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THE ROLE OF ARCHITECTURE ON URBAN REVITALIZATION: THE CASE OF „OLYMPIC ARENAS“ IN BERLIN-PRENZLAUER BERG

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The Role of Architecture on Urban Revitalisation: The Case of Olympic Arenas in Berlin-Prenzlauer Berg*

Abstract: This paper investigates socioeconomic impacts of three multifunctional sports arenas situated in Berlin-Prenzlauer Berg, Germany. The three arenas were chosen for their potential to contribute to revitalisation of their economically deprived neighbourhoods. We employ a difference-in-differences approach to check for structural breaks in development of land values within areas of potential impact. Our results suggest that arenas emanate positive externalities and apparently have accelerated the process of gentrification going on in Prenzlauer Berg. However, evidence also supports concerns that congestion problems may adversely affect property values, at least when not addressed appropriately during planning.

Keywords: Stadium Impact, Stadium Architecture, Gentrification, Berlin

JEL classification: R53, R58

Version: May 2007

1 Introduction

Spectacular and innovative architecture has long been associated with buildings designed to host cultural institutions like museums or theatres. Some of the most prominent examples are the Guggenheim Museum in Bilbao, the Centre Pompidou in Paris or the Sydney Opera House. However, more recently, architecture has also begun to play an increasingly important role in construction of sports facilities. For instance, some of the most recognised architects have been chosen to

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design the Palau Sant Jordi Sports Palace in Barcelona (Arata Isozaki), the new Wembley Stadium in London (Foster and Partners), Durban's Kingspark Stadium (Gerkan Marg and Partners), Munich's Allianz-Arena and the Beijing National Stadium (both Herzog and de Meuron). While these stadiums have obviously been designed with respect to appearance and aimed at creating new visiting cards for their hometowns, scholarly debate on new stadium construction still focuses on more traditional arguments. Accordingly, subsidies for new stadiums are justified by potential increases in business and tourism, and the creation of construction jobs, which lead to increasing tax revenue and economic stimulation of the host community. This reasoning, however, has been criticised for unrealistic assumptions about multiplier effects, underestimation of substitution effects and neglecting opportunity costs (BAADE, 1996; COATES & HUMPHREYS, 2000; MATHESON, 2007; NOLL & ZIMBALIST, 1997; ROSENTRAUB, 1997; ZARETSKY, 2001). Siegfried and Zimbalist (2000) provide a good overview of this research. This criticism has been supported by numerous econometric ex-post studies (BAADE, 1988; BAADE & DYE, 1990; BAADE & SANDERSON, 1997; COATES & HUMPHREYS, 1999, , 2003; SIEGFRIED & ZIMBALIST, 2006) and only few studies have found positive effects on MSA (Metropolitan Statistical Area) level (BAIM, 1990; CARLINO & COULSON, 2004).

Generally, neighbourhood activists oppose stadium construction, since they expect property values to be adversely affected by emerging congestion problems and annoying fan-crowds. Recently, stadium construction has been empirically investigated from the homeowners' perspective. Tu (2005) used property-transaction data and found a positive impact on property prices around FedEx Field in Prince Georges County, Maryland. Coates and Humphreys (2006) showed that voters in close proximity to facilities tend to favour subsidies more than voters living farther from the facilities, indicating that benefits from stadiums might exhibit an unequal spatial distribution.

These findings further inform the debate about impacts of stadium construction. Not only may stadium projects have been inadequately designed to improve neighbourhood quality and stimulate local economies, empirical studies have probably investigated impact at an unreasonable scale. With the exception of Tu (2005) the aforementioned studies all make use of aggregated data on MSA level although it had been recognised early in the debate that stadiums and corresponding franchises might be too small as "businesses" to have effects at a highly aggregated level (ROSENTRAUB, 1997).

Moreover, only empirical analysis on a neighbourhood-scale can assess whether new stadiums are key-determinants in gentrification processes, particularly in economically deprived neighbourhoods. With few exceptions (DAVIES, 2006; MELANIPHY, 1996) this question has rarely been addressed in scholarly discussion.

This paper addresses the detail of how new sports facilities affect their neighbourhoods. We conduct differences-in-differences analysis on a set of highly disaggregated data, to assess the socioeconomic impact of three sport arena projects developed within an area of urban renewal. These projects were explicitly designed to contribute to a process of revitalisation, and realised during the 1990s in downtown Berlin, Germany. Our results support positive expectations of stadium impacts, and also confirm that some concerns about congestion problems are well-founded, when not appropriately addressed by planning authorities.

The article is organised as follows: Section 2 presents both projects in more detail and emphasises their architectonical particulars. In section 3 and 4 the data and empirical strategy are discussed. In section 5 empirical results and interpretation are presented. Section 6 contains the conclusion.

