

**PLACEHOLDER THESIS TITLE**  
**A VERY MEANINGFUL THESIS**

by

**LIM JIEW PENG**

**DEPARTMENT OF ECONOMICS**  
**NATIONAL UNIVERSITY OF SINGAPORE**

**2016/2017**

# ABSTRACT

Here is some filler text.

# FOREWORD

Acknowledgements blah blah blah

## ABBREVIATIONS

**GM:** Green Mark environmental certification in Singapore.

**FE:** Fixed effect/s

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# 1 INTRODUCTION

The aim of this paper is to explore the signalling effects of a certification or award. The signalling effects of environmental certifications are important because these certifications are meant to incentivise certain behaviour, in this case, constructing energy efficient buildings. In order for certifications to incentivise private companies to adopt certain practices, they need to act as credible signals, i.e. provide a price premium to offset the cost premium associated with “good behaviour”. Certified buildings can have a price premium due to two reasons: either the signalling effect provided by the certification, or that good features tend to cluster together such that green buildings are also higher quality buildings in other aspects. This paper uses a fixed effects (FE) approach to isolate the signalling effect from any other factors that might contribute to a price premium.

Certification is required to incentivise the construction of green buildings because information asymmetries associated with green buildings imply that potential buyers and tenants will not price in the benefits from green buildings (Matisoff, Noonan, and Flowers 2016). While green features provide tangible and intangible benefits such as lower electricity bills and better environment, these features are unobservable at the demand side before purchase. Some of these features such as material sourcing might not even be observable after purchase. This problem is similar to the “market for lemons” problem (Akerlof 1970), where potential buyers cannot differentiate between the presence and absence of green features. As a result, there is a pooling equilibrium where potential buyers/tenants are not willing to pay more for green features which landlords or developers claim to exist. Assuming green features require additional costs to build in, the lack of price premiums means that building in green features leads to lower profits. Developers and constructors will choose not to build in green features to their buildings because the additional costs are not covered by a corresponding price premium.

A credible certification can verify these unobservable green characteristics and hence act as a signal to potential buyers about the green features and quality of the building. This would result in a price premium for green features, which would justify the additional costs required to build green buildings, increasing the construction of these buildings.

This paper uses a feature of the Green Mark (GM) program in Singapore to isolate the signalling effects of an environmental certification. Because buildings which were built before the scheme was launched (2005) can also apply for the certification, I can assert that any price premium associated with GM buildings built before 2005 are purely due to the certification, and not other unobserved characteristics, which may cluster together with green features. I use only private residential properties, because commercial and office buildings

do undergo asset enhancement initiatives (AEI) every once in a while; GM-certified commercial properties built before 2005 may have changes in their green features before and after their AEIs.

## **1.1 Green Mark (GM) Certification in Singapore**

The Green Mark scheme was launched in January 2005 to encourage the construction of more environmentally friendly buildings. Buildings which apply for the Green Mark certification would be assessed on their energy efficiency, environmental impact and indoor environmental quality. They would be scored on a points basis, and then these scores would be converted to an award type (Certified, Gold, Gold Plus, Platinum) based on the scores. More information can be found on the BCA Green Mark Website.<sup>1</sup>

## **1.2 Other Considerations**

Some literature have shown that the costs of building green features are actually not that high. Some studies have demonstrated that the average cost premium for green buildings are only about 1% to 2% (see Bartlett and Howard 2000; also Kats 2003). As such, the price premium required to justify the inclusion of green or energy efficient features is not that high.

Regardless, even if the cost premiums are low, these cost premiums still need to be offset by a corresponding price premium. Buyers and tenants are unwilling to pay for green features not because they do not value green features, but because they cannot observe them before the purchase or rental agreement. A certification is required as a signal or assurance of quality, to allow potential tenants and buyers to price in the benefits from the green features.

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<sup>1</sup>Website can be found here: [https://www.bca.gov.sg/GreenMark/green\\_mark\\_buildings.html](https://www.bca.gov.sg/GreenMark/green_mark_buildings.html)

## 2 LITERATURE REVIEW

There is a fair amount of literature showing the price effects of environmental certifications on property prices. However, there are fewer publications on why certifications have an effect on prices. Certifications can have an impact on prices in the market through the information that they provide to the market (information effect), and also by signalling unobservable quality (signalling effect).



## 3 DATA AND METHODOLOGY

### 3.1 Data Sources

Housing transactions ranging from Jan 2003 to Mar 2016 was obtained from the Real Estate Information System (REALIS) of Singapore. Information about the GM awards was obtained by scraping the Building Construction Authority of Singapore (BCA) Green Mark Buildings Directory,<sup>2</sup> searching for Residential and Mixed Developments. Since the GM Buildings Directory only contained the year of award, I had to obtain the exact dates of the award by searching for “BCA Awards” the Straits Times archive from LexisNexis. Green Mark winners are announced on the BCA awards night, so I searched for the dates of the BCA awards night for each year (2005 till 2015).

### 3.2 Methodology

This paper uses a fixed effects (FE) approach to isolate the signalling effect of the GM certification from other unobserved characteristics correlated with a GM certification.

