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Arenas, Arena Architecture and the Impact on Location Desirability: The Case of "Olympic Arenas" in Berlin-Prenzlauer Berg[1]

Abstract: This paper investigates impacts of three multifunctional sports arenas situated in Berlin-Prenzlauer Berg, Germany employing highly disaggregated data on land values. The three arenas, their architecture and location within the city structure were explicitly designed 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 that improve location desirability in their neighbourhoods. However, evidence also supports concerns that negative external effects of arenas may adversely affect neighbourhoods, when not addressed appropriately during planning.

Keywords: Stadium Impact, Stadium Architecture, Location Desirability, Berlin
JEL classification: R53, R58

1 Introduction

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 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; Noll and Zimbalist, 1997; Rosentraub, 1997; Coates and Humphreys, 2000; Zaretsky, 2001; Matheson, 2007). 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 and Dye, 1990; Baade and Sanderson, 1997; Coates and Humphreys, 1999, 2003; Siegfried and Zimbalist, 2006) and only few studies have found positive effects on MSA (Metropolitan Statistical Area) level (Baim, 1990; Carlino and 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 processes of urban renewal, particularly in economically deprived neighbourhoods. With few exceptions (Melaniphy, 1996; Davies, 2006) this question has rarely been addressed in scholarly discussion.

This paper addresses the detail of how new sports facilities affect their neighbourhoods from an urban economic perspective. Real estate markets being in equilibrium, any increase in location desirability caused by development of sports facilities and surrounding urban spaces will thus be reflected in positive price differentials. We conduct differences-in-differences analysis on a set of highly disaggregated data, to assess 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.[2] 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 Jörg 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. Nonetheless, the architectonical quality of the remaining visible parts and their appealing designs fitted well with the ambitions of originality in Berlin at that time (Mandrelli, 1994; Adam, 1997; Meyer, 1997; Argenti, 2000; Myerson and Hudson, 2000; Perrault and Ferré, 2002).

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 (Mandrelli, 1994; Cycling Stadium, 1997). 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 and Hudson, 2000; Perrault and Ferré, 2002).[3] 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 31 December 2005 had 141 210 inhabitants and an area of only 11 km^2, one of Berlin's highest population densities. We use standard land values that reveal market values for undeveloped properties as the primary endogenous variable. Standard land values are aggregated market values for properties lying within block boundaries and are provided for zones of similar use and valuation, assessed on the basis of statistical evaluation (including outlier elimination) of all transactions during the reporting period. Property transactions where extreme prices are realised due to unrepresentative particularities are excluded to avoid bias. Following aggregation, standard land values are traditionally smoothed. For the purpose of identifying an amenity effect related to the presence of arenas, standard land values are appropriate to identify changes in location desirability over time, since their application guarantees that any positive impact is driven by an increase in overall location desirability, rather than by transactions of individual properties that might exhibit a particularly strong price reaction be particularly due to special use. Standard land values provided by committees of valuation experts are highly regarded among Germany's real estate community. These committees were established in the late 1950s and their expertise has enjoyed an unquestioned reputation since that time. Standard land values have an increasingly important role within the German taxation system, e.g. for the determination of inheritance and land taxes. Due to the widely recognized reliability of standard land values, there are recommendations in the property management literature to replace the present combined tax on land and buildings by a simple model based exclusively on standard land values (Weiss, 2004). 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 plot's FSIs.[4]

The study period was from 31 December 1992 (the first year of available data for districts in former East Berlin) to 1 January 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 of 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.[5] Data on motor vehicle registrations and population demographic characteristics data at block-level were obtained from the Statistical Office of Berlin. Based on the City and Environmental Information System of the Senate Department a set of variables representing typical residential building structure at block level is created using GIS tools.

We collect data for 1992, 1996, 1998, 2000 and 2005.[6] This is a reasonable choice since it allows comparison of trends during pre- and post-completion periods and consideration of novelty effects limited to the period immediately following arena inauguration.

