

巨量資料的估價梯度(Gradients)活用之研究 -以土地租稅估價資料為例

房地產投資與決策分析

個案分析

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Overview

- Introduction
- Literature
 - Land Price Gradients
 - Korean Mass Appraisal System
 - Retail Market Area Analysis & Transportation Policy
- Data
- Applications
 - Market Area Analysis
 - Transportation Policy Analysis
- Conclusion

Introduction

- New real estate curriculum development
 - Real estate big data analysis, for the first time in Korea
- Data driven research
 - 40 million land lots for about 30 years
 - Gwangjin district in Seoul, Korea
- Smart phone application
 - Pilot project
 - GIS specialist + CE professor + myself
- First paper in this kind
 - Easy~~

Literature

- McMillen (2003) studies changes in housing **price gradients** per house over time in the Chicago area to test the monocentric city model of Chicago.
 - the phenomenon of “Back to the City of Chicago” is evident by showing that the gradients estimated by a hedonic model decline by more than 8% with each mile of distance from the central business district (CBD).
- Cosman and Davidoff (2015) test whether land **rent gradients** in large metropolitan cities influence the levels and growth rates of apartment rents and housing prices (gradient as location premium).
 - They conducted a metropolitan city-level analysis and therefore had to estimate an average spatial gradient for a city by integrating the gradients across locations within the city.
- Heikkrila et al. (1989) use the housing price gradient **per lot area**.
- In this paper we focus on only one district of a large city by calculating assessed **land value gradient** measures **per square meter**.

Literature

- Retail market area analysis

Literature

- Real estate price and transportation policy change

Mass appraisal in Korea

- We use the tax-assessed value of each land lot, which is assessed jointly by both property appraisers and government staff.
- In Gwangjin District, two teams of certified property appraisers (two on each team for a total of four) are appointed as assessors. They **appraise** 919 representative land lots comprising roughly 3.1 % of all land lots in Gwangjin in 2015.
- Then the government staff **mass-assess** the remaining non-representative land lots.
- As of 2015 there were 3,792 certified public appraisers, or 0.74 per 10,000 people in South Korea.