2 Velodrom and Max-Schmeling-Arena

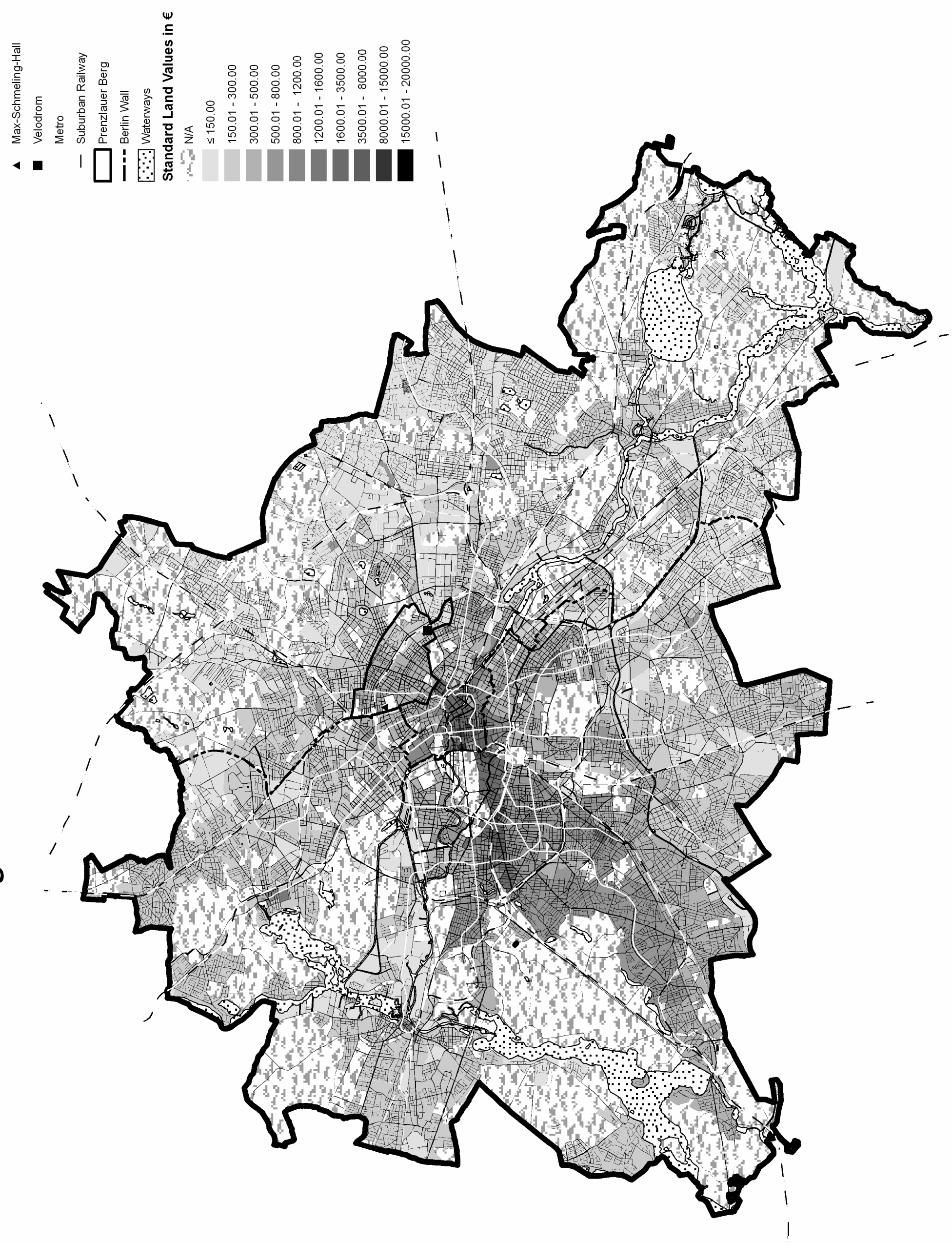
We investigate two sports complexes in the district of Prenzlauer-Berg, within the boundaries of former East Berlin.[1] Max-Schmeling-Arena and Velodrom/Swimming-Arena were initially designed to fulfil all standards for international competitions, since they were an integral component of the unsuccessful bid of Berlin for the 2000 Olympics, commenced in the late 1980s. Max-Schmeling-Arena was intended for boxing competitions, while Velodrom and Swimming-Arena were intended for Olympic track cycling and aquatics, respectively. To simplify matters hereafter Velodrom signifies Velodrom and Swimming-Arena, since Velodrom is the much larger of the two arenas, which are grouped together The ideas of the arenas need to be understood in the context of aspirations in Berlin of the early 1990s, shortly after the fall of the Berlin Wall. The German Parliament decided that Berlin would become the capital city of unified Germany and economic prospects were positive. Building activity was high and large residential areas formerly belonging to East Berlin started to be revitalised. Many projects of this period, such as the government district and the large office and retail areas around Potsdamer Platz and Friedrichstrasse have become internationally prominent. It was a time of extraordinary projects.

An international competition awarded the Velodrom project to the design of Dominique Perrault, an architect who had just become an international "shooting-star" due to his spectacular design for the new French National Library. In contrast, the group of young architects around Joerg Joppien and Albert Dietz was still internationally unknown when entrusted with the design of Max-Schmeling-Arena. Nevertheless, both architectural designs share the same basic idea. Instead of placing monolithic blocks into densely populated residential areas and threatening the fragile urban equilibrium, they decided for a sensitive approach. They reduced the visible building volumes by sinking the facilities into the earth and embedding the visible parts into park landscapes as recreational spaces. Nonethe-

[1] Exact location of arenas is shown in Figure 1, which also illustrates standard land value pattern for 2006.

less, the architectonical quality of the remaining visible parts and their appealing designs fitted well with the ambitions of originality in Berlin at that time (ADAM, 1997; ARGENTI, 2000; MANDRELLI, 1994; MEYER, 1997; MYERSON & HUDSON, 2000; PERRAULT & FERRÉ, 2002).

Fig. 1 Standard Land Values 2006



Notes: Map was created on the base of the "City and Environment Information System" of the Senate Department.

The arenas had been under construction for several months in 1993 when the International Olympic Committee (IOC) announced that the 2000 Olympic Games would be in Sydney. Subsequently, building costs were reduced and architects and engineers redesigned the arenas to be multi-purpose. Notwithstanding, the arenas were of extraordinary dimensions. The Velodrom roof has a diameter of 142 m and a clear span of 115.2 m, and is one of the largest of its kind. It contains more than 3500 tonnes of steel, a similar quantity to the famous Eiffel Tower in Paris (CYCLING STADIUM, 1997; MANDRELLI, 1994). Since Velodrom was sunk up to 17 m, it is virtually invisible from street level. After accessing a plateau, however, it is an impressive sight. Within a park of 450 apple trees, the visitor suddenly catches sight of Velodrom and Swimming Arena which protrudes above the surface by less than one metre.

Although smaller, the architectural concept of Max-Schmeling-Arena is special as well. Deutz and Joppien convinced the jury of the desirability of a green bridge from Wedding to Prenzlauer Berg, providing additional green spaces for a very densely populated area, and symbolically linking the two districts formerly divided by the Berlin Wall. The complex is embedded in a heap of World War II rubble with two thirds of its volume below street level. The building has a tripartite structure consisting of a major arena in the centre, flanked by two aisles hosting additional sports facilities. A conventional steel roof covers only the middle part, while the tops of the two aisles are covered with greenery. Being walkable and smoothly descending to street level, they fit into the surrounding park landscape of the Mauerpark, one of Berlin's larger inner-city recreational spaces.

Both projects have received important architectural awards. In 1999 the Jury of the German Architectural Award gave the second prize to Dominique Perreault's plans for the Velodrom. The first prize went to no one less than Daniel Liebeskind with his plans for the Jewish Museum Berlin. Two years later the exemplary design and function of Max-Schmeling-Arena received an IOC/IAKS Gold medal. This prize, sponsored by the IOC and the International Association for Sports and Leisure Facilities is the only international architectural prize explicitly awarded to operating sports and leisure facilities.

Velodrom and Max-Schmeling-Arena are comparable in terms of architectonical quality and concept, which also includes a radical low-energy philosophy, and also in size. Velodrom has a capacity for 11500 spectators while Max-Schmeling-Arena accommodates up to 10000 in the main arena. Both complexes also host a wide range of sports facilities for non-professional sports. Accessibility by public transport was an important determinant for both locations. Velodrom is immediately accessible by tram and the circular line of the suburban railway network (S-Bahn). Another S-Bahn station is within 800 m of Max-Schmeling-Arena, as well as four underground and various tram stations. No further improvement of transport infrastructure was needed.

