Contents

Figures		9
Tables		11
Acknowledgements		13
0	Introduction	15
0.1	Research questions	18
0.2	Research design and methodologies	18
Part I		
1	**Theoretical considerations regarding urban economics**	27
1.3	**Residence as a differentiated good**	27
1.4	**Alonso and his followers**	28
1.4.1	Muth-Mills model	35
1.4.2	**Advances in urban economics**	38
1.5	Hedonic prices and urban amenities	41
1.6.	**Concluding remarks**	42
2	**Criticism of urban economics and alternative approaches**	43
2.1	Introduction	43
2.2	Criticism of urban economics	43
2.3	Defining city	45
2.4	Complex and self-organizing systems: an alternative to urban analysis	47
2.4.1	Cellular automata	49
2.4.2	Agents, actors and cells	50
2.4.3	Transition rules	51
2.4.4	White and Engelen's model	51
2.5	Other cellular automata models	53
2.6	Concluding remarks	54
3	**An extension to White and Engelen's model**	55
3.1	Theoretical compatibility and the Brazilian case	55
3.2	The extended bottom-up model, including social heterogeneity and negative feedback	57
3.3	Detailing the model	60
3.3.1	The neighborhood effect (N)	60
3.3.2	Accessibility (A)	61
3.3.3	**Constraints and competition between actors**	62
3.3.4	Further adaptation: zoning and suitability	63

Furtado, Bernardo Alves
Modeling social heterogeneity, neighbourhoods and local influences on ...
2009

digitalisiert durch:
IDS Basel Bern

3.4 Implementing the model: the METRONAMICA System 63
3.5 Calibration procedures and the importance of parameters 64
3.6 Validation 64

Part II

4 **Historical contextualization** 67
4.1 Brazilian rapid urban population growth 67
4.2 Historical description at the state level 68
4.2.1 Establishing Belo Horizonte as Minas Gerais' capital 68
4.2.2 Urban-economic evolution 69
4.2.3 1950s and 1960s: "urban land production" and speculation 71
4.2.4 Population growth of RMBH 72
4.3 Specific intra-urban evolution of RMBH 73
4.4 Administrative and legislation issues 82
4.4.1 Municipalities boundaries 82
4.4.2 A brief history of Belo Horizonte's land-use legislation 84
4.4.3 Description of the present administrative legal situation in RMBH and its trends 84
4.5 Concluding remarks 85

5 **The neighborhood** 87
5.1 The literature and the definition of neighborhood 87
5.2 The spatial unit chosen 89
5.3 Data: describing urban space 90
5.3.1 Neighbourhood quality index 90
5.3.2 Level of activities index 91
5.3.3 Level of industrial activities index and Predominance of innovative sector 91
5.3.4 Other data 91
5.4 Methodology 92
5.5 Results 92
5.5.1 Neighborhood quality index 93
5.5.2 Level of activities and Level of industrial activities indices 93
5.5.3 Predominance of innovative sectors 101
5.6 Concluding remarks 101

6 **Analyzing the neighborhood hedonic prices function using spatial and quantile regression modeling** 103
6.1 Introduction 103
6.2 Methodology 105
6.2.1 Spatial analysis and spatial econometric models 105
6.2.2 Weight matrices 106
6.2.3 Quantile regression analysis 107
6.2.4 Spatial-quantile regression analysis 107
6.3 Dataset 108
6.3.1 Dataset used in the model 111

6.4	Model, diagnoses, tests, weight matrix alternatives, and results	111
6.4.1	Weight matrices	113
6.5	Interpretation of results and use of matrices	115
6.5.1	OLS and spatial	115
6.5.2	Quantile Regression Results	118
6.5.3	Spatial-quantile (IVQR)	120
6.6	Concluding remarks	122
7	**Description of reference data for calibration and validation**	125
7.1	Methodology: multivariate analysis – clustering	125
7.2	Data	127
7.3	Results and discussion	128
7.3.1	Results of the clustering procedures	128
7.3.2	The reference year: 1991	128
7.3.3	Validation reference for 2000	137
7.3.4	Description of evolution from 1991 to 2000	139
7.3.5	Quantitative occupation of space by different actors	141
7.4	Spatial configuration of prices in 2007	141
7.5	Concluding remarks	143
8	**Application: cellular automata model for the Greater Area of Belo Horizonte (1897-1991)**	145
8.1.	Objective of the application	145
8.2.	Definition of actors	145
8.2.1	Exogenous historical features implemented	147
8.3	Application data	147
8.3.1	Workspace: study area	147
8.3.2	Exogenous demand	149
8.3.3	Accessibility	149
8.4	Possible scenarios: data	150
8.5	Model application time scheme and validation	150
8.6	Choice of parameters	152
8.6.1	Neighborhood (N)	152
8.6.2	Accessibility (A)	153
8.6.3	Price (P)	157
8.6.4	Comparison with the reference map to confirm parameter choice	157
8.6.5	Relative price configuration and comparison with reference map	164
8.7	Validation part I: actors	164
8.8	Sensitivity analysis	166
8.8.1	Simulation results without prices	166
8.8.2	Simulation results with double influence of prices	167
8.8.3	Simulation results without accessibility parameters	169
8.8.4	Simulation results with similar N parameters for all residential income levels	169
8.8.5	Simulation without accessibility parameters, with similar N parameters, and without price parameters	169

8.9 Scenario analysis 171
8.10 Concluding remarks 172

9 **Cross-validation: part II, prices** 175
9.1 Models 175
9.2 Results, analyses and interpretation 176

10 **Concluding remarks** 181
10.1 Critical concluding remarks 181
10.2 Research questions revisited 182
10.3 Limitations 183
10.4 Suggestions for further research 184

References 185

11 **Appendix** 197
11.1 Initial occupation of Belo Horizonte 197
11.2 RMBH municipalities at creation in 1974 197
11.3 Principal components 197
11.4 Other data 200
11.5 Metrics on quantifying maps 200
11.6 Methodological note on the data availability for 1991 201
11.7 CA model data 201

Resumo em português (Portuguese extended summary) 215
Samenvatting in het Nederlands (Dutch summary) 223
Curriculum Vitae 227
Endnotes 229