus the sum of the book value of common stock and balance sheet deferred taxes

[31] It is the identifier of individual stock in the COMPUSTAT database.

[32] Though R&D has been an important factor in accounting for performance variation (e.g., Konar and Cohen, 2001; King and Lenox, 2002), it is largely unavailable for Asian property companies which are unlikely to either engage in R&D expense or disclose such data.

market, there is no solid evidence of the positive impact of age on firm value[33].

In addition, time fixed effects control for macro-economic climate common to all. Also, market fixed effects in which real estate companies are listed rather than originated are included to manifest the fact that public real estate companies are eager to establish environmental reputation by complying with local regulations market participants are more familiar with[34].

To empirically examine the potential impact of different national regulatory or institutional frameworks on the CSR-CFP relationship, several interacting variables between market fixed effects and the two environmental sustainability proxies are constructed accordingly.

2.4.4 Descriptive Statistics

As shown in Table 2.1, there are 40 and 62 real estate companies included in the ASR 2010 and ASR 2011, respectively. Over 80% of firms are listed in China, Hong Kong and Singapore. Specifically, Hong Kong-listed firms have the largest representation with 47 firm-year observations, while firms from Indonesia and Malaysia only appear once. As a whole, the environment dimension of ASR remains consistent at 14%. Specifically speaking, improvements in the environmental performance can be seen in China and Hong Kong, while dramatic drop takes place in India, Philippine and Singapore, of which results of the latter two may be attributed to the addition of poor performers to the data sample.

- Insert Table 2.1Here -

Furthermore, around 30% of firms commit to green buildings, of which firms listed in Singapore and Hong Kong, are

[33] Thus, it remains an empirical question and largely depends on contextual specifics. Also, the impact of age on firm value is not the focus of this study.

[34] The property-fixed effect is excluded here. Since this essay empirically examines the CSR-CFP relation at firm level, and the sample property companies operate in multiple business lines and across property types, it is not practical to categorize a firm as exclusively focusing on single property type without reference to its whole portfolio

regional leaders.[35]

Table 2.2 presents summary statistics of major financial variables. Compared to other variables, there seems a wide variation in firms' sale growth opportunities. Importantly, correlations among control variables are acceptably low, leading multi-co-linearity not to be an issue in regression.

- Insert Table 2.2 Here -

2.5 Empirical Analysis

2.5.1 Prior Empirical Studies on CSR-CFP Debate

Empirical literatures relating CSR to CFP fall into three subsets: event studies; portfolio studies; multivariate regression analysis. Until now, most studies have been too fragmented to draw any generalized conclusions (Orlitzky et al., 2003). Ulman (1985) and Griffin et al. (1997), for example, posit that methodological inconsistencies make most evidences incomparable and inconclusive. Other flaws include stakeholder mismatching (Wood, 1991), measurement errors (Waddock and Graves, 1997), omitted variable bias (e.g., Aupperle et al., 1985), and endogenity issues (e.g., Nogareda et al., 2006), etc.

Firstly, event studies examine the immediate effect of new information content of an environmental issue on the announcement return (MacKinlay, 1997).Literatures have reported a negative market reaction to the release of bad environmental news(e.g., Joshiet.al., 2005; Kona and Cohen, 1997), as well as the asymmetric effect (e.g., Hamilton, 1995; Klassen et al., 1996)[36]. And yet, the validity of the linkage is challenged by the so-called "cash-flow effect" that investors may react to cash-flow projections instead of environmental news.

[35] The ASR rating score and green building dummy is moderately correlated, with statistical insignificance though at 5% level, which reflects that green building rating signal concrete commitment to sustainability property while the ASR does not necessarily unveil the firms' efforts to go green.

[36]That is, stock price increase following positive environmental information about the firm is less strong than a price decline in response to negative news

Secondly, portfolio analysis typically involves a comparison of risk-adjusted returns between mutually exclusive portfolios with differing environmental performance. Scholars (e.g., Guenster et al., 2011 and Derwall et al., 2005) find a positive and dynamic relation between environmental performance and stock returns, while Cohen et al. (1997) find that investors receive neither a premium nor a penalty for investing in environmental leaders. Notably, portfolio analyses exclusively examine the investor perspective and do not examine causal effects.

Thirdly, multivariate regressions are used to explore relatively long-run CSR and CFP relation. In particular, some find CSR to be positively related to financial performance and negatively linked with financial risks (Spicer, 1978; Konar and Cohen, 2001), whereas others fail to report a significant CSR-CFP relation (e.g., Chen and Metcalf, 1980;Mahapatra, 1984; Elsayed and Paton, 2005). Nonetheless, those results should be interpreted with the caution that correlation does not necessarily imply causation.

An important caveat is the issue of the endogenity between CSR and CFP : on the one hand, based on the "good management theory" (e.g., Waddock and Graves, 1997; Sharma and Vredenburg, 1998), good management of relationships with stakeholders, such as government, employees or investors, can improve legitimacy, staff productivity and market visibility and reputation, which ultimately lead to competitive advantages; on the other hand, the "slack resource theory" (e.g., Waddock and Graves, 1997; Margolis and Walsh, 2003) hold that firms with superior financial performance are more likely to commit to socially responsible practices because they have more resources to afford CSR activities than less profitable companies. Among few studies addressing the endogenity issues are Wagner et al. (2002), Aerts et al. (2008), and Galdeano-Gomez (2008), and Cheng et al. (2011), in which either the simultaneous equation model or instrumental variables (IV) approach is employed.

Emerging literatures on CSR in Asia provide some evidence that environmental information is valued by market participants but at a gradual pattern (e.g., Pargal and Wheeler, 1996; Powers et al., 2010). For example, Gupta and Golder (2005) using Indian data find the market penalized environmental unfriendly behavior with negative abnormal returns of up to 30%. By contrary, Wang and Yuan (2004) find that the effect of environmental certification, such as

ISO 9000 and ISO 14000, on equity pricing is statistically insignificant in China. Also, the Japanese stock market seems to respond to environmental information significantly after the underlying environmental policy got more stringent (Takeda and Tomozawa, 2008). Nonetheless, most of the results offer a short-term perspective, leading to weak economic and statistical significance in the CSR-CFP relation.

2.5.2 Model Specification

As compared to the event study examining the short-term market reaction to CSR and the portfolio approach using asset pricing model, the multivariate regression approach is appropriate to this paper's data sample.

Importantly, it is noted that CSR and firm value may be associated through other variables, i.e., correlated with error terms. For example, high-value firms are more likely to attract investors, and greater international investor holdings may lead to better performance in CSR (Cheung et al., 2010). Thus, to address the endogenity issues that result in biased and inconsistent estimates, this study follows Cheng et al (2011) using instrumental variables (IV) approach[37] to partly mitigate the endogenity issues and omitted variable bias. The instrument is the lagged environmental sustainability performance measured by the two proxies, aiming to capture the persistence of environmental performance measures[38].

$$Q_{it} = c + \beta X_{it} + \sum_{n=1}^{3} \gamma_n M_n + \sum_{n=1}^{1} \delta_n Y_n + \alpha ENV_{it} + \varepsilon_{it} \qquad (1)$$

In model (1), Q_i denotes the natural logarithm of Tobin's Q. c is a constant and ε_i is an independently identical distribution (*iid*) error term. X_i includes a set of value-relevant control variables, such as firm size, leverage, sale growth, profitability, and firm age. M_n aims to capture market fixed effects[39]. The year dummy, $Y_{n,}$ is intended to

[37] The advantage of the instrumental variables approach is that the estimated coefficients are more likely to be consistent, whereas the estimates from an instrumental variables approach are less efficient because the standard errors are large (Wooldridge, 2002).

[38]Correlation analysis, available upon request, shows that the lagged disclosure-based CSR rating score and green dummy appear good instruments given their high correlation coefficients with the environmental measures but low and insignificant coefficients with Tobin's Q.

[39]There are 7 markets in the raw data. To gain economic significance, we group India, Indonesia, Philippine and Malaysia markets as one

control for macro-economic attributes common to all[40]. $\beta, \gamma_n, \delta_n$ are estimated coefficients. Importantly, ENV_{it} represents both measures of environmental performance, i.e., the disclosure-based environmental rating score and the binary variable indicating green building practices. Thus, α measures the possible association between environmental performance and firm valuation in real estate industry.

$$Q_{it} = c + \beta X_{it} + \sum_{n=1}^{2} \gamma_n M_n + \sum_{n=1}^{1} \delta_n Y_n + \sum_{n=1}^{3} \phi_n M_n ENV_{it} + \varepsilon_{it} \quad (2)$$

Model (2) is developed to investigate if the CSR-CFP association varies across markets with differing regulatory and institutional frameworks. To accomplish it, several interacting variables between market dummies and environmental measures are created, and $\Phi_{n,}$ captures this potential effect accordingly.

The IV regressions are estimated as follows:

$$ENV_{it} = a + \delta Z_{it}^{ENV} + \beta X_{it} + \sum_{n=1}^{3} \gamma_n M_n + \sum_{n=1}^{1} \delta_n Y_n + w_{it} \quad (3)$$

$$Q_{it} = c + \beta X_{it} + \sum_{n=1}^{2} \gamma_n M_n + \sum_{n=1}^{1} \delta_n Y_n + \sum_{n=1}^{3} \phi_n M_n ENV_{it}^{*} + \varepsilon_{it} \quad (4)$$

, where Z_{it}^{ENV} denotes instruments and others denote exogenous variables in model (3). ENV_{it}^{*} is the fitted value of ENV_{it} from model (3), which is subsequently used as an independent variable in model (4). In the following tables, only the second-stage regressions are reported, while the first-stage is available upon request.

category–"others". The validity of doing so is backed up by the small portion of firm-year observations in the data sample. Besides, China, Hong Kong and Singapore markets are measured separately.

[40]The year of 2010 is the base group.

2.5.3 Empirical Results

Table 2.3 reports the IV estimate results of model (1), of which environmental performance are measured by disclosure-based rating score in column (1) and by green building dummy variable in column (2), respectively. Using the lagged environmental performance measures as instrument reduces the sample size to 74 firm-year observations that appear twice over the sample period.

- Insert Table 2.3 Here -

Overall, most control variables have expected sign, except for the sale growth and riskiness. Only firm age is statistically significant across all model specifications. Notably, column (1) and (2) both yield positive results, though marginally significant at 10% level. The economic significance is substantial: 1% increase in the environmental dimension of ASR rating score is associated with about 30% increase in firm value proxied by Tobin's Q, while a 15% firm value premium is commanded by real estate companies committing to green property, *ceteris paribus.*

Table 2.4 provides estimate results for model (2).Interestingly, column (1) using the disclosure-based rating environmental proxy reports no significant results, whilst column (2) with the substantive green building proxy finds significant results at 1% level. Economically, it suggests that compared to other markets, only in Singapore are real estate companies committing to green buildings valued higher by capital market by roughly 20%, *ceteris paribus.* Plausibly, it can be attributed to the well combination of stringent regulatory and institutional frameworks and market structure that draw societal interest in corporate efforts to address environmental issues.

- Insert Table 2.4 Here -

2.5.4 Robustness Test

The robustness test is conducted by performing the IV regression on within real estate operating companies (REOCs)

of 66 firm-year observations, as opposed to the total sample including real estate investment trusts (REITs). There exist inherent difference between REIT and REOC in terms of earning distribution, corporate taxation, and business activity. For instance, at least 90% of taxable income must be distributed to unit-holders to maintain the favorable tax status for REITS. In Asia, REITs are mainly focused on acquisition, operation, asset management to seek stable rental income, and avoid the speculative developments, as REOCs do. Accordingly, How to respond to and incorporate environmental sustainability into business practices is quite different between them.

Estimate results from column (3)-(4) in Table 2.3 again provide the marginal evidence of the positive relation between environmental performance and firm value, which is significant at 10% level. Also, results in column (3)-(4) of Table 2.4 remain consistent in that only in Singapore are real estate companies committing to green buildings valued higher than its non-green counterparts.

In addition, for any specification of Table 2.4, *EnvScore* are by no means significant, which may lend support to the criticisms of the symbolic nature of disclosure-based CSR rating (e.g., Patten, 1991; Gray and Bebbington, 2007; Cormier et al., 2011).

2.6 Conclusion & Future Research

The past decade has witnessed the growing popularity of CSR among business community and policy makers. Given the fact that real estate sector accounts for over one third of global energy consumption (RICS, 2008), it provides a tremendous potential to address global CO2 emission and achieve energy efficiency (Eichholtz et al., 2010). Institutional investors are eager to assess and improve the environmental performance of their direct and indirect property holdings, and in turn real estate companies tend to improve their environmental performance to draw investor interest via either CSR reporting or committing to green building practices.

Literatures, mostly from the western society, have emerged to focus on the financial impact of sustainable property investment. However, Asia largely lags behind its western counterpart due to the lack of public awareness of

environmental sustainability. Against this backdrop, this essay seeks to conduct the first Asia-focused comparative analysis to identify the best practices to direct the built environment towards environmental sustainability, as well as initially evaluate how environmental sustainability in real estate is valued financially in Asia. Tobin's Q is used to measure the intangible asset of firm value, while the use of two types of environmental performance proxies can shed light on the appropriateness of environmental screening for sustainable property investment. Empirically, the "Instrumental Variable" (IV) regression is employed to in part alleviate the reverse causality issue.

Having acknowledged the heterogeneous institutional set-up sand market structure in directing towards environmental sustainable real estate investment across Asia, this essay concludes Singapore as the regional leader in greening its built environment. Importantly, it documents that whether or not environmental sustainability in real estate is valued relies on the underlying institutional frameworks and market structure in the sense that only in Singapore, property companies committing to green buildings enjoy a higher value, as opposed to other markets. Also, it document the superiority of using green building practices as screening criteria for sustainable real estate investment to the conventional rating scheme, of which the former represents substantive, concrete and visible corporate resources committing to environmental sustainability than the latter.

Implications can be substantial to other emerging Asian economies eager to promote environmental sustainability in the built environment: The positive CEP-CFP relation can help ease corporate concern to go green without compromising financial objectives. This is consistent with the existing literature (see for example, King and Lenox, 2002). Those interested in sustainable real estate investment in Asia should invest in markets where a good combination of institutional set-up and market structural have been well established and rigorously implemented. Policy makers are encouraged to design proper environmental legislation as well as economic programs to direct the economy towards environmentally sustainability.

Notably, the dependency of CEP-CFP relation in real estate industry on the market structure and institutional

framework warrants further studies at market-level. Due to the data limitation[41], the current sample only covers the two-year ASR rating data and green building information. Nevertheless, the current study do contain a sample for individual firma that represent a wide cross-section of emerging Asian markets as well as a significant proportion of respective market total stock market capitalization[42].

[41] The ASR 2009 is incompatible with ASR 2010 and ASR 2011 in terms of methodology. ASR 2012 is simply unavailable given data disclosure reason.

[42] Due to the substantial monopoly of large property conglomerate in Asia, the sample property companies do account for over 80% of market cap in each property sector.

Table 2.1 Summary Statistics of Environmental Measures

	Full Sample			ASR 2010			ASR 2011		
Markets	Obs	Environment Sustainability	Green Building	Obs	Environment Sustainability	Green Building	Obs	Environment Sustainability	Green Building
China *(Mean)*	13	7.4%	15.4%	7	3.6%	14.3%	6	11.8%	16.7%
(Std.dev)		7.0%	37.6%		6.3%	37.8%		5.2%	40.8%
Hong Kong	47	12.1%	25.5%	20	9.1%	25.0%	27	14.3%	25.9%
		15.6%	44.1%		14.0%	44.4%		16.6%	44.7%
Indonesia	1	15.8%	0	0			1	15.8%	0
India	7	8.0%	0	3	10.0%	0	4	6.6%	0
		7.7%			10.0%			6.6%	
Malaysia	1	5.0%	0	1	5.0%	0	0		
Philippines	4	46.3%	0	1	85.0%	0	3	33.3%	0
		44.8%				.		44.8%	
Singapore	29	18.9%	55.2%	8	32.5%	75.0%	21	13.8%	47.6%
		29.8%	50.6%		39.3%	46.3%		24.5%	51.2%
Total	102	14.5%	29.4%	40	14.7%	30.0%	62	14.3%	29.0%
		22.0%	45.8%		24.8%	46.4%		20.2%	45.8%

Data Source: Asian Sustainability Rating

Table 2.2. Summary Statistics of Major Variables

Variables	Obs	Mean	Std. Dev.	1	2	3	4	5	6
1. Tobin's Q	102	0.97	0.33	1					
2. Size ($ mil)	102	14,877.68	13,162.34	-0.16	1				
3. Leverage (*100)	102	18.36	8.35	0.19*	-0.11	1			
4. Sale Growth (*100)	102	38.30	122.05	-0.01	0.00	0.03	1		
5. ROA (*100)	102	7.62	5.33	-0.10	0.09	-0.20**	-0.11	1	
6. Firm Age (# of days)	102	5,394	3,405	-0.22**	0.43***	-0.38***	-0.18*	0.15	1

Notes:

Significance level of 1%, 5%, and 10% is indicated by *, **, and ***, respectively.

Table 2.3. IV Estimate Results of Regression on Environmental Sustainability (Dependent Variable: Natural logarithm of Tobin's Q)

	(1)	(2)	(3)	(4)
Independent Variables				
EnvScore (%)	0.3066*		0.3847*	
	(0.1737)		(0.2059)	
Green(1=Yes)		0.1487**		0.1435*
		(0.0654)		(0.0819)
Control Variables				
Size ($mil)	-0.0269	-0.0401	-0.0026	-0.0336
	(0.0425)	(0.0463)	(0.0459)	(0.0474)
Leverage (*100)	0.0060	0.0094**	0.0036	0.0087*
	(0.0038)	(0.0037)	(0.0046)	(0.0046)
Sale Growth (*100)	-0.0003	-0.0004	-0.0004*	-0.0004
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
ROA (*100)	0.0022	0.0045	0.0062	0.0061
	(0.0042)	(0.0033)	(0.0061)	(0.0046)
Firm Age (# of days)	-0.00003***	-0.00002***	-0.00003**	-0.00002**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Intercept	0.1463	0.2282	-0.0205	0.1844
	(0.4720)	(0.5448)	(0.4939)	(0.5638)
Year Fixed Effect	Y	Y	Y	Y
Market Fixed Effect	Y	Y	Y	Y
Adjusted R^2	37.77%	33.86%	39.41%	32.11%
Obs	37	37	33	33

Notes:

The IV estimate method is employed to in part mitigate the endogenity issue, of which the lagged environmental performance is taken as the instrument. Since there are 74 overlapping firm-year observations over 2010-2011, the sample size for IV regression is narrowed down from 102 to 74;
Only the second stage regression results are reported here, while the first-stage regression estimate is available upon request. Each model includes year and market dummies;
Column (1)-(2) reports estimate results for full sample of 74 data point, while column (3)-(4) report robustness test results only within REOC group; Newey-West Heteroskedasticity-robust standard errors are reported in the parenthesis; *EnvScore* and *Green* denote disclosure-based environmental dimension of ASR score and green building dummy variable, respectively;
Significance level of 1%, 5%, and 10% is indicated by *, **, and ***, respectively.