Max-Schmeling-Arena was finished in 1997 and Velodrom in 1999. They were financed by state funds and planned and carried out by a building-property company founded by the Senate and Chamber of Deputies of Berlin. Overall expenditure was $118 Million (205 Million DM, current prices) for Max-Schmeling-Arena, and for Velodrom a total of over $295 Million (545 Million DM) (MYERSON & HUDSON, 2000; PERRAULT & FERRÉ, 2002).[2] Projects of this size would not have occurred if ordered by club owners or managers purely aiming at private profitability. There was a clear attempt to generate positive external effects by providing valuable recreational spaces and sports facilities for the residents, by creating landmarks which signalled a clear new direction in that urban area and to attract tourists.

3 Data

For reasons discussed below, we restrict our study area to the area of Prenzlauer Berg, which on December 31, 2005 had 141 210 inhabitants and a spatial extent of only 11 km^2, one of Berlin's highest population densities. The local Committee

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[2] Dollar values have been calculated based on the average exchange rates during the years of completion. For Max-Schmeling-Arena the average 1997 exchange rate of 1.7348 DM per dollar has been applied while values referring to the Velodrom complex relate to the average 1999 exchange rate of 1.0658 Euros per Dollar and 1.95583 DM per Euro.

of Valuation Experts (Gutachterausschuss) determines standard land values (Bodenrichtwerte), these values reveal market values for undeveloped properties and are used as the primary endogenous variable. Standard land values are provided for zones of similar use and valuation (Bodenrichtwertzonen), assessed on the basis of statistical evaluation (including outlier elimination) of all transactions during the reporting period. Floor-space-index (FSI) values give information on the legal density of development for all zones. To account for individual zoning regulations, adjustment coefficients allow revaluation of particular plots FSIs.[3]

The study period ranges from December 31, 1992 (the first year for which data is available for districts in former East Berlin) to January 1, 2006, when the most recent data was available. Analysis is on the basis of the official block structure of Berlin, in December 2005, this is the highest level of data disaggregation from the Statistical Office of Berlin. Thus Prenzlauer Berg consists of 376 blocks with a median surface area covering less than 14 000 m^2, corresponding to a typical downtown block of houses. The mean population of 258 populated blocks was 545 (median 457) at the end of 2005. Use of GIS-tools and a projected GIS-map of the official block structure bring in the geographic dimension.[4] Data on motor vehicle registrations and population demographic characteristics data at block-level were obtained from the Statistical Office of Berlin.

Land value data is not available in a directly applicable digital form. Block-level information from the Statistical Office of Berlin is expensive, so due to financial and time constraints, we restricted data collection to 1992, 2000 and 2005.[5] This is a reasonable choice since it allows comparison of trends during pre- and post-completion periods.

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3 More information on sources and the process of collection of standard land values can be found in the data appendix.

4 All GIS-maps were provided by the Senate Department of Urban Development (Senatsverwaltung für Stadtentwicklung) and are based on "The City and Environment Information System" of the Senate Department.

5 In general all data strictly refers to December 31 of the corresponding year. Although officially referring the January 1 of 2001 and 2006, standard land values provided in these atlases are based on data collected during reporting periods 2000 and 2005.

4 Empirical Strategy

If arena construction significantly contributed to an improvement in neighbourhood quality one might expect increased land values in close proximity, relative to those at greater distances. Our empirical strategy consists of comparing growth rates of land values before and after arena completion. We employ a difference-in-differences approach (ELLEN *et al.*, 2001; GALSTER, TATIAN, & PETTIT, 2004; GALSTER, TATIAN, & SMITH, 1999; REDDING & STURM, 2005; TU, 2005) to assess whether impact areas systematically experienced increased relative growth rates. Galster, Tatian and Pettit (2004) provide a survey about the appropriate application of differences-in-differences estimations. Three interesting difference-in-differences specifications are briefly discussed and applied by Ellen, Schill, Susin and Schwartz (2001).

One crucial part of any difference-in-differences study is defining treatment and control areas. Since reunification, Berlin has experienced overwhelming changes in spatial structure and distinct socioeconomic developments. Processes of gentrification and catch-up, particularly within selected eastern districts and areas close to the old border, are matched by segregation and ongoing decline in other parts. The functional reactivation of the traditional eastern CBD, extensive migration and immigration of people of distinct social milieus from and into particular boroughs all complicate assessing feasible counterfactuals. These processes are of special importance for this analysis since both arenas are in Prenzlauer Berg, one of 23 boroughs according to pre-2001 legal definition,[6] and a borough not representative of Berlin in population composition. Figures 2a and 2b show how demographic structure changed after reunification, and how this differs to the rest of Berlin. The figures reflect a major process of gentrification in Prenzlauer Berg with the influx of relatively young professionals, usually in search of the particular urban lifestyle and scenic spirit for which Prenzlauer Berg is now recognised.

[6] End of 2001, 23 boroughs have been merged to 12 boroughs of approximately same population size.

Fig. 2a Population of Prenzlauer Berg and Berlin 2005

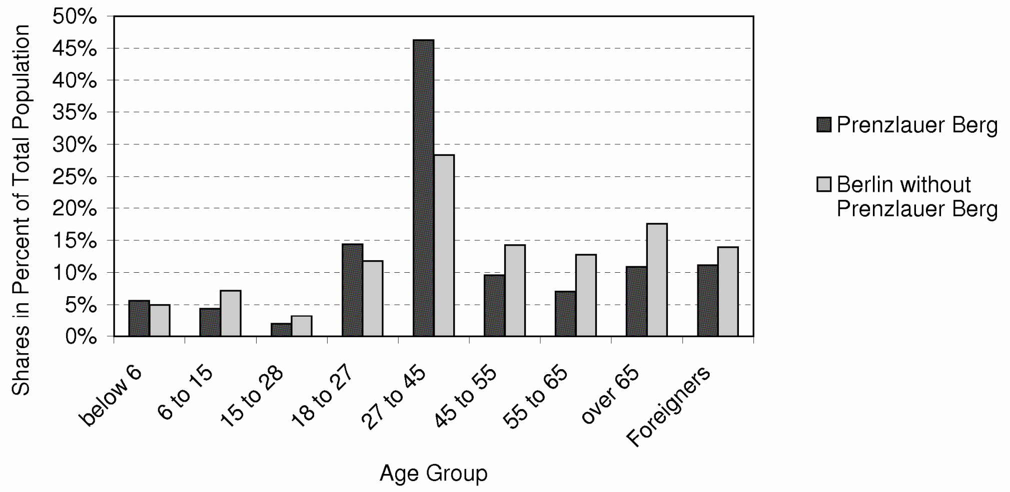


Fig. 2b Population of Prenzlauer Berg by Age Groups

As a consequence we restrict our analysis to the area of Prenzlauer Berg that has been similarly affected by overall socioeconomic shocks. Moreover, since Prenzlauer Berg lies more-or-less along a concentric distance ring around CBD-East there is no concern of potential bias caused by control and treatment areas being affected asymmetrically by re-emergence of the CBD-East.