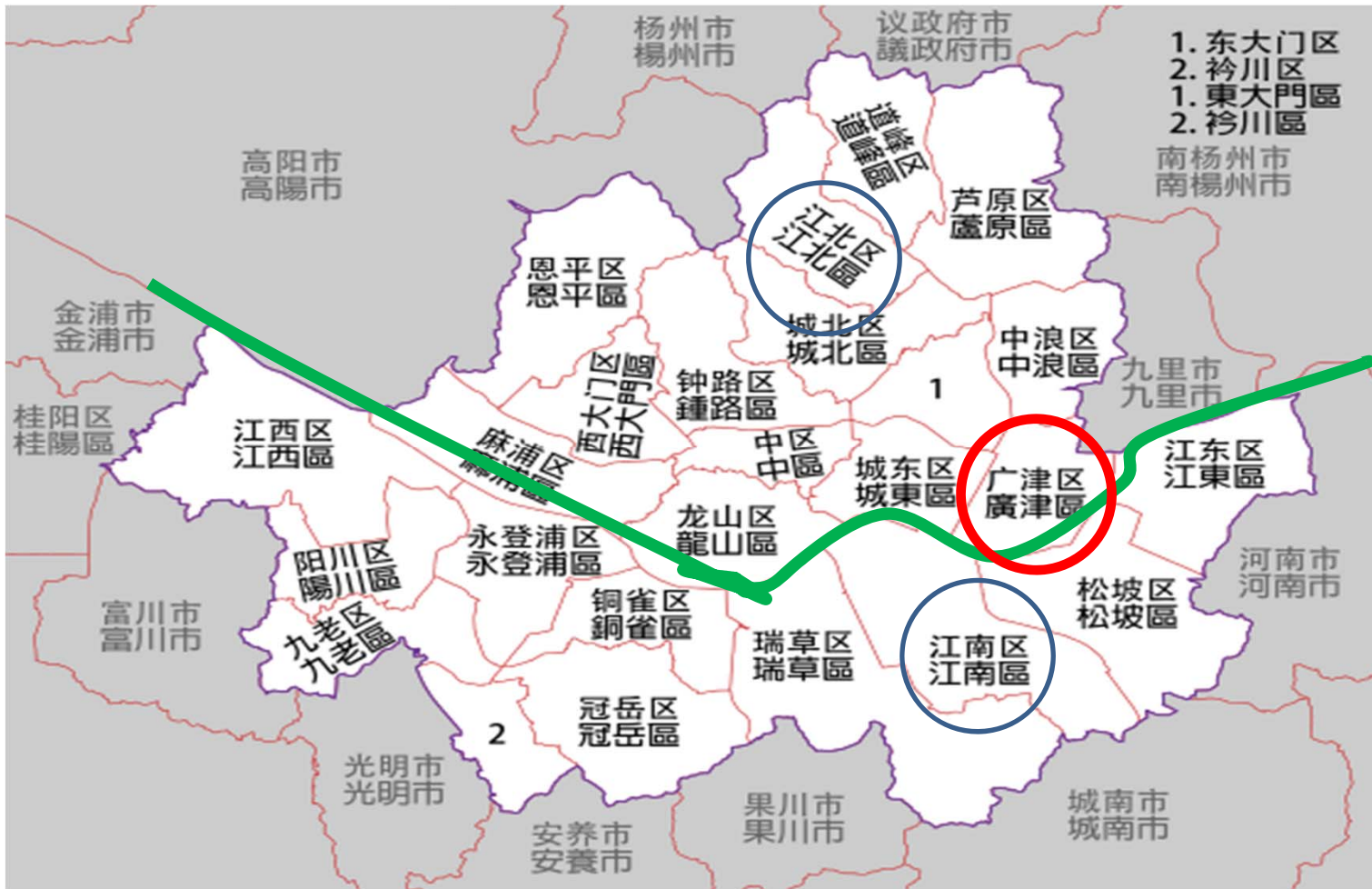
II. 稅基:公示地價和公示價格

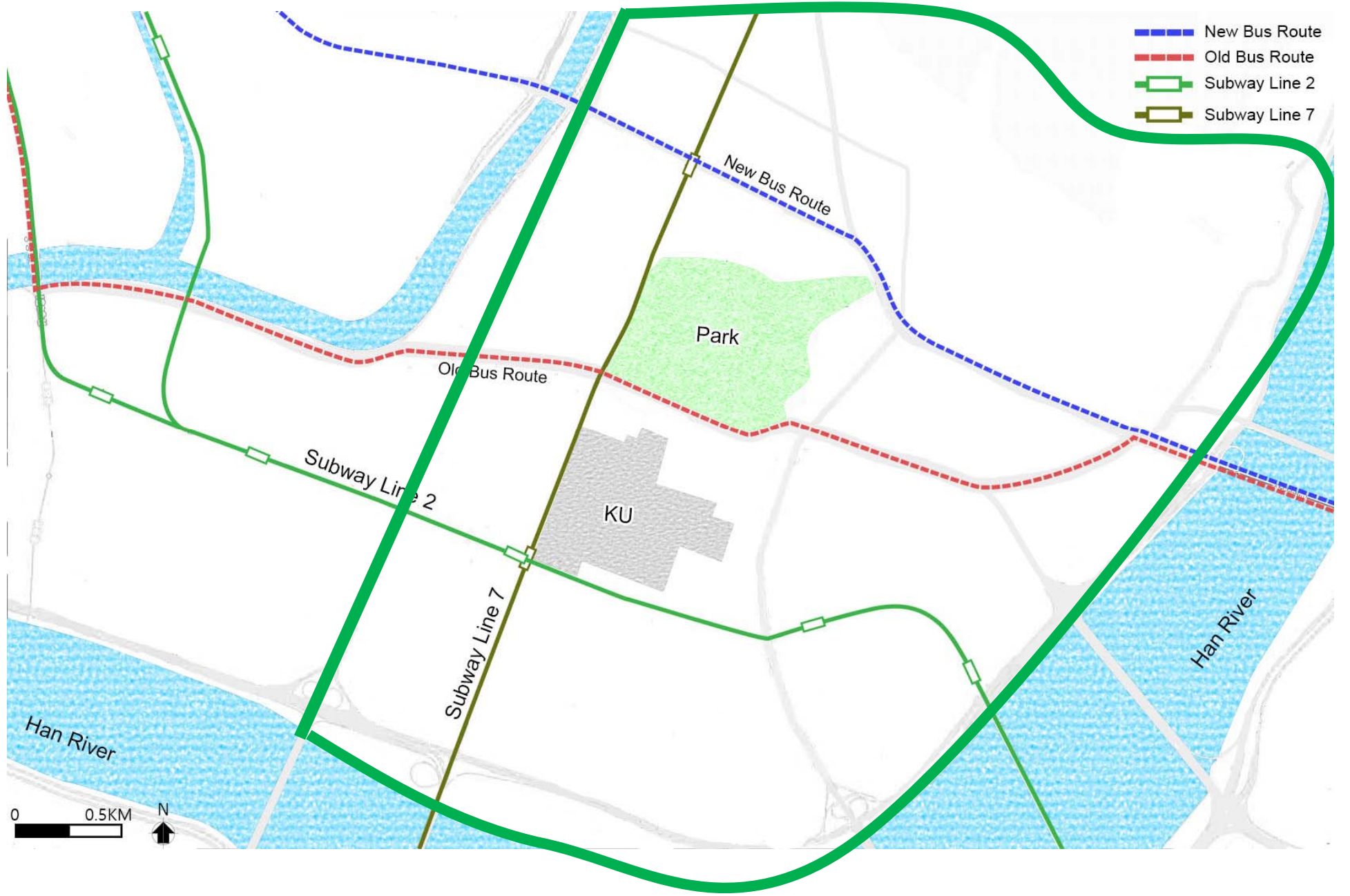
公示地價制度(*every yr*) VS. 規定地價法制

韓國	標準地 & 標準單獨住宅	共同住宅(Apt等)	大量估價： 個別地 & 個別非共同住宅
公示主體	國土交通部長官		市·郡·區長
評價主體	估價師(,評價)	鑑定院職員,算定	行政自治部公務員, 算定
方式	個別評價	個別評價, 土地及建物一體評價	大量估價
對象數字	500,000 & 200,000	10.6MM [Apt,863MM)	32MM/19.4MM
臺灣	公告土地現值	公告地價	房屋現值
公示主體	直轄市·縣(市)		直轄市·縣(市)
評價主體	地價人員	地價人員	不動產評價委員會
方式	地價區段	地價區段	等級標準單價
對象數字	112,000 筆土地 / 14.7MM筆土地		

標準地(R.O.K.) vs 標準宗地(基準地, ROC)

Seoul, Korea





Gwangjin district, Tax assessment, 2015

<Table 1> Descriptive statistics; area size and assessed value

	N	Min	Max	Mean	STD	Skew	Kurtosis
Area size(m ²)	29,610	0.1	785,110	518	6,040	84.0	9,954.3
Value(KRW/m ²)	29,610	13,200.0	22,860,000	2,847,747	1,501,716	2.6	14.7

- m² is a square meter, roughly 10 square feet.
- Value is measured in Korean Won (KRW), which is roughly USD 1/1000.
