Using Monte-Carlo simulation to improve the Hypothetical Development

Weidong Qu and Jiajia Wang
Renmin University of China
Visiting scholar at TUM, Germany

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Contents

1 Research background

2 Research significance

3 Monte Carlo simulation

4 The values and distributions of parameters of the improved method

5 Test and result

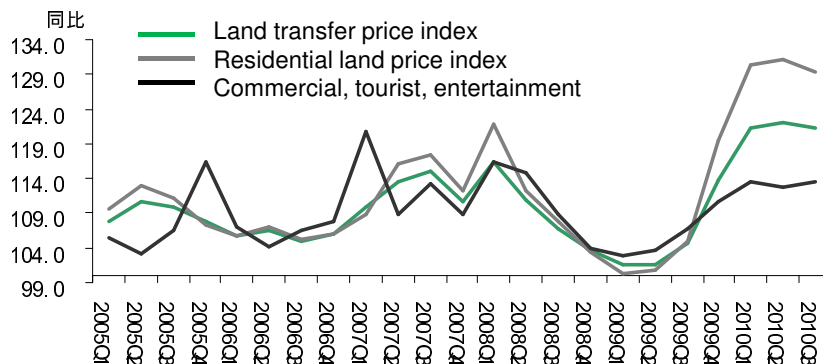# 1 Research background

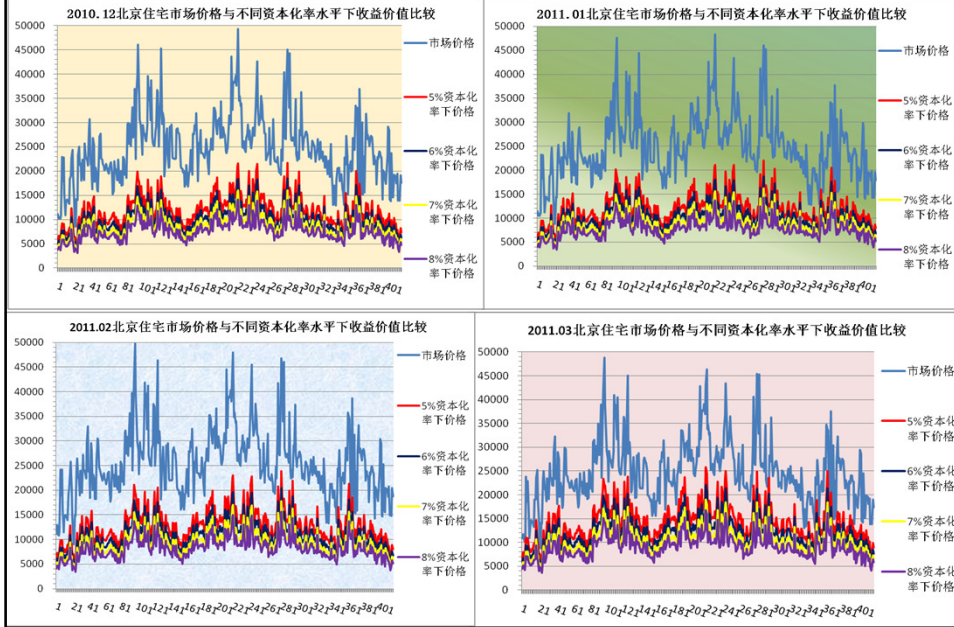- State-owned land transfer market situation of China
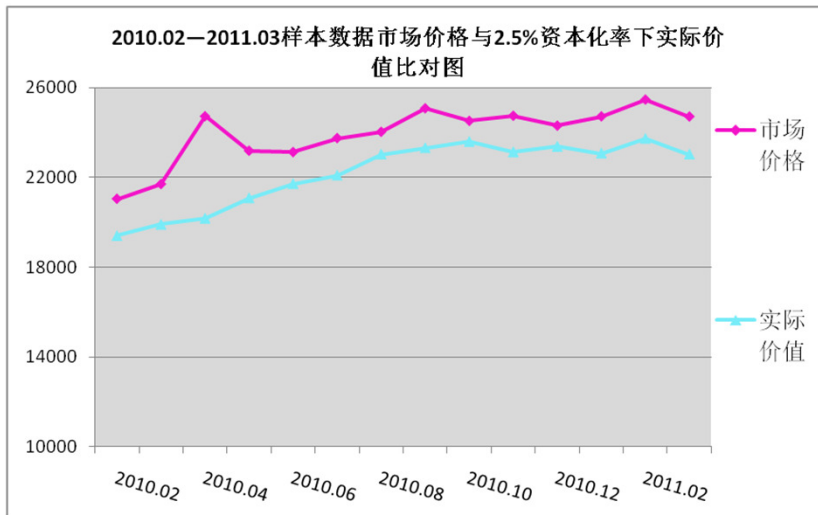- The evaluation methodology