As noted above, the basic idea behind our difference-in-differences approach is to test for structural breaks in relative growth of land values within impact-areas. Compound annual growth rates of standard land values within areas in immediate proximity of Max-Schmeling-Arena and Velodrom are compared to those of the control area within a comparable neighbourhood of Prenzlauer Berg. Highly disaggregated population data is considered, to assess whether possible impacts on land values are driven by changes in resident population and its composition. All data strictly refers to block level. An in-depth analysis of selected socioeconomic variables follows.

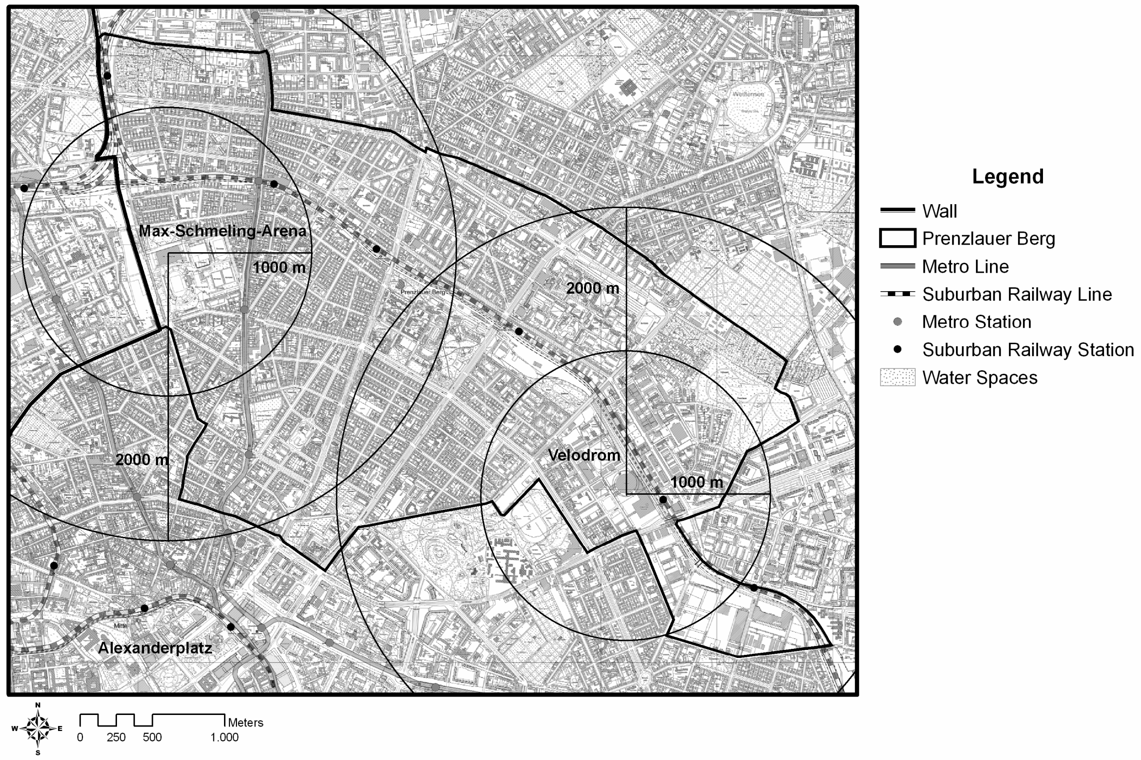
We use a similar specification to Redding and Sturm (2005). In our baseline difference-in-differences specification, compound annual block growth rates of land values are pooled over 1992–2000 and 2000–2005, the former representing the development period and the latter for post-completion. We regress growth rates ($Growth_{it}$) on a set of time dummies (Pre_t, $Post_t$), two area impact dummies ($Velo_i$, MS_i) denoting blocks that lie within impact areas of Velodrom and Max-Schmeling-Arena respectively, and two post-area interactive terms between the arena-impact dummies ($Velo_i$, MS_i) and the $Post_t$ dummy representing the post-completion period:

$$\begin{aligned} Growth_{it} &= \alpha_1 Pre_t + \alpha_2 Post_t + \beta_1 Velo_i + \beta_2 MS_i \\ &\quad + \gamma_1 (Post_t \times Velo_i) + \gamma_2 (Post_t \times MS_i) + \varepsilon_{it} \end{aligned} \qquad (1)$$

By choosing this specification, unobserved block fixed effects in standard land value levels are differentiated out. The coefficients α_1 and α_2 on time dummies represent average growth rates for control blocks and control for common overall impacts at a district level. Area-impact dummies capture area-specific deviation in growth rates during both periods. In this particular model-specification ${}_1$ and ${}_2$ reflect the differences in average growth rates between impact and control areas for the pre-completion period. Finally the interactive terms capture impacts on relative growth rates following completion. γ_1 and γ_2 represent the changes in differences between growth rates of impact and control areas after completion. For instance, positive values for γ_1 and γ_2 would provide strong evidence for a positive impact on average growth rates of land values in close arena proximity during the post-completion period. Stated simply, difference-in-differences are estimated as we difference between areas (control and treatment) *and* time (pre- and post completion).

In contrast to most comparable projects, improvement in land values cannot be attributed to improvements in public transportation infrastructure following stadium construction. Both sites were chosen due to their extraordinary transport linkages, making subsequent improvements unnecessary. However, there is at least one source of potential bias remaining. Standard land values assessed by the Committee of Valuation Experts refer to typical legal densities of development represented by FSI-values. To ensure that changes in legal building densities do not bias estimates, land values are normalised to a FSI of 1.5, the approximate average density of development within the area. The process of normalisation is described in more detail in the data appendix.

Fig. 3 Prenzlauer Berg



Notes: Map created on the basis of the "Digitale Grundkarte (K5)" (Senatsverwaltung fuer Stadtentwicklung Berlin, 2006) and "City and Environment Information System" of the Senate Department. (Kartengrundlage: Informationssystem Stadt und Umwelt der Senatsverwaltung für Stadtentwicklung).

