

The relationship between urban street configuration and office rent patterns in Berlin

CONTENTS

PhD Thesis by Dr. Jake Desyllas

www.intelligentspace.com

About this thesis

This thesis presents a study of the influence of urban street configuration on the pattern of commercial office rents in Berlin. The hypothesis is that there is a relationship between the two, and that the alteration of the street network with reunification has precipitated a spatial reorganisation of office rents.

To read a full abstract and download other chapters, visit www.intelligentspace.com/news/desyllasthesis.htm.

Fathom™ is a trademark of Intelligent Space Partnership. Ordnance Survey®, OS MasterMap™, TOID™, Land-Line® and OSCAR® are trademarks or registered trademarks of Ordnance Survey, the national mapping agency of Great Britain. MapInfo® and MapInfo Professional® are registered trademarks of MapInfo Corporation. Other trademarks are the property of their respective owners. Copyright Intelligent Space Partnership 2004, unless otherwise stated. All rights are reserved. Permission is granted for the personal, non-commercial downloading, printing, transmission and temporary storage. Such permission does not allow for incorporation of material or any part of it in any work or publication, whether in hard copy, electronic, or any other form. All other use of the materials, in whole or in part (including without limitation reproduction, permanent storage, re-distribution and incorporation into other materials or web pages) is prohibited without the prior consent of Intelligent Space Partnership



Intelligent Space Partnership

81 Rivington Street, London EC2A 3AY

phone +44 (0) 20 7739 9729 fax +44 (0) 20 7739 9547 www.intelligentspace.com

Partners: Dr. Jake Desyllas B.A. M.Sc. Ph.D., Elspeth Duxbury B.Sc. M.S.c.

**THE RELATIONSHIP BETWEEN URBAN STREET
CONFIGURATION AND OFFICE RENT PATTERNS IN BERLIN**

A Thesis submitted in partial fulfilment of the requirements of University College London for
the degree of Doctor of Philosophy in Architecture

Jake Desyllas

September 1999

Resubmitted with minor amendments June 2000

University College London

ACKNOWLEDGEMENTS

I would like to thank my supervisor Alan Penn for his valuable support during this thesis and his challenging questions. At the Bartlett I would also particularly like to thank Bill Hillier who was an inspirational source of ideas during the EU funded research project that I worked on whilst undertaking this research. The experience taught me a great deal about how to analyse spatial problems. I would like to thank everyone at the Space Syntax Laboratory for providing me with so many research opportunities that stimulated my own work during the writing of this thesis. At the Centre for Advanced Spatial Analysis I would particularly like to thank Mike Batty, Simon Doyle and Muki Hakalay, who were very helpful in the use of relational databases and Geographic Information Systems (GIS) that were instrumental in the methodology of this thesis.

This study would not have been possible without the support of Jones Lang LaSalle, who provided the primary sample of rent data. I am particularly grateful to Nigel Roberts, Richard Maidment, Sascha Hettrich and everyone at JLL Berlin for their foresightedness in supporting research and their willingness to offer their time and assistance. The research has also benefited from the support of the UCL Graduate School, the Deutscher Akademischer Austauschdienst and the Abgeordnetenhaus Von Berlin to whom I am very grateful.

I would like to thank Dr Thomas Dietrich, the Fechnerstraße clan and the many other Berliners who provided a wide-eyed visitor with guidance and inside stories in that strange world that was Berlin in the 1990s. Special thanks to my parents Jannie and Justin and to ZK, KK and VB for their support and for putting up with my preoccupation with Berlin, space and the property market between 1994-1999. Responsibility for the contents remains mine.

**THE RELATIONSHIP BETWEEN URBAN STREET
CONFIGURATION AND OFFICE RENT PATTERNS IN BERLIN**

Jake Desyllas

email jdesyllas@intelligentspace.com

ABSTRACT

This thesis presents a study of the influence of urban street configuration on the pattern of commercial office rents in Berlin. The hypothesis is that there is a relationship between the two, and that the alteration of the street network with reunification has precipitated a spatial reorganisation of office rents.