Table 2.4. IV Estimate Results of Cross-Country Environmental Sustainability Regression (Dependent Variable: Natural Logarithm of Tobin's Q)

	(1)	(2)	(3)	(4)
Independent Variables				
CH_EntScore	0.5034		0.2436	
	(0.9734)		(0.9822)	
HK_EnvScore	-0.2972		-0.3519	
	(0.1797)		(0.1856)	
SG_EnvScore	0.0013		0.1089	
	(0.1109)		(0.1439)	
CH_Green		0.1372		0.0939
		(0.1961)		(0.1917)
HK_Green		0.0095		-0.0123
		(0.0880)		(0.0934)
SG_Green		0.2042***		0.2915*
		(0.0710)		(0.1512)
Control Variables				
Size ($mil)	-0.0483	-0.0391	-0.0292	-0.0208
	(0.0519)	(0.0593)	(0.0503)	(0.0640)
Leverage (*100)	0.0072	0.0072	0.0037	0.0058
	(0.0056)	(0.0055)	(0.0067)	(0.0058)
Sale Growth (*100)	-0.0003	-0.0003	-0.0004	-0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ROA (*100)	0.0015	0.0036	0.0037	0.0073
	(0.0046)	(0.0036)	(0.0062)	(0.0055)
Firm Age (# of days)	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Intercept	0.3133	0.2383	0.2376	0.0954
	(0.6152)	(0.6505)	(0.6408)	(0.7187)
Year Fixed Effect	Y	Y	Y	Y
Market Fixed Effect	Y	Y	Y	Y
Adjusted R^2	32.84%	33.91%	31.99%	32.65%
Obs	37	37	33	33

Notes:

The IV regression is employed to in part mitigate the endogenity issue, of which the lagged environmental performance is taken as the instrument. Since there are 74 overlapping firm-year observations over 2010-2011, the sample size for IV regression is narrowed down from 102 to 74;
Only the second stage regression results are reported here, while the first-stage regression estimate is available upon request. Each model includes year and market dummies. Interacting variables are constructed between market dummies – CH, HK, and SG, and environmental measures –*EnvScore* that is disclosure-based rating and *Green* indicating commitment to green building practices;
Column (1)-(2) reports estimate results for full sample of 74 data point, while column (3)-(4) report robustness test results only within REOC group; Newey-West Heteroskedasticity-robust standard errors are reported in the parenthesis;
Significance level of 1%, 5%, and 10% is indicated by *, **, and ***, respectively.

CHAPTER THREE

DOES IT PAY TO GO GREEN? EVIDENCE FROM SINGAPORE HOUSING MARKET*

ABSTRACT

Since January of 2005, 250 building projects in the City of Singapore have been awarded the Green Mark for energy efficiency and sustainability. This paper analyzes the private returns to these investments, evaluating the premium in asset values they command in the market. It analyzes almost 37,000 transactions in the Singapore housing market to estimate the economic impact of the Green Mark program on Singapore's residential sector.

A two-stage research design is adopted here; in the first stage, a hedonic pricing model is estimated based on transactions involving green and non-green residential units in 697 individual projects or estates. In the second stage, the fixed effects estimated for each project are regressed on the location attributes of the projects, as well as control variables for a Green Mark rating. My results suggest that the economic returns to green building are substantial. This is one of the first analyses of the economics of green building in the residential sector, and the only one analyzing property markets in Asia. Empirical results provide insight about the operation of the housing market in one country, but the policy implications about the economic returns to sustainable investments in the property market may have broader applications for emerging markets in Asia.

* This chapter is a modified version of Deng, Yongheng, Li Zhiliang, John,M, Quigley, 2012, Economic Returns to Energy-Efficient Investments in the Housing Market: Evidence from Singapore, *Regional Science and Urban Economics*, 42(3):506-515. Further, the original paper was presented at the Symposium on Urbanization and Housing in Asia on May 3-4, 2010, Singapore.

3.1 Introduction

In the past decade, systems for rating and evaluating the sustainability and energy efficiency of buildings have proliferated (Kotchen, 2006). In part, this reflects the potential importance of real property in matters of environmental conservation. For example, buildings and their associated construction activities account for almost a third of world greenhouse gas emissions. The construction and operation of buildings account for about 40% of worldwide consumption of raw materials and energy. Thus, small increases in the "sustainability" of buildings, or more specifically in the energy efficiency of their construction, can have large effects on their current use of energy and on their life-cycle energy consumption. Projected trends in the urbanization of developing economies, particularly in Asia, suggest that the importance of energy efficiency in building will increase further in the coming decades (Costa and Kahn, 2009; Davis, 2009; Zheng, et al, 2009).

In the U.S., two major programs have evolved to encourage the development of energy-efficient and sustainable buildings through systems of ratings to designate and publicize exemplary buildings. The government-sponsored Energy Star program began as a voluntary labeling program intended to identify and promote energy-efficient products. The Energy Star label was extended to new homes in 1993 and subsequently to commercial buildings. Buildings can receive an Energy Star certification if the source energy use of the building, as certified by a professional engineer, achieves a specified benchmark level; the label is awarded to the top quarter of all comparable buildings, ranked in terms of energy efficiency.

In a parallel effort, the U.S. Green Building Council (USGBC), a private nonprofit organization, has developed the LEED green building rating system to encourage the “adoption of sustainable green building and development practices.” The requirements for certification of LEED buildings are substantially more complex than those for the award of an Energy Star rating, and the certification process measures six distinct components of “sustainability,” one of which is energy performance.

In the short time since these rating systems for buildings were developed in the U.S., analogous certification procedures have been developed in many other countries. For example, the "BREEAM" rating system is now widely diffused in the UK, and the "Greenstar" rating system for buildings has been adopted in Australia. Both the British and Australian rating systems have much in common with the LEED system in the U.S. A program to publicize exemplary buildings in Canada, called "BOMA-Best," has been launched, and the European Union is currently negotiating a common system for the certification of commercial and residential buildings.

In 2005 Singapore became the first Asian country to adopt a system of green labeling for newly constructed and rehabilitated buildings. The system, called "Green Mark," has been widely publicized in the city-state, and the award of Platinum, Gold-plus, Gold, and Certified plaques for exemplary buildings regularly reported in the newspapers.

Despite the international diffusion of these rating systems, little is known about their impact on the choices of consumers and investors or about their impact on energy usage or carbon emissions. Moreover, the adoption of global green rating system or certification program in property sector may be greatly impeded by the lack of market evidence of financial benefits of going green, particularly from the investors' perspective. By now, there are a few studies of rating systems for commercial office buildings in the U.S. (e.g., Eichholtz, *et al*, 2010, 2011, and Fuerst and McAllister, 2011), but there is no systematic body of evidence for other countries. There is also no evidence at all about the effects of these certification programs on the housing market.

This paper analyzes the "Green Mark" program in Singapore, evaluating the effect of the program on the housing market, in particular, the consequences for the asset values of dwellings in multifamily housing projects. Section 2 reviews and discussed the literatures on social responsibility and green buildings. In Section 3 below, the salient features of the "Green Mark" program and its history is described. In Section 4 it presents a detailed analysis of the sales of 74,278 housing units in 1,439 projects. About 4% of these projects had earned a Green Mark label by 2009. In Section 5, it summarizes the evidence on the economic premium for Green Mark projects. *Ceteris paribus*, it finds that Green Mark-labeled dwellings command a substantial premium in the Singapore housing market. Section 6 is a brief conclusion.

3.2 Literatures on Green Building Economics

Early evidence on both energy savings and higher construction cost associated with green buildings were either from engineering perspective that is an *ex ante* predictions for policy implementation (Jacobsen and Kotchen, 2009) or pilot projects. What's more, location remains the major purchasing concern, and financial burden of green certification is still substantial (Pivo, 2005).

In spite of modest evidences of consumers' willingness to pay for green building (Kwame et.al, 2009; Eves and Kippes, 2010), several market barriers that prior studies have not addressed remain. Firstly, although eco-friendly buildings are modelled to efficiently alter infrastructure, how individual really behaves and responds is not unambiguous (Greening et al. 2000). It's important to distinguish what they actually consume from what they state. The "rebound effect" in energy usage, for example is documented by Kwame et al (2009); Secondly, the extent to which the green scheme is enforced matters to the success of green building (Jaffe and Stavins, 1995). Metcalf and Hassett (1999) find without well established institutions, the realized returns are dramatically lower than what simulation model predicts. Thus, as most green rating systems are voluntary in nature for building sector, substantive evidence of willingness to pay and corresponding supply response should be directly from marketplace.

To mainstream the sustainable real estate for reducing the environmental footprint, demand from either occupants or investors for energy efficient and sustainable real estate is important. Recent evidence on the willingness to pay for energy efficiency in real estate sector is mostly focused on commercial real estate. Using the CoStar transaction database of the U.S commercial properties, Miller et al. (2008), controlling for some building structural variables, find that Energy Star and LEED certified properties yield around 6% to 10% premium in transaction price, respectively, while the results are not statistically significant at 5 % level.

Eichholtz et al (2010) conduct the first systematic study and document evidence on the economic value of green building, which is based on the impersonal market transactions rather than *ex ante* engineering estimates. In essence,

they find about 3% and 6% price premiums in rent and effective rent, respectively, for green certified buildings compared to non-certified ones. Also, selling prices of certified buildings is about 16 % higher than its counterparts. Equally, they find that the price premium variation associated with green labels indeed relates to the corresponding energy efficiency performance for each building, which significantly implies that market participants in the U.S. properly capitalize the energy information into their asset pricing decision. The implication for developers currently considering the green certification program is particularly substantial. Moreover, the sharp recession in property market due to the recent economic downturn and the simultaneous growth in green building supplies have not significantly deteriorated the returns to energy efficient buildings relative to non-green ones (Eichholtz et al., 2011).

Likewise, to mitigate the issues that the complex interaction of rents and vacancy rates may raise some endogenity problem, Fuerst and McAllister (2011), using the same database but in smaller sample size, find a 10% and 31% selling price premium for Energy Star and LEED certified office buildings, respectively. Also, within the same metropolitan region, certified buildings have a significant rental premium relative to its counterparts, whose value variation corresponds with the green rating levels. More importantly, they argue for three main drivers for the price differentials: occupiers' benefits relating to productivity and image; low holding cost and higher rents; and lower risk premium. Nonetheless, evidence from Australia (Brown and Wills, 2008) shows that, although real estate investors could accept to pay more for a green building mostly because it is considered to be easier to sell and lease, there is still not a significant "green" rental premium; instead, the tenants can get "green" as a bonus for longer rental leases.

Rregardless of the emerging literatures in commercial properties, studies on the willingness to pay in green housing property is sparse. Indeed, most prior studies show that environmental externality, like pollution and traffic, remain the key to household relocation decisions, relative to carbon emission and energy efficiency to be addressed by adopting green building practices (Bourassa et al., 2004; Hanna, 2007). Remarkably, building codes have become more and more stringent over the past years to improve the energy performance of the built environment. Aroonruengsawat et al (2009), Costa and Kahn (2009) and Jacobsen and Kotchen (2009) empirically document that building codes on energy efficiency play a dominant role in lowering household electricity consumption by around 3-5% and decrease in natural gas consumption roughly by 4% on average. Nevertheless, Davis (2009) empirically reports that renters are

significantly less likely to have energy efficient appliance. Thus, the public seems to lack the recognition of economic payoff from energy efficiency investment in buildings (Nassen et al., 2008), reflecting that inefficient disclosure on energy consumption restricts energy savings behaviour of consumers (Kempton and Layne, 1994).

To sum up, investors to large extent still consider it the fiduciary responsibility to avoid the tradeoff between financial and environmental performance and consider investing responsibly as dilutive to investment returns, in spite of the perceived economic benefits of sustainable property investment in general and green buildings in particular. So far, most empirical studies are mainly focused on commercial property market characterized by the growing data availability. To convince the market agents of economic pay-off of green buildings, evidences from a variety of market types needs to be documented (Fuerst and McAllister, 2011). Residential real estate, being the major household wealth (Case, Shiller and Quigley, 2001), nearly accounts for the equivalent amount of energy consumption and CO2 emission as commercial property. Therefore, this study, based in Singapore private housing market is meant to fill in the gap of no green housing market study in Asia, with the aim to obtain a good knowledge of the economic performance of green buildings in residential real estate market.

3.3 The Singapore Green Mark Program & Certification

The Singapore Green Mark program (GM), which evaluates buildings for their environmental impact and energy performance, was launched by Singapore's Building and Construction Authority (BCA) in January 2005. The program seeks to provide a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, construction, and operations practices in buildings.

The GM scheme covers a wide range of property sectors – commercial, residential, retail, industrial, hotel, institutional, office, park and public housing. Typically, the regulations and building codes differ between residential and non-residential buildings. The scheme provides incentives for developers and design teams to construct green, sustainable buildings which can promote energy savings, water savings, and healthier indoor environments, as well as the adoption of more extensive greenery for their projects. For existing buildings, the GM scheme encourages building

owners and operators to meet specified operational goals and to reduce adverse impacts of their buildings on the environment and the health of occupants over the building life cycle.

The label is marketed for its ability to reduce water and energy consumption, to improve indoor environmental quality and to reduce potential negative impacts on the environment. Importantly, the label also helps to recognize developers with strong commitments to corporate social responsibility. It also helps publicize achievements in environmental sustainability.

The GM Program has evolved over time in promoting environmental sustainability through a variety of other supply-side incentives. For example, in 2006 a S$ 20 million Green Mark Incentive Scheme for New Buildings was introduced, which offers direct cash incentives to selected developers, building owners and project consultants whose new development achieves a Green Mark Gold or higher certification. Building codes were amended in April 2008, imposing minimum standards on environmental sustainability for all new buildings, requiring that new construction be comparable to the Green Mark-certified level.

In 2009, a Green Building Master Plan was announced; it sets a goal of Green Mark certification in 80% of all buildings by 2030. Other initiatives have been introduced in the past several years.

3.3.1 Application and Assessment Process

Developers, building owners and government agencies may apply to the BCA to register their interest in participating in the BCA Green Mark Scheme. Following that, the assessment process involves a briefing to the project team to clarify BCA Green Mark requirements and the certification process.

The actual assessment is carried out at a later stage to verify that the building meets the certification criteria. The assessment includes design and documentary reviews as well as site verification. Upon completion of this assessment, a letter of award is sent to the team.

3.3.2The Rating System

The assessment criteria cover the following key areas:

- Energy Efficiency
- Water Efficiency
- Environmental Protection
- Indoor Environmental Quality
- Other Green Features and Innovation

The Green Mark program rates the environmental attributes of a building based on a point score. Up to 120 points are awarded for incorporating conservation features which exceed standard practice. Depending on the score, the rating is categorized in four quality levels - Platinum (90 points or more), Gold Plus (85-90 points), Gold (75-85 points) and Certified (50-75 points). Detailed information on the scoring system is presented in the Appendix 3.1.

-Insert Appendix 3.1 Here -

After achieving certification, Green Mark buildings are required to be re-assessed every three years to maintain Green Mark status. Newly-constructed, newly-certified, and existing buildings are subsequently re-assessed under uniform criteria for existing buildings.

3.4 Data Collection & Description

As of June 2010, 250 building projects were awarded the Green Mark, of which 86 are residential housing estates. Thus, the names and addresses[43] of GM awarded projects are identified on lists released by the Singapore Building

[43] In Singapore, each building corresponds to a unique postal code.

and Construction Authority (BCA). As one residential project usually consists of several buildings, the GM-rated residential project names and addresses is matched to the most comprehensive source of real estate information for Singapore, as of June 2010[44].

Public housing accounts for about 80% of the overall housing stock in the Singapore residential housing market. The private housing stock is dominated by non-landed property, i.e., condominium and apartment properties (See Table 3.1). Because property characteristics are quite heterogeneous among different submarkets (see Phang and Wong, 1997, and Sing *et al*, 2006), it concentrates on private condominiums and apartments in this analysis.

- Insert Table 3.1 Here -

Some 62 GM-rated residential projects (condominiums and apartments), including both new and existing properties were matched. Transactions for some of 18,296 dwelling units in those 62 GM-rated projects between January 2000 and June 2010 were identified[45]. Besides price, the transactions records included unit size, floor level, tenure type, property type, transaction date, transaction type, property location, and whether the purchaser previously lived in a public or private dwelling unit.

For control purposes this paper also identified some 1,377 projects with 55,982 dwelling unit transactions in projects that were not GM-rated.

The sample consists of sales of some 74,278 multifamily dwelling units sold between January, 2000 and June 2010. These units are in 1,439 different housing projects (condominium and apartment residential estates) across Singapore, of which 62 projects (with 18,296 dwelling unit transactions) are GM-rated, while 1,377 (with 55,982 dwelling unit

[44] The Real Estate Information System (REALIS) provides information for residential, commercial and industry property market. Specifically, it includes Time Series - more than 1,300 time series; Project Database - integrated information on each project, such as the approval status and the number of units launched and sold; Stock Database - allows users to customize their own stock and vacancy statistics; Transaction Database - contains records of caveats lodged at the Singapore Land Registry since 1995 for the residential, commercial and industrial sectors. The Transaction Database is updated fortnightly.

[45] The sample period of 2000-2010 allows to study the housing units before and after they received Green Mark in line with the principles of "Difference-in-Difference" approach

transactions) are not GM-rated (NGM). Figure 3.1 compares the annual average sales price per square meter in GM and NGM projects over the 2000-2010.

- Insert Figure 3.1 Here -

The figure shows that sales of GM-rated dwellings typically commanded a higher sale price than NGM dwellings. Figure 3.2 reports the temporal variations in the fraction of GM-rated sales.

- Insert Figure 3.2 Here -

As indicated in Figure 3.2, the proportion of GM sales reached a peak of over 35% of all sales in Q2 2007. Since Q1 2006, the fraction of GM-rated sales more-or-less fluctuates with the dynamics of the overall property market. Notably, the dramatic drop in the fraction of green unit sales since Q2 2009 arises because a great number of non-green private dwelling projects were undertaken following the financial crisis, as a part of Singapore's recovery stimulus. Yet, regardless of the percentage drop of green unit sales, the absolute size of green unit sales from 2009 onwards has increased.

For each dwelling unit that has been sold, information is gathered about its hedonic characteristics as much as possible[46]. Data on some of the attributes measured in other studies in the US or Europe are hardly relevant to the Singapore context. For example, all private housing projects in Singapore have air conditioning, a garage, and a swimming pool; the climate makes fireplaces less important. Some attributes (e.g., the number of rooms and bathrooms) are simply unavailable, but since the size of rooms in residential housing projects in Singapore is quite standardized, it can measure the total area of each unit. Some other attributes may be more important in the

[46] It argues that the "reputation" premium may exist. However, there has been no satisfactory metric to proxy for it. Also, how to control for the dynamic feature of reputation is questionable, given that it could be upgraded or downgraded considerably as exogenous shocks take place. In addition, as resale sales are included in the sample, the reputational effect may be less or barely relevant to selling price, as compared to other factors, such as, location, quality, etc.

Singapore context. For example, there is empirical evidence that a good view is greatly valued among Singaporeans (Yu, Han and Chai, 2007). Accordingly, it expects the floor level to be positively related to sale price, other things being equal[47].

Apart from structural attributes, it controls for location by adding indicator variables for properties located in 55 different planning areas.[48] It also includes indicator variables for the month and year of sale, from 2000 to 2010, to control for the broader economic environment. Furthermore, this study exploits information on the property type (condominium or apartment), the type of transaction (new-sale, re-sale or sub-sale), planning area, and the tenure type (freehold or leasehold). In addition, it also identifies the type of purchaser -- a buyer who already lives in a public housing unit (an "HDB" flat) and seeks to upgrade to private housing, a buyer from the private economy (who currently lives in a private dwelling unit), or else a first-time buyer ineligible for purchase of an HDB flat[49].

Columns (1) to (3) in the first panel of Table 3.2 report a comparison of the mean values of the hedonic attributes in GM and NGM-rated residential projects. All dwelling sale prices are converted to constant 2000 dollar values.

- Insert Table 3.2 Here -

On average, GM-rated buildings are of higher quality than NGM buildings. In particular, the likelihood that GM certified dwellings are on a higher floor level (greater than twenty) is twice that of NGM certified units. GM housing is larger in unit size than NGM by about thirteen square meters. Clearly, there exists a substantial difference in the average transaction prices and unit prices per square meter between GM and NGM-rated units, confirming some

[47] In Singapore where most of population lives in high-rise public housing, it has been well documented that the willingness and adaptability to live at high floors has grown dramatically, especially for younger generation. There is also a consensus that high-rise buildings are a model of sustainable building (Abel, 2003).

[48] See Lum, S.K. et al., 2004; and Ong et al., 2003 for a discussion of these planning areas.