5 Empirical Results

Our baseline differences-in-differences specification compares relative growth trends of land values for the two study areas before and after arena completion, while controlling for common changes affecting all of Prenzlauer Berg. If Velodrom and Max-Schmeling-Arena had a positive impact on location desirability, this would be reflected in a post-completion increased growth of blocks within impact areas, relative to the control group. As previously discussed we restrict our study area to Prenzlauer Berg to maintain homogeneity. We split Prenzlauer Berg into three parts: two treatment areas each defined by 1000 m distance rings surrounding arenas, and the control group consisting of the remaining area. The locations of Velodrom and Max-Schmeling-Arena and the surrounding distance rings are in Figure 3. Blocks are assigned to areas according to the location of their geographic centroids.

The first column of Table 1 presents baseline difference-in-differences estimation for normalised land values. To check for robustness, estimations are repeated with reduced sample-sizes. In the second column relative growth rates for blocks in close proximity (within 1000 m) of Velodrom are compared to those lying within the surrounding 1000–2000 m distance ring. The third column represents the corresponding estimates for Max-Schmeling-Arena. More robustness checks are presented in Table 2, where column (1) shows estimation results for unnormalised standard land values, while column (2) provides estimates for an enlarged study area, which also covers blocks of adjoining districts. Our baseline results prove to be robust for variation of sample-size, with normalisation of land values having only a minor effect on the regression.

Tab. 1 Baseline Empirical Results of Differences-in-Differences Estimations

	(1) Land Value Growth (normalized)	(2) Land Value Growth (normalized)	(3) Land Value Growth (normalized)
Pre	-0.015986*** (0.001629)	-0.017051*** (0.002276)	-0.012579*** (0.002101)
Velo	-0.013058*** (0.004531)	-0.011993*** (0.004811)	
MS	0.001106 (0.003254)		-0.002302 (0.003515)
Post	-0.091492*** (0.000503)	-0.092062*** (0.001098)	-0.090850*** (0.000383)
Post x Velo	0.014007*** (0.005149)	0.013512** (0.005486)	
Post x MS	0.001254 (0.003510)		0.004019 (0.003739)
Block Sample	Prenzlauer Berg	Velo2000	MS2000
Observations	681	294	411
R-squared	0.783802	0.746173	0.823459
R-squared adjusted	0.782200	0.743548	0.822158

Notes: Until 2001, Berlin was legally subdivided into 23 boroughs, one of which was Prenzlauer Berg. Prenzlauer Berg consists of 376 statistical blocks forming the basis of our panel. Endogenous variables are growth rates in normalized land values for 1992–2000 and 2000–2006. Land values had been normalized to account for varying legal building densities. The procedure of normalization is documented in the technical appendix. Velo and MS are dummies which take the value of 1 if a block lies within a 1000 m distance ring surrounding the corresponding arena and 0 otherwise. In columns (2) and (3) we restrict our sample to blocks lying either within a 2000 m distance ring surrounding Velodrom (Velo2000) or Max-Schmeling-Arena (MS2000). Areas corresponding to reduced samples and impact areas are graphically illustrated in Figure 3. Pre is a dummy variable denoting the period of 1992–2000 while Post stands for the period of 2000–2005. Standard errors (in parentheses) are heteroscedasticity robust. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

As initially noted, both Max-Schmeling-Arena and Velodrom were initiated in the post-unification state of euphoria, when Berlin was still expected to rapidly regain economic strength. This short period was accompanied by a boom in real estate markets, the following disillusionment regarding the general economic prospects of Berlin led to easing of markets towards a lower equilibrium. The significantly negative coefficients on time dummies in all estimations reveal that, despite gentrification, Prenzlauer Berg was affected by this overall depreciation.

Tab. 2 Checks for Robustness

	(1) Land Value Growth (not normalized)	(2) Land Value Growth (normalized)
Pre	-0.014142***	-0.024913***
	(0.001649)	(0.001684)
Velo	-0.013736***	-0.007275*
	(0.004253)	(0.004070)
MS	-0.000738	0.000279
	(0.003263)	(0.003575)
Post	-0.091577***	-0.090678***
	(0.000732)	(0.000671)
Post x Velo	0.015102***	0.010520**
	(0.005018)	(0.004829)
Post x MS	0.004709	0.001809
	(0.003710)	(0.003728)
Block Sample	Prenzlauer Berg	Prenzlauer Berg and adjoining areas
Observations	644	1201
R-squared	0.762233	0.602338
R-squared adjusted	0.760593	0.600675

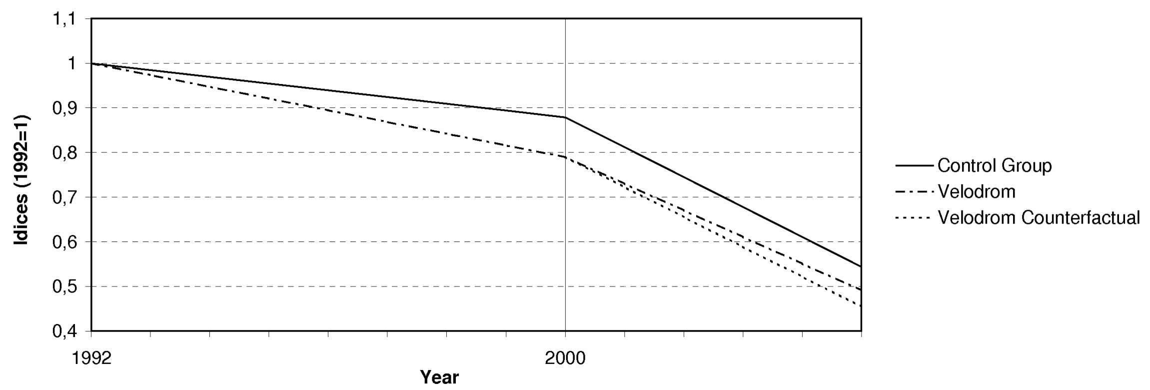
Notes: Sample Prenzlauer Berg is the same as in Table 1. Prenzlauer Berg is one of 23 boroughs into which Berlin had been subdivided until 2000. At the next stage of disaggregation Berlin, since reunification, consists of 195 statistical areas, which sum up to boroughs. In column (2) we use an enlarged block sample including all statistical areas that immediately adjoin Prenzlauer Berg. It includes areas of following boroughs: Wedding, Friedrichshain, Mitte and Lichtenber. Variables are defined as in Table 1. Column (1) represents estimation results for unmodified standard land values as officially reported by the Gutachterausschuss. Standard errors (in parentheses) are heteroscedasticity robust. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Depreciation can be seen in Figure 4 in indices of mean land value development based on the estimates in column (1) of Table 1.[7] Average standard land values in Prenzlauer Berg decreased approximately 40% over 1992–2005.