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 differences-in-differences approach (Galster, Tatian, and Smith, 1999; Ellen, Schill, Susin, and Schwartz, 2001; Galster, Tatian, and Pettit, 2004; Redding and Sturm, 2005; Tu, 2005) to assess whether impact areas systematically experienced increased relative growth rates following arenas' inaugurations. Stated simply, we estimate differences-in-differences as we differentiate both across space (treatment areas and control areas) *and* time (pre-completion, inauguration and post-completion). Galster, Tatian and Pettit (2004) provide a survey about the appropriate application of differences-in-differences estimations. Three interesting differences-in-differences specifications are briefly discussed and applied by Ellen, Schill, Susin and Schwartz (2001).

One crucial part of any differences-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,[7] 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 urban renewal 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.

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 differences-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. We use a similar specification to Redding and Sturm (2005). In our baseline differences-in-differences specification, compound annual block growth rates of land values are pooled over 1992–1996, 1996–1998, 1998–2000 and 2000–2005, where 1996–1998 and 1998–2000 are the respective periods of inauguration for Max-Schmeling-Arena and Velodrom, which are denoted by dummy variables In_MA_t and In_Velo_t., Similarly post-completion periods from 1996-2005 and 1998-2005 are denoted by $Post\_MS_t$ and $Post\_Velo_t$. We regress annualised growth rates ($Growth_{it}$) on a full set of time dummies (d_t), two area impact dummies ($Velo_i$, MS_i) denoting blocks that lie within impact areas of Velodrom and Max-Schmeling-Arena, two post-area and two inauguration-area interactive terms between the arena-impact dummies ($Velo_i$, MS_i) and the dummies representing post-completion periods and inauguration periods, respectively.

$$\begin{aligned} Growth_{it} = {} & \alpha_1 Velo_i + \alpha_2 MS_i + \beta_1 (In\_Velo_t \times Velo_i) + \beta_2 (In\_MS_t \times MS_i) \\ & + \gamma_1 (Post\_Velo_t \times Velo_i) + \gamma_2 (Post\_MS_t \times MS_i) + d_t + \varepsilon_{it} \end{aligned} \quad (1)$$

Time dummies control for common overall impacts at district level. Coefficients α_1 and α_2 on impact area dummies represent differences in growth rates for treatment blocks before arenas' inaugurations. Post-area interactive terms capture impacts on relative growth rates following completion. Coefficients γ_1 and γ_2 represent persistent changes in differences between growth rates of impact relative to control areas after completion. For instance, positive values for γ_1 and γ_2 would strongly indicate a positive impact on average growth rates of land values in close arena proximity during the post-completion period. Coefficients β_1 and β_2 on inauguration-area interactive terms capture any additional impact within periods immediately following inauguration. Positive values for β_1 or β_2 indicate that arenas, regardless of possible effects on long-term trends, have persistent level effects on property prices.

Our specification allows for unobserved block fixed effects in standard land value levels, thereby implicitly controlling for neighbourhood characteristics that remained unchanged over the period of observation. 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. Robustness checks are provided to account for changes in location characteristics, such as changes in legal density of development and changing preferences towards building structure. Alternative treatment groups are also considered to control for barriers preventing external effects from spilling over. Treatment effects are reflected by significant coefficients on interactive terms β_x and γ_x. Model alterations explaining treatment effects will lead to insignificant β_x and γ_x.

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. There is evidence in the literature that stadiums may have an impact on the surrounding area at distances of up to of 5000 m (Tu, 2005). However, beside the fact that our study arenas are much smaller and expected to have a more limited economic impact, our main concern is the contribution of sophisticated architecture and urban design to location desirability. The new urban spaces represent an amenity that is basically enjoyed by residents within walking distance. Therefore, as discussed below, the 1000 m distance ring corresponds approximately to a 1500 m effective road distance and, hence, represents a feasible region of influence.

Table 1 presents our baseline differences-in-differences results. Column (1) refers to equation (1). Estimation is repeated with reduced sets of variables referring either to Max-Schmeling Arena (2) or Velodrom (3). The general pattern of results remains unchanged, indicating robustness of estimates.

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 after 1996 reveal that, despite ongoing modernisation, Prenzlauer Berg was affected by this overall depreciation.