### 3.3 Descriptive Statistics

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<sup>2</sup>Website can be found here: [https://www.bca.gov.sg/green\\_mark/KnowledgeResources/BuildingDirectory.aspx](https://www.bca.gov.sg/green_mark/KnowledgeResources/BuildingDirectory.aspx)

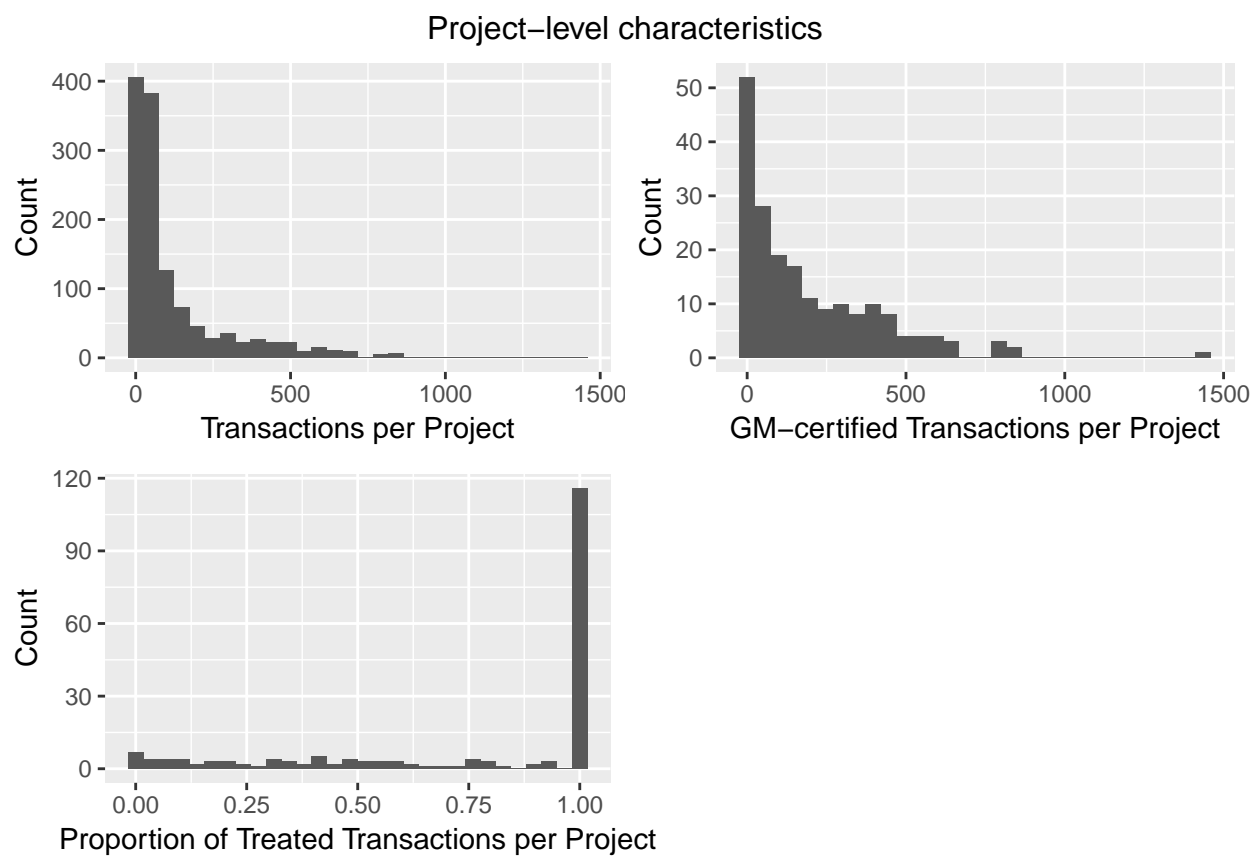


Figure 3.1: test caption

## 4 EMPIRICAL RESULTS

Table 4.1: Effects of GM Award on Price

	<i>Dependent variable:</i>		
	Natural log of Price		
	(1)	(2)	(3)
GM Award (1 = Yes)	0.176*** (0.003)	0.062*** (0.002)	-0.041*** (0.002)
ln(Area)		0.697*** (0.002)	0.816*** (0.002)
Floor		0.011*** (0.0001)	0.013*** (0.0001)
HDB Buyer		-0.224*** (0.002)	-0.223*** (0.002)
Year-Quarter Fixed Effects	No	No	Yes
Observations	152,021	151,957	151,957
R <sup>2</sup>	0.027	0.497	0.643
Adjusted R <sup>2</sup>	0.027	0.497	0.643
Residual Std. Error	0.517 (df = 152019)	0.372 (df = 151952)	0.313 (df = 151899)

*Note:*

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 4.2: Difference-in-difference Models

	<i>Dependent variable:</i>
	Natural log of Price
GM Award (1 = Yes)	-0.085*** (0.002)
GM x After GM (1 = Yes)	0.071*** (0.003)
ln(Area)	0.812*** (0.002)
Floor	0.013*** (0.0001)
HDB Buyer	-0.222*** (0.002)
Year-Quarter Fixed Effects	Yes
Observations	151,957
R <sup>2</sup>	0.644
Adjusted R <sup>2</sup>	0.644
Residual Std. Error	0.313 (df = 151898)
F Statistic	4,746.772*** (df = 58; 151898)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

Table 4.3: Placebo Difference-in-difference Tests

	<i>Dependent variable:</i>	
	Natural log of Price	
	(1)	(2)
GM Award (1 = Yes)	-0.083*** (0.003)	-0.080*** (0.004)
GM x After (6 months before GM), 1 = Yes	0.002 (0.005)	
GM x After (12 months before GM), 1 = Yes		-0.004 (0.005)
ln(Area)	0.779*** (0.002)	0.779*** (0.002)
Floor	0.012*** (0.0001)	0.012*** (0.0001)
HDB Buyer	-0.205*** (0.002)	-0.205*** (0.002)
Year-Quarter Fixed Effects	Yes	Yes
Observations	114,253	114,253
R <sup>2</sup>	0.628	0.628
Adjusted R <sup>2</sup>	0.628	0.628
Residual Std. Error (df = 114194)	0.303	0.303
F Statistic (df = 58; 114194)	3,329.714***	3,329.742***
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	

## 5 CONCLUSION

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