The identification of an independent spatial variable that can be used to account for the pattern of rent is a key problem in office rent studies. Unlike previously used distances to a point in the Central Business District (CBD) or other destinations, this study uses 'space syntax' measures of the morphology of the street network. 'Global integration' is used to measure the role of each street within the entire configuration, revealing fundamental changes in the spatial structure of Berlin both with the city's historical development and with reunification.

Whereas most previous office rent studies have used yearly average asking rents per building for a short period, a sample of 412 achieved rents over a 7 year period was collected to control for the influence of lease provisions and the effect of market change over time on rents. The spatial pattern of 'location rents' is investigated through visual representations using GIS. Significant variation from street to street and a marked rise from periphery to centre are found. Unlike previous studies, spatial changes over time were investigated: a marked shift in the pattern of rents from West Berlin to the East has occurred in the 7 years following reunification. This shift corresponds to the changing spatial structure of the city revealed in the spatial analysis.

Multiple Regression Analysis (MRA) is used to quantify the importance of spatial variables (space syntax measures) in rent determination but also taking non-spatial variables (time, building quality, and lease provisions) into account. The main findings are that rents in West Berlin can be explained by the date of lease commencement (falling with the recession) and the global spatial integration as it was in divided Berlin. In East Berlin the global integration pattern of *reunified* Berlin is most important and secondly the date of lease commencement. Other variables such as floorspace and lease length are not found to have statistical significance. It is concluded that the change in Berlin's spatial structure that occurred with reunification led to a spatial reorganisation of prime office rents from the West Berlin CBD into the former East Berlin district of Mitte. It is argued that 'location value' will be an emergent property of any spatial system because a differentiated potential for co-presence is created.

CONTENTS

1	Introduction.....	15
1.1	Research Field	15
1.2	The Case of Berlin.....	16
1.3	Location and Rent: Three Questions	17
1.4	Hypothesis	19
1.5	The Scope of the Research	20
1.6	Summary	22
2	Literature Review	23
2.1	Introduction	23
2.2	The Agricultural Antecedents of Urban Rent Theory.....	23
2.3	Beginnings of Urban Rent Theories	27
2.4	Empirical studies of office Rent	32
2.5	Non-Spatial Influences On Rent.....	35
2.6	Measures of the Independent Spatial Variable	43
2.7	The Pattern of Rent: Representing the Dependent Variable	59
2.8	Problems and Debates in the Study of Office Rent	71
2.9	Discussion: Rent and the problem of Space	75
2.10	Summary	76
3	Methodology	78
3.1	Introduction	78
3.2	Rent Data Sample Selection and Analysis.....	79
3.3	Representativeness of the Lease Sample	84
3.4	Variables.....	89
3.5	Methodology of Rent Data Representation	94
3.6	Methodology of Spatial Analysis	98
3.7	Measures of the Spatial Analysis.....	103
3.8	Summary	118
4	Historical Development Of Urban Morphology And Land Use In Berlin .	120
4.1	Introduction	120
4.2	Evolution of Urban Morphology and Land Use Pattern.....	121
4.3	The Historic Centre of Berlin	124
4.4	Pre-industrial Expansion of Berlin	130

4.5	Industrialisation and the First Central Business District.....	140
4.6	Divided Berlin	152
4.7	Main Findings of the Historical Analysis	158
4.8	Discussion	159
4.9	Summary	161
5	Urban Spatial Structure and the Property Market in Reunified Berlin	163
5.1	Introduction	163
5.2	Spatial Analysis of Reunification	164
5.3	Economic Restructuring and the office Market.....	166
5.4	office Demand Development.....	167
5.5	The Spatial Pattern of office Demand	171
5.6	Office Supply Development	180
5.7	The Spatial Distribution of office Supply.....	182
5.8	Vacancy.....	186
5.9	The Turn From a Landlords to Tenants Market	187
5.10	Discussion	188
5.11	Summary	190
6	Non-Spatial Characteristics of the Lease Sample.....	192
6.1	Introduction	192
6.2	The Lease Sample.....	192
6.3	Analysis of Non-Spatial Variables and the Lease Sample.....	194
6.4	Incentive Adjusted Rents.....	209
6.5	Isolating Location Rent	217
6.6	Discussion	226
6.7	Summary	228
7	Representing The Spatial Patterns Of Office Rents.....	230
7.1	Introduction	230
7.2	The Pattern of Rent.....	231
7.3	Isopleth Analysis	241
7.4	Discussion	247
7.5	Summary	249
8	Modelling The Pattern Of Rents	250
8.1	Introduction	250
8.2	Analysis of rents by Area	251
8.3	Analysis of Rents Year By Year.....	252