The negative coefficient on *Velo* demonstrates that the Velodrom treatment area performed poorly relative to the control group before the arena's completion. After completion there is a positive impact on relative growth rates of land values, represented by the positive coefficient on *Post_Velo* × *Velo* interactive dummy. The implication is that after completion the Velodrom impact area experienced average growth rates approximately 2% higher than pre-completion trends would have predicted. In contrast, for Max-Schmeling-Arena we only observe a short-run impact of about 1.3% represented by the coefficient on *In_MS* × *MS*. Coefficients on *MS* and *Post_MS* × *MS* are not significant at conventional levels, indicating that the treatment area of Max-Schmeling-Arena performed inline with the control area before completion and that there is no persistent impact on growth trend after inauguration. Based on column (1) estimates of Table 1, Figure 4 represents indices of land value development for treatment areas relative to control group. Counterfactuals I indicate how indices would have developed if pre-completion trends had continued. Similarly, counterfactual II for Max-Schmeling-Arena represents the scenario where short-term impact on growth rates remains persistent during long run.

Standard land values refer to typical legal densities of development represented by FSI-values. To ensure that changes in legal building densities do not bias estimates, we repeat our baseline estimation employing land values normalised to a FSI of 1.5, the approximate average density of development within the area. Results are presented in column (2) of Table 2. The process of normalisation is described in more detail in the data appendix.

Table 1 estimates correspond to treatment areas *MS* and *Velo* defined on the basis of straight-line distances. However, natural and unnatural barriers may prevent arenas' external effects from spreading concentrically, as some properties at similar straight-line distance may be characterised by distinct effective road distances. For instance, the suburban railway line passing close to both facilities can only be crossed at designated bridges, although crossovers are provided at relatively short intervals. Thus, in Table 2, column (2), we define alternative treatment areas relying on effective road distances. As blocks' road distances to arenas on average were approximately 1.5 times the straight-line lengths, *MS_Road* and *Velo_Road* denote blocks lying within 1500 m of effective road distance to the respective arena.

In column (3) of Table 2, we focus on the "old" urban fabric of Wilhelminian period tenement blocks, which deserves special attention for two reasons: Firstly, as suggested by Figure 2b, Prenzlauer Berg, since the early 1990s experienced an overwhelming change in resident composition. Secondly, the old buildings, which had been desolate after unification, have largely been modernized during our observation period. Both effects may have led to increasing desirability of this particular building structure. If attractiveness substantially increased during our observation period and arena's neighbourhoods are characterized by a particularly old building structure, then increased location desirability may be erroneously attributed to arenas' appealing architecture and challenging design of urban recreational spaces instead of changing preferences towards the surrounding developments. In column (3) of Table 2, we introduce a set of interactive terms between time dummies and a dummy variable denoting all blocks, that according to the Urban and Environmental Information System (Senatsverwaltung für Stadtentwicklung Berlin 2006) of the Senate Department are characterised by a predominantly pre-1920s building structure. These terms pick up effects of increased desirability capitalising into differences in growth of property prices. However, results represented in column (3) of Table 2 suggest that old housing blocks considerably outperformed their newer counterparts only during the early period after unification from 1992 to 1996, when annualised growth rates were 1.3% larger. During the following periods differences are, if significant, much lower. Moreover, column (3) results reveal the pattern of estimated impact coefficients remains virtually unchanged, providing evidence for treatment effects not being caused by preexisting building structure. The only considerable change following the introduction of time-building-structure interactive terms is the coefficient on *MS* becoming weakly statistically significant and negative. This reveals that, accounting for surrounding building structure, relative growth rates within impact area of Max-Schmeling-Arena were slightly smaller than the control area before the arena's inauguration. Columns (1) and (2) of Table 2 tell the same story as column (3), indicating robustness of estimates.

Before arenas' completions, Velodrom treatment area performed poorly compared to that of Max-Schmeling-Arena and the control area. After inauguration, our results suggest a larger impact of Velodrom on property prices compared to Max-Schmeling-Arena. These effects may be conclusive when considering that before development of Velodrom the site was occupied by

Werner-Seelenbinder-Arena, a multifunctional sports-arena comparable to Velodrom in size and utilisation, but not architectural quality. If the removal of Werner-Seelenbinder-Arena has led to a decline in location desirability, then the functional reactivation of a traditional local amenity could have additional impact.