- Thus, the average size of a land lot is 5,150 square feet, while the average value is USD 2,848 per 10 square feet.

NTD = KRW 40,
NTD 70,000/M2

<Table 2> Zoning and Current Usage Mismatch⁴

Zone ₁		Current Usage ₁										Total ₁
		Resid ₁ entia ₁	Comm ₁ ercia ₁	Resi ₁ +Com ₁	Indu ₁ stria ₁	Agri ₁ Cultu ₁ ra ₁	Woods ₁	Roads ₁	River ₁ side ₁	Park ₁	Others ₁	
Residential ₁	N ₁	18,633	2,755	3,903	5	9	64	2,663	8	177	42	28,259
	% of Zone total ₁	65.9% ₁	9.7%* ₁	13.8% ₁	.0% ₁	.0% ₁	.2% ₁	9.4% ₁	.0% ₁	.6% ₁	.1% ₁	100.0 % ₁
Commerci ₁ al ₁	N ₁	94	341	78	-	-	-	78	-	-	-	591
	% of Zone total ₁	15.9% ₁	57.7% ₁	13.2% ₁	0.0% ₁	0.0% ₁	0.0% ₁	13.2% ₁	0.0% ₁	0.0% ₁	0.0% ₁	100.0 % ₁
Green ₁	N ₁	82	63	-	-	4	215	225	148	5	18	760
	% of Zone total ₁	10.8% ** ₁	8.3% ** ₁	0.0% ₁	0.0% ₁	.5% ₁	28.3% ₁	29.6% ₁	19.5 % ₁	.7% ₁	2.4% ₁	100.0 % ₁
Total ₁	N ₁	18,809	3,159	3,981	5	13	279	2,966	156	182	60	29,610
	% of Total ₁	63.5% ₁	10.7% ₁	13.4% ₁	.0% ₁	.0% ₁	.9% ₁	10.0% ₁	.5% ₁	.6% ₁	.2% ₁	100.0 % ₁