[49] In Singapore, those who are eligible for public housing (HDB) receive a substantial government housing subsidy and favorable mortgage terms. Most Singaporeans live in public housing. The rest of the population, who are in general belong to upper end of the income distribution, live in private housing. As a result, the control for share of private buyers can be used as an instrument for household income and social status, not otherwise available in Singapore.

difference in quality or the existence of a price premium for GM housing. In terms of property type, both GM and NGM share a similar pattern: more than half of projects/dwelling units are condominiums. Over 60% of housing transactions in both groups consist of new units, reflecting the dominance of the primary private housing market over the resale market. More than 60% of dwelling sales occurred in the central region, which is consistent with land scarcity and the fierce competition for land use in the centre. The number of buyers who previously owned private housing units or first-time buyer ineligible for public housing criteria exceeds the buyers trading up from public ("HDB") flats.

The data show that most of the dwelling units sold in this sample is freehold in tenure, though its share in the GM group is smaller than that in the NGM group. Freehold tenure yields more secure property rights and longer occupancy terms to the owner than leasehold, making buyers willing to pay a price premium (Tu and Bao, 2009). It controls for this potential impact on housing prices in the regressions reported below.

Within GM-rated dwelling units, about 57% have been awarded the Green Mark Gold, 21% and 19% of total GM-rated sales have the Green Mark Gold-plus and the Green Mark certification, respectively, leaving 3% of dwellings rated Platinum. Housing sales vary over time between 2000 and 2010. 22% and 25% of sales took place in 2007 and 2009, respectively, which reflects the underlying property market cycle in Singapore.

It gathered information on the location and amenity characteristics of each of the 1,439 projects in the sample. For each of these projects (housing estates), it defines a set of location and amenity variables. These take the value of one if the project is located within 300 meters of an expressway (*Express*), a bus or MRT subway station (*Bus/MRT*), or a park (*Park*), respectively. Another variable, *Dist2Orch*, measures the distance in kilometers of each project to Orchard Road (the country's major shopping district). Since buyers from the private economy have higher incomes and greater wealth, on average, than citizens residing in government public housing (HDB), the proportion of new purchasers who come from the private economy may reflect (or help provide) a more desirable neighborhood environment for a given project. Thus, it is recognized by including the percentage of private buyers for each project, *PrivateRatio*. I expect

this variable to be positively associated with housing price.

The average values of these variables also differ substantially between GM and NGM properties. This is also presented in columns (1) to (3) in panel II of Table 3.2.

The research design recognizes the distinction between attributes measured at these two levels: dwelling units and the projects in which they are situated. Note that this research design will also lead to quite conservative estimates of the importance of green certification on asset values. By design, all the co-variation between higher quality dwelling units and green certified properties is attributed to the dwelling units, not the environmental certification.

To control for the fact that the average characteristics of the GM and NGM samples are different, it employs Propensity Score Matching (PSM) techniques to weight the observations in the NGM group (control group) so that the control and treatment groups are more similar in terms of average characteristics.

Dwelling units sold in NGM group are weighted corresponding to their propensity scores, that is, the probabilities that their hedonic characteristics are identical to those in the GM group (Black and Smith, 2004). It matches on the basis of this scalar propensity score rather than matching on the basis of all housing characteristics (Rosenbaum and Rubin, 1983 and 1984). Among the specific matching methods, it finds Nearest One-to-One Neighbor Matching is the best fit to the sample. It minimizes differences in the distributions between GM and NGM groups[50].

Column (4) and (5) in Table 3.2 present the mean values for GM and NGM groups weighted by their propensity scores. After matching, it is clear that the average values of the hedonic attributes of the NGM group are far closer to those of the GM group. For instance, prior to PSM, the average sizes for GM and NGM are 131 and 118 square meters,

[50] The key idea of One-to-One Nearest Neighbor Matching (NNM) is that for each unit sold in GM group we choose the dwelling in NGM group with the closest propensity score. We impose the common support restriction that units in GM group whose propensity scores are larger than the largest score in the NGM group are left unmatched. By doing so, we eventually manage to match 18,256 pairs of dwelling units, representing 697 projects in total.

respectively; around 73%, 21% and 70% of GM-rated dwelling units are condominiums, on higher floors, purchased by private buyers, respectively, while only 62%, 10% and 66% of NGM-rated dwelling units are condominiums, on high floors, purchased by private buyers. After nearest-neighbor matching, the matched GM and NGM-rated pairs have more similar average quality measures. The average sizes for GM and NGM are 131 and 126 square meters, respectively. Around 73% instead of 62%, 17% instead of 10% and 69% rather than 66% of NGM group are condominiums, situated on high floors purchased by buyers from the private economy.

3.5 Empirical Analysis

The empirical analysis encompasses two estimation strategies. First, it adopts the most straightforward and conservative way to investigate the economic premium of Green Mark. In this approach, it simply relates the logarithm of unit sale price per square meter to a set of structural, spatial and temporal control variables (floor area, floor level, tenure, property type, purchaser type, and transaction type, time-fixed effects, i.e., transaction year, month of sale and fixed effects for each of 22 communities).

In the first stage, the logarithm of unit selling price per square foot is related to a set of structural variables—floor level, floor area, property type, tenure, construction type, transaction type, purchaser type, and spatial and time fixed effects, as well as green indicator. In detail, given the satisfaction of living in high-rise building and appreciation of good view, building height is expected to positively relate to selling price; also, as condominiums are generally newer than apartments in design, it expects them to yield higher prices than other housing types. Freehold properties, yielding longer terms of occupancy and property rights, are anticipated to command higher values than leasehold properties. It expects that projects associated with larger fractions of private borrowers are more desirable.

$$logP_i = c + \beta X_i + \sum_{n=1}^{21} \gamma_n R_n + \sum_{n=1}^{10} \delta_n Y_n + \sum_{n=1}^{11} \phi_n M_n + \alpha g_i + \varepsilon_i \qquad (1)$$

In equation (1), the dependent variable is the logarithm of the selling price per square meter P_i of transaction *i*. *c* is a constant and ε_i is an error term. X_i is a vector of hedonic characteristics of property *i*. To control further for regional differences, R_n, a community indicator is added, representing the planning area in Singapore in which each project is located. Y_n and M_n are year and month dummy indicators. $\beta, \gamma_n, \delta_n, \phi_n$ are coefficients. $\exp(\alpha)$ measures the price premium of a Green Mark certification.

$$logP_i = c + \beta X_i + \sum_{n=1}^{21} \gamma_n R_n + \sum_{n=1}^{10} \delta_n Y_n + \sum_{n=1}^{11} \phi_n M_n + \sum_{n=1}^{4} \alpha_n g_n + \varepsilon_i \qquad (2)$$

Equation (2) analyzes the four categories of the Green Mark premium: Platinum, Gold-plus, Gold and Certified.

The second approach adopts a two-stage hedonic pricing equation (Hanushek, 1974). In the first stage, it estimates a unit-level hedonic pricing equation similar to equation (1), except that it drops the project level variables, and it includes instead project-specific fixed effects. The second stage considers the location and amenity attributes measured at the project level, attributing all the co-variation to dwelling characteristics. All dwellings in a given project have the same location and environmental attributes.

$$logP_i = c + \beta X_i + \sum_{n=1}^{10} \delta_n Y_n + \sum_{n=1}^{11} \phi_n M_n + \sum_{n=1}^{696} \theta_n Proj_n + \varepsilon_i \qquad (3)$$

Equation (3) specifies the unit level hedonic model in the first stage. The essential difference of equation (3) from equation (1) is the inclusion of 696 project fixed effects. Since the indicator variables for projects and communities are likely to be highly correlated, it drops the community variables, R_n, from equation (3). The estimated coefficient θ_n, the project-specific fixed effect is used as the dependent variable at the second stage hedonic equation.

In the second stage hedonic equation, each project fixed effect is related to project-level neighborhood variables – distance to the city center—Orchard Road, the proximity to expressway, bus or MRT stop and parks, as well as the fraction of private buyers for each housing projects. Because of the enhanced convenience and easy access to city centre, a higher selling price is expected for dwellings closer to Orchard Road. Existing evidence of the impact of proximity to nearby amenities (expressway, bus or MRT, and park in this study) on property value is inconclusive and mixed[51] so it estimates the link between these neighborhood amenities property values. As noted above it expects that more private buyers for each project, selling prices will be higher.

$$\hat{\theta}_i = c + \beta X_i + \sum_{n=1}^{21} \gamma_n R_n + \alpha g_i + \varepsilon_i \qquad (4)$$

In equation (4), the dependent variable, $\tilde{\theta}_i$the premium or discount for each project, is regressed on a set of accessibility variables. Here, *c* is a constant and ε_i is an error term. X_i is a vector of location attributes for project *i*, including distance to orchard road (*Dist2Orch*), closeness to bus stop or subway (*Bus/MRT*), access to expressway (*Express*) and closeness to park (*Park*). R_n, a community dummy variable, is used to control for the spatial variation among projects. The coefficient of primary interest is α, the economic price premium of Green Mark at the project level.

Table 3.3 presents the results of the hedonic model using 36,512 transactions in GM and NGM groups matched by propensity scores.

- Insert Table 3.3 Here -

[51] Hendon (1971, 1974), Wilhelmsson, (2000)

For each model, community, month and year dummies are included, which are not reported separately in the table. Overall, housing attributes have the expected effects. It confirms the statistically significant value of a good view by noting the negative sign for the low level and the positive sign for the high level compared to medium level. Other housing characteristics, such as condominium dwelling type, new-sale, freehold tenure, and private purchasers, all consistently have anticipated positive effects on unit price. Although trivial in magnitude, larger dwelling units are likely to yield a bit higher unit price than small size units.

In Model 1, the Green Mark price premium is statistically significant at the 1% level, indicating that Green Mark certification commands about a 6% premium over comparable, non-certified dwellings. Model 2 includes spatial fixed-effects. The Green Mark price premium is estimated to be 4%, but the fitting of the model improves dramatically (R^2 improves from 47% in Model 1 to 85% in Model 2). Model 3 shows that the GM premium also varies significantly across different levels of certification: Platinum earns the highest return of 14%; gold earns a 6% price premium. The estimated coefficient of gold-plus is smaller than that of the gold award; nevertheless all green awards are statistically significant at 5% level.

Table 3.4 reports the results of the two-stage regression, the second stage regression at the project level.

- Insert Table 3.4 Here -

The first stage estimation results (not reported here) are similar to those reported in Table 3.3. In the second stage regression, the estimated premium for each project, obtained from the first stage equation, is regressed on a set of property level location and amenity variables and spatial fixed effects (community dummy variables). In general, *ceteris paribus*, the average sale price increases with the share of private purchasers. Closeness to open space, *Park*, is statistically significant at the10% level with a positive effect on property value. The closeness to the bus or subway stop has a significant but negative impact on the price, which is consistent with the intuition that most of the private condo purchasers are less dependent on public transportation; they simply prefer privacy to easy access by mass

transportation. Likewise, the closeness to an expressway is found to have significantly negative impact of property value at 10% level. Also, projects with less access to Orchard Road have lower selling prices.

The two-stage hedonic pricing model again suggests that all categories but Platinum of GM certified projects enjoy a statistically significant price premium compared to NGM rated projects, with magnitudes ranging from 10% for GM Certified, 15% for Gold and Gold-plus, and 21% for Platinum projects. On average, the Green Mark is estimated to yield a 15 % price premium on property value *ceteris paribus*, which is somewhat larger than the result reported in Table 3.3.

3.6 Conclusion

The empirical analysis based on 697 individual projects and 36,512 transactions in the Singapore housing market suggest substantial economic returns to green building. The two-stage estimation shows that the Green Mark premium of 4% is statistically significant even after controlling for community amenities.

Of course, it cannot claim to have controlled completely for all differences in quality between GM and NGM dwellings. But it has measured and controlled for a large number of the hedonic characteristics of properties, including the characteristics and amenities of the neighborhoods in which they are located. It has also employed propensity matching techniques to control further for differences in the observed and unobserved characteristics of GM and NGM dwellings. The nearest- neighbor research design is intended to be conservative as is the two step estimation procedure.

Based on nearest one-to-one neighbor matching between control and treatment samples, it finds a significant premium in selling prices for dwellings with Green Mark Certification. The estimated premium is larger for dwellings certified at higher levels in the Green Market process -- Platinum, Gold Plus, and Gold rated dwellings.

This is one of the first analyses of the economics of green building in the residential sector, and the only one analyzing property markets in Asia. The results provide insight about the operation of the housing market in one country, but the policy implications about the economic returns to sustainable investments in the property market may have broader application for emerging markets in Asia.

Table 3.1. Characteristics of Private and Public Housing Markets in Singapore

Housing type	Average floor/land area(sqm)	Average transaction price (S$)	Housing stock (as of 4Q03)	Market Share (%)
Private housing market				
Detached house	1,314	4,927,479	9,915	0.97
	(2,506.51)	(7,053,406)		
Semi-detached house	340	1,440,098	20,628	2.01
	(114.03)	(488,121)		
Terraced house	208	1,052,364	36,549	3.56
	(75.64)	(369,661)		
Condominium	133	803,168	85,869	8.36
	(56.99)	(813,068)		
Apartment	125	743,830	57,973	5.65
	(88.22)	(463,331)		
Public housing market			815,633	79.45

Source: Sing et al, 2006

Table 3.2 Comparison of GM and NGM-rated Dwelling Units
(Standard deviation in parenthesis)

	Overall	GM-rated	NGM-rated	PSM GM-rated (1:1 Nearest)	PSM NGM-rated (1:1 Nearest)
	(1)	(2)	(3)	(4)	(5)
Panel I: Units level Hedonic Characteristics					
Unit price/m^2 (S$)	10,206.06	11,049.44	9,930.428	11,050.31	10,543.35
	(5,237.81)	(6,063.97)	(4,906.65)	(6,070.27)	(5,889.90)
Unit size (sqm)	121.12	130.87	117.93	130.66	126.33
	(91.30)	(107.69)	(85.42)	(107.45)	(130.14)
Floor level (percent)					
Low (<10)	59.72	49.61	63.04	49.58	53.33
	(49.11)	(49.99)	(48.39)	(49.99)	(49.99)
Medium (10-20)	27.40	29.59	26.68	29.60	29.60
	(45.10)	(45.84)	(44.86)	(45.84)	(47.36)
High (>20)	12.88	20.80	10.28	20.83	17.07
	(32.71)	(40.63)	(29.32)	(40.63)	(35.49)
Freehold (percent)	57.80	34.63	65.37	34.68	45.69
	(49.91)	(47.69)	(49.26)	(47.70)	(49.34)
New construction (percent)	46.53	77.18	36.52	77.27	63.61
	(49.78)	(40.08)	(47.59)	(40.08)	(43.65)
Property type (percent)					
Condominium	64.72	73.30	61.92	73.37	72.63
	(46.95)	(42.77)	(47.85)	(42.78)	(42.48)
Apartment	35.28	26.70	38.08	26.63	27.37
	(46.95)	(42.77)	(47.85)	(42.78)	(42.48)
Transaction type (percent)					
New sale*	62.00	68.88	59.75	68.96	64.91
	(48.55)	(44.85)	(49.21)	(44.86)	(45.30)

Table 3.2. Comparison of GM and NGM-rated Dwelling Units (Continued)
(Standard deviation in parenthesis)

Sub-sale**	16.46	21.00	14.98	21.00	20.98
	(36.02)	(39.22)	(34.90)	(39.23)	(31.71)
Resale***	21.54	10.12	25.27	10.04	14.11
	(41.9)	(28.49)	(44.38)	(28.50)	(37.99)
Purchaser type (percent)					
Private	66.79	69.79	65.81	69.76	69.01
	(47.95)	(46.22)	(48.37)	(46.23)	(47.24)
Public	33.21	30.21	34.19	30.24	30.99
	(47.95)	(46.22)	(48.37)	(46.23)	(47.24)
Location[52] (percent)					
Central region	70.67	63.90	72.88	63.83	66.55
	(48.05)	(48.09)	(48.04)	(48.09)	(49.03)
East region	17.84	13.96	19.11	13.99	17.41
	(35.81)	(33.26)	(36.52)	(33.27)	(35.57)
West region	6.75	11.17	5.31	11.19	10.88
	(34.40)	(32.41)	(34.97)	(32.41)	(38.01)
Northeast region	4.74	10.97	2.71	10.99	5.16
	(26.12)	(32.15)	(23.81)	(32.16)	(26.81)
Green Mark Award (percent)					
Platinum	0.76	3.07		3.07	
	(10.84)	(21.91)		(21.91)	
Gold-Plus	5.11	20.74		20.78	
	(21.16)	(39.97)		(39.98)	
Gold	13.95	56.62		56.53	
	(34.07)	(49.51)		(49.52)	
Certified	4.82	19.57		19.62	
	(20.16)	(38.44)		(38.45)	
Transaction year (percent)					
2000	0.04	0.16	0.00	0.03	0.00
	(2.15)	(3.73)	(1.33)	(3.73)	(2.40)
2001	0.16	0.06	0.20	0.04	0.02
	(4.91)	(2.30)	(5.46)	(2.30)	(2.30)
2002	2.37	0.64	2.93	0.64	0.48
	(14.68)	(7.48)	(16.23)	(7.49)	(7.36)
2003	2.18	1.27	2.47	1.27	1.51
	(17.34)	(10.51)	(18.91)	(10.51)	(11.95)
2004	4.37	5.14	4.11	5.15	1.99
	(19.69)	(20.79)	(19.34)	(20.80)	(11.53)
2005	8.74	12.26	7.58	12.29	7.62
	(27.37)	(31.04)	(26.08)	(31.05)	(22.33)

[52] The four regions listed are Singapore planning regions: intended to facilitate the planning of the use and development of land (https://spring.ura.gov.sg/lad/ore/login/GLOSSARY.cfm?no=1#p).