Besides apparently having smaller short-run impact compared to Velodrom, the impact of Max-Schmeling-Arena is found to have no significant long-term impact on growth rates. This indicates considerable disillusionment following a short period of relatively increased demand. Counterfactual II in Figure 4 illustrates how property prices would have developed if short-term impact on growth rates had endured. Considering that no comparable decline was found for Velodrom and assuming positive externalities of both arenas to be comparable, this disillusionment might be explained by negative externalities (Galster, Tatian, and Pettit, 2004) surrounding Max-Schmeling-Arena. There are at least two potential sources: the presence of highly involved fan-groups[8] 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.[9] Despite reasonably low attractiveness of individual transportation, a considerable amount of visitors still arrive by car. 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.[10] 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-Schmeling-Arena (Meyer, 1997). No solution to the problem is expected in the near future. A more detailed discussion of residents' complaints is provided by the local tenants association (Schuster, 2004). These negative experiences have already led to a rethink of planning authorities. O2 World, a new multipurpose arena under construction on the riverbank of the Friedrichshain district is intended to serve as an anchor structure for presently the largest project of urban renewal in Berlin. O2 World, with a capacity of 17,000 seats, will be the largest multipurpose area in Berlin when inaugurated by the end of 2008. Although, very optimistically, 83% of spectators are expected to arrive by means of public transport, the traffic planners of FSG City and Traffic Research and Planning have foreseen the need for at least 1200 parking spaces to avoid a negative impact on the attractiveness of the new district (Schmidt, 2004).

Ahlfeldt and Maennig (2008) have shown that there is a positive and highly significant relationship between car registrations per capita and property prices in Berlin. The parking scarcity within the neighborhood of the Max Schmeling Arena potentially affected land values by keeping away car-owning households, which potentially belong to relatively higher income groups and, hence, led to an adverse impact on land values. Table 3 shows the descriptive statistics for per capita car registrations at block level for the years 2000 and 2005. Mean car numbers of the control group increased significantly between 2000 and 2005. In 2000, car numbers in the impact area of the Max Schmeling Arena were comparable to the control area, but 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.[11] No records on car registrations are available before 2000, therefore 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 in close proximity to Max-Schmeling-Arena during the period of relatively lower growth rates. 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.

After all, our results might be interpreted in a way that inauguration of Max-Schmeling-Arena and Velodrom has led to residents and business perceiving substantial improvements in location desirability, which capitalised into property prices. Velodrom apparently has a persistent effect counteracting the negative pre-completion trend possibly caused by removal of a pre-existent sports arena. In the case of Max-Schmeling-Arena, after a significantly positive impact following inauguration, residents appear to have become aware of problems related to congestion. By becoming less attractive for car-owners, households of potentially relatively higher income might be kept away, leading to a negative impact on property prices and neutralising positive externalities emanated by Max-Schmeling-Arena.

All three arenas were planned with a quality of the architectural design that should enhance positive spillovers to their neighbourhoods. In our model, we could not isolate the effects of the architectural design from the effects of the arenas per se. We nevertheless can conclude that—if such effects of "iconic buildings" exists—the three Berlin arenas did not have adequate architectural design quality or the effects of the architecture are not large enough to assure an effect on the development of the neighbourhoods, which differs significantly from arenas with no special architectural design. In the case of Max-Schmeling-Arena, effects are low anyway. In the case of Velodrom, effects are not very different from the Washington FedEx Field which has no special architectural features and which was examined by Tu (2005). However, the maximum capacities of Max-Schmeling-Arena and Velodrom of around 10000 spectators are small compared to FedEx field with almost 80000.