*9.7% of land lots in residential zones actually involve commercial use.⁴

**19.1% (10.8+8.3) of land lots in the green zone actually involve either residential or commercial use.⁴

Specification of assessment error

We constructed the following model of a given land lot's assessed value:

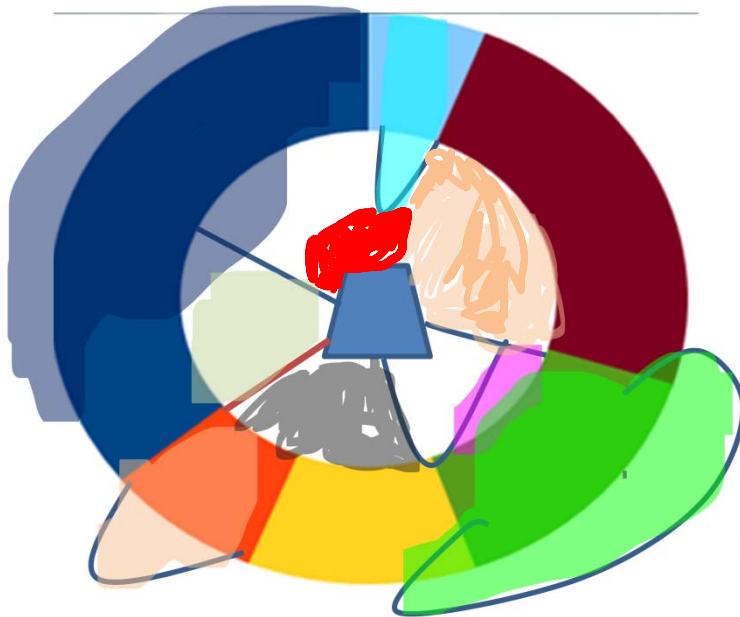
$$V_{i,t} = P_{i,t} + \varepsilon_{i,t},$$

where V is the assessed value and P is the true value of land lot i at time t , and ε is an error term.

Our gradient measure is calculated by subtracting $V_{i,t}$ from $V_{j,t}$, where j is another land lot in the market area. Therefore, if $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$ are *i.i.d.*, then the error will be canceled out in the gradients. Also our return measure is calculated by $\frac{V_{i,s}}{V_{i,t}}$, where $s > t$. Thus there remains some bias in our return measure

Gradients calculation

How to and why?
Only the Center pt matters



Sense of community,
Bust station distance

< Table 4> Number of surrounding land lots used in gradient calculations ⁴

Statistics ⁴	10M ⁴	10~20M ⁴	20~30M ⁴	30~50M ⁴	50~70M ⁴	70~100M ⁴
Max ⁴	12 ⁴	21 ⁴	25 ⁴	60 ⁴	80 ⁴	135 ⁴
Min ⁴	1 ⁴	1 ⁴	1 ⁴	1 ⁴	1 ⁴	1 ⁴
Mean ⁴	0.6 ⁴	4.5 ⁴	6.5 ⁴	19.5 ⁴	27.7 ⁴	55.9 ⁴
STD ⁴	1.0 ⁴	2.3 ⁴	3.2 ⁴	8.3 ⁴	11.5 ⁴	22.2 ⁴
Zero Gradient* ⁴	18,519 ⁴	1,517 ⁴	895 ⁴	308 ⁴	182 ⁴	81 ⁴

*If the land lot in question is too big to have surrounding land lots within the given radius criterion, it is assigned a gradient of zero.⁴

Four groups

- we divide all the land lots in the retail market area into four groups using both the assessed value and the measured gradient of each land lot:
 - (HVHG) lots with higher assessed values and higher gradients
 - (HVLG) lots with higher assessed values but lower gradients
 - (LVHG) lots with lower assessed values but higher gradients
 - (LVLG) lots with lower assessed values and lower gradients, Ignored here and after