Land transfer price rise rapidly

同比

Land transfer price index
Residential land price index
Commercial, tourist, entertainment

Resource：2010～2011China real estate market report，REICO

Difference between housing market price and yield capitalization value

Market value and the capitalization yield value with 2.5% cap. rate

State-owned land transfer market situation of Beijing ,China

- The "bidding, auction, listing transferring state-owned land use rights provision"
- The "bidding, auction, listing transferring system"
- The land transaction price has kept increasing and the "land king" phenomenon gradually becomes normal since the transfer of state-owned land entering market allocation
- Along with the land market prosperity, the premium rate gradually increases
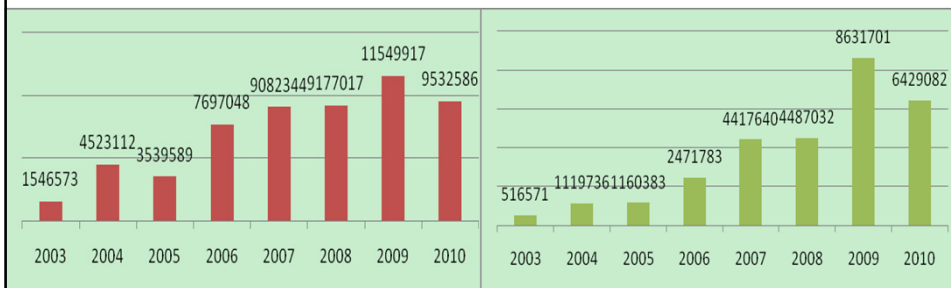
The total area of lands transferred by listing and auction in 2003-2010 in Beijing (s.m)

The total sum of lands transferred by listing and auction in 2003-2010 in Beijing (10 thousand Yuan)

The evaluation methodology

Market Comparison Method

Hypothetical Development Method

Standard Land Value Coefficient Correction Method

The evaluation methodology

- In order to sidestep shortcomings of the Basic and Standard Land Value Coefficient Correction Method, the government department will intend to use the Hypothetical Development Method in regions that have an active market and plentiful land transactions to evaluate the land reserve price.

The evaluation methodology

The Hypothetical Development Method

$$V = CV - DC - AE - I - ST - DP - BT$$

V: the evaluation value;
CV: the real estate value after development;
DC: the development costs;
AE : the administrative expenses;
I: the interest on investment;
ST: the sales taxes;
DP: the development profit;
BT: the buyer's account taxes.

Weakness of the evaluation methodology

- Disposal the complexity of economic environment in a utopian way
- Lack of rigorous mathematical argument in quantifying parameters
- The result is easily be influenced by subjective factors

$$V = \boxed{CV} - DC - AE - I - ST - DP - BT$$

2 Research significance

- The real estate market situation is conflict with the government regulation
- The evaluation methodology does not conform to the rule of market development
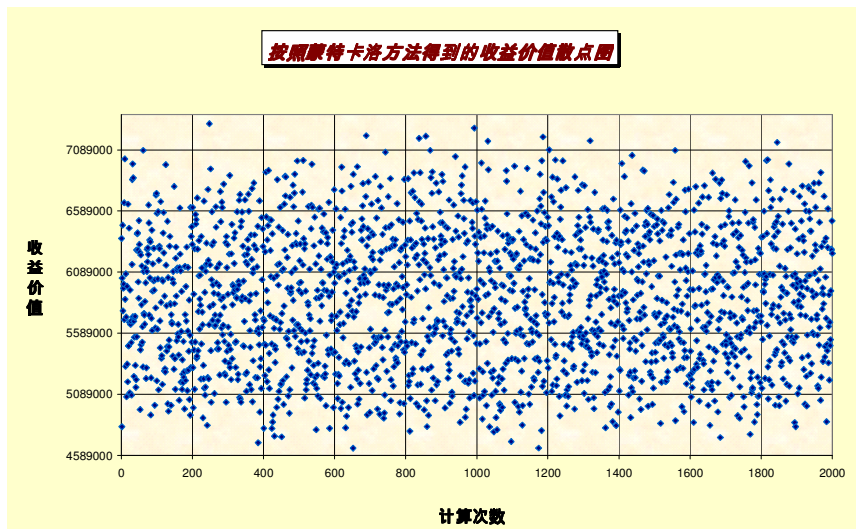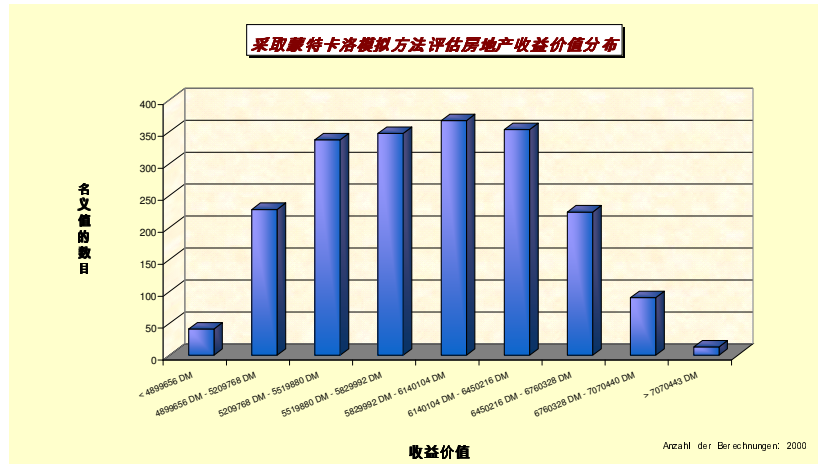- The Hypothetical Development Method can't satisfy the requirement of land value evaluation.