Table 3.2. Comparison of GM and NGM-rated Dwelling Units (Continued)
(Standard deviation in parenthesis)

2006	12.96	14.71	12.39	14.75	12.88
	(32.67)	(33.58)	(32.37)	(33.59)	(32.93)
2007	21.96	32.68	18.46	32.75	30.23
	(40.19)	(45.27)	(38.10)	(45.28)	(44.29)
2008	7.09	8.61	6.59	8.63	8.10
	(25.53)	(26.47)	(25.23)	(26.48)	(26.57)
2009	24.50	18.29	26.54	18.33	26.41
	(44.07)	(42.08)	(44.61)	(42.09)	(45.78)
2010	15.63	6.18	18.72	6.12	10.76
	(37.06)	(30.65)	(38.63)	(30.57)	(35.28)
No of dwellings	74,278	18,296	55,982	18,256	18,256
Panel II: Project Level Accessibility and Amenity Characteristics					
Dist2Orch (kilometers)	6.48	4.31	6.57	4.31	5.49
	(37.03)	(3.63)	(37.76)	(3.63)	(3.91)
Express (percent)	13.54	17.74	13.37	17.74	15.75
	(34.22)	(38.51)	(34.04)	(38.51)	(36.45)
Bus/MRT (percent)	93.82	93.55	93.83	93.55	92.23
	(24.10)	(24.77)	(24.07)	(24.77)	(25.15)
Park (percent)	23.58	22.58	23.62	22.58	21.73
	(42.46)	(42.15)	(42.49)	(42.15)	(41.27)
PrivateRatio (percent)	68.04	77.84	67.60	77.88	68.67
	(27.88)	(19.14)	(28.14)	(20.88)	(33.62)
No of Projects	1,439	62	1,377	62	635

Notes:

*New sale: The sale of a unit directly by a developer before the issuance of the Certificate of Statutory Completion and the Subsidiary Strata Certificates of Title or the Certificates of Title for all the units in the development;

**Sub-sale: The sale of a unit by an owner who has signed an agreement to purchase the unit from a developer or a subsequent purchaser before the issuance of the Certificate of Statutory Completion and the Subsidiary Strata Certificates of Title or the Certificates of Title or the Certificates of Title for all the units in the development;

***Resale: The sale of a unit by a developer or subsequent purchaser after the issuance of the Certificate of Singapore Completion and the Subsidiary Strata Certificates of Title or the Certificates of Title for all the units in the development;

Table 3.3 PSM Regression Estimation of Unit Price on Dwelling Units Attributes (Dependent variable: Logarithm of Unit Price per square meter)

Variables	(1)	(2)	(3)
Green Mark (1=Y)	0.0607***	0.0420***	
	(0.0039)	(0.0021)	
Platinum (1=Y)			0.1434***
			(0.0138)
Gold-Plus (1=Y)			0.0227***
			(0.0036)
Gold (1=Y)			0.0555***
			(0.0028)
Certified (1=Y)			0.0081**
			(0.0036)
Size (sq.m)	0.0003***	0.0001***	0.0001***
	(0.0001)	(0.0000)	(0.0000)
Floor Level			
Low (1=Y)	-0.0931***	-0.0431***	-0.0438***
	(0.0042)	(0.0025)	(0.0025)
High (1=Y)	0.2188***	0.0892***	0.0871***
	(0.0056)	(0.0033)	(0.0033)
Condominium (1=Y)	-0.2129***	0.0485***	0.0518***
	(0.0052)	(0.0031)	(0.0031)
Freehold (1=Y)	0.1794***	0.0674***	0.0728***
	(0.0040)	(0.0026)	(0.0026)
New Construction (1=Y)	0.0172***	0.0305***	0.0281***
	(0.0051)	(0.0031)	(0.0031)
Private Buyer (1=Y)	0.2106***	0.0235***	0.0225***
	(0.0045)	(0.0022)	(0.0022)
Transaction Type			
New-sale (1=Y)	-0.0326***	0.0656***	0.0674***
	(0.0052)	(0.0029)	(0.0029)
Resale (1=Y)	-0.1999***	-0.0705***	-0.0699***
	(0.0076)	(0.0042)	(0.004271
Constant	9.2085***	8.7516***	8.7380***
	(0.0985)	(0.0901)	(0.0903)
Month dummy	Y	Y	Y

Table 3.3 PSM Regression Estimation of Unit Price on Dwelling Units Attributes (Continued)
(Dependent variable: Logarithm of Unit Price per square meter)

Year dummy	Y	Y	Y
Spatial fixed effects	N	Y	Y
Number of Observations on Dwellings	36,512	36,512	36,512
Adjusted R^2	0.4407	0.8354	0.8403

Notes:

All models are estimated by Ordinary Least Square (OLS) weighted by propensity scores. White Heteroskedasticity consistent standard errors are reported in brackets and Significance at 0.1, 0.05 and 0.01 level indicated by *, ** and ***, respectively; all models except for column (1) include spatial fixed effects (i.e., 21 planning area dummies) and time fixed effects (i.e. 11 month and 10 year span);

Base purchaser type is 'Public'; base dwelling type is 'apartment'; base floor level is 'medium level'; base sale type is 'sub-sale'; base tenure type is 'leasehold';

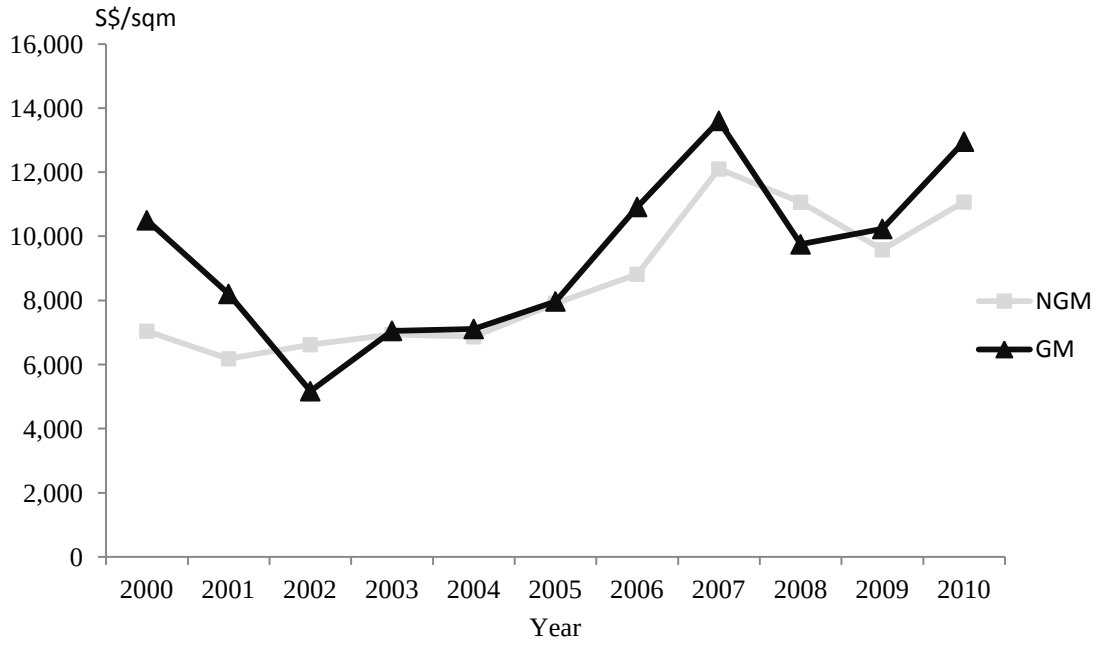
Table 3.4 Estimation of Project Fixed Effects
(Dependent Variable: Project Fixed Effect)

Variables	(1)	(2)	(3)
Green Mark (1=Y)	0.2112***	0.1453***	
	(0.0389)	(0.0281)	
Platinum (1=Y)			0.2098
			(0.1400)
Gold-Plus (1=Y)			0.1504***
			(0.0562)
Gold (1=Y)			0.1523***
			(0.0395)
Certified (1=Y)			0.1008***
			(0.0330)
Neighborhood Variables			
Dist2Orch (km)	-0.0668***	-0.0411***	-0.0410***
	(0.0030)	(0.0078)	(0.0079)
Express (1=Y)	-0.0985***	-0.0438*	-0.0427*
	(0.0293)	(0.0247)	(0.0249)
Bus/MRT (1=Y)	-0.2452***	-0.1069***	-0.1064***
	(0.0526)	(0.0397)	(0.0399)
Park (1=Y)	0.0162	0.0370*	0.0364*
	(0.0263)	(0.0215)	(0.0216)
Private ratio (%)	0.2474***	0.1188***	0.1181***
	(0.0339)	(0.0276)	(0.0277)
Constant	0.6457***	0.239245	0.2446
	(0.0609)	(0.0839)	(0.0834)
Spatial fixed effects	N	Y	Y
Number of Observations on Projects	697	697	697
Adjusted R^2	51.09%	70.49%	70.39%

Notes:

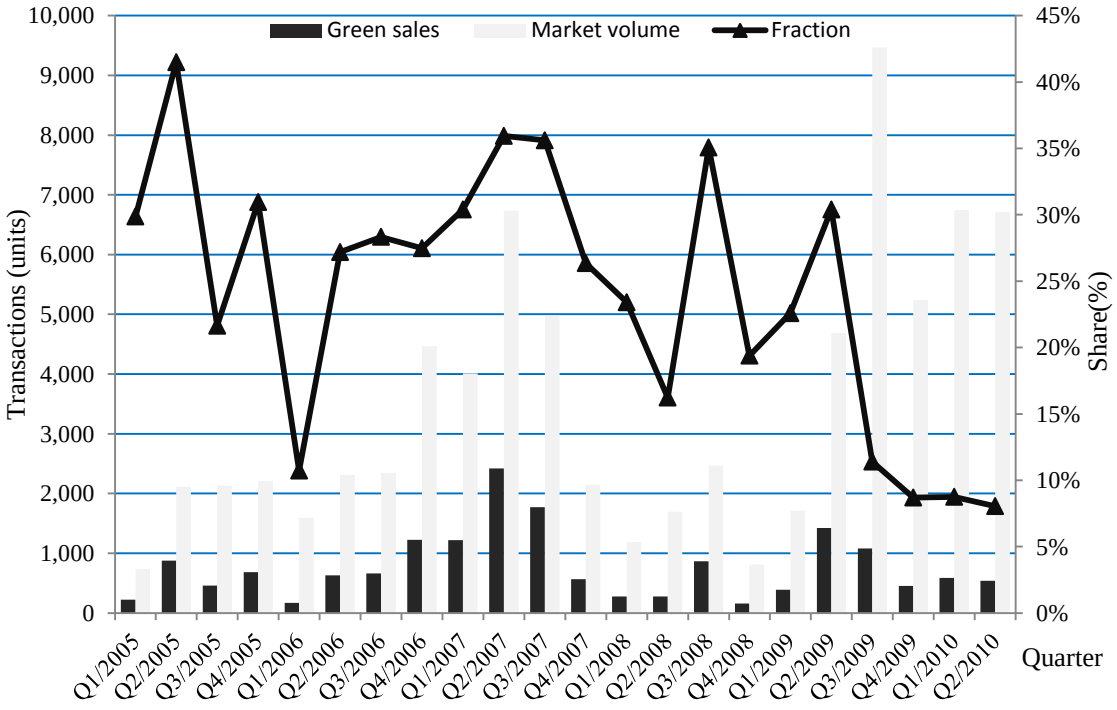
Each regression is estimated with a sample of 697 GM and NGM projects matched by propensity scores. All models are estimated by Ordinary Least Square (OLS) in which White Heteroskedasticity consistent standard errors are reported in brackets and Standard errors are reported in brackets and Significance at the 0.1, 0.05 and 0.01 level indicated by *, ** and ***, respectively; All regressions except for column (1) include spatial fixed effects (i.e., 21 planning area dummies).

Figure 3.1 Annual Average Unit Price per square meter, 2000-2010



Data source: Real Estate Information System-REALIS

Figure 3.2 Green Fraction & Trading Volumes, 2005Q1-2010Q2



Data source: Real Estate Information System-REALIS

CHAPTER FOUR

THE FINANCIAL IMPLICATION OF GREEN BUILDING INVESTMENT: EVIDENCE FROM SINGAPORE PROPERTY COMPANIES*

ABSTRACT

Despite the reported economic returns to direct investments in sustainability and energy efficiency in buildings at asset market, initial capital outlay has rarely been considered, leading to little knowledge on the net financial benefits of green building investment. Provided financial performance of property companies is the eventual outcome of the interplay between green costs and benefits, this paper focuses on the financial performance of property companies committing to green building investment to shed some light on the net benefits of going green. Theoretical inference can be borrowed from the well-developed literatures on the corporate social responsibility (CSR) and corporate financial performance (CFP) debate.

Notably, given the increasingly tightened green mandate in Asian economies, particularly in Singapore, this paper is featured by its focus on the moderating effect of underlying environment institution on the CSR & CFP debate. Detailed data on Singapore green buildings is matched with property companies' financial information from 2005 to 2010. Overall, estimate results document financial outperformance of investments in green properties, and more importantly report a substantial impact of policy pressure on the financial consequence of green building investment. This paper is the first in Asia to provide a business case for property companies committing to green building investment, and its implications can be substantial to policy makers, corporate managers, and property investors in the region.

* This chapter is the modified version of the paper that was presented at the 4th international Oikos UN-backed PRI young scholars finance academy in Switzerland in February 2012, and the Asia-Pacific Real Estate Research Symposium (APRSRS) in Tsinghua University, Beijing, in June 2012, and is to be presented at "Green Building Economics" session of the 2013 AREUEA annual meeting in San Diego Jan, 2013.

4.1 Introduction

Small improvements in energy efficiency and sustainability of buildings have great potential to mitigate life-cycle energy consumption and carbon footprint, given that it accounts for over one third of global CO2 emission (IPCC, 2007). Buildings certified as 'green' are not only marketed as having better energy and environmental performance, but also manifest developers' strong commitment to environmental stewardship (Eichholtz et al., 2010). Emerging literatures have increasingly private returns to investment in green buildings, e.g., higher rents, higher transaction price, and lower vacancy rate (Eichholtz, Kok, and Quigley, 2010 and 2011a; Kok, Miller and Morris, 2012; Fuerst and MacAllister, 2011a and 2011b; Brounen and Kok, 2011; Kok and Jennen, 2011; and Deng, Li and Quigley, 2012).

And yet, the market adoption of green real estate remains sluggish (Kok et al., 2011). Presumably, it is because: (1) the cost-benefit analysis for green property is still in its infancy, leading to market participants uncertain of the net benefits of going green (2) little knowledge on market response to the greening of real estate industry, at the center of which is the misalignment between demand and supply side of property market, i.e., the so-called "Vicious Circle of Blame"[53] (e.g., Cadman, 2000 and 2007; RICS, 2008; Pivo, 2008). Several case studies and pilot projects on the economic cost of green buildings have yet to arrive at conclusive findings (e.g., Ciochetti, McGowan, 2009; Lockwood, 2008). Furthermore, those cost studies could be flawed (e.g., Jiang, 2010), leading to the lack of convincing results on net benefits of going green.

As the financial performance of property companies – Real Estate Operating Companies (REOCs) that are directly involved in property development and investment[54], is the eventual consequence of the interplay between the cost and benefits of green buildings, examining this interplay can consequently shed some light on the net financial consequence of investment in green buildings (Eichholtz et al., 2012). In contrast with the demand-side study (Eichholtz et al., 2011b), focusing on property markets' supply-side may more effectively address the "vicious circle" in that developers always take the lead in implementing green building practices (RICS, 2008). If they are further

[53] That is, each stakeholder blames one another subsequently in the loop for their lack of commitment to green building. The primary interest in this paper is that developers complain that investors would not pay for them even if they ask for green properties.
[54] An REOC is similar to a real estate investment trust (REIT), except that an REOC can reinvest its earnings into the business, rather than distributing them to unit holders like REITs do.

rewarded in their balance sheets, the projected wider adoption of green building practices would in turn enhance the awareness of building buyers and occupiers, eventually resulting in the market norm of green real estate[55] (Furest and MacAllister, 2011a; Yoshida and Sugiura, 2010).

Despite there is few study relating green building investment to corporate financial performance, theoretical inferences can be made from a well-established strand of literatures on the corporate social responsibility (CSR) and the corporate financial performance (CFP) debate (e.g., Waddock and Grace, 1997; Margolis, et al., 2007). Moreover, the fact that the minimum environmental sustainability performance has been mandated in Singapore as of 2008 allows us to investigate the effectiveness of environmental policy in this paper[56] (e.g., Khanna, 2001; Alberini and Segerson, 2002; Telle, 2006).

I developed a dynamic dataset of green property portfolios by matching data on the Singapore "Green Mark" (GM) certified projects to property portfolios of all REOCs included in the SNL Real Estate database from 2005 to 2010. Unlike real estate investment trust[57] (REITs), return on assets (ROA) and return on equity (ROE) that represent the corporate profitability, and the market-based firm valuation are of primary interest to decision-making[58].

Empirically, sub-period analyses, within the periods of 2005-2007 and 2008-2010, document the significant moderating effect of underlying environmental policy on the financial implication of green building investment: only under stringent environmental policy regime do property companies committing to green building investments in Singapore outperform the market, which offers valuable insight into net financial performance of green building investment in Asia. Estimate results are robust across alternative approaches addressing both sampling issues and the endogenity concern. Furthermore, some important implications to policy makers, investors, and corporate managers can be drawn in this study.

[55] The institutional and cultural uniqueness in Asia in general and Singapore in particular, e.g., the top-down governance, get local property companies to rapidly respond to government-backed initiatives, which refers to the green building certification in this study.
[56] That is, Whether or not should the market-based policy tools, e.g., green tax or mandates be supplemented or substituted by the so-called 'information-based' instruments, as the latter is cost efficient by reducing enforcement cost and allowing firms to opt for cheapest environmental strategies.
[57] REITs investors are more concerned about net asset value (NAV), funds from operations (FFO), adjusted funds from operations (AFFO) and cash available for distribution (CAD)
[58] http://www.investopedia.com/terms/r/reoc.asp#axzz1vOFO40fu

The remainder of the paper is organized as follows: section 2 reviews managerial and financial literatures on the CSR-CFP debate, in which hypotheses are formed; Section 3 discussed the influence of institutional pressure on the financial implication of green building investment; Data on green building and financial performance are presented in Section 4; Section 5 presents the empirical analysis and estimation results; Section 6 concludes the paper; Lastly, limitations and future works are discussed in section 7.

4.2 Theoretical Argument

4.2.1. General Literatures on the CSR & CFP Association

Literatures on CSR and its impact on CFP in real estate industry are rare. Pivo (2008) finds that despite the increased benefits and reduced risk, the lack of information on the financial performance and market responses remain major barriers to investment in green buildings. Recently, scholars and practitioners have started borrowing managerial literatures to understand the greening of real estate industry. For example using the conceptual corporate environmental responsiveness model (Bansal and Roth, 2000) with a real estate dimension, Eichholtz, Kok and Quigley (2011b) systematically analyze what drives green office rental decision in the U.S.

In this paper, the financial implication of green building investment may be inferred from the well-documented strand of literatures on the CSR & CFP debate. Given the multidisciplinary and evolving nature of CSR (Carroll, 1979), the CSR & CFP association becomes an empirical issue as different theoretical reasoning may be considered and different results can thus be anticipated. Specifically, management science and financial economics have developed models and hypotheses that seek to align social or environmental responsibility with the value-creating potential.

4.2.1.1 Managerial Arguments

The CSR-CFP debate has been analyzed mostly in the empirical studies, where the question 'does it pay to be green?' is explored (e.g., Hart and Ahuja, 1996; Telle, 2006). Nonetheless, given the measurement errors, omitted variable bias, and the stakeholder mismatching, etc (e.g., Waddock and Graves, 1997; Wood and Jones, 1995; Ullman, 1985; Cochran and Wood, 1984), attempts to generalized the findings fails. Literally, two competing arguments prevail: Firstly, it believes that the allocation of corporate resources to CSR activities is against the principles of shareholder wealth maximization, while benefits may be in a distant future (e.g., Friedman, 1962 and 1970; Walley and Whitehead, 1994; Telle, 2006). Also, any attempt to improve CSR that cause additional costs may be viewed as a waste of resource, according to the Porter's (1980) view on the least cost strategy of competitive advantage.

In this study, the direct green building construction cost is believed to be higher than conventional buildings', due to more expensive eco-friendly materials, better modeling integration, and longer time span on the integrated design etc (Circo, 2007). Some case studies document the "green construction cost premium" (e.g., Yudelson, 2008). Meanwhile, indirect construction cost matters as well (Gottfried, 2003). As green building investment as a whole entails great capacity to coordinate and manage a series of interrelated activities efficiently[59] such that considerable cost of coordination with internal and external stakeholders is inevitably incurred.

As such, a negative relationship between property companies' green building investment and operating performance can be expected:

***H_{1a}**: There is a negative profitability implication of green building investment, ceteris paribus.*

Secondly, the positive CSR-CFP link is favored by the argument of competitive advantage (e.g., Porter and Linde, 1995; Porter and Kramer, 2006). Bansal and Roth (2000) hold that competitively motivated firms always tend to proactively innovate eco-efficient production process to reinforce their market positions. Russo and Fouts (1997) posit that proactive environmental governance within the firm requires a structural change in production and service

[59] Generally, any real estate development is a multifaceted business where developers work with several different stakeholders along each step, such as purchase a parcel of land, finance real estate deals, build or have builders build projects, and ultimately sell it

delivery processes involving the development and implementation of new technologies, ultimately leading to the reduced operational cost and increased product value without compromising the environment credit (Porter and Van der Linde, 1995). Once corporate environmental governance has been embedded into business practices, it in turn generates competitiveness through learning and innovation cycles (Vilanova et al., 2009).

The stakeholder theory (Freeman, 1984; Jones, 1995) also suggests that firms must satisfy the expectations and demands of several stakeholder groups (e.g., employees, customer, and etc.) before they become problematic. It argues that good CSR performance is the direct result of firms engaging and contracting with stakeholders on the basis of mutual trust and cooperation. What's more, the stakeholder theory can be embedded in the resource-based view of the firm that economic success and competitive advantage evolves from firms' internal resources and capabilities that are valuable, rare, and difficult to imitate by competitors (e.g., Barney, 1991; Hart, 1995). For example, a good and effective management of relationships with environmental-related groups may lead to increased working productivity, firm image improvement, cost reductions, and higher sales profits (e.g., Russo and Fouts, 1997; Turban and Greening, 1996; Davis, 1973).