6 Conclusion

This paper contributes to the debate on stadium impact by providing an empirical analysis on how three arenas of sophisticated design improved location desirability within a formerly deprived inner-city area. Two multifunctional sports complexes in Prenzlauer Berg were chosen for their outstanding architecture and potential to improve neighbourhood quality. In addition to being comparable in size, architectural concept and utilisation, Velodrom and Max-Schmeling-Arena were developed at almost 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 while capturing short-run novelty effects. Results suggest that with appropriate choice of location and adequate arena design and surrounding urban spaces, positive effects on neighbourhoods are to be expected. The restoration of a pre-existent equilibrium by developing Velodrom on an area formerly occupied by a multifunctional sports arena, has led to a stronger reaction than construction of Max-Schmeling-Arena, where no similar facility previously existed. Moreover, Max-Schmeling-Arena's construction is found to have impacts limited to a short period after inauguration with no significant impact on long-term growth trend. However, this 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.

These results bring a new dimension into the discussion on stadium impact at neighbourhood scale. Stadium impact is typically regarded with skepticism both by neighborhood activists opposing stadium construction in proximity to their properties and scholars who rarely find positive economic impacts. Previous research (Baade, Nikolova, and 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. Considering this skepticism, the dimension of quality of architecture and urban design of sports arenas has to be emphasised. Even Max-Schmeling-Arena, although causing typical problems of congestion, does have a significantly positive impact that is not removed in the long-run. Moreover, Figure 4 suggests that impact could have been even stronger if congestion problems had been addressed. Thus, our results indicate that well designed sports arenas may substantially improve location desirability. This might well be an objective on its own for planning authorities, justifying public expenditures even if econometric ex-post studies so far have tended to find no traditional economic impact in terms of income, employment and taxes (Baade, 1988; Baade and Dye, 1990; Baade and Sanderson, 1997; Coates and Humphreys, 1999, 2003; Siegfried and Zimbalist, 2006).

Our empirical model attributes land value variation spatially and temporally to the construction of arenas. Thus, we conclude that our results indicate that the objective to contribute to an increase in a neighbourhood's location desirability was achieved. However, we cannot state definitively whether it was the investment in sophisticated architecture that generated the positive effects, as we cannot separate effects of architecture from those of the original functions of sports facilities. Nevertheless, due to the limited size of the study arenas, it is unlikely that positive impacts are caused mainly by an increase in economic activity within the neighborhood, as argued by Tu (2005). More empirical evidence is needed to gain useful insights from comparing the results of different case studies. We therefore recommend that future analyses of stadium construction impacts are conducted with an emphasis on architectural quality and urban design of the venues under consideration. After all, our results should encourage authorities following a strategy of supporting redevelopment of deprived urban areas with sports facilities' construction as attempted for the forthcoming Olympic Games 2012 in London. However, 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 is in need of revitalization? Have potential negative externalities been dealt with satisfactorily? Most importantly, is the project likely to be perceived as a location amenity due to a comprehensive urban design?