8.4	Multiple Regression Analysis.....	257
8.5	West Berlin.....	261
8.6	East Berlin.....	264
8.7	Time and Location in rent determination.....	269
8.8	The Changing Pattern of Location Rents in Berlin.....	272
8.9	Discussion: the decline and rise of centres.....	276
8.10	Summary.....	277
9	Conclusions.....	278
9.1	Introduction.....	278
9.2	Summary of Findings and Conclusions.....	278
9.3	Limitations of the Study.....	281
9.4	Suggestions for Further Research.....	282
9.5	Discussion.....	285
10	Appendix A: Bibliography.....	278
11	Appendix B: Definition of Lease variables.....	298
12	Appendix C: Econometric Studies of Office Rent and Location.....	300
13	Appendix D: Key to the Planzeichenverordnung.....	303
14	Appendix E: Summary of Multiple Regression Models.....	305
15	Appendix F: Glossary.....	309

FIGURES

Figure 2.1: Park and Burgess concentric ring model	28
Figure 2.2: The effect of incentives on the actual rent paid in each year of the lease (Davidson and Darlow 1993)	37
Figure 2.3: The Office Market Cycle (Bond 1991)	43
Figure 2.4: Isochrones on a uniform rectangular street grid (left) and with two intersecting highways added (right).....	47
Figure 2.5: Isochrones on a rectangular street grid with two intersecting highways and a rectangular loop (Alonso 1964)	48
Figure 2.6: Rent patterns of two competing neighbouring centres of the same size (left) and unequal sizes (right)	50
Figure 2.7: Rent Surface for the Chicago Central Business District (Brennan, Cannaday et al. 1984) ..	66
Figure 2.8: Knos' difference between actual and distance-predicted rents (Knos 1962).....	74
Figure 3.1: Number of Leases by Source	83
Figure 3.2: Mean Rent Price (DM/m ² /month) of the two Data Sources	84
Figure 3.3: Unit floorspace size of leases by source of sample	84
Figure 3.4: Agents Estimates of Berlin's Office Market Size	85
Figure 3.5: Estimated Size of market compared to study sample	86
Figure 3.6: Sample as percentage of total Market Estimate	87
Figure 3.7 : Box Plots of Axial Line Length in Berlin	105
Figure 3.8: Correlation between Ln line length and Ln connectivity	107
Figure 4.1: Population Growth of Berlin	123
Figure 4.2: Population Growth London, Berlin and Santiago de Chile	123
Figure 4.3: Correlation of local and global integration for Berlin Axial Map in 1650	132
Figure 4.4: Correlation of local and global integration for Berlin Axial Map in 1690	133
Figure 4.5: Correlation of local and global integration for Berlin Axial Map in 1750	133
Figure 4.6: Correlation of local and global integration for Berlin Axial Map in 1850	138
Figure 4.7: Correlation of local and global integration for Berlin Axial Map in 1940	147
Figure 5.1: Office Employment in West Berlin.....	167
Figure 5.2: Berlin's Post-reunification boom and bust in office rents.....	168
Figure 5.3: Aengevelt mean rents (Aengevelt Research 1996).....	169
Figure 5.4: The shift in rent price towards the East according to Engel and Völkers.....	176
Figure 5.5: Integration of West Berlin CBD (Highlighted) in Divided Berlin	177
Figure 5.6: Integration of West Berlin CBD (Highlighted) in Reunified Berlin	178
Figure 5.7: Integration of Mitte (Highlighted) in Divided Berlin.....	178
Figure 5.8: Integration of Mitte (highlighted) in Reunified Berlin.....	179
Figure 5.9: Aengevelt Office Completions estimates	181
Figure 5.10: Office Stock Estimates in Berlin	182
Figure 5.11: Distribution of Supply in East and West Berlin (SenStadtUm and IHK 1995).....	183
Figure 5.12: Vacant space estimates	186