3 Monte Carlo simulation

- The Monte Carlo simulation is a technique to forecast variables under uncertain environment
- First, establishing a probability model or random process which is to forecast the variables distributions
- Second, calculating the characteristics of parameters through observing the model (process) or the sampling test
- Third, providing the most probable value and related statistical analysis results according to the simulation result
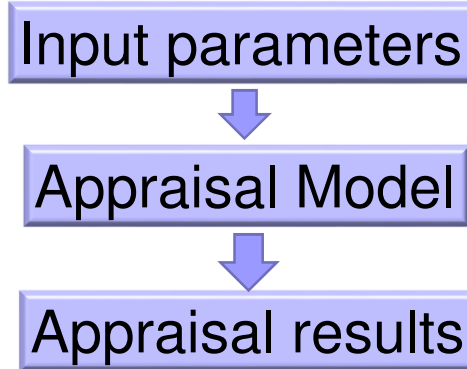
Traditional appraisal process

Input parameters

⬇

Appraisal Model

⬇

Appraisal results

The improved appraisal process

Input parameters

⬇

Monte Carlo simulation

⬇

Appraisal Model

⬇

Appraisal results
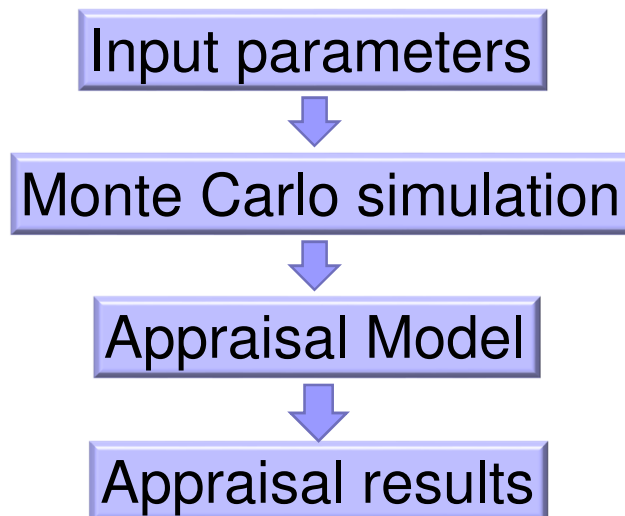
4 The values and distributions of parameters of the improved method

- The development cycle
- The residential real estate value after development
- The inflation rate
- The development costs

$$V = \boxed{CV} - DC - AE - I - ST - DP - BT$$

5 Testing the improved methodology

- The residential part of the total opening price is 1.1 billion
- The residential part of the total transaction price is 1.7 billion
- The evaluation reserve price of the residential part is 2.1 billion (2006),4.1 billion (2007),5.8 billion (2008) (the Hypothesis Development Method (static))

5 Testing the improved methodology

The indicators of variables

| Variable	Distribution pattern	Expected value	Standard deviation	Minimum	Maximum
Development cycle	Normal distribution	3.2	1.3	1	4
Growth rate of the value of the completed real estate	Normal distribution	10.50%	0.03	7%	13%
Inflation rate	Normal distribution	2.00%	0.02	-2%	6%
Development costs	2640 Yuan per s.m				
Sales taxes	Accounting for 18% of the value of the completed real estate				
Investment profit					
Buyer's account taxes	Accounting for 4% of the evaluation value				
Planned construction area	558243s.m				
The evaluation value		V= The value of the completed real estate- Development costs- Various taxes and fees			