<Table 5> Descriptive Statistics: Year 1990

Unit: KRW	HVHG_Value	HVHG_Gradient	LVHG_Value	LVHG_Gradient	HVLG_Value	HVLG_Gradient
Max	2,700,000	1,365,173	1,400,000	594,000	2,100,000	433,667
Min	1,400,000	435,532	660,000	434,858	1,500,000	- 172,592
Mean	1,657,825	643,091	1,283,586	459,499	1,553,103	263,541
STD	237,042	162,665	100,566	23,407	133,882	155,804
Number of data	869	869	145	145	145	145

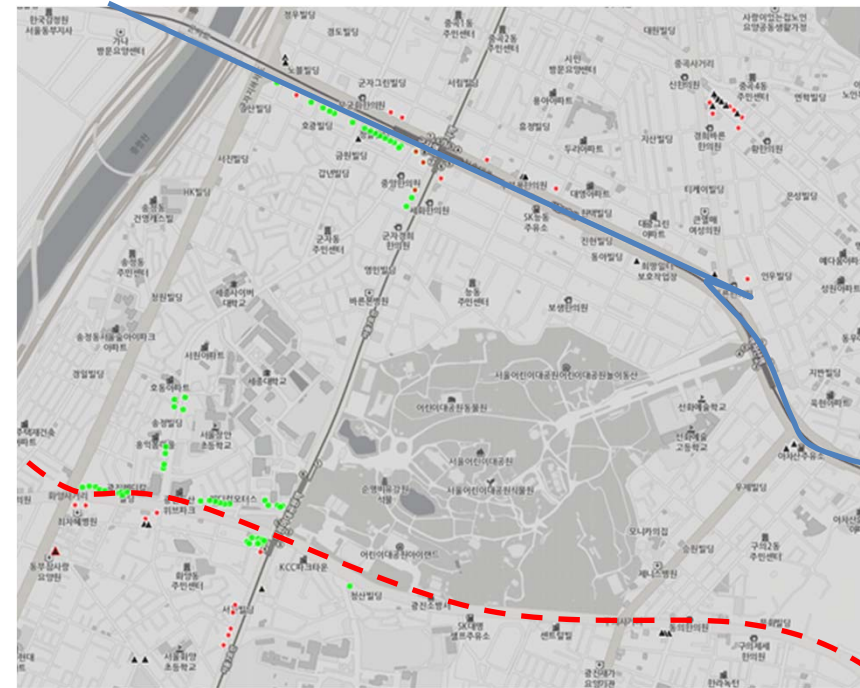
<Figure 2> Visualizing the HVHG group: Year 1990



Discussions

- Three Hypotheses
- First, the then mayor of Seoul changed the public bus route in the market area in 2004.
- Second a new but third subway line was opened in 1996 and this change can also be visualized and analyzed.
- Third, assuming that four hypothetical investors purchased whole land lots in 2010, in four land groups respectively—HVHG, HVLG, LVHG, and LVLG—what will be the outcomes in 2015?
 - By analyzing annualized yields and standard deviations of five yearly return series, we can test the mean variance theorem, or the “no risk, no return” hypothesis by using both Sharpe ratio measure and statistical test method.