In this paper, apart from the foregoing benefits of CSR, green buildings consume less resources, generate less externality (Kotchen, 2006), lower operating cost, and thus enhance property value and rental income (e.g., Eichholtz, Kok and Quigley, 2010; Deng, Li and Quigley, 2012). Also, it finds that the green construction cost seems to be magnified. Johnson (2007) argues that costs of green buildings were overestimated by 300 % and the green cost premium seems lower than is often thought. Further, Matthiesena and Morris (2007) report no significant difference in average cost between LEED and conventional buildings[60].

As a whole, the maturity of green construction technique, the awareness of environmental issues, as well as the scale economy in green property development, all lead to cost savings and enhanced profit. As such, operating profits of property companies committing to green buildings can thus be achieved on the balance sheets:

***H_{1b}**: There is a positive profitability implication of green building investment, ceteris paribus.*

[60] More recently, scholars poise that the studies reporting the green construction cost premium are problematic themselves, e.g., Jiang (2010)

4.2.1.2 Finance Arguments

Financial markets have become increasingly responsive to the Environmental, Social and Governance (ESG) consequences of investment decisions (e.g., Groysberg et al., 2011; Ioannou and Serafeim, 2010). Thus, institutional investors are keen to incorporate the ESG information as a critical screening criterion, i.e., the so-called "socially responsible investing" (SRI), to achieve their social or environmental and financial obligations[61].

Scholars have established theoretical frameworks that ether favor or object to the validity of CSR from investors' perspective (e.g., Moskowitz, 1972), at the center of which is whether investors benefit from holding shares of environmentally responsible firms rely on how financial markets value CSR. Hamilton, Jo and Statman (1993) and Guenster et al. (2011) postulated several possible scenarios that capital markets can make to corporate environmental performance in the risk-return domain.

The first is in accordance with the classical framework of asset pricing (Sharpe, 1964; Lintner, 1965; Mossin, 1966) where factors that do not proxy for systematic risks are not priced into stocks' expected returns to investors. In this case, the market does not value corporate environmental sustainability and investors do not tie better environmental performance to lower risk. As a result, the cost of capital of environmentally responsible firms is not different from that of irresponsible ones, meaning that firm value is independent of environmental performance. Empirically, this is manifested in the no statistically significant relation between green building investment and the firm value:

***H_{2a}**: There is no firm value implication of green building investment, ceteris paribus.*

The second scenario, however, argues that investors do value CSR in a positive manner. Specifically, the influences of environmental responsibility on the risk-return framework relates directly to the deviation from the perfect capital

[61] For example, mutual funds that invested in socially responsible firms by 2007 have had assets under management of more than $2.5 and $2 trillion dollars in the United States and Europe, respectively, while the figure is $164 billion in Asia-Pacific region (Ioannou and Serafeim, 2010)

market assumption in the sense that investors with non-financial utility form the basis for a segmented and imperfect capital market.

Merton (1987) put forward a general equilibrium model in which socially (environmentally) irresponsible firms have higher expected returns as they may be ignored due to information asymmetry and thus lose risk-sharing opportunities. Heinkel et al. (2001) find that markets with a large number of 'green investors' may drive up the cost of capital of firms with poor environmental performance via boycott, reducing their investor-base and ultimately risk-sharing opportunities. Likewise, the "shunned-stock hypothesis" argues economic agents with non-financial utility may opt for fulfilling desirable environmental goals by overriding the profit maximization objective (e.g., Derwall, 2007; Derwall et al., 2011). Thus, the expected risk premium ought to offset investors for bearing CSR-related idiosyncratic risks, e.g., litigation or lawsuit (e.g., Karpoff et al., 2005), at a capital market with a large presence of green investors, which could be an unsystematic risk under standard finance framework. Lately, Hong and Kacperczyk (2007) have reported that litigation risk associated with socially or environmentally controversial companies has become more relevant to investors expecting to earn premium of holding those stocks.

In particular, green properties may hedge against several risks: (1) the lower vacancy rate and higher rental income of green buildings help property companies smoothens the volatile market cycles (e.g., Furest and McAllister, 2011a and 2011b); (2) property companies may be less exposed to market risk due to the lower energy consumption of green buildings (Kok, McGraw and Quigley, 2011); (3) property companies may be largely free from the policy and obsolescence risk, given the increasingly tightened building codes and environmental mandates; (4) lastly, they can also secure the scrutiny of capital markets featured by a large presence of responsible property investors pursuing environmental taste.

In summary, the notion that property companies committing to green properties are less risky investments than their counterparts implies that investors demand a lower premium of holding these firms' shares, ultimately leading to a higher firm value. Hence, the hypothesis consistent with the second scenario is:

***H_{2b}**: There is a positive firm value implication of green building investment, ceteris paribus.*

Alternatively, it is also possible that the expected returns on environmental leaders are higher than that of laggards, provided capital market misprices the environmental information and fails to fully incorporate the negative environmental performance into valuation (e.g., Derwall, 2007). In this case, the prevalence of investing in environmentally irresponsible companies and the mispricing of environmental information would drive up their price, whereas dragging down the stock price of environmental leaders given less demand. Therefore, it leads to:

***H_{2c}**: There is a negative firm value implication of green building investment, ceteris paribus.*

4.2.2 The Reverse Causality Issue

Suggested by Waddock and Grace (1997), the exploration of the direction, other than the existence, has become a sub-strand of the long-running CSR-CFP debate (Vogel, 2005). Basically, the two stances prevail, i.e., the "slack resource theory" and the "good management theory". Central to this is the question: whether good management of environmental issues is the source of superior financial performance or it is the other way around (e.g., Galdeano-Gomez, 2008).

Superior financial performance may result in the availability of slack financial or other resources as a pre-condition for firms to manage the environmental/social issues in the future (Busch and Hoffmann, 2011; Orlitzky et al., 2003). If the slack resource exists, good financial performance may be a predictor of better corporate environmental performance (e.g., McGuire et al., 1990; Stanwick & Stanwick, 1998); On the flip side, good management practices may improve relationship with key stakeholders (Freeman, 1984) and then leads to better financial performance probably through improved work productivity, staff satisfaction, and reduced operational and regulatory risk (Hart, 1995). Ultimately, the proactive environment management requires unique competitively valuable organizational capabilities, which in turn have implications for competitiveness (Sharma & Vredenburg, 1998). In other words, good performance in managing environmental issues can be viewed as one condition for future superior financial performance (Barnett et al., 2006).

As this paper seeks to understand the financial implication of green building investment to property companies, I follow the 'good management theory' and attempt to investigate the financial consequence of property companies committing to green building investment.

4.3. Underlying Environmental Policy

Apart from the general discussion on the financial implication of property companies committing to green building investment, it is likely that the aforementioned relationships may run in another direction due to the tightened underlying policy (e.g., Ziegler et al., 2011). Given the growing awareness of environmental issues (e.g., Stern, 2008), the perception that climate change poses a multi-faceted challenge for today's societies has risen. Accordingly, the stringency of environmental policy has increased.

It used to believe social benefits arising from environmental policies come at the expense of private cost (e.g., Porter and Linde, 1995): policy makers acted in the manner unnecessarily driving up compliance costs and deter innovation, while individual firms aggressively resist environmental standards. In contrast, the modern view of environmental governance holds that companies operating in the world of dynamic competition always seek innovative solutions to the pressures of all sorts of stakeholders (Porter and Kramer, 2006). Further, under appropriately designed environmental policies, innovation can be spurred to allow for resource productivity and operational efficiency, thus leading to decreased cost and increased value. Eventually, improvements in environment and competitiveness come together.

Compared to others reporting a direct association between climate policies and corporate financial performance (e.g., Oberndorfer, 2009; Brunnermeier and Cohen, 2003), this study instead investigates whether the environment institutional pressure can have a material influence on the financial implication of green building investment to property companies.

In this regard, it is plausible to argue that the stakeholder theory can be reinforced such that under more stringent policy regime, good management of stakeholder relationship enables companies to be immune from legislative risks (Ziegler et al., 2011). Therefore, corporate efforts to address concerns or meet expectations of environmental stakeholders appears more important resources of firms, and thus leads to higher profit expectations under more stringent policy regimes than the less stringent regime; by contrary, the cost argument of CSR may be weakened if more stringent regulation leads to higher non-compliance costs when firms do not react. Heinkel et al. (2001) argue environmentally poor performers opt for structurally reforming when the cost of non-compliance exceeds the reform cost.

Put together, both the strengthening of the stakeholder argument and the weakening of the cost argument can benefit environmentally responsible firms. When these benefits are financially relevant, it can be expected that the financial implication of green building investment tends to be positively influenced by a properly designed and stringent environmental policy.

Since the inception of "Green Mark" scheme in 2005, Singapore has progressively implemented economic incentive schemes to direct its built environment towards sustainability[62]. It has set a target of 80% of buildings being green by 2030. Most importantly, Singapore is one of the few countries in the world to impose minimum environmental sustainability requirements on buildings, as of 2008 when the building control act was revised (For details, please refer to the Appendix 4.1).

- Insert Appendix 4.1 Here -

Thus, the year of 2008 can be considered as a tipping point at which and product market for green property is created and property companies in Singapore must comply with the stringent green mandate to reform and innovate

[62] For example, the Green Mark Incentive Scheme for New Buildings (GMIS-NB) and the "Building Retrofit Energy Efficiency Finance" (BREEF) mortgage

development and investment process. Fuelled by considerable public subsidies that help absorb the private costs of going green, operational profits can be achievable. Therefore, Hypothesis 3a is:

***H_{3a}**: The profitability implication of green building investment is positively influenced by the 2008 institutional pressure.*

Nevertheless, the firm value implication may be two-fold: on the one hand, as the policy stringency in Singapore increased, the public awareness of the environmental risks and opportunities can greatly more than before. Given the large presence of green investors (Heinkel et al., 2001), holding shares of property companies committing to green properties can be regarded as less risky investment relative to environmental laggards, leading to the lower cost of capital and thus higher firm value. So, Hypothesis 3b is:

***H_{3b}**: The firm value implication of green building investment is positively influenced by the 2008 institutional pressure.*

On the other hand, since green properties become market norm affecting industry peers in a similar way, the resource-based view of firm[63] (e.g., Hart, 1995; Russo and Fouts, 1997) implies that the unique reputational advantage of being early adopters and leaders of green buildings may be mitigated and thus be less capitalized into firm value, as basic compliance with green regulation will not deliver competitive advantages to the firm (Derwall et al., 2011). Hence, Hypothesis 3c assumes:

***H_{3c}**: The firm value implication of green building investment is negatively influenced by the 2008 institutional pressure.*

[63] This theoretical perspective argues that CSR can be shaped such that it becomes a valuable asset that is unique to the firm and not simply replicated by peers, which overall requires more proactive efforts and changes in production and manufacturing processes and a forward-looking management style

4.4. Data Collection & Description

4.4.1 Green Building Data

This study follows the existing literatures on the financial performance of Singapore green buildings (e.g., Deng, Li and Quigley, 2011). In Singapore, buildings are certified as green by the "Green Mark" (GM) rating scheme, launched by the Building and Construction Authority (BCA) in 2005 to evaluate buildings for their overall environmental impact and energy performance.

The GM scheme covers a wide range of property sectors - commercial, residential, retail, industrial, hotel, etc. It provides incentives for stakeholders to construct sustainable buildings which can promote energy savings, water savings, and healthier indoor environments, as well as the adoption of more extensive greenery for their projects. Importantly, the scheme is not only marketed for its ability to reduce resource consumption, but helps recognize developers with strong commitments to corporate social responsibility and publicize achievements in environmental sustainability.

As of 2010, some 308 building projects were awarded the Green Mark, of which over two thirds are office and residential building projects. Data on all properties in Singapore is obtained from the SNL Real Estate database. Since each building corresponds to a unique postal code in Singapore, the SNL dataset is matched to green building database maintained by the BCA that publicize winning projects of the Green Mark certification annually. The dynamic dataset of green properties for each property company - REOC[64] for each year is thus established[65].

Figure 4.1 exhibits the dynamic market penetration of green buildings from 2005 to 2010: only 10 projects were certified as green across 3 companies in 2005, whereas that number climbed up to 80 green projects across 12

[64] Unlike REITs that often focus on specific property type, REOC are more flexible in business activities in developing and investing multiple property types.

[65] For commercial properties, the year of certification and the year of sale and acquisition are extracted from the BCA and the SNL database. For example, if a property company developed or acquired a commercial property in 2005, sold it in 2008, and the property was certified in 2006, then the property is counted as green only in 2006 and 2007. In contrast, residential properties are counted as green from when it got certified onwards, no matter whether the property is pre-sold or not.

companies in 2010. Due to the recent IPOs of some property firms, 122 firm-year observations are identified during the sample period, of which approximately 34 % commits to green building investments.

- Insert Figure 4.1 Here -

Only 3 property companies committed to 10 green certified properties in 2005, while the 2008 witnessed the surge of the GM adoption, with the number of green properties growing by 76% compared to the 2007 level. In particular, the number of REOCs committing to green building investment doubled in 2008 relative to 2005, and the number of green buildings is almost four times as many as it was in 2005, due mostly to the revised building control act. Also, the number of property companies committing to green properties reaches its peak of 12 in 2010 when there are totally 81 green certified properties.

4.4.2 Green Building Investment of Property Companies

Panel A of Table 4.1 presents the summary statistics for green building investment. It shows that, property companies committing to green building investment on average have 6 green properties in their portfolios.

- Insert Table 4.1 Here -

Figure 4.2 discloses the temporal spread of green properties and the sales growth comparison between green and total property supplies. The green diffusion measured by the ratio of the green certified property sales to the total market transactions increased dramatically since 2008, which coincides with a sharp downturn in the real estate market (Deng et al., 2012; Eichholtz et al., 2011a). In 2010, over 10% of properties are labeled as green. Also, the growth rate of green properties moves in the same direction as the market cycle but in greater magnitude, accounting for the upside growth of green property share.

- Insert Figure 4.2 here -

4.4.3 Financial Data

Data on property companies' financial performance is also collected from SNL database. To avoid sample selection bias, companies not committing to green properties are also included. To avoid the look-ahead bias (Baquero et al., 2005; Jaffe et al., 1989), financial performance is measured at each year end[66]. Further, the window between 2005 and 2010 is chosen to control for any difference in property companies' characteristics.

Suggested by the seminal work of Waddock and Graves (1997), firm size and riskiness are considered: bigger firms may exhibit more overt socially responsible behavior than smaller firms as their reputations and legitimacies are greatly influenced by press and public attention, which is particularly true given the rising societal concern in climate change. Management's risk tolerance may affect corporate activities, which applies to the life-cycle management of green building. Size is measured by the book value of assets, and the ratio of long-term debt to total asset serves as a proxy for firm riskiness.

Inspired by Barber and Lyon (1996) and Cohen et al., (1997), the operational dimension is measured by return on assets (ROA) that capture assets efficiency in producing income, and return on equity (ROE) that represents the shareholder return. The valuation dimension is captured by Tobin's q, which is understood as an indicator of intangible asset of firm value (e.g., Konar and Cohen, 2001). Arguably, using this variable is appropriate and adequate especially for the CSR studies, since it stands for firm reputation, brand image, and investor trust and risk (Guenster et. al. 2011). Following Kaplan and Zingales (1997), it is computed as the market value of assets divided by the book value of assets[67].

[66] Typically, BCA releases the list of GM certified projects by the end of first half of each year.

[67] The market value of assets is defined as the sum of the book value of long term debts, net current liabilities, and the market value of equity outstanding minus the balance sheet deferred taxes. In comparison with other more sophisticated methods to compute it, this type of calculation is the most efficient approximation to ensure sufficient data availability for the sample used in this paper.

To condition on any firm attributes vital to future profitability expectation assigned by investors, I include the past 1-year sale growth as an explanatory variable (e.g., Hirsch, 1991). Also, firm age, i.e., the difference between the first trading day on the "Factset" dataset and each year-end is included. Presumably, the age of a firm's assets may negatively relate to intangible-asset value because a firm with older technology and equipment may be less efficient and thus not as profitable as one with new technology (Konar & Cohen, 2001).

Panel B of Table 4.1 presents the descriptive statistics of financial variables distinguishing between green and non-green firms. Generally, green companies outperform their counterparts, except for firm value. Green group appears larger, older and growing slower than non-green group, both of which possess a low gearing ratio in their capital structures.

A further investigation of dynamics of financial performance in Panel C of Table 4.1 reveals that, for all observations, both profitability and firm value plummeted in 2008 when the historically severe financial crisis outburst. Notably, the extent of financial loss of green group is relatively smaller than that of the non-green group, and the post-crisis recovery of the green group is faster than the latter.

Table 4.2 provides the correlation matrix of key variables of interest. Overall, as the coefficients among control variables are acceptably low (e.g., the largest is below 0.3), the multi-collinearity does not seem a concern to the subsequent regressions analysis.

- Insert Table 4.2 Here -

4. 5 Empirical Analysis

4.5.1 Green Building Investment and Profitability

To investigate the profitability implication of green building investment to property companies, the following equations are estimated using the pooled OLS method with robust standard error clustered at firm level:

$$ROA_{it}(ROE_{it}) = \alpha_i + \beta_2 Leader_{it} + \beta_3 Laggard_{it} + \lambda_{it} X_{it} + \varepsilon_{it} \quad (1)$$

where ROA_{it} and ROE_{it} denote return on asset and return on equity, respectively. X_i includes control variables, and α_i is the intercept. ε_{it} is the estimated *i.i.d* error term. Importantly, as suggested by Guenster et al (2011), a non-linear association may exist between green building investment and financial performance[68]. Accordingly, model (1) is developed to capture this effect, in which two dummy variables indicating the extent of property companies' commitments to green buildings are considered: $Leader_{it}$ equals 1 if a property company *i* is an early adopter of green building practices since 2005 and its number of green properties is within the upper 10 percentile of the total green building distribution. $Laggard_{it}$ has the value of 1 for other property companies with at least one green property during the sample period. Thus, β_2 and β_3 measure the potential effect of green building investment on operational performance of green leaders and laggards, respectively, relative to the non-green reference group[69].

Keep in mind the emphasis on the impact of underlying environmental policy on the financial consequence, the year of 2008 is taken as the cutting-off point where two sub-periods analyses, i.e., 2005-2007 and 2008-2010, are implemented, respectively[70]. Table 4.3 reports estimate results, in which ROA and ROE are trimmed at upper and lower 1 percentile to mitigate the outlier bias. In general, estimates of control variables are consistent with Waddock and Graves (1997), except for the trivial effect of firm size.

- Insert Table 4.3 here -

[68] Though literatures report the financial performance differential across companies with varying level of commitment, the potential influence of tightened underlying policy on the performance differential is largely under-researched, on which this essay shed slight.

[69] Across the sample period, "City Development Limited" and "Capitaland" are classified as green leaders, based on the defined criteria, while others with at least one green property owned or operated are deemed as green laggards.

[70] Given that Singapore government is highly efficient in facilitating the implementation of new policies, a set of *ex ante* preparatory work have always been carried out beforehand to educate the public. Hence, although the revised building code was officially effective as of April 2008, it holds that market participants have been well informed and prepared for it prior to 2008.

The aggregated results in Panel A yield no significant results. More importantly, the disaggregated analyses in Panel B and Panel C exhibit the varying profitability implications of green building investment, moderated by the strengthened environmental policy in Singapore built environment. Specifically, results in Panel B support the H_{1a} in that a 8% and 9.2% underperformance is seen in ROA and ROE for green leaders relative to non-green firms, respectively, which is significant at 1% level. Yet, the underperformance of green laggards is smaller than leaders and statistically insignificant at 10% level; in contrast, Panel C favors the H_{3a} in that green leaders enjoy a significant 2.4% and 5.4% profitability in ROA and ROE at 5% level, while green laggards do not enjoy significant higher operational gain in spite of the positive sign of estimate results.