Figure 6.1: Agents Stated Top Office Rents (Aengevelt Research 1996; Müller GmbH 1996)..... 196

Figure 6.2: Box plot of nominal rent values 196

Figure 6.3: Comparison of Top Rents 197

Figure 6.4: Berlin's Falling Office Rents 197

Figure 6.5: Headline rents in new and old buildings for the JLW sample 198

Figure 6.6: Leases in new and old buildings per year by number (left) and floorspace (right) 199

Figure 6.7: Average obligatory lease length 199

Figure 6.8: Frequency distribution of obligatory lease terms in all leases (left) and JLW leases (right)
..... 200

Figure 6.9: Rent in leases of different lengths 201

Figure 6.10: Mean total optional renewal period in years (95% confidence intervals) 201

Figure 6.11: Frequency distribution of optional renewal time..... 202

Figure 6.12: Optional renewal time as a fraction of obligatory lease length for 5 year leases (left) and
10 year leases (right)..... 203

Figure 6.13: average rents in small leased areas compared to larger leased areas..... 204

Figure 6.14: Unit floorspace size 204

Figure 6.15: Box plot of unit floorspace size: linear scale (left) and log 10 (right)..... 205

Figure 6.16: Mean Pre-letting times per year in the JLW lease sample..... 206

Figure 6.17: Mean pre-letting time in new and old buildings..... 206

Figure 6.18: Number of rent-free months per contract 207

Figure 6.19: Percentage of rent-free time in new and old buildings 208

Figure 6.20: Mean rent appreciation multiplier per year 208

Figure 6.21: Consideration rent value as a percentage of headline rent for each year of the lease life 210

Figure 6.22: consideration rent percentages over time 211

Figure 6.23: Effective rent percentages for 5-year leases 212

Figure 6.24: Correlation between headline and effective rents for various discount rates 216

Figure 6.25: Correlations between consideration rent and headline rent..... 217

Figure 6.26: Correlations between effective rents and headline rents 217

Figure 6.27: Linear regression of rent against time 220

Figure 6.28: Polynomial Regression (6 degrees) of Rent over Time..... 221

Figure 6.29: Linear (left) and Log-linear (right) regressions for rent against time (1992 to 1997) 222

Figure 7.1 Box plots of rents on Kurfürstendamm and within 500m radius..... 240

Figure 7.2: Data points and contour lines for the isopleth representation..... 244

Figure 8.1: box plot of rents by area and build type for all headline rent (left) and residual headline rent
(right) 252

Figure 8.2: 1991 rents by area box plot 253

Figure 8.3: 1992 Rents by area box plots 254

Figure 8.4: 1993 rents by area and build quality 254

Figure 8.5: 1994 rent by area and build quality for all leases (left) and JLW leases (right) 254

Figure 8.6: 1995 rent by area and build quality for all leases (left) and JLW leases (right) 255

Figure 8.7: 1996 rent by area and build quality for all leases (left) and JLW leases (right)256

Figure 8.8: 1997 rent by area and build quality box plot for all leases (left) and JLW leases (right) ...256

Figure 8.9: Effective rent percentages for 5-year leases in Berlin 1991-1997.....257

Figure 8.10 (a & b): Scatterplots from the MRA for rent in West Berlin new buildings.....261

Figure 8.11 (a & b): MRA for Ln Headline Rent in West Berlin old Buildings.....262

Figure 8.12: MRA for Ln Headline Rent new buildings in East Berlin 1992-1997264

Figure 8.13: Reunified Global integration Vs residual of MRA for Ln Headline Rent new buildings in East Berlin 1992-1997265

Figure 8.14: MRA for Ln Headline Rent Old buildings in East Berlin 1992-1997266

Figure 8.15: MRA for East Berlin old unlogged266

Figure 8.16: The relationship between time and Ln headline rent in West Berlin (left) and East Berlin (right) for new and old buildings.270