Bus route change, 2004

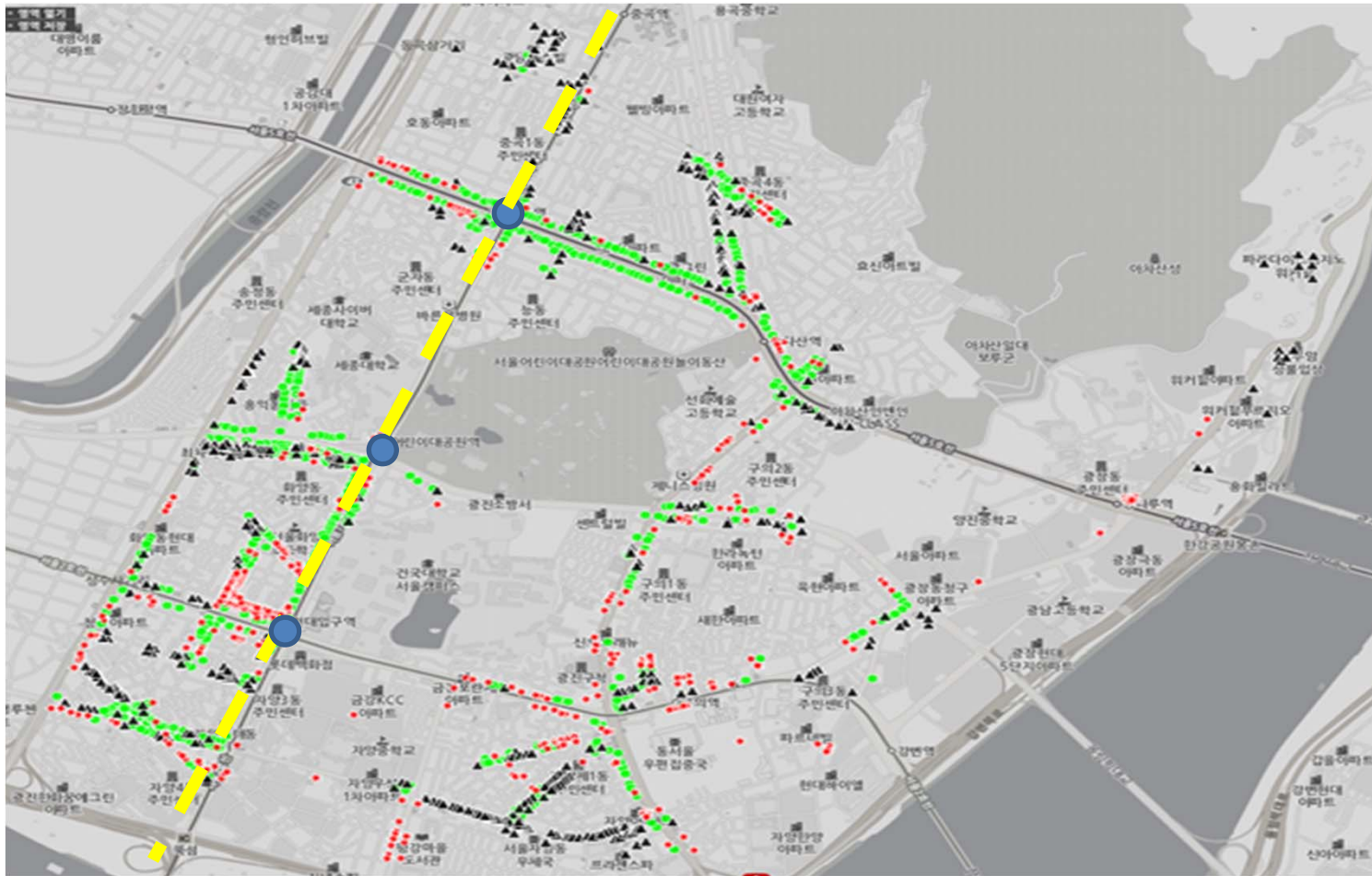


Green dot: In the HVHG group in both years.

Red star: Shifted to the HVHG group in 2006 from not being in the HVHG group in 2003.

Black triangle: Falls out of the HVHG grouped in 2006 after being in the HVHG group in 2003.

New subway station, 1996



Green dot: Remains in the HVHG group from 1990 to 2001.

Red star: Shifts to the HVHG group in 2001 after not being in the HVHG group in 1990.

Black triangle: Falls out of the HVHG group in 2001 after being in the HVHG group in 1990.

Dotted line is subway line 7, which opened in 1996, while the three large circles are stations along the line.