The negative coefficient on *Velo* demonstrates that the Velodrom treatment area performed poorly during the development period. After completion there is a positive impact on relative growth rates of land values, represented by the positive coefficient on *Post* × *Velo* interactive dummy. The implication is that after

[7] Max-Schmeling-Arena is not considered in this figure due to insignificant estimates of corresponding impact coefficients.

Fig. 4 Indices of Mean Standard Land Value



completion the Velodrom impact area experienced average growth rates 1.4% higher than pre-completion trends would have predicted.

Since pre- and post-completion impacts sum to a positive value there is an indication of recovery. The effects are particularly conclusive when considering that before development of Velodrom the site was occupied by Werner-Seelenbinder-Arena, a multifunctional sports-area comparable to Velodrom in size and utilisation, but not architectural quality.[8] The decline of location desirability following the removal of Werner-Seelenbinder-Arena did not end until Velodrom was complete.

The empirical results for Max-Schmeling-Arena are more ambiguous. In column (1) of Table 1 both coefficients on pre-completion relative growth rates of land values and post-completion impact are not statistically significant. This may be no surprise for the pre-completion trend, since there was no major shock affecting price such as the removal of the previous stadium, as in the case of Velodrom. However, for the post-completion period one would intuitively expect Max-Schmeling-Arena to have had a positive effect on land values.

In order to directly assess relative trends for the post-completion period, the specification is altered by substituting baseline impact dummies *Velo* and *MS* by interactive terms $Pre \times Velo$ and $Pre \times MS$. Our regression equation becomes:

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[8] It had a capacity of 10000 spectators and was utilised for various purposes, including cycle racing and concerts.

$$Growth_{it} = \alpha_1 \mathrm{Pr}e_t + \alpha_2 Post_t + \beta_1(\mathrm{Pr}e_t \times Velo_i) + \beta_2(\mathrm{Pr}e_t \times MS_i) + \gamma_1(Post_t \times Velo_i) + \gamma_2(Post_i \times MS_i) + \varepsilon_{it} \quad (2)$$

Consequently, the coefficients of post-completion interactive dummies no longer reveal impacts on relative trends, but relative post-completion growth rates. Relative growth rates for the impact area of Max-Schmeling-Arena are positive and weakly significant (Table 3).

Tab. 3 Relative Growth Trends after Completion

	(1) Land Value Growth (normalized)	(2) Land Value Growth (normalized)
Post	-0.091492***	-0.090850***
	(0.000503)	(0.000383)
Post x Velo	0.000949	
	(0.002444)	
Post x MS	0.002360*	0.001718
	(0.001316)	(0.001275)
Block Sample	Prenzlauer Berg	MS2000
Observations	681	411
R-squared	0.783802	0.823459
R-squared adjusted	0.782200	0.822158

Notes: Model (1) and (2) alter from (1) respectively (3) of Table 1 just by interacting area impact dummies with the Pre (completion) dummy. Since these model specifications necessarily produce the same results for the pre-completion period as in Table 1 we only display coefficient estimates for the post-completion period. Standard errors (in parenthesis) are heteroscedasticity robust. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

However, growth trends having changed from “insignificantly positive” to “significantly positive” after completion, provide less evidence for a positive impact than the significant impact factors for Velodrom. Moreover, results in column (2) of Table 3 indicate that, in comparison to the corresponding 1000–2000 m distance ring, the impact area of Max-Schmeling-Arena experienced neither a significant post-impact *nor* a significantly positive post-trend. These findings are inline with results of cross-sectional hedonic analysis. (AHLFELDT & MAENNIG, 2007).

The baseline equation is extended by average population growth rates to assess whether the impact of Velodrom can be explained by population changes. Column (1) of Table 4 repeats the baseline regression with reduced sample size, considering only populated blocks. The results again prove to be robust for variation in sample-size. Average population growth rates are introduced in column (2). Both pre- and post-completion impact factors of Velodrom remain almost unchanged and highly significant, revealing that impact on land values was not driven by increased demand, which would have been reflected by systematic changes in population.

However, it is likely that challenging urban developments in the neighbourhood will attract some groups. The population group, which has shown the most striking growth is the 27–45-year-olds, whose numbers dramatically increased in Prenzlauer Berg since unification. One might expect this group to be most flexible to changes in location desirability and to be relatively free of constraints in location choice. This group covers the stereotype of the new Prenzlauer Berg resident who immigrates to Berlin in search of a scenic metropolitan life-style, and probably very receptive to the appealing appearance and architectural concepts of both arena projects.

Average growth rates of shares of 27–45-years-olds are introduced in column 3 of Table 4. Although the coefficient on shares itself remains statistically insignificant, coefficients of impact for Velodrom are now non-significant for both the pre-completion growth trend and the post-completion impact. Growth rates of shares of 27–45-years-olds removing the treatment effect of Velodrom provides evidence that impact on land values was driven by this population group.

Tab. 4 Empirical Results of Extended Differences-in-Differences Models

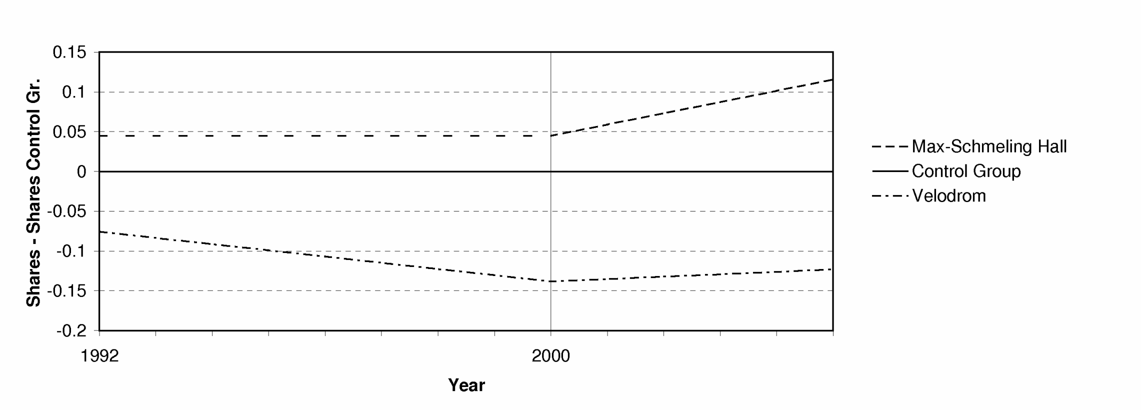
	(1) Land Value Growth (normalized)	(2) Land Value Growth (normalized)	(3) Land Value Growth (normalized)
Pre	-0.014152*** (0.001963)	-0.013962*** (0.002022)	-0.016617*** (0.003515)
Velo	-0.013982** (0.006760)	-0.014587** (0.006414)	-0.010122 (0.006887)
MS	0.003038 (0.003260)	0.003235 (0.003294)	0.003073 (0.003303)
Post	-0.091902*** (0.000492)	-0.092133*** (0.000684)	-0.092426*** (0.000673)
Post x Velo	0.015300** (0.007559)	0.016059** (0.007144)	0.011390 (0.008138)
Post x MS	-0.000449 (0.003595)	-0.000767 (0.003668)	-0.001002 (0.003791)
Pop		0.019198 (0.039909)	
Share_27_45			0.054355 (0.051489)
Block Sample	Prenzlauer Berg Populated Blocks	Prenzlauer Berg Populated Blocks	Prenzlauer Berg Populated Blocks
Observations	478	478	459
R-squared	0.802447	0.802715	0.804695
R-squared adjusted	0.800354	0.800201	0.802102