As a whole, the significance of underlying environmental policy to the profitability implication of green building investment is substantial, i.e., only under the stringent environmental institution does property companies committing to green building investment enjoy significant operational outperformance. It also implies that the tightened building control act is effective in stimulating corporate resource productivity and operational efficiency in green building production (Porter and Linde, 1995). Plausibly, the greater profitability outperformance of green leaders than that of green laggards may be attributed to the scale economy in green buildings.

4.5.2 Green Building Investment and Firm Value

Similarly, model (2) is used to investigate the firm value implication of green building investment:

$$Q_{it}(Log(Q_{it})) = \alpha_i + \beta_2 Leader_{it} + \beta_3 Laggard_{it} + \lambda_{it} X_{it} + \varepsilon_{it} \qquad (2)$$

Q_{it} and $Log(Q_{it})$ represent Tobin's Q and natural logarithm of Tobin's Q[71], respectively, for property company *i* in year *t*, and X_{it} include a set of control variables economically relevant to firm valuation, i.e., size, riskiness,

[71] Using the log dimension seeks to partly mitigate the non-normality issues in dependent variables.

profitability, sale growth, and firm age. Again, the two binary variables - $Leader_{it}$ and $Laggard_{it}$ are used to capture the potential non-linear association. λ_{it} denotes the coefficient estimates for control variables, α_i is the intercept, and ε_{it} is the estimated *i.i.d* error term. Essentially, β_2 and β_3 measure the possible value premium/discount of green leaders and laggards, respectively, relative to the reference non-green group.

Table 4.4 presents estimate results of model (2), where Q_{it} and $Log(Q_{it})$ are trimmed at the upper and lower 1 percentile to alleviate the outliers.

- Insert Table 4.4 Here -

In aggregate, estimate results in Panel A provide strong supports to the H_2, i.e., green leaders enjoy significant firm value premium at 1% level, *ceteris paribus*, equivalent to 23%-26% of the average Tobin's Q observed for all firms in the sample. Firm value premium for green laggards, however, is statistically insignificant. Regardless of the choice of dependent variable, the coefficients on most control variables remain consistent.

Sub-period analyses in Panel B and C find that green leaders are significantly valued higher than the reference group at 5% level, confirming the $H_{2b.}$ Interestingly, , the firm value premium of green leaders drop from 30-36% of the average Tobin's Q in Panel B to approximately 20% in Panel C, supporting the H_{3c} that the transforming market norm weakens the unique reputational advantage of being green property leaders and adopters (e.g., Hart, 1995). In contrast, estimate results for green laggards favor the H_{3b} in that environmental institutional pressures motivate social climate to value environmental issues in real estate industry, though without statistical significance.

Overall, findings suggest that investors have factored environmental information into their pricing decisions in Singapore: green leaders are significantly valued higher than the reference group, whilst its value premium is somehow mitigated by the higher institutional pressure. Across model specifications, it yields no statistically significant firm value implication to green laggards.

4.6 Robustness Test

To test the temporal consistency of coefficient estimate, a variant of the Fama-MacBeth (1973) two-step regression method (for details, please see Bali, Caikci and Whitelaw, 2011), is employed. As is shown in Table 4.5, the time-series averages of the cross-sectional regression coefficients and standard errors in each sub-period for each variable are computed, which yield consistent results: only coefficient estimates for green leaders are statistically significant different from zero. Also, the magnitude of economic gain or loss of green leaders is always larger than that of green laggards.

- Insert Table 4.5 Here -

Specifically, the *ex ante* 2008 operational underperformance for green leaders derived from the pooled OLS regression ranges from 8-9%, while results from the Fama-MacBeth estimation are smaller and marginally significant; The *ex post* 2008 operational outperformance for green leaders using the pooled OLS method is 2-5%, whilst no significant results are drawn by the Fama-MacBeth method. Also, the firm value implication of green building investment remain consistent, i.e., only green leaders enjoy significant firm value premium *ex ante* 2008 of around 30% of the average Tobin's Q, whereas the green firm value premium declines to 20% *ex post* 2008 moderated by the environmental policy pressure.

Besides, to mitigate the aforementioned reverse causality concern, the "Instrumental Variable" (IV) regression method is employed[72], where a property company's 1-year lagged environmental performance is used as the instrument.

Results are also presented in Table 4.6, where the IV estimate firm value premium of green leaders is significant and a little bigger in magnitude than OLS-estimate results within both sub-periods. Again, the moderating effect of

[72] The advantage of the instrumental variables approach is that the estimated coefficients are more likely to be consistent, whereas the estimates from an instrumental variables approach are less efficient because the standard errors are large (Wooldridge, 2002)

underlying environmental policy is documented by the reduced firm value premium of green leaders *ex post* 2008 compared to the figures *ex ante* 2008. And yet, this effect is weakly witnessed in the estimates of the operational implication, as the IV-estimated results in column (9) and (10) of Panel B are mixed and insignificant.

Taken as a whole, estimate results remain robust across alternative estimation methodologies that partly address the endogenity issue and test the unbalanced panel dataset, though only by means of pooled OLS estimation methods is the significant *ex post* 2008 operational underperformance of companies committing to green properties witnessed.

4.7 Conclusion & Discussion

Despite a growing body of literatures reporting financial advantages of investment in green properties at asset market (e.g., Eichholtz et al., 2010; Deng et al., 2012), little has been known about the net benefits of green building investment. Inspired by Eichholtz et al. (2012), financial performance of property companies is the eventual outcome of the interplay between cost and benefits from green properties. This paper, from the perspective of property market supply side, attempts to examine the financial performance of property companies committing to green building investment in Singapore. Results may shed some light on the research into the net financial performance of investment in energy efficiency and sustainability of buildings, and complement the demand-side study (Eichholtz et al., 2011b) to complete the full picture of market responses to green real estate.

Data on green properties certified by the "Green Mark" (GM) rating system and corporate financial performance – operating performance and firm value, is readily observable to property companies listed in Singapore. Although to sophisticatedly address the reverse causality embedded in the previous studies on CSR – CFP debate (Waddock and Grace, 1997) is beyond the scope this paper, the "Instrumental Variable" (IV) regression method is employed to test the robustness of the estimate results.

Asian markets have increasingly strengthened building codes and environmental policies to direct their economies towards environmental sustainability. Anecdotal researches have contributed to a general discussion of the

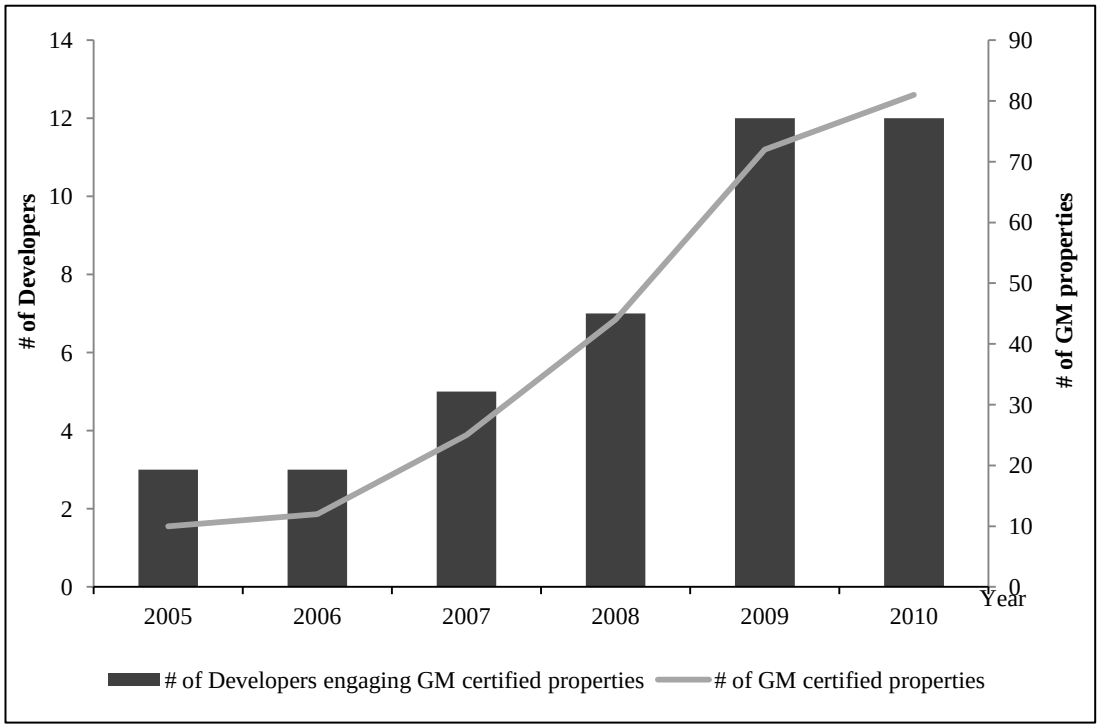
effectiveness of environmental policy instruments (e.g., Khanna, 2001; Alberini and Segerson, 2002; Telle, 2006). Hence, focusing on Singapore where minimum environmental performances requirements are imposed on buildings as of 2008 offers a unique test-bed for the effectiveness of the environmental policy in the built environment, as well as shed light on the important role of underlying policy regime in understanding the financial implication of green building investments.

Following Ziegler, Busch and Hoffmann (2011), sub-period analyses are empirically performed. Estimate results document the varying financial performance of property companies committing to green buildings, moderated by the underlying environmental institution. Overall, it lends much support to the criticism of the information-based instruments that ignores the impact of institutional pressure on societal environmental awareness and desire to seek legitimacy within the transforming market norm (Bansal and Roth, 2000). Policy implication can be substantial to emerging markets in the region where top-down governance exists: governments should lift the stringency of green mandates within the built environment given properly designed subsidy or incentive programs to help absorb the green cost incurred. Besides it is suggestive for investors to invest in green property companies especially in period when a tightened environmental policy is in place. Moreover, results may help property companies' manager to ease the tradeoff between economic success and environmental investment.

Results in this paper may be interpreted with caution in that: (1) Previous literatures hint that to addressing the endogenity issue requires a sufficiently large data sample and period, particularly in the CSR domain, which this essay has failed to gather so far. Also, an in-depth investigation on the issue is beyond the scope and focus of this study, which warrants future research given a larger sample; (2) estimated results may be biased in that the strengthened environmental policy as 2008 overlaps with other outstanding events, e.g., the 2008 global financial crisis (GFC) that may erode the financial performance of companies. Nonetheless, the GFC can hardly relate to the positive profitability and firm value implication of green building investment *ex post* 2008. It is thus more possible that the positive impact of the tightened policy pressure overweighs the negative impact of the crisis on the financial performance of property companies; (3) due to the inherent differences in distinct types of properties, REOCs specializing in different sub-markets may be considered separately. Yet, given the fact that most of the sampling REOCs involve in diverse

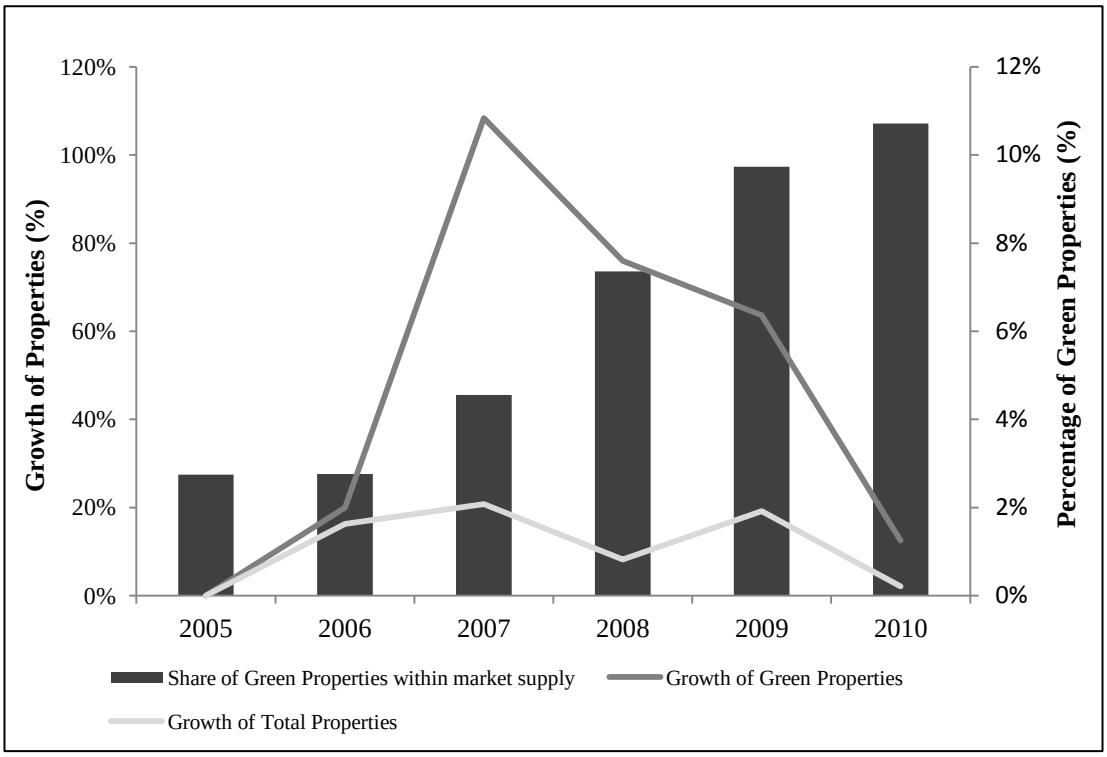
business lines and sub-markets, the foregoing issue is compromised with the relatively small sample; (4) as estimate results poised a consistent and significant firm value premium of property companies committing to green buildings, a research into investors' expected return, or the cost of capital, of holding shares of green property companies or portfolios is of particular interest of indirect real estate investors, which is guaranteed for the future studies.

Figure 4.1 Green Mark Certified Properties in Singapore Developers' Portfolio



Data Source: SNL Real Estate & BCA

Figure 4.2 The Diffusion and Growth of Green Certified Properties



Data Source: SNL Real Estate & BCA

Table 4.1. Descriptive Statistics of Green & Financial Variables

Panel A Green Measure									
				Obs	Mean	Std.Dev.	Min	Max	
Number of GM certified Properties (#)				42	5.81	6.30	1	25	
Panel B Financial Measures									
	Total Group			Green Group			Non-Green Group		
Variable	Obs	Mean	Std.Dev	Obs	Mean	Std.Dev	Obs	Mean	Std.Dev
ROA (*100)	122	6.36	6.2	42	6.42	6.03	80	6.33	6.33
ROE (*100)	122	12.29	10.48	42	13.04	10.32	80	11.89	10.61
Tobin's Q	116	1.08	0.31	40	1.06	0.26	76	1.09	0.34
Asset ($ millions)	122	4,366.88	5,075.41	42	7,832.06	6,773.57	80	2,613.42	2,598.27
Riskiness (*100)	122	22.19	11.16	42	21.98	9.33	80	22.3	12.04
Sale Growth (*100)	116	25.21	77.65	40	20.26	60.33	76	27.78	85.5
Firm Age (#)	116	5,692.98	3,421.80	40	6981.93	2928.32	76	5056.08	3483.74
Panel C Dynamic Financial Performance									
	Total Group			Green Group			Non-Green Group		
Year	ROA	ROE	Q	ROA	ROE	Q	ROA	ROE	Q
2005	4.65	9.50	1.03	3.58	9.61	1.14	4.85	9.48	1.01
2006	7.50	14.68	1.39	7.09	16.99	1.52	7.58	14.24	1.37
2007	12.22	24.02	1.24	9.37	23.64	1.21	13.17	24.15	1.24
2008	1.89	4.44	0.80	2.17	5.96	0.85	1.75	3.68	0.78
2009	3.62	6.78	1.05	3.88	7.81	1.06	3.29	5.40	1.02
2010	8.41	14.72	0.98	10.75	17.87	0.97	5.61	10.94	0.99

Notes:

Panel A shows descriptive statistics for green measures;
Panel B presents summary statistics for major dependent and control financial variables for total group , green group and non-green group, respectively: *ROA* refers to return on asset, and *ROE* is return on equity. *Leverage* is the ratio of long-term debt to total debt. *Sale Growth* is the past 1 year sale growth; *Firm Age* is the day lapse since the first trading day appeared on the "Factset" database till the respective ending date of analysis; Panel C uncovers the dynamics of dependent variables among total, green and non-green groups, respectively.

Table 4. 2 Correlation Matrix for Major Variables

	Variable	1	2	3	4	5	6	7	8
1	Tobin's Q	1							
2	ROA	0.18*	1						
3	ROE	0.33***	0.90***	1					
4	Green	-0.05	0.01	0.05	1				
5	Size	-0.06	0.16*	0.15*	0.49***	1			
6	Riskiness	0.08	-0.23**	-0.09	-0.01	0.01	1		
7	Sale Growth	0.19**	0.01	0.00	-0.05	0.00	0.09	1	
8	Firm Age	-0.28***	0.18**	0.06	0.27***	0.29***	-0.05	-0.22**	1

Notes:

Significance level of 1%, 5% and 10% indicated by ***,** and *, respectively.

Table 4.3. Pooled OLS Estimates on Sub-periods Analysis
(Dependent Variables: Operating Performance)

	ROA	ROE
Panel A (Overall Sample Period)		
Variables	(1)	(2)
Leader (1=Y)	-0.9484	1.2184
	(1.6516)	(2.3821)
Laggard (1=Y)	0.3626	1.8573
	(2.2025)	(3.8927)
Control Variables		
Asset ($millions)	0.0002	0.0003
	(0.0002)	(0.0002)
Leverage (*100)	-0.1064**	-0.0501
	(0.0427)	(0.0721)
Intercept	9.2558***	13.2401***
	(1.6296)	(2.2248)
Year Fixed Effect	Y	Y
R^2	37.14%	40.93%
Obs	119	119
Panel B (2005-2007)		
Leader (1=Y)	-8.0254***	-9.2434***
	(0.9993)	(2.1466)
Laggard (1=Y)	-2.3043	0.9078
	(3.4456)	(3.9004)
Control Variables		
Asset ($millions)	0.0006***	0.0009***
	(0.0001)	(0.0002)
Leverage (*100)	-0.1246*	-0.0647
	(0.0665)	(0.1055)
Intercept	9.1574***	13.9228***
	(2.3706)	(3.1400)
Year Fixed Effect	Y	Y
R^2	39.66%	40.42%
Obs	57	57
Panel C (2008-2010)		
Leader (1=Y)	2.3989**	5.3913**
	(0.9330)	(2.1024)
Laggard (1=Y)	1.3154	2.857
	(2.1818)	(3.8632)
Control Variables		
Asset ($millions)	0.0000	0.0000
	(0.0001)	(0.0002)
Leverage (*100)	-0.0682	-0.0176
	(0.0628)	(0.0935)

Table 4.3. Pooled OLS Estimates on Sub-periods Analysis (Continued)
(Dependent Variables: Operating Performance)

	(1)	(2)
Intercept	8.5002***	12.9665***
	(1.5721)	(2.5229)
Year Fixed Effect	Y	Y
R^2	35.85%	33.29%
Obs	62	62

Notes:

This table reports the Pooled OLS coefficient estimates on the regression of operating performance on the green measures and other control variables. Panel A reports regression results for full sample periods, Panel B for 2005-2007and Panel C for 2008-2010; Column (1) reports results of regression of ROA, while column (2) reports regression results of ROE;
Both ROA and ROE are times 100 and trimmed at upper and lower 1% boundaries to mitigate potential outlier issues; *Leader* equals 1 if a property company is an early adopter of green building practices and the number of green properties owned/developed is within the upper 10 percentile of the distribution of total green properties over the entire sample period, and 0 otherwise; *Laggard* is equal to 1 for other property companies with at least one green property in their portfolio, and 0 otherwise;
For each model specification, the year dummies are included but not reported. Significance at 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. Robust standard errors clustered at the firm level are shown in parentheses.