Figure 8.17: Divided Global Integration and Location rents in West Berlin270

Figure 8.18: Reunified Global Integration and Location rents in East Berlin271

Figure 8.19: Reunified Global integration and Location rents in East Berlin 1994-1997271

Figure 8.20: sample size in new and old buildings within reunified global integration percentiles273

Figure 8.21: location rent split by reunified global integration band.....273

Figure 8.22: Location rent by global integration band for 1992-94 (left) and 1995-97 (right).....274

Figure 8.23: location rent in new and old buildings by reunified global integration band for West (left) and East (right).....275

Figure 8.24: Fluctuations in location rent by global integration band276

TABLES

Table 2.1: Types of Office Rent Data.....	34
Table 3.1: Inclusion Criteria for JLW Lease Database.....	82
Table 3.2: Major Commercial Estate Agents in Berlin (alphabetical).....	85
Table 3.3: Scale comparison for choropleth representation.....	98
Table 3.4: Criteria for the selection of spatial measures as the location variable.....	99
Table 3.5: Length of axial lines split by road type.....	106
Table 3.6: Local Spatial Measures.....	107
Table 3.7: Measures of block-face length.....	109
Table 3.8: Connections per kilometre split by road type.....	111
Table 3.9: Average segment length split by road type.....	111
Table 3.10: K values for Berlin axial map.....	112
Table 3.11: Correlation Matrix for Axial map variables.....	116
Table 3.12: Correlation Analysis for Spatial Measures.....	117
Table 5.1: Top and mean rent estimates.....	168
Table 5.2: Rents for new and old buildings in 1995 and 1996 (Blumenauer Immobilien 1997).....	170
Table 5.3: New Office Completion Estimates ('000's m ² gross floorspace).....	181
Table 5.4: Vacant Office Space Estimates ('000's m ²).....	186
Table 5.5: Vacancy rate estimates (percentage of available space not let).....	187
Table 6.1: Summary Statistics of the Leases in the Jones Lang Wootton Sample (n=206).....	194
Table 6.2: Summary Statistics of the Lease Incentives in the Jones Lang Wootton Sample (n=206).....	195
Table 6.3: Summary Statistics for the landlords sample (n=437).....	195
Table 6.4: Consideration and effective rent percentages.....	209
Table 6.5: The 5 lowest and 5 highest effective rent percentages (5 year leases only).....	213
Table 6.6: Correlation Matrix for Lease Variables.....	218
Table 6.7: Correlation Analysis for Lease Variables.....	219
Table 6.8: Location Blind Multiple Regression Analysis for Ln Headline Rent.....	219
Table 8.1: MRA models for All Berlin.....	260
Table 8.2: MRA models for West Berlin.....	263
Table 8.3: MRA models for East Berlin.....	267
Table 8.4: Residual Statistics for all MRA models.....	268
Table 8.5: Frequency Distribution for Reunified Global Integration.....	272
Table 11.1: Definition of lease variables.....	299
Table 12.1: Econometric Studies of Office Rent and Location (continued overleaf).....	301
Table 13.1: Key to the Planzeichenverordnung (PlanzVO).....	304