Investment analysis, 2010 to 2015

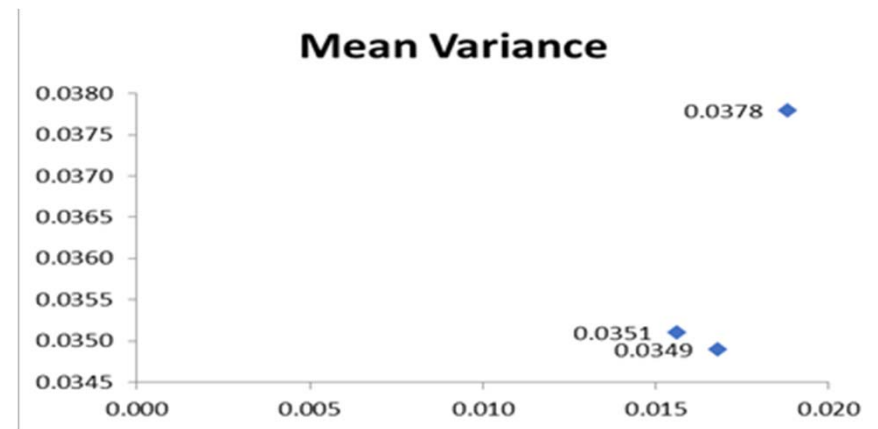
**Transition probability,
T-test**

	To	2015	
From		HVHG	% of HVHG (1,177)
2010	HVHG (1,205*)	1,117	92.7%
	HVLG (276*)	39	14.1%
	LVHG (276*)	21	7.6%

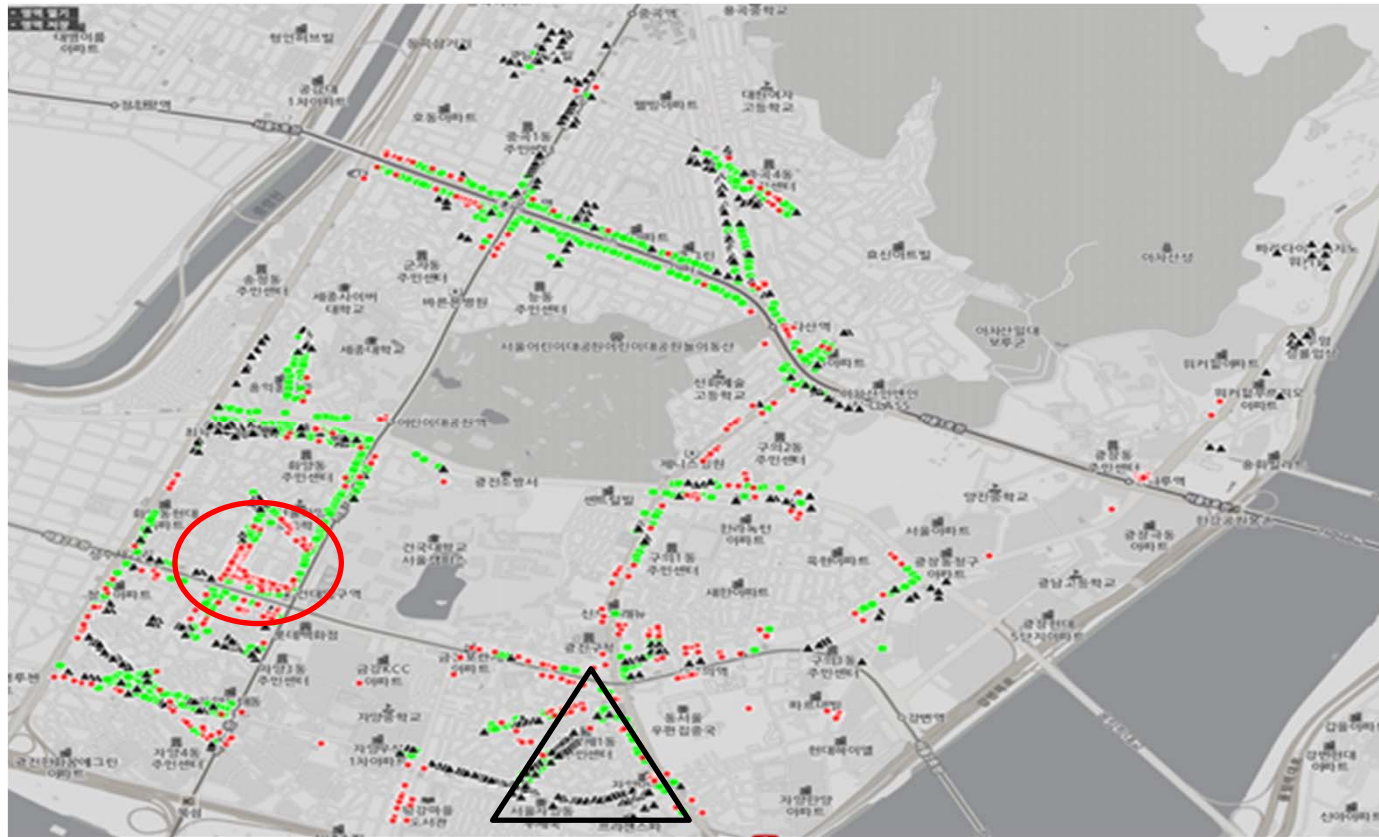
Test of returns difference	t-value
HVHG & LVHG	.11
HVHG & HVLG	-2.27**
HVLG & LVHG	1.90*