Table 4.4 Pooled OLS Estimates on Sub-periods Analysis
(Dependent Variables: Firm Value)

	Q	Log(Q)
Panel A (Overall Sample Period)		
Variables	(1)	(2)
Leader (1=Y)	0.2924***	0.2580***
	(0.0999)	(0.0834)
Laggard (1=Y)	0.0205	0.0107
	(0.0578)	(0.0546)
Control Variables		
Log (Asset)	-0.0305	-0.0270
	(0.0311)	(0.0290)
Leverage (*100)	0.0008	0.0010
	(0.0027)	(0.0023)
Sale Growth (*100)	0.0003	0.0003
	(0.0003)	(0.0002)
ROA (*100)	0.0029	0.0033
	(0.0037)	(0.0031)
Firm Age (#)	0.0000	0.0000
	(0.0000)	(0.0000)
Intercept	1.2618***	0.1977
	(0.2778)	(0.2506)
Year Fixed Effect	Y	Y
R^2	47.66%	49.20%
Obs	112	112
Panel B (2005-2007)		
Leader (1=Y)	0.3947**	0.3245***
	(0.1439)	(0.1107)
Laggard (1=Y)	-0.0947	-0.0844
	(0.0765)	(0.0616)
Control Variables		
Log (Asset)	-0.0485	-0.0392
	(0.0506)	(0.0426)
Leverage (*100)	0.0019	0.0019
	(0.0034)	(0.0028)
Sale Growth (*100)	0.0009	0.0007
	(0.0006)	(0.0005)
ROA (*100)	0.0040	0.0042
	(0.0055)	(0.0047)
Firm Age (#)	0.0000	0.0000
	(0.0000)	(0.0000)
Intercept	1.3363***	0.2479
	(0.3833)	(0.3183)
Year Fixed Effect	Y	Y

Table 4.4 Pooled OLS Estimates on Sub-periods Analysis (Continued) (Dependent Variables: firm Value)		
R^2	42.96%	43.47%
Obs	53	53
Panel C (2008-2010)		
Leader (1=Y)	0.2088**	0.2093**
	(0.0818)	(0.0822)
Laggard (1=Y)	0.0266	0.0217
	(0.0728)	(0.0713)
Control Variables		
Log (Asset)	-0.0204	-0.0217
	(0.0320)	(0.0329)
Leverage (*100)	-0.0009	-0.0003
	(0.0027)	(0.0025)
Sale Growth (*100)	-0.0002	-0.0001
	(0.0005)	(0.0005)
ROA (*100)	0.0046	0.0041
	(0.0058)	(0.0054)
Firm Age (#)	0.0000	0.0000
	(0.0000)	(0.0000)
Intercept	1.2015***	0.1753
	(0.2770)	(0.2807)
Year Fixed Effect	Y	Y
R^2	31.78%	33.08%
Obs	59	59

Notes:

This table reports the Pooled OLS coefficient estimates on the regression of firm value on the green measures and other control variables. Panel A reports regression results for full sample periods, Panel B for 2005-2007and Panel C for 2008-2010; Column (1) reports results of regression of Tobin's Q, while column (2) reports regression results of logarithm of Tobin's Q;
Both Tobin's Q and natural logarithm of Tobin's Q are trimmed at upper and lower 1% boundaries to mitigate potential outlier issues; *Leader* equals 1 if a property company is an early adopter of green building practices and the number of green properties owned/developed is within the upper 10 percentile of the distribution of total green properties over the entire sample period, and 0 otherwise; *Laggard* is equal to 1 for other property companies with at least one green property in their portfolio, and 0 otherwise;
For each model specification, the year dummies are included but not reported. Significance at 1%, 5%, and 10% level is indicated by ***, **, and *, respectively. Robust standard errors clustered at the firm level are shown in parentheses.

Table 4.5 Robustness Test of Alternative Estimation Approaches

	Pooled OLS Estimation				**Fama-MacBeth Estimation**				**IV Estimation**			
	Panel A (2005-2007)											
	ROA	ROE	Q	Log (Q)	ROA	ROE	Q	Log (Q)	ROA	ROE	Q	Log (Q)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Leader (1=Y)	-8.03***	-9.24***	0.39**	0.32***	-5.12*	-7.32*	0.34**	0.29***	-7.32***	-7.37*	0.43**	0.37***
Laggard (1=Y)	-2.3	0.91	-0.09	-0.08	-2.4	-2.07	0.03	0.03	-2.9	1.28	-0.03	-0.02
	Panel B (2008-2010)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Leader (1=Y)	2.40**	5.39**	0.21**	0.21**	1.23	2.55	0.23*	0.24*	-0.51	2.91	0.22**	0.23**
Laggard (1=Y)	1.32	2.86	0.03	0.02	0.81	2.16	0.05	0.06	2.36	3.92	0.04	0.04

Notes:

This table presents coefficient estimates from Pooled OLS, the Fama-MacBeth approach, and the instrumental variable (IV) estimation. ROA and ROE are return on asset and return on equity, respectively, which are times 100. Q and Log (Q) denote Tobin's Q and natural logarithm of Tobin's Q, respectively; all dependent variables are trimmed at upper and lower 1 % level;
For each model specification, only estimates for *Leader* and *Laggard* are reported, while others are available upon request; *Leader* equals 1 if a property company is an early adopter of green building practices and the number of green properties owned/developed is within the upper 10 percentile of the distribution of total green properties over the entire sample period, and 0 otherwise; *Laggard* is equal to 1 for other property companies with at least one green property in their portfolio, and 0 otherwise;
Significance at 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

CHAPTER FIVE

CONCLUSION & DISCUSSION

5.1 Background

Though academic and practitioners' interest in sustainable property investment has been growing, a solid understanding of the market performance of it is largely missing. Put differently, whether investing in environmental sustainability and energy efficiency in real estate industry aligns with fiduciary responsibilities remain ambiguous. As opposed to the west where the sustainable investing practice was originated, the societal awareness of environmental sustainability is starting and academic studies is sparse in Asia, due largely to the data limitation. Hence, the thesis aims to contribute to the sustainable property literatures by providing an in-depth study on the financial merits of property investments based on environmental sustainability criteria in the Asian context.

5.2 Summary of Major Findings & Implications

The first essay explores whether and how sustainable property investment is valued in emerging Asia. Given the uniqueness of institutional set-up, cultural background, and market structure, governments among Asian economies promote sustainable property investment via a top-down approach, different from the bottom-up manner in the west. It finds marginal evidence of a positive relation between environmental performance and firm value at capital market. More importantly, it suggests that the extent to which individual market values environmental sustainability of real estate investment is significantly different, subject to both the underlying environmental policy and market structure.

The second essay centers on the economic return of investing in sustainable property at asset market, specifically in Singapore housing market. In concludes that the green price premium is significant even controlling for the broadest number of hedonic characteristics. Nonetheless, the market penetration of sustainable property investing practice is still sluggish. Presumably, it could be attributed to both the lack of to evidence of net/true financial benefits and the so-called "Vicious Circle of Blame" where key market players blame each other for their hesitation to go green in a

loop (Cadman, 2000). In spite of emerging demand-side studies, so far no supply-side knowledge has been provided, potentially being the key to address the obstacle to green movement. As the financial performance of property companies is the eventual result of the interplay between the cost and benefits of sustainable properties, focusing on this interplay can shed some light on the net or true financial consequence of investment in sustainable properties. Further, if property companies committing to green practices are financially rewarded, the projected wider adoption of sustainable property practices would in turn enhance the awareness of demand side, eventually resulting in the market norm of green real estate. Therefore, the third essay, focusing on public real estate companies in Singapore, aims to exploit the financial implication of environmental sustainability in real estate industry.

Overall, this PhD dissertation acknowledges heterogeneous institutional set-up and market structure in directing towards environmental sustainable real estate investment across different Asian economies. It is the first in Asia that systematically examines the financial economic merit of environmental sustainability in real estate investing, which has substantial implications for other Asian markets keen to direct the economy towards environmental sustainability. For example, the reported positive relationship between environmental sustainability in real estate industry and financial performance can help ease corporate concern to balance financial objectives and environmental pursuit, which is consistent with existing literatures. Investors interested in sustainable real estate investment in Asia should be aware both where and when a good combination of institutional set-up and market structural have been well established and rigorously implemented. Additionally, policy makers in the region are encouraged to design proper environmental legislation as well as economic programs to direct the economy towards environmentally sustainability.

5.3 Limitations & Further Research

No research is free from limitations. So is my academic work. In this section, each essay's limitation is presented, followed by a discussion of future research.

In the first essay, a cross-country analysis to identify the ongoing best practice to promote environmental sustainability and its capital market response in real estate industry is conducted. And yet, due to the data limitation, the current

sample only covers a two-year environmental data, and future research based on larger sample size and longer time series could provide additional information about long term relationship between CEP and CFP. Nevertheless, the current study do contain a sample for individual firms that represent a wide cross-section of Asian markets as well as a significant proportion of respective market's total capitalization. Meanwhile, the reported dependency of CEP-CFP relation in real estate industry on the market structure and institution framework warrants further market-level studies in Asia.

The second essay is one of the first studies is Asia to report the economic price premium of sustainable properties in housing market. However, given the lack of green construction cost data, the net financial performance of sustainable dwelling units is under-researched. Besides, as the environmental sustainability gains growing popularity and the sustainable property is becoming the market norm, the reported green price premium may be more likely to decrease than increase since the environmental information is gradually factored into asset pricing decision. With longer time series, the dynamic green price premium may be further researched. Another promising area would be to look at what's truly driving the green premium? In other words, which sustainability factors contribute to the higher selling price of green project?

Notably, results in the third essay should also be interpreted with several cautions. Though the reverse causality issue inherent in the CSR-CFP debate is touched on to test the robustness of estimate results, an in-depth analysis on the endogenity issue is not fully addressed and beyond the major focus of this thesis. Going forward, the issue could be deliberately investigated with more data on hand and advanced models such as simultaneous equations; secondly, in terms of the sub-period analysis to examine the role of underlying environmental policy, the timing of strengthened environmental institution as of 2008 in Singapore happens to overlap with the 2008 global financial crisis, thus leading to possible biased results. Nevertheless, the GFC dampening corporate performance can barely relate to the positive financial performance of green building investment at the second sub-period analysis.

Last but not the least, despite the reported incorporation of environmental sustainability performance into asset pricing decision-making, little is known about the expected investor return, or the cost of capital, to invest in shares of green

property companies. Hence, such a research can not only provide evidence on return to indirect green building investment, but also empirically examine the notion that financial markets are growingly attentive to CSR by affecting firms' cost of capital (Derwall et al., 2007).

BIBLIOGRAPHY

Aerts, W., Cormier, D., and Magnan, M. 2008. Corporate Environmental Disclosure, Financial Markets and the Media: An International Perspective. *Ecological Economics*. 64 (3): 643-659

Akerlof, G., 1970. The Market For ‘‘Lemons’’: Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economic,* 84: 488–500

Aupperle, K. E., 1991. The Use of Forced-Choice Survey Procedures in Assessing Corporate Social Orientation. In J. E. Post (Ed.), *Research In Corporate Social Performance and Policy,* 12: 269-280

Aupperle, K.E., Carroll, A.B., and Hatfield, J.D. 1985.An Empirical Examination of the Relationship Between Corporate Social Responsibility And Profitability. *Academy of Management Journal*, 28: 446-463

Bansal, P., And Roth, K. 2000. Why Companies Go Green: A Model Of Ecological Responsiveness. *Academy of Management Journal*, 43: 717–736

Barnett, M. L., & Salomon, R. M. 2006. Beyond Dichotomy: The Curvilinear Relationship Between Social Responsibility and Financial Performance. *Strategic Management Journal*, 27: 1101–1122

Baumol.W., 1991. Perfect Markets and Easy Virtue: Business Ethics and the Invisible Hand. *Basil Blackwell, Oxford*

Bauer T. N., and Aiman-Smith L. 1996. Green Career Choices: The Influences of Ecological Stance on Recruiting. *Journal of Business And Psychology,* 10(3): 445-458

Bauer, R., Derwall, J. And Hann, D. 2009. Employee Relations and Credit Risk. *Working Paper*. Available At: Http://Ssrn.Com/Abstract=1483112

Bauer, R., Eichholtz, P.M.A., Kok, N., and Quigley. J. M. 2011. How Green Is Your Property Portfolio? The Global Real Estate Sustainability Benchmark, *Rotman International Journal of Pension Management*, 4 (1): 24-43

Besley, T., and Ghatak, M. 2007, Retailing Public Goods: The Economics of Corporate Social Responsibility, *Journal of Public Economics*, 91 (9): 1645–1663

Brounen, D., and Kok, N. 2011.On The Economics Of Energy Labels In The Housing Market. *Journal of Environmental Economics and Management*, Forthcoming

Brundtland Commission. 1987. *Report Of The World Commission On Environmental Development: Our Common Future,* Transmitted To The General Assembly As An Annex To Document A/42/427 - Development And International

Cooperation: Environment, UN General Assembly

Chen, K.H., Metcalf, R.W., 1980. The Relationship Between Pollution Control Record and Financial Indicators Revisited. *The Accounting Review,* 55(1): 168-177

Cheng, Beiting ,Ioannou, Ioannis and Serafeim, George, 2011, Corporate Social Responsibility and Access To Finance. *Harvard Business School Research Paper No. 1847085*

Cheung, Y. L., Tan, W., Ahn, H. J., and Zhang, Z. 2010. Does Corporate Social Responsibility Matter in Asian Emerging Markets? *Journal of Business Ethics*, 92: 401-413

Chiang, Y.H., Tang, B.S., Leung, W.Y., 2001. Market Structure of the Construction Industry in Hong Kong. *Construction Management and Economics*, 19: 675–687

Cormier, D., Ledoux, M.J., and Magnan, M. 2011.The Informational Contribution of Social and Environmental Disclosures for Investors. *Management Decision*, 49 (8): 1276-1304

Dasgupta, S., Laplante, B., And Mamingi, N., 2001.Pollution And Capital Markets In Developing Countries. *Journal of Environmental Economics and Management,* 42: 310–335

Davis, K., 1973. The Case For and Against Business Assumption of Social Responsibilities. *Academy Of Management Journal*, 16: 312-322

Deng, Y., Li, Z., Quigley, J. M. 2012. Economic Returns to Energy-Efficient Investments In The Housing Market: Evidence From Singapore, *Regional Science And Urban Economics*, 42 (3): 506-515

Dennis, K., 2006. The Compatibility of Economic Theory and Proactive Energy Efficiency Policy. *Electricity Journal*, 19 (7): 58–73

Derwall, J., Guenster, N., Bauer, R. And Koedijk, K. 2005. The Eco-Efficiency Premium Puzzle. *Financial Analysts Journal*, 61 (2): 51- 63

Derwall, J. And Verwijmeren, P. 2007. Corporate Social Responsibility and the Implied Cost Of Equity Capital, *Working Paper Presented At 2007 Academy Of Management Meetings.*

Derwall, J., Koedijk, K., and Horst, J.T. 2011.Investors. *Journal of Banking and Finance*. Forthcoming

Derwall, J.M.M., 2007, The Economic Virtues Of SRI And CSR, *Erasmus Research Institute Of Management Doctoral Thesis*

Dowell, G.A., Hart, S., Yeung, B., 2000. Do Corporate Global Environmental Standards Create or Destroy Market

Value? *Management Science,* 46(8): 1059-1074

Durnev, A. And Kim, E. 2005. To Steal Or Not To Steal: Firm Attributes, Legal Environment, And Valuation. *Journal of Finance*, 60: 1461-1493

Eichholtz, P. M. A., Kok, N., and Quigley, J. M. 2010. Doing Well By Doing Good: Green Office Buildings. *American Economic Review*, 100(5): 2494–511

_____. 2011a. The Economics Of Green Building. *Review Of Economics And Statistics*. Forthcoming.

_____. 2011b. Why Do Companies Rent Green? Ecological Responsiveness and Corporate Real Estate. *Working Paper*. Berkeley: Berkeley Program on Housing and Urban Policy

Etzion, D. 2007. Research On Organizations and the Natural Environment, 1992-Present: A Review. *Journal of Management*, 33(4): 637-664

Eyre, N., 1997. External Costs: What Do They Mean For Energy Policy? *Energy Policy,* 25: 85–95

Fama, E. 1970. Efficient Capital Markets: Review of Theory and Empirical Evidence. *Journal of Finance*, 25:383

Fombrun, C., Shanley, M. 1990. What's in a Name? Reputation Building and Corporate Strategy. *Academy of Management Journal*, 33 (2): 233–258

Freeman, R. E. 1984. *Strategic Management: A Stakeholder Approach*. Boston: Pitman.

Friedman, M., 1962. *Capitalism and Freedom*. University Of Chicago Press. Chicago

_____.1970. The Social Responsibility Of Business Is To Increase Its Profits, *New York Times Magazine:* 122-126.

Fuerst, F. and Mcallister, P. 2011a, Green Noise or Green Value? Measuring the Effects of Environmental Certification On Office Values. *Real Estate Economics*, 39 (1): 45-69

_____. 2011b. An Investigation Of The Effect Of Eco-Labeling On Office Occupancy Rates. *Journal of Sustainable Real Estate,* 1 (1): 49-64

Ghoul, E. S., Guedhami, O, Kwok, C. C.Y. and Mishra, D.R. 2010. Does Corporate Social Responsibility Affect The Cost Of Capital? *Journal of Banking & Finance,* 35 (9): 2388-2406

Gompers, P., Ishii, M., Metrick, A. 2003. Corporate Governance And Equity Returns. *The Quarterly Journal of Economics*, 118(1), 107-155

Graves, S.B., and Waddock, S.A., 1994. Institutional Owners and Corporate Social Performance. *Academy Of Management Journal,* 37:1034-1046

Gray, R. And Bebbington, J. 2007, Corporate Sustainability: Accountability and the Pursuit of the Impossible Dream, *Handbook of Sustainable Development.* Atkinson, G., Dietz, S. & Neumeyer, E. (Eds.). Edward Elgar, P. 376-390

Griffin, J.J., Mahon, J.F., 1997. The Corporate Social Performance and Corporate Financial Performance Debate. Twenty-Five Years of Incomparable Research. *Business & Society,* 36 (1): 5-31

Guenster, N., Bauer, R., Derwall, J., Koedijk, K. 2011. The Economic Value of Corporate Eco-Efficiency. *European Financial Management*, 17 (4): 679-704

Gupta, S. and Goldar, B. 2005. Do Stock Markets Penalize Environment-Unfriendly Behavior? Evidence from India. *Ecological Economics,* 52: 81-95

Hamilton, S., Jo, H., Statman, M. 1993. Doing Well While Doing Good? The Investment Performance of Socially Responsible Mutual Funds. *Financial Analysts Journal*,49(6): 62-66

Hamilton, J.T. 1995. Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data. *Journal Of Environmental Economics And Management,* 28: 98-113

Hart, S. L. 1995. A Natural-Resource-Based View of the Firm. *Academy Of Management Review*, 20(4): 986-1014

Heinkel. R, Kraus, A., and Zechner, J. 2001. The Effect of Green Investment on Corporate Behavior. *Journal of Financial and Quantitative Analysis*, 36 (4): 431-449

Heal, G., 2005. Corporate Social Responsibility: An Economic and Financial Framework. *The Geneva Papers on Risk and Insurance – Issues and Practice*, Pp. 1–23

Henderson, D., 2002. Misguided Virtue: False Notions Of Corporate Social Responsibility. *Institute of Economic Affairs*, London.

Hirsch, B.T., 1991. Union Coverage and Profitability among U.S. Firms. *Review of Economics and Statistics,* 73 (1): 69-77

Hoffman R.E, Wood RC, and Kreiss K. 1993. Building-Related Asthma In Denver Office Workers. *American Journal of Public Health,* 83(1): 89-93

Hong, H., Kacperczyk, M. 2009. The Price Of Sin: The Effect Of Social Norms On Markets. *Journal of Financial Economics*, 93: 15–36

IPCC. *Climate Change 2007: The Physical Science Basis*. Cambridge, UK: Cambridge University Press.

