Exploring Determinants of Railway Arch Property Value

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ABSTRACT

Railway arches from the Victorian era in the UK have evolved from marginal spaces to valuable commercial properties. In 2019, Network Rail sold a significant portfolio of these arches, revealing their economic potential. Despite their growing importance, there is a lack of robust valuation models for railway arch properties in the literature. This study addresses the gap by exploring the determinants of railway arch property values using the hedonic pricing model. The analysis includes 2,162 properties and investigates the influence of building characteristics, place quality, socio-economic factors, and accessibility on property values. Key findings highlight that proximity to public transport, lower index of multiple deprivation, and strategic location contribute positively to property values, while noise factors have mixed impacts. The study emphasizes the need for urban regeneration strategies to enhance accessibility and leverage socio-economic factors in the valuation of railway arch properties.

Keywords: Railway Arches; Property Valuation; Hedonic Pricing Model.

1 INTRODUCTION

UK railway arches from the Victorian era, once marginal spaces, are now being repurposed for commercial use, demonstrating their adaptability (Froy and Davis, 2017). In February 2019, Network Rail sold a £1.46 billion property portfolio, mainly converted railway arches, to Telereal Trillium and Blackstone Property Partners to address funding shortfalls. This portfolio includes 5,261 rental spaces, with 70% being railway arches and 60% in London (NAO, 2019). Similarly, TfL manages over 800 arches in London, with over 93% leased to small and medium-sized businesses (TfL, 2021).

A House of Commons debate (2023) noted that traditional industrial tenants are being replaced by higher-rent-paying businesses. Despite the commercial potential of these properties, there is a gap in valuation models in the literature. The bid-rent theory and its extensions (Von Thunen, 1910; Alonso, 1964; Muth, 1969) provide a useful framework for understanding the economic dynamics involved in repurposing railway arches.

The literature on the effects of transportation infrastructure on residential property values is quite extensive. However, there is a smaller body of work on the determinants of commercial property values, with only a few studies specifically examining transport-related factors (Johnson et al., 2023; Seo et al., 2019; Cervero and Duncan, 2002). Some studies focusing on the impacts on central business districts (CBD) also include transportation-related factors as explanatory variables (Beekmans et al., 2014; Debrezion et al., 2007; Sivitanidou, 1995).

Understanding rail-related commercial property is crucial for recognising the potential benefits of land value. However, there is a gap in the existing literature on the valuation models for rail-related commercial properties, particularly railway arches. Conducting this study is therefore crucial to bridge the existing knowledge gap, providing a more comprehensive understanding of the valuation and strategic use of railway arches in urban environments. The research aims to explore the determinants of railway arch property value.

2 METHODOLOGY

The study focuses on 2,162 railway arches in four cities: London, Birmingham in the West Midlands, Manchester in North West England, and Leeds in Yorkshire and the Humber. This scope allows for a comparative analysis across different parts of England. The study involves three main stages: data collection and preparation, exploratory data analysis, and hedonic pricing regression.

2.1 Data Collection and Preparation

The development of the hedonic price model required a large amount of cross-sectional data with spatial features. Most of the data are publicly available online. The Adopted Rateable Value, area, and business type of railway arches units were obtained from the Valuation Office Agency (2023c). Population density and employment data were sourced from the Office of National Statistics (2023). Information on rail, road, and agglomeration noise was provided by the Department for Environment, Food & Rural Affairs (2019). Indices of Multiple Deprivation were accessed through the Ministry of Housing, Communities, and Local Government (2019). Data on railway station entrances, bus/coach stops, and tram/metro/underground entrances were gathered from the Office of Rail and Road (2023), which also provided the annual passenger data for stations. Bike-sharing docking station data were obtained from CDRC (2024), while information on open green spaces and access points was sourced from the Ordnance Survey (2023). Lastly, the National Statistic Postcode Lookup (NSPL) from the 2021 Census was provided by the Office for National Statistics (2024). Significant time was dedicated to data processing and spatial mapping before proceeding with the hedonic pricing modelling. QGIS and STATA were employed in this stage of the study, as illustrated in Figure 1. A summary of the dataset and variables is provided in Table 1.