A Data Appendix

We collected data on standard land values and FSI-values from atlases of standard land valuation (Bodenrichtwertatlanten) (Senatsverwaltung 1993, 2001, 2006). 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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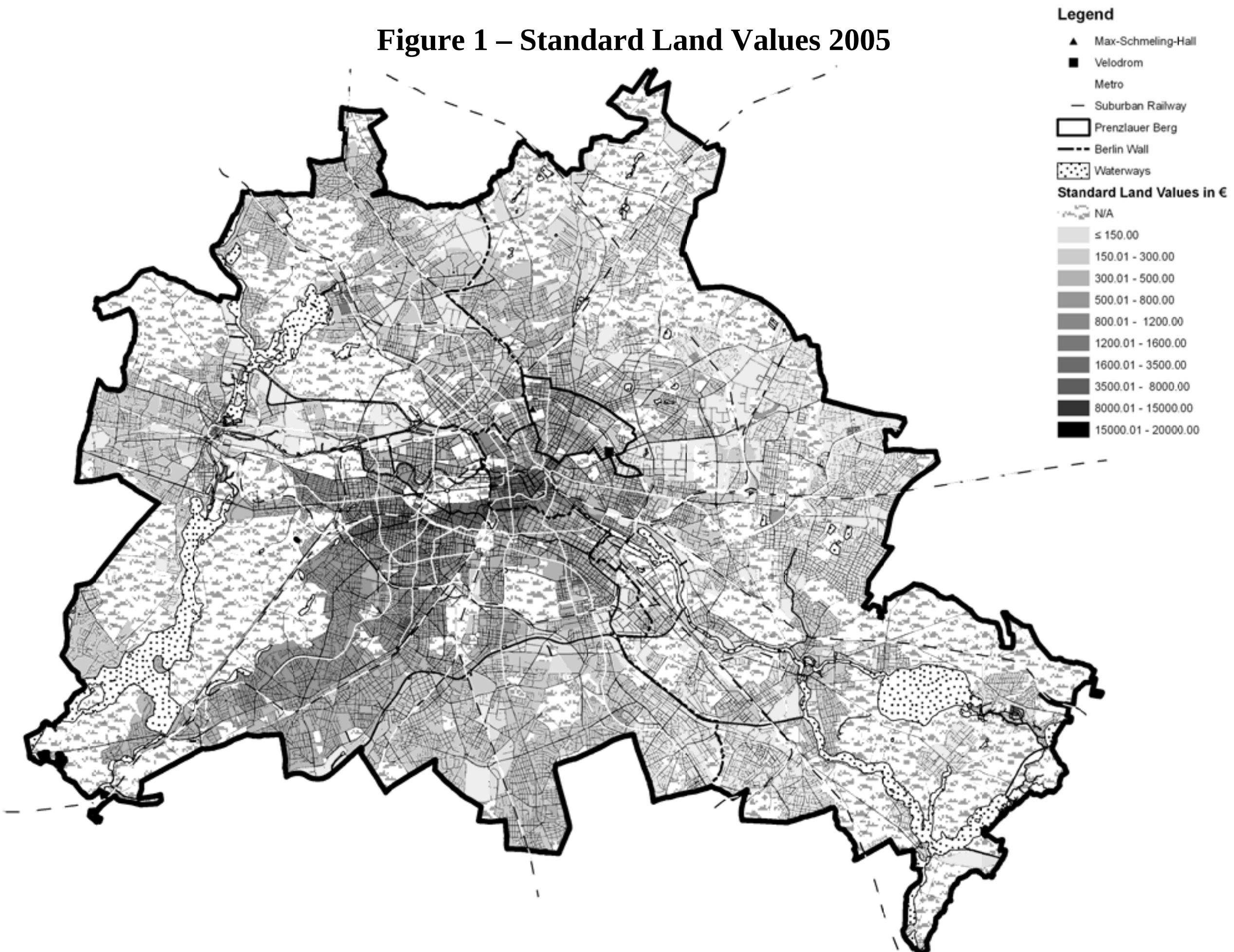
Figure 1 – Standard Land Values 2005