Jaffe, Adam, B, 1986, Technological Opportunity and Spillovers of R&D: Evidence from Firm Patents, Profits And

Market Value, *American Economic Review*, 76(5): 984-1001

Jaffe, A., Newell, R., Stavins, R., 2002. Environmental Policy and Technological Change. *Environment and Resource Economics*, 22: 41–69

Jensen, M., Meckling, W. 1976. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economic*, 3: 305-360

Jensen, M. 2001. Value Maximization, Stakeholder Theory, and the Corporate Objective Function, *Journal of Applied Corporate Finance*, 14 (3)

Joshi, S., Khanna, M., &Sidique, S. 2005. Effect of Environmental Management Systems on Investor Reactions to Emission Reactions, *Academy Of Management Conference Paper.*

Kaplan S.N., Zingales, L. 1997. Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? *Quarterly Journal of Economics*, 112: 169-215

Karpoff, J.M., Lott, Jr J.R. and Wehrly, E.W. 2005. The Reputational Penalties for Environmental Violations: Empirical Evidence, *Journal of Law and Economics*, 48: 653-675

King, A., Lenox, M. 2002. Exploring the Locus of Profitable Pollution Reduction. *Management Science*, 48(2): 289-299

Klapper, L., and Love, I. 2004. Corporate Governance, Investor Protection and Performance in Emerging Markets. *Journal of Corporate Finance*, 10: 703-728

Klassen, R. D., and Mclaughlin, C. P. 1996. The Impact of Environmental Management on Firm Performance. *Management Science*, 42(8): 1199-1214

Kok, N., Mcgraw, M., and Quigley, J. M. 2011.The Diffusion of Energy Efficiency in Buildings. *American Economic Review*, 101 (2)

Kok, N., And Jennen, M. 2011. The Value of Energy Labels in The European Office Market. *Working Paper. Maastricht University.*

Kok, N. Miller, N.G., Morris, P. 2012. The Economics of Green Retrofits. *Journal of Sustainable Real Estate*, 4(1)

Konar, S., and Cohen, R. A. 1997. Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions. *Journal of Environmental Economics and Management*, 32 (1): 109-124

Konar, S., and Cohen, R. A. 2001. Does The Market Value Environmental Performance? *Review of Economics and*

Statistics, 83(2): 281-289

Kotchen, M. J. 2006. Green Markets and the Private Provision of Public Goods. *Journal of Political Economy*, 114 (4): 816-34

Lee, W.L., Yik, F.W.H., 2004. Regulatory and Voluntary Approaches for Enhancing Building Energy Efficiency. *Progress in Energy and Combustion Science* 30, 477–499

Lindenberg, Eric B., and Stephen A. Ross, 1981, Tobin's Q Ratio and Industrial Organization, *Journal of Business*, 54(1): 1-32

Luther, R., Matatko, J., 1994. The Performance of Ethical Unit Trusts: Choosing an Appropriate Benchmark. *British Accounting Review* 26, 77–89

Luther, R., Matatko, J., Corner, D., 1992. The Investment Performance of UK Ethical Unit Trusts. *Accounting, Auditing and Accountability Journal Review,* 5: 57–70

Mackinlay, A. C. 1997. Event Studies in Economics and Finance. *Journal of Economic Literature*, 35(1): 13-39

Mahapatra, S. 1984. Investor Reaction to A Corporate Social Accounting. *Journal of Business Finance and Accounting*, 11(1): 29-40

Mcwilliams, A. And Siegel, D. 2000. Corporate Social Responsibility and Finance Performance: Correlation or Misspecification? *Strategic Management Journal*, 21 (5): 603-609

Mcwilliams, A. And Siegel, D., 2001, Corporate Social Responsibility: A Theory of the Firm Perspective, *Academy of Management Review,* 26: 117-127

Mcwilliams, A., D. Siegel, and P.M. Wright. 2006. Corporate Social Responsibility: Strategic Implications, *Journal of Management Studies*, 43: 1-18

Merton, R. C. 1987. A Simple Model Of Capital Market Equilibrium With Incomplete Information, *Journal of Finance*, 42: 483-510

Moskowitz, M. 1972. Choosing Socially Responsible Stocks. *Business and Society Review,* 1: 71-75

Nogareda, J. S., and Ziegler, A. 2006. Green Management and Green Technology – Exploring The Causal Relationship, *Discussion Paper No. 06-040. Mannheim: Centre for European Economic Research (ZEW)*

OECD, A., 2003. Environmentally Sustainable Buildings, Challenges and Policies. *OECD Publications Service*, Paris, France.

Orlitzky, M., Schmidt, F. L., and Rynes, S. L. 2003. Corporate Social and Financial Performance: A Meta-Analysis. *Organization Studies*, 24(3): 403-441

Pargal, S., and Wheeler, D. 1996. Informal Regulation of Industrial Pollution in Developing Countries: Evidence from Indonesia. *Journal of Political Economy*, 104: 1314-1327

Patten, D.M. 1991. Exposure, Legitimacy, and Social Disclosure, *Journal of Accounting and Public Policy*, 10 (4): 297-308

Perfect, S.B., Wiles, K.W., 1994. Alternative Constructions of Tobin's Q: An Empirical Comparison. Journal Of Empirical Finance 1(3), 313-341

Pivo, G. 2005. Is There A Future For Socially Responsible Property Investments? *Real Estate Issues*, Fall 2005: 16-26

Pivo,G. 2008. Exploring Responsible Property Investing: A Survey of American Executives. *Corporate Social Responsibility and Environmental Management*, 15: 235-248

Porter, M. E. 1980. Industry Structure and Competitive Strategy: Keys to Profitability. *Financial Analyst Journal*, 36(4).

Porter, M. E., and Van Der Linde, C. 1995. Green and Competitive - Ending the Stalemate. *Harvard Business Review*, 73(5): 120-134

Powers, N., Allen, B., Thomas, L., and Urvashi, N. 2010. Does Public Disclosure Reduce Pollution? Evidence from India's Pulp and Paper Industry. *Working Paper, University Of Michigan*.

Prakash, A., 2002. Green Marketing, Public Policy and Managerial Strategies. *Business Strategy and the Environment*, 11: 285–297

Qian, Q.K., Chan, E.H.W., 2008. Features of Incentive Schemes as Part of Public Policy for Promoting Building Energy Efficiency. Eco-City World Summit 2008 International Conference, San Francisco, The USA, 22–26, April, 2008.

Renneboog, L., and Horst, J. T., and Zhang, C. 2008. Socially Responsible Investments: Institutional Aspects, Performance, and Investor Behavior. *Journal of Banking and Finance*, 32: 1723-1742

Rivers, N., Jaccard, M. 2006. Choice of Environmental Policy in the Presence of Learning by Doing. *Energy Economics*, 28: 223–242

Royal Institution of Chartered Surveyors (RICS). 2008, *Breaking the Vicious Circle of Blame-Making the Business*

Case for Sustainable Buildings.

Ruf, B., Muralidhar, K., and Paul, K., 1993. Eight Dimensions of Corporate Social Performance: Determination of Relative Importance Using the Analytic Hierarchy Process. *Academy of Management Best Paper Proceedings.*

Russo, M.V., and Fouts, P.A. 1997. A Resource-Based Perspective on Corporate Environmental Performance and Profitability. *Academy of Management Journal*, 40: 534-559

Schmalensee, R. 1989. Good Regulatory Regimes. *Rand Journal of Economics,* 20 (3): 417-436

Shane, P.B., Spicer, B.H., 1983. Market Response To Environmental Information Produced Outside The Firm. *The Accounting Review,* 58(3): 521-285

Sharma, S., & Vredenburg, H. 1998. Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities. *Strategic Management Journal*, 19(8): 729-753

Shleifer, A. 2004. Does Competition Destroy Ethical Behavior? *American Economic Association Papers and Proceedings,* 94 (2): 414–418

Shrivastava, P., 1995. Eco-Centric Management For A Risk Society. *Academy Of Management Review,* 20: 118-137

Spicer, B. H., 1978. Investors, Corporate Social Performance and Information Disclosure: An Empirical Study. *The Accounting Revie*w, 53(4): 781-796

Stern, N., 2008. The Economics of Climate Change, *American Economic Review: Papers & Proceedings*, 98 (2): 1-37

Takeda, E., and Tomozawa, T. 2008. A Change in Market Responses to The Environmental Management Ranking in Japan. *Ecological Economics,* 67: 465-472

Telle, K. 2006. It Pays To Be Green – A Premature Conclusion? *Environmental And Resource Economics*, 35: 195-220

Tirole, J., 2001. Corporate Governance. *Econometrica,* 69: 1–35

Turban, D.B., and Greening, D.W., 1996. Corporate Social Performance and Organizational Attractiveness to Prospective Employees. *Academy Of Management Journal,* 40(3): 658-672

Ullmann, A. A. 1985. Data in Search of a Theory: A Critical Examination of the Relationships among Social Performance, Social Disclosure, and Economic Performance of U. S. 29 Firms. *Academy of Management Review*, 10(3): 540-557

Vandermerwe, S. and Oliff M.D. 1990. Customers Drive Corporations Green, *Long Range Planning*, 23:3-9

Varone, F., Aebischer, B. 2000. Energy Efficiency: The Challenges of Policy Design. *Energy Policy*, 29: 615–629

Waddock, S.A., and Graves, S.B. 1997. The Corporate Social Performance-Financial Performance Link. *Strategic Management Journal*, 18(4): 303–19

Waldman, D., Siegel, D., and Javidan, M., 2006. Components of CEO Transformational Leadership and Corporate Social Responsibility. *Journal of Management Studies*, 43(8): 1703-1725

Wang, L. And Yuan, Y. 2004. Stock Price Effects of Environment and Quality Management Certification. *Economic Science.*

Wargocki P, Wyon D. P., Baik Y. K., Clausen G, and Fanger P. O. 2004. Perceived Air Quality, Sick Building Syndrome (SBS) Symptoms and Productivity in an Office with Two Different Pollution Loads. *Indoor Air,* 9(3): 165-179

Wood, D.J. 1991. Corporate Social Performance Revisited. *Academy Of Management Review,* 16: 691-718

Zheng, ,Siqi, Jing Wu, Matthew E. Kahn, and Yongheng Deng, 2012, The Nascent Market For "Green" Real Estate In Beijing. *European Economic Review*, Forthcoming

Ziegler, A., Busch, T., and Hoffmann, V. H. 2011.Disclosed Corporate Responses to Climate Change and Stock Performance: An International Empirical Analysis. *Energy Economics*, Forthcoming.

APPENDICES

Appendix 2.1. Corporate Environmental Sustainability Score

Question Number	Environmental Criteria
1	Is there an environment code/policy?
2	Is the environment code/policy comprehensive? (i.e. covers water, energy, building, transport)
3	Does the company follow an international/national environmental management system? (e.g. ISO 14001)
4	Does the company provide GHG emissions data?
5	Is the data clear and comprehensive?
6	Does the company provide energy consumption data?
7	Is the energy consumption data clear and comprehensive?
8	Does the company have any energy consumption initiatives?
9	Does the company set targets on energy consumption?
10	Does the company respond to the latest version of the Carbon Disclosure Project?
11	Does the company respond to the latest version of the Carbon Disclosure Project and make the CDP data public?
12	Has the company allocated resources to develop energy efficient technologies or solutions?
13	Has the company set targets for % of energy to come from renewable?
14	Does the company provide water consumption data?
15	Is the water consumption data clear and comprehensive?
16	Does the company have any water consumption initiatives?
17	Does the company set targets on water consumption?
18	Does the company provide waste production data?
19	Is the waste production data clear and comprehensive?
20	Does the company have any waste reduction initiatives?
21	Does the company set targets on waste reduction?

Notes:

Binary score, i.e. 1 or 0, is allocated to each criteria; If only local language is available without English version, half point is granted, which fully takes into account the local expertise on sustainability

Appendix 2.2 Asian Sustainability Rating (ASR) Company Selection

To ensure that the ASR results represent the largest and most important companies domiciled and listed in Asian markets, several proprietary and comprehensive sample selection measures were taken. Specifically, a three-step approach was implemented for ASR 2010:

1. An initial shortlist of companies was extracted from a universe of 3,000 publicly listed companies in Asia, ex Japan. The top 500 companies based on their free float weighted market capitalization were selected for inclusion;
2. his initial list was subsequently examined and cross-referenced with the Fortune 500 Global 2009 list to ensure that key Asian companies were not excluded;
3. To ensure that the universe provided a detailed view of sustainability performance across Asia and opportunities for country comparison, ASR extended the research to ensure coverage of the largest 20 companies in each of the ten Asian markets, by free float market capitalization.

As far as the ASR 2011 is concerned, other stylized considerations than the aforementioned measures were undertaken to both reflect the market dynamics and reach broad market coverage as much as possible. For example, the criteria for firm inclusion were a minimum free flow market capitalization (FFMC) of US$ 0.5Billion. After several thousand companies that met that FFMC cut off were taken from the proprietarily chosen markets, China was arbitrarily capped at 200 companies and Malaysia, Indonesia, Philippines and Thailand set a minimum of 30 companies so as to maintain a balanced sample. Notably, in the case of the latter four countries, the ASR 2011 did allow some companies with less than US$ 0.5 Billion FFMC in the sample in order to satisfy the 30 company minimum that was established for those markets.

Appendix 2.3 Firm Value Decomposition & Tobin's Q

A firm's market valuation is based on the present value of future profitability discounted at financial market risk perception of the firm (Fama, 1970). Typically, a firm's value can be composed of two parts: tangible and intangible assets[73]. Given that the potential role of environmental sustainability reputation in firm valuation is of major interest in this paper, the following contributes to a specification that justifies the use of Tobin's Q to capture the intangible asset value of firms, which follows from prior studies (Lindenberg and Ross, 1981; Jaffe, 1986; Konar and Cohen, 2001).

The market value can be expressed as:

$$MV = V_T + V_I \quad (1)$$

Where MV is the market value of firm, and V_T and V_I are the component of firm value contributed by the tangible and intangible assets of the firm, respectively. In practice, the MV of a firm is observable and the V_T is usually measured by replacement cost (RC) of the tangible assets of firm (Konar and Cohen, 2001). However, V_I is not visible to markets. Subsequently, let equation (1) divided by V_T at both sides,

$$MV / V_T = 1 + (V_I / V_T) \quad (2)$$

Since V_T can be measured by RC, equation (2) becomes:

$$MV / RC = 1 + (V_I / V_T) \quad (3)$$

Clearly, the left side of equation (3) shows how Tobin's Q is defined by Tobin (1969)[74]. As such, equation (2) can then

[73]Tangible asset s consist of replacement value of property, plant and equipment and so forth; Intangible assets are either production factors or resources that enable firms to earn return over it tangible assets, such as patents, trademarks and brand names as well as litigation or liability. (Konar and Cohen, 2001)

[74]According to Tobin (1969), the Tobin's Q is defined as the ratio between the market value and replacement value of the same physical asset, of which the numerator is the valuation in the market for exchanging existing assets while the denominator is the replacement or reproduction cost

be written as:

$$Q = 1 + (V_I / V_T) \text{ or } \quad Q - 1 = (V_I / V_T) \tag{4}$$

Thus, for a firm with no intangible asset value, the market value of the firm should equal the replacement value of its tangible assets, and Tobin's Q should equal 1. As intangible asset value of a firm increases, the value of Tobin's Q will increase accordingly. Although theory does not indicate a specific functional form for an equation to estimate the Q, most prior literatures use the additive form derived from the equation (1). As such, the following specification is estimated to test the impact of various factors, especially environmental sustainability reputation in this study, on the intangible asset value of the firm:

$$Q - 1 = (V_I / V_T) = \alpha + \sum \beta X + \varepsilon \tag{5}$$

, where X is a vector of explanatory and control variables that may affect intangible asset values.

in the market for newly produced commodities.

Appendix 3.1 Point Allocations - BCA Green Mark for Residential Buildings (Version RB/3.0)

Category			Point Allocations
(I)	Energy Related Requirements		
Maximum Cap of 50 points	Minimum 30 points	**Part 1 : Energy Efficiency**	
		1-1 Building Envelope – RETV	15
		1-2 Dwelling Unit Indoor Comfort	16
		1-3 Natural Ventilation in Common Areas	2
		1-4 Lighting	15
		1-5 Ventilation in Carparks	8
		1-6 Lifts	2
		1-7 Energy Efficient Features	7
		Category Score for Part 1 – Energy Efficiency (Exclude Bonus Points)	**65**
Bonus 20 points		1-8 Renewable Energy *(Bonus Points)*	20
(II)	Other Green Requirements		
Maximum Cap of 50 points	Minimum 20 points	**Part 2 : Water Efficiency**	
		2-1 Water Efficient Fittings	10
		2-2 Water Usage	1
		2-3 Irrigation System	2
		Category Score for Part 2 – Water Efficiency	**13**
		Part 3 : Environmental Protection	
		3-1 Sustainable Construction	12
		3-2 Greenery	6
		3-3 Environmental Management Practice	9
		3-4 Public Transport Accessibility	2
		Category Score for Part 3 – Environmental Protection	**29**
		Part 4 : Indoor Environmental Quality	
		4-1 Noise Level	1
		4-2 Indoor Air Pollutants	3
		4-3 Waste Disposal	1
		4-4 Indoor Air Quality in Wet Areas	1
		Category Score for Part 4 – Indoor Environmental Quality	**6**
		Part 5 : Other Green Features	
		5-1 Green Features & Innovations	7
		Category Score for Part 5 – Other Green Features	**7**
		Total Points Allocated :	**120**
		Total Point Allocated (Include BONUS points):	**140**
		Green Mark Score (Max) :	**100 + Bonus 20 points**

(Source: Building and Construction Authority-BCA)

Appendix 3.2 Sample Distribution across Planning Regions

	Dwelling Units			Projects		
Planning Region	GM	NGM	Total	GM	NGM	Total
Bedok	1,032	6,629	7,661	2	223	225
Bukit Merah	925	2,343	3,268	2	26	28
Bukit Timah	320	4,151	4,471	3	114	117
Clementi	2,043	2,970	5,013	5	21	26
Downtown Core	2,523	1,754	4,277	3	11	14
Geylang	334	3,439	3,773	2	141	143
Hougang	1,314	1,356	2,670	2	67	69
Kallang	1,362	4,767	6,129	3	82	85
Marine Parade	427	4,260	4,687	3	99	102
Newton	121	1,674	1,795	3	62	65
Novena	1,174	5,249	6,423	5	159	164
Orchard	317	259	576	2	8	10
Pasir Ris	651	2,885	3,536	1	30	31
Queenstown	314	2,524	2,838	1	53	54
River Valley	514	3,057	3,571	6	73	79
Rochor	449	1,396	1,845	2	32	34
Sengkang	693	159	852	1	2	3
Singapore River	1,343	1,238	2,581	4	14	18
Southern Islands	554	737	1,291	3	6	9
Tampines	871	1,186	2,057	1	14	15
Tanglin	679	2,410	3,089	6	121	127
Toa Payoh	336	1,539	1,875	2	19	21
Total	18,296	55,982	74,278	62	1,377	1,439

Notes:

The last planning region, Toa Payoh, serves as the reference group in regression

Appendix 4.1 Legislation on Environmental Sustainability for Buildings

As Singapore aspires to be a leading global city in environmental sustainability, there is scope to further improve on energy efficiency requirements in buildings, to address the impact of climate change. While the focus on energy efficiency remains important, a more holistic approach was taken to encourage environmental friendliness in buildings to ensure that environmental quality and comfort are not compromised. Among other initiatives, BCA has enhanced the Building Control Act and put in place the Building Control (Environmental Sustainability) Regulations, to require a minimum environmental sustainability standard that is equivalent to the Green Mark Certified Level for new buildings and existing ones that undergo major retrofitting. This regulation took effect from 15 Apr 2008. Projects that are submitted for URA planning permission on or after 15 Apr 2008 will be subject to this requirement.

The Building Control (Environmental Sustainability) Regulations 2008 will apply to:

- All new building works with gross floor area of 2000 m^2 or more ;
- Additions or extensions to existing buildings which involve increasing gross floor area of the existing buildings by 2000 m^2 or more;
- Building works which involve major retrofitting to existing buildings with existing gross floor area of 2000 m^2 or more.

Alteration to existing buildings which does not involve major retrofitting works is not subject to this requirement. The requirements on environmental sustainability of buildings will be integrated with the building plan process.