Notes: Variables are same as in Table 1. Pop is the annual compound growth rate of block population. Share_27_45 is the same for shares of 27–45 years-olds. Block sample is restricted to populated blocks. Standard errors (in parentheses) are heteroscedasticity robust. * denotes significance at the 10% level; ** denotes significance at the 5% level; *** denotes significance at the 1% level.

Descriptive statistics for block level shares of 27–45-year-olds are presented in Table 5. Mean shares within the impact-area of Velodrom start from below-average in 1992 and decline relative to the control group during the development period. Five years after completion, the mean share had approximately returned to 1992 level. Within the neighbourhood of Max-Schmeling-Arena the share had been larger relative to the control group before arena development, and remained virtually unchanged until 2000, and only increased after arena completion. In Figure 5 differences in mean shares relative to the control groups can be seen for both impact areas. Both impact neighbourhoods have attracted more of the 27–45-year-old age group after completion than other areas of Prenzlauer Berg. This raises the question of why increased attractiveness was not accompanied by increased land values around Max-Schmeling-Arena.

If the positive externalities of both arenas are assumed to be comparable, the puzzle of positive impacts on shares of 27–45-year-olds for both arenas, together

Fig. 5 Shares of 27 to 47 years-olds relative to Control Area



with insignificant impacts on values within the impact area of Max-Schmeling-Arena must be due to negative externalities (GALSTER, TATIAN, & PETTIT, 2004) surrounding Max-Schmeling-Arena. There are at least two potential sources: the presence of highly involved fan-groups[9] and problems related to congestion, particularly parking scarcity.

Since Prenzlauer Berg is in the most densely populated area of Berlin, much attention was paid to avoiding increased traffic volume. One of the main planning objectives was to have close to 100% of spectators arriving by public transport. To increase attractiveness of public transport and to minimise incentives for spectators to arrive by car, planning authorities did not provide additional parking facilities.[10] Despite reasonably low attractiveness of individual transportation, a considerable amount of visitors still arrive by car.

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[9] In contrast to Velodrom, Max-Schmeling-Arena is the home of two sports clubs of supra-regional importance. Resident teams are the basketball team of Alba Berlin and the handball team of Fuechse Berlin".

[10] The original plans for Max-Schmeling-Arena included an underground car park. These plans were abandoned after Berlin's bid for the 2000 Olympics was rejected by the IOC (MEYER, 1997).

Tab. 5 Descriptive Statistics for 27–45-year-old age group

		1992	2000	2005
Control Group	Mean	28.80%	41.38%	42.95%
	Median	30.51%	44.19%	46.22%
	Maximum	100.00%	100.00%	68.55%
	Minimum	0.00%	0.00%	0.00%
	Std. Dev.	11.87%	14.11%	15.08%
	Observations	171	168	177
	Mean rel. to CG	100.00%	100.00%	100.00%
	Median rel. to CG	100.00%	100.00%	100.00%
Velodrom	Mean	21.25%	27.56%	30.64%
	Median	21.46%	29.28%	33.79%
	Maximum	38.64%	42.68%	50.00%
	Minimum	0.00%	0.00%	6.98%
	Std. Dev.	8.92%	9.01%	10.38%
	Observations	32	30	38
	Mean rel. to CG	73.77%	66.61%	71.33%
	Median rel. to CG	70.34%	66.25%	73.12%
Max-Schmeling Arena	Mean	33.29%	47.55%	54.52%
	Median	33.23%	48.97%	54.09%
	Maximum	40.00%	59.15%	66.67%
	Minimum	23.01%	16.67%	44.62%
	Std. Dev.	3.35%	7.37%	4.83%
	Observations	45	45	45
	Mean rel. to CG	115.59%	114.90%	126.92%
	Median rel. to CG	108.90%	110.80%	117.05%

For Max-Schmeling-Arena, local district authorities contracted an expert who came to the conclusion that 20–60% of spectators arrived by car, depending on the event.[11] As a consequence, an undeveloped plot of land close to Velodrom was transformed into a car-park to address any future congestion. Since no comparable reserve spaces were available in close proximity to Max-Schmeling-Arena, the increasing scarcity of parking soon led to anger among residents. Construction of multi-storey car parks was considered, but projects were not financially viable. The lack of solutions produced some curious attempts to deal with the problem. To keep spectators from arriving by car, the Senate Department unsuccessfully tried to confuse drivers by not installing traffic signs indicating the way to Max-

[11] Quoted according to URL: http://www.bmp.de/vorort/9711/s08.html (07.02.2007).

Schmeling-Arena (MEYER, 1997). No solution to the problem is expected in the near future.

The parking scarcity potentially affected land values by keeping away car-owning households, which potentially belong to relatively higher income groups. No records on car registrations are available before 2000, so analysis is limited to the post-completion period. Table 6 shows descriptive statistics for per capita car registrations at block level for 2000 and 2005. As one would expect, considering ongoing gentrification, mean car numbers of the control group significantly increased between 2000 and 2005. In 2000 car numbers in the impact area of Max-Schmeling-Arena were comparable to the control area, by 2005 they had declined by approximately one third in comparison to the control area. At the same time car numbers close to Velodrom had increased relative to the control group.[12] Due to data limitations, we were unable to check for pre-completion trends, which could have provided additional valuable insights. However, the results support that owning cars has become considerably less attractive following inauguration of Max-Schmeling-Arena.

Inadequate parking may not only affect the resident population. Baade (2000) found that in the case of Seattle's Kingdome, surrounding ethnic restaurants, art galleries, professional services, legal services and most retailers reported declines in their business due to difficulties in meeting clients on game days.