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

Figure 2a – Population of Prenzlauer Berg and Berlin 2005

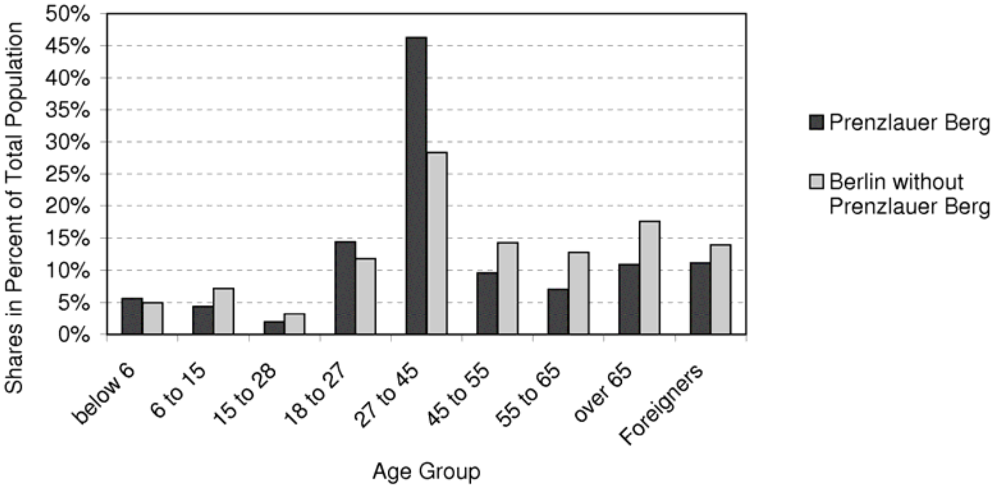


Figure 2b – Population of Prenzlauer Berg by Age Groups

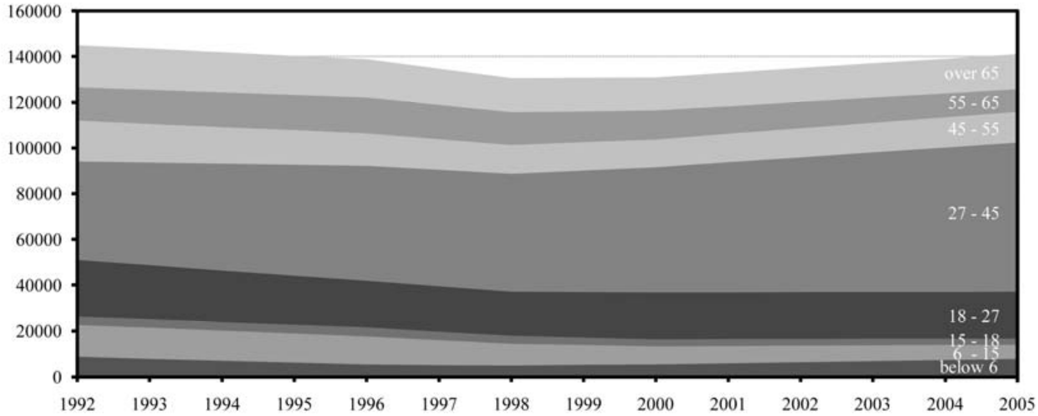
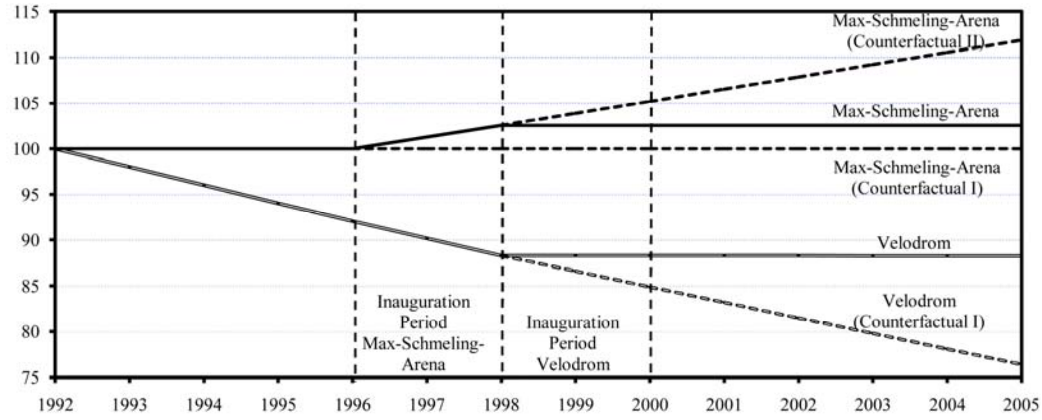


Figure 3 – Prenzlauer Berg

Notes: Map created on the basis of the “Digitale Grundkarte (K5)” (Senatsverwaltung für Stadtentwicklung Berlin 2006c) and "City and Environment Information System” of the Senate Department.

Figure 4 – Indices of Mean Standard Land Value



Notes: Graphs visualise estimation results represented in Table 1 column (1).