5 Testing the improved methodology

part of the simulation result

The development cycle (year)	The growth rate of the value of the completed real estate	Taxes (Yuan)	Inflation rate	The development costs (Yuan per s.m)	the value of the completed real estate (Yuan per s.m)	The unit price (Yuan per s.m)	The total evaluation value (100 million Yuan)
1.31	0.14	1760.51	0.04	2773.92	9780.60	5246.18	28.16
2.90	0.11	1984.76	0.02	2792.69	11026.46	6249.01	33.54
-0.25	0.11	1438.20	0.00	2640.58	7989.97	3911.19	20.99
4.65	0.12	2514.27	-0.02	2357.11	13968.16	9096.78	48.83
0.32	0.09	1518.25	0.01	2652.06	8434.74	4264.44	22.89
2.67	0.12	2007.13	0.03	2823.72	11150.75	6319.89	33.92
4.28	0.12	2386.12	0.02	2875.84	13256.22	7994.27	42.91
6.08	0.12	2884.84	0.06	3803.88	16026.88	9338.16	50.12
2.57	0.07	1770.73	0.01	2712.57	9837.38	5354.08	28.74
4.50	0.07	1982.41	-0.01	2492.06	11013.36	6538.90	35.10
4.15	0.10	2159.28	0.00	2671.11	11996.03	7165.63	38.46

5 Testing the improved methodology
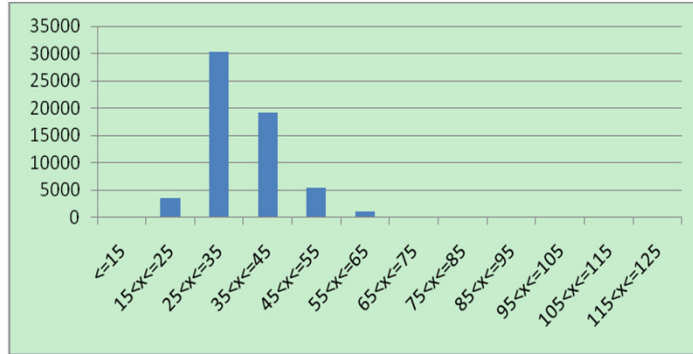
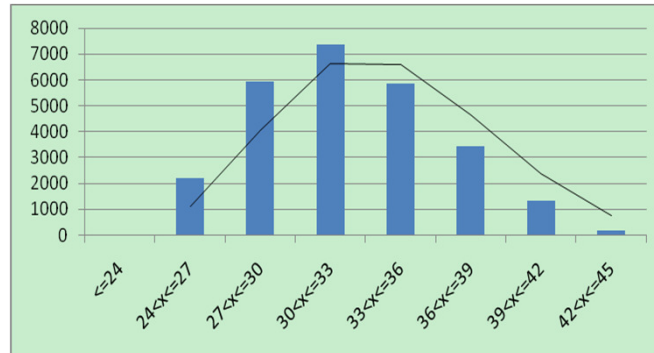Counting of the simulation result
(100 million，60,000 simulations)

5 Testing the improved methodology

description of the statistics of
the remained 26,277 results

mean	32.33	Skewness	0.32
Standard error	0.02	Range	20.42
Median	32.03	Minimum	24.00
Standard deviation	3.93	Maximum	44.42
Variance	15.46	sum	849449.80
Kurtosis	-0.48	Number of observations	26277.00

5 Testing the improved methodology

description of the statistics of
the remained 26,277 results

5 Testing the improved methodology

- The simulation results follow a Normal distribution
- The mean is 3.23 billion
- The standard deviation is 3.93
- The variation coefficient is 0.12
- The standard error is 0.02

Conclusion

The basic evaluation equation

$$V = \{[p((1+r_1)^t - d_1) - c(1+r_2)^t]/(1+d_2)\} * S$$

V: the total evaluation value,
p: the price after development at the date of value(unit value),
c: the development costs,
r1: the yearly growth rate of real estate value,
r2: the inflation rate,
t: the development cycle,
d1: the ratio of taxes and profits account for the price after development,
d2: the ratio of taxes and expenses account for the transfer value,
S: the planned construction area.

Conclusion

The basic evaluation equation in Excel Form

$$V = \{[p[(1+norminv(rand(),0.105,0.03))^{norminv(rand(),3.2,1.3)} - d_1]$$
$$- c(1+norminv(rand(),0.02,0.02)^{norminv(rand(),3.2,1.3))}]/(1+d_2)\} * S$$

The evaluation process using the improved Hypothesis Development Method by the Monte Carlo simulation

1. Determine the distribution types, the mean, the standard deviations and the ranges of value under certain confidence interval according to the historical data and expert advice etc.
2. Determine the mathematical model to evaluate the real estate value according to the characteristics of parameters analyzed above.
3. Get large numbers of simulation results by combining the basic equation of the Hypothetical Development Method.
4. Determine the final evaluation value by combining the analysis of the simulation results in Step 3 with the consideration of the reality.

Conclusion

- The improved methodology can make the evaluation value more reliable and accurate.
- The mean of the eligible simulation results has ideal representative and can be chosen to be the final evaluation value.