Independently of the development of land values, overall population growth and/or problems related to congestion, both impact neighbourhoods managed to attract more of the 27–45-year-old group after completion than other areas of Prenzlauer Berg. Taking into account that gentrification in Prenzlauer Berg is driven by the influx of this age-group we conclude that development of both are-

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[12] It must be noted that this increase, as well as the relatively high level of per capita registrations, may be at least partially attributable to the presence of single block showing an extremely high number of registrations in relation to the resident population. However, comparing median values, which are less sensitive to extreme values, yields basically the same results. This indicates that car numbers around Velodrom have remained virtually unchanged in relation to the control group, while the impact area of Max-Schmeling-Arena shows a considerable decline.

nas and surrounding spaces has acted as a motor of district revitalisation. This is by giving Prenzlauer Berg a new face and improving location desirability, and also by attracting new residents who ultimately gave the district its present vital character.

Tab. 6 Descriptive Statistics of Car Registrations

		2000	2005
Control Group	Mean	0.302456	0.376395
	Median	0.287037	0.268833
	Maximum	2.230769	7.666667
	Minimum	0	0.009091
	Std. Dev.	0.187428	0.821163
	Observations	175	177
	Mean rel. to CG	100.00%	100.00%
	Median rel. to CG	100.00%	100.00%
Velodrom	Mean	0.785647	1.009908
	Median	0.335537	0.308287
	Maximum	17.14286	26.41667
	Minimum	0	0.017094
	Std. Dev.	2.765695	4.234567
	Observations	37	38
	Mean rel. to CG	259.76%	268.31%
	Median rel. to CG	116.90%	114.68%
Max-Schmeling Arena	Mean	0.288887	0.255897
	Median	0.257951	0.230104
	Maximum	1.169271	1.136891
	Minimum	0.002829	0.144654
	Std. Dev.	0.17603	0.143754
	Observations	45	45
	Mean rel. to CG	95.51%	67.99%
	Median rel. to CG	89.87%	85.59%

6 Conclusion

This paper contributes to the debate on how stadium construction affects regional economic development, by providing an empirical analysis on the role of new stadiums to serve in urban development for deprived inner-city areas. Two multifunctional sports complexes in Prenzlauer Berg were chosen for their outstanding architecture and potential to improve neighbourhood quality. In additional to being comparable in size, architectural concept and utilisation, Velodrom and Max-Schmeling-Arena were developed at the same time and within the same general neighbourhood.

Application of highly disaggregated data allows comparisons of relative land value trends within impact-neighbourhoods, before and after completion, with a determined control-area. The analysis of socioeconomic variables allows more comprehensive interpretations and more precise policy implications. Results suggest that Max-Schmeling-Arena's failure to increase immediate neighbourhood values is not necessarily attributable to noisy fans, or to inadequate or unappealing appearance. Indeed, positive effects on location desirability appear to have been neutralised by congestion problems, which could have been avoided by providing an underground car park.

However, our results also suggest that with appropriate choice of location and adequate arena design and surrounding urban spaces, positive effects on neighbourhoods are to be expected. After all, both subject arenas apparently have succeeded in increasing location desirability for the typical new Prenzlauer Berg residents, although this did not increase land values around Max-Schmeling-Arena. That the group of young professionals who play a key-role in revitalisation of Prenzlauer Berg seem attracted by both arenas provides evidence for appealingly designed arenas as instruments to boost gentrification in deprived inner-city neighbourhoods.

These results bring a new dimension into the discussion on stadium impact at neighbourhood scale. Previous research (BAADE, NIKOLOVA, & MATHESON, 2006) found that even those stadiums well integrated into the local urban grid may have an ambivalent economic impact, since they induce economic development which might not be in the best interest of the neighbourhood. Our results, however, suggest that successful district revitalisation might also be attributable to architectural appearance and the surrounding urban landscapes, by attracting particular types of residents who otherwise would have been unlikely to migrate into the area. We recommend future analyses of stadium construction impacts be conducted with an emphasis on architectural quality and urban design of the considered venues. To address whether cities should pay for sports facilities or not (ZARETSKY, 2001), we emphasise that this depends largely on the kind of proposed stadium. Is it within a neighborhood that might become gentrified? Have potential negative externalities been satisfactorily dealt with? Most importantly, is the project likely to be a valuable location amenity?

Data Appendix

We collected data on standard land values and FSI-values from atlases of standard land valuation (Bodenrichtwertatlanten) (SENATSVERWALTUNG FUER BAU- UND WOHNUNGSWESEN BERLIN (ED.), 1993; SENATSVERWALTUNG FUER STADTENTWICKLUNG BERLIN, 2006; , 2001). The Committee of Valuation Experts in Berlin has been publishing these atlases at intervals of one to four years, since 1967.

Local Committees of Valuation Experts were established throughout Germany to provide market transparency in real estate markets, which returned to a system of market economies during the late 1950s. Previously, German real estate markets had undergone a period of intense regulation begun in WWI with the first rental fee regulation and culminating in 1936, during the period of the "Third Reich", in a general price stop for all real estate assets. After WWII, regulation initially continued, since scarcity of living spaces made public provision and allocation necessary. The Committee of Valuation Experts in Berlin was established in 1960 when the major price restrictions implemented in 1936 were finally abolished. Apart from providing market transparency in deregulated markets, standard land values provided by the Committees of Valuation Experts play a role in determining tax burdens related to property ownership.

Data collection was conducted by assigning values represented in atlases of standard land valuation to a block-ID-key-variable determined by the official block structure as defined in December 2005. If more than one value was provided by an atlas of standard land valuation for one particular block, then an average of the highest and lowest values was used. The Committee of Valuation Experts assesses standard land values with respect to area-typical densities of development, represented by FSI-values. To make sure that changes in values are not attributable to modified zoning regulation, but reflect changes in location desirability we normalised all standard land values to a FSI-value of 1.5, a value that approximates the average for Prenzlauer Berg. To normalise values we used FSI adjustment coefficients (GFZ Umrechnungskoeffizienten) provided in the respective atlases of standard land valuation. We used coefficients given for areas of mixed use, which, according to the recommendation of the Committee of Valuation Experts, are to be obtained by averaging coefficients given for residential areas and those provided for office and retail areas. Division of a given standard land value by an adjustment coefficient, corresponding to the given area-typical FSI, yields the value that a plot of land had if the legal density of development corresponded to the FSI base value in the table of adjustment coefficients. Such a table may easily be adjusted to any base value, which we chose to be 1.5.

The Committee of Valuation Experts was neither willing to offer information on the underlying function of adjustment coefficients nor on the corresponding process of assessment. However, we were able to estimate the functional relationship between given FSI-values and coefficients in the adjustment table with an R^2 = 1.0. Estimation results suggest a concave impact of FSI on land valuation, inline with theory. Having found the underlying functional form, adjustment coefficients could be determined and applied individually for all blocks and all years, thereby eliminating potential impact of changing FSI-values.

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