Table 1 – Baseline Empirical Results of Differences-in-Differences Estimations

	(1) Land Value Growth	(2) Land Value Growth	(3) Land Value Growth
MS	-0.006845 (0.00455)	-0.004944 (0.004604)	
Velo	-0.020514*** (0.003452)		-0.020523*** (0.003438)
In_MS x MS	0.012563*** (0.004313)	0.017392*** (0.004234)	
In_Velo x Velo	0.00644 (0.007044)		0.006447 (0.007041)
Post_MS x MS	0.000812 (0.005904)	-0.001724*** (0.005885)	
Post_Velo x Velo	0.020422*** (0.004365)		0.021490*** (0.004303)
D1992_1996	0.004009 (0.003055)	0.000171 (0.003054)	0.003011 (0.003038)
D1996_1998	-0.02653*** (0.001426)	-0.030723*** (0.001442)	-0.025536*** (0.001233)
D1998_2000	-0.027301*** (0.003253)	-0.026106*** (0.002852)	-0.028367*** (0.003108)
D2000_2005	-0.090067*** (0.000941)	-0.089991*** (0.000893)	-0.091126*** (0.000667)
Treatment Distances	Straight-Line	Straight-Line	Streight-Line
Observations	1832	1832	1832
R-squared	0.381410	0.365406	0.379208
R-squared adjusted	0.378355	0.363320	0.377167

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 annualised growth rates in land values for 1992–1996, 1996-1998, 1998-2000 and 2000–2005. 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_MS and, In_Velo denote the periods immediately following inauguration. Similarly Post_MS and Post_Velo denote post-completion periods. Model (1) corresponds to equation (1). We repeat the estimation just considering variables referring to Max-Schmeling-Arena (1) and Velodrom (2). 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.

Table 2 –Checks for Robustness

	(1) Land Value Growth (Normalised)	(2) Land Value Growth	(3) Land Value Growth
MS	-0.005349 (0.004385)		-0.008477* (0.004537)
Velo	-0.020410*** (0.010722)		-0.018864*** (0.003504)
MS_Road		-0.008925 (0.004763)	
Velo_Road		-0.029019*** (0.004901)	
In_MS x MS	0.010722*** (0.003684)		0.011208*** (0.00429)
In_Velo x Velo	0.008696 (0.006018)		0.005421 (0.007395)
In_MS x MS_Road		0.014486*** (0.004308)	
In_Velo x Velo_Road		0.016393 (0.011269)	
Post_MS x MS	0.001179 (0.005327)		0.001910 (0.005834)
Post_Velo x Velo	0.019960*** (0.004329)		0.019776*** (0.004398)
Post_MS x MS_Road		0.002484 (0.00609)	
Post_Velo x Velo_Road		0.026752*** (0.006502)	
D1992_1996	-0.002408 (0.003140)	0.003341 (0.003035)	-0.001766 (0.0044148)
D1996_1998	-0.026551*** (0.001417)	-0.027509*** (0.001297)	-0.029961*** (0.002133)
D1998_2000	-0.025155*** (0.002157)	-0.027459*** (0.002951)	-0.027342*** (0.005276)
D2000_2005	-0.090277*** (0.000726)	--0.089854*** (0.000869)	-0.091871*** (0.001304)
Old x D1992_1996			0.012015** (0.006028)
Old x D1996_1998			0.007397*** (0.002609)
Old x D1998_2000			0.000255 (0.005611)
Old x D2000_2005			0.003605** (0.001454)
Treatment Distances	Straight-Line	Road	Straight-Line
Observations	1732	1832	1832
R-squared	0.414226	0.385372	0.385477
R-squared adjusted	0.411164	0.3823363	0.381083

Notes: Model (1) repeats estimation represented in column (1) of Table 1 using growth rates of standard land values normalised to a FSI- of 1.5. Endogenous variables in models (2) and (3) are growth rates of standard land values as in Table 1. MS_Road and Velo_Road are dummy variables denoting the treatment group of blocks lying within 1500 m effective road distance to the respective arena. Old, similarly denotes blocks predominantly characterised by pre world war II building structure. All other exogenous variables are the same as in Table 1. 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.

Table 3 – 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%

[1] Acknowledgements: We would like to thank the editors and three anonymous referees for valuable comments and suggestions. We acknowledge the support of the Berlin Senate Department for Urban Development for provision of Data and GIS content. We would also like to thank Steffen Nixdorf for interesting thoughts and Nicolai Wendland for comments and discussion.

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

[3] 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.

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

[5] 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.

[6] 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.

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

[8] 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 "Füchse Berlin".

[9] 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).

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

[11] 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.