**Risk adjusted Sharpe,
Efficient frontier**

Groups in 2010	Mean return**	STD***	Mean return/STD
HVHG (1,205*)	3.51%	1.56%	2.24
HVLG (276*)	3.78%	1.88%	2.01
LVHG (276*)	3.49%	1.68%	2.06



Change of market area, from 1990 to 2001



Green dot: Is in the HVHG group in both years.

Red star: Shifts to the HVHG group in 2001 after being in either the HVLG group or the LVHG group in 1990. This might be seen as something of an upgrade.

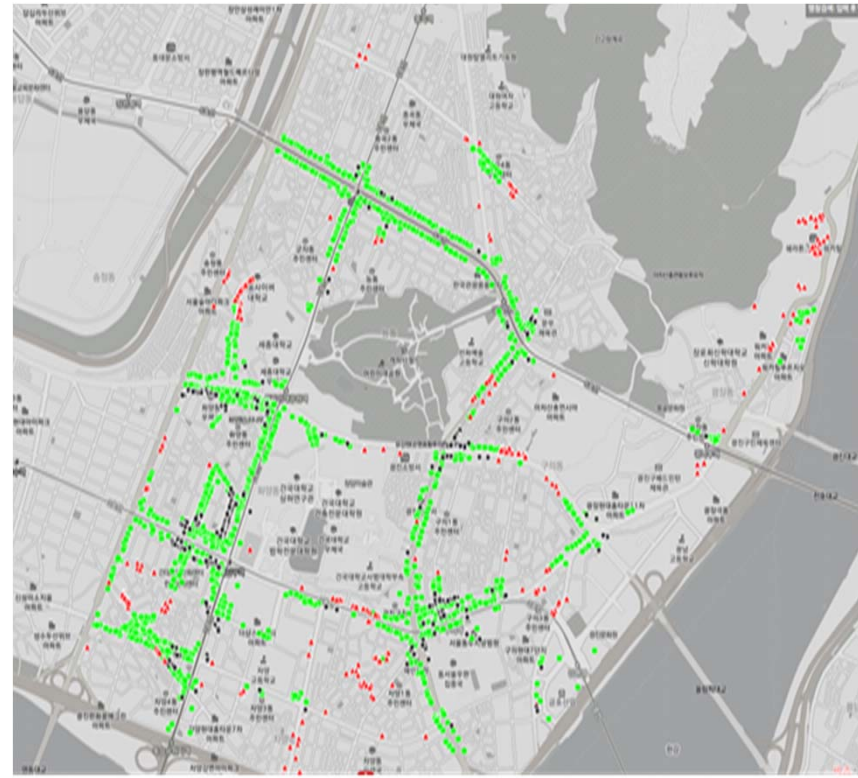
Black triangle: Shifts to either the HVLG group or the LVHG group in 2001 from the HVHG group in 1990. This might be seen as something of a downgrade.

Change of market area, from 1990 to 2015

1990



2015



From 2003 to present



Limitations

- Both the 70~100 meter radius used in gradient calculation and the criterion of being in the top 5% in assessed value for grouping land lots into our four categories are arbitrary choices.
- However, from the applicability point of view, these criteria provide flexibility.
- Secondly, regarding the applicability of the findings to land investment, we fail to define the economic intuition behind the HVLG, LVLG and LVHG categories as precisely as possible.

Smartphone application

- User can choose
- Region
- Distance for gradient
- Sampling threshold for 4 groups
- Years for market area change
- Years for investment analysis
- Problem
 - Service delivery time of map
- Tile map
 - Server capacity

Beginning is the answer.

韓國公車:

1個票卡感應區:1996年

3個票卡感應區:2007年



- 敬請指教 !!!
- 謝謝~~~



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