MAPS

Map 2.1: Office rent map of central London (Hillier Parker 1990).....	61
Map 2.2: Commercial land values in Minneapolis, measured in \$ per front foot (Hurd 1903).....	62
Map 2.3: Isoplethic Representation of land values in the City of London (Anstey 1965).....	63
Map 2.4: Assessed land value surface for Topeka, Kansas (Knos 1962)	64
Map 2.5: Surface of Location Value for House Prices in Stafford (Gallimore, Fletcher et al. 1996).....	65
Map 2.6: Plot based representation of retail values in a GIS (Wyatt 1996).....	67
Map 4.1: Memhard’s 1652 Map of Berlin	124
Map 4.2: Land Use 1650 Berlin	127
Map 4.3: Schultz and Schleuen’s 1688 Map of Berlin	128
Map 4.4: Schmettau’s 1748 Map of Berlin.....	130
Map 4.5: Land Use 1750 Berlin	135
Map 4.6: Sineck’s 1856 Map of Berlin.....	136
Map 4.7: Land Use 1850 Berlin	139
Map 4.8: Hobrecht Plan.....	140
Map 4.9: Land Use 1880 Berlin	141
Map 4.10: Land Use 1910 Berlin	142
Map 4.11: Commercial land uses within the Mitte District in 1923.....	144
Map 4.12: Land Use 1940 Berlin	148
Map 4.13: Typical ‘Mietskaserne’ Block Structure.....	150
Map 4.14: Damaged and Destroyed Buildings 1945 Berlin	152
Map 4.15: Built form in Mitte in 1940 (left) and 1989 (right).....	153
Map 4.16: Land Use 1986 Berlin (wall highlighted).....	155
Map 4.17: West Berlin CBD in 1986	156
Map 4.18: Mitte in 1986.....	157
Map 5.1: Engel & Völkers Office Rent Patterns	172
Map 5.2: Jones Lang Wootton Office Rent Patterns	173
Map 5.3: Jones Lang Wootton Western Centre	173
Map 5.4: Jones Lang Wootton Office Rent in Mitte	174
Map 5.5: Eureal Office Rent Patterns.....	175
Map 5.6: Müller Office Rent Contour Map (Müller GmbH 1996).....	175
Map 5.7: Major Projects in Berlin Mitte.....	184
Map 7.1: Buildings Containing Leases in the Study Sample.....	231
Map 7.2: Location rents in Berlin 1991-1997.....	232
Map 7.3: Location rents in Berlin 1991-1994.....	235
Map 7.4: Location rents in Berlin 1995-1997.....	235
Map 7.5: Selected 1000m section of Kurfürstendamm and 500m radius of side streets	237
Map 7.6: Location rents on Kurfürstendamm and its side streets.....	237
Map 7.7: Location rents for old buildings in Mitte 1991-1997.....	239
Map 7.8: Location rents for new buildings in Mitte 1991-1997.....	239

Map 7.9: Effective rent percentages for 5-year leases in Berlin 1991-1997241

Map 7.10: Location Rent Surface for Berlin Office Rents 1991-1997 (IDW 20 nearest neighbours)..242

Map 7.11: Location rent surface for Berlin in 1991-1994 (left) and 1995-1997 (right)243

Map 7.12: Location rent surfaces in Mitte using the nearest neighbour (left) and fixed radius (right) techniques245

Map 7.13: 3D Location Rent Surface for Berlin office Rents246

AXIAL MAPS

Axial Map 3.1: Section of Berlin excluding routes in Tiergarten.....	102
Axial Map 3.2: Section of Berlin including routes in Tiergarten	102
Axial Map 3.3: Length of axial lines in Berlin (colour spectrum).....	105
Axial Map 3.4: Ln Connectivity of axial lines in Berlin (colour spectrum)	108
Axial Map 3.5: An example of the connections per metre of axial lines in an area of Berlin	110
Axial Map 3.6: An example of the average Block-face length in an area of Western Berlin	110
Axial Map 3.7: An example of K_3 Values in Berlin	114
Axial Map 4.1: Global Integration of Berlin in 1650	125
Axial Map 4.2: Local Integration of Berlin in 1650	126
Axial Map 4.3: Global Integration of Berlin in 1690	129
Axial Map 4.4: Local Integration of Berlin in 1690	129
Axial Map 4.5: Global Integration of Berlin 1750	131
Axial Map 4.6: Local Integration of Berlin 1750	132
Axial Map 4.7: Step Depth from Rathausstraße in 1750	134
Axial Map 4.8: Step Depth from Friedrichstraße in 1750	134
Axial Map 4.9: Global integration of Berlin in 1850.....	137
Axial Map 4.10: Local integration of Berlin in 1850	138
Axial Map 4.11: Global Integration of Central Berlin in 1940 (originally from Walter 1993)	145
Axial Map 4.12: Local Integration of Central Berlin in 1940 (Walter 1993)	146
Axial Map 4.13: Global Integration of Divided Berlin in 1986.....	154
Axial Map 5.1: Global integration of Divided Berlin in 1989.....	165
Axial Map 5.2: Global integration of Reunified Berlin in 1999.....	165