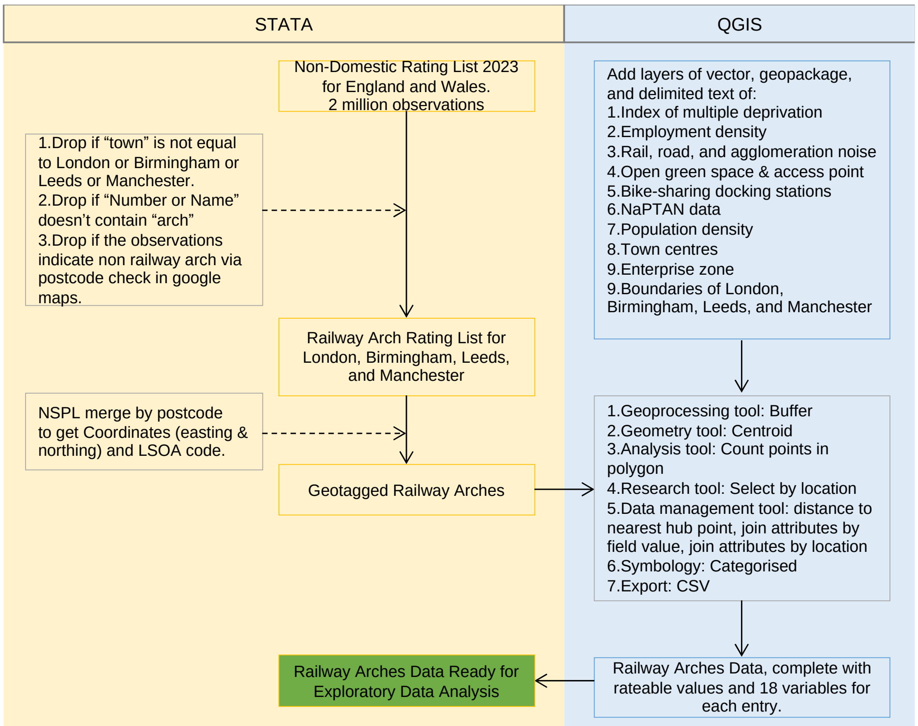

Figure 1. Processing of raw dataset using STATA and QGIS

Table 1. Summary of variable definitions and variable sign expectation

Variable	Sign Expectation	Description
area	-	Total area of the hereditament (m^2)
retail_service	+	Retail=1 denotes the business category is retail Retail=0 denotes the business category is office
industry	-	Industry=1 denotes the business category is industry Industry=0 denotes the business category is office
num_green_space	+	Number of green space access point within 500 m
dist_green_space	-	Distance to nearest green space access point (m)
rail_noise	-	Rail noise exposure (dB). Mid value of the range - 45 dB
road_noise	-	Road noise exposure (dB). Mid value of the range - 45 dB
employment_density	+	Number of employees per square kilometre
IMD	+	Indices of Multiple Deprivation Decile 1 for most deprived to 10 for least deprived
population_density	+	Number of usual residents per square kilometre
rail_passenger	+	Annual passenger of nearest railway station
num_bus_stop	+	Number of bus/coaches stop on street within 500 m
num_tram_stop	+	Number of tram/metro/underground stop within 500 m

Variable	Sign Expectation	Description
dist_rail_station	-	Distance to nearest railway station entrance (m)
dist_airport	-	Distance to nearest airport (m)
num_bike_station	+	Number of bike-sharing docking station within 500 m
dist_town_centre	-	Distance to nearest town centre centroid (m)
dist_enterprise_zone	-	Distance to nearest enterprise zone point (m)

2.2 Exploratory Data Analysis

Exploratory Data Analysis (EDA) is a key initial step in data analysis (EPA, 2024). EDA is essential for understanding the dataset's main characteristics and identifying potential issues such as multicollinearity and outliers. Descriptive statistics were calculated for all variables to understand their central tendencies and dispersion. Additionally, this study uses three business categories instead of the 423 categories employed by the VOA (2023b).

In this study, a correlation matrices and Variance Inflation Factor (VIF) calculations were employed using STATA to evaluate multicollinearity, allowing for appropriate actions if detected. A VIF below 5 typically indicates no multicollinearity, while a VIF above 10 suggests significant multicollinearity, which may necessitate corrective measures (Myers, 1990).

2.3 Hedonic Pricing Regression

The hedonic pricing model was employed to investigate the variables affecting the value per square meter of railway arch properties. This study developed models for commercial property as a whole, as well as for each business category separately: industry, retail and service, and office. Based on findings from the literature, a semi-log functional form was adopted as it is most representative of the hedonic price model, allowing for easy interpretation of the estimations (Beekmans et al., 2014). The interpretation of the coefficients for the explanatory variables represents the percentage change in the dependent variable when the explanatory variable increases by one unit (Jiang et al., 2021). Another advantage of using the log form is to promote the normality of the data.

This dissertation uses STATA and the stepwise procedure with selection and elimination criteria. Jiang et al. (2021) also employed stepwise selection in their study. This command builds a regression model by iteratively adding significant variables (p-value ≤ 0.05) and removing non-significant variables (p-value ≥ 0.10), aiming to find the most suitable set of predictors for the dependent variable.

3 RESULT AND DISCUSSION

There are no violations of the linear regression assumptions in this study. The normality of residuals is demonstrated by their histogram and quantile-quantile plot. Additionally, the absence of multicollinearity is confirmed by Variance Inflation Factor (VIF) calculation result <5 and is further supported by their correlation matrices which shows no high correlations between the independent variables. As stated in the methodology, the ‘vce(robust)’ command was employed to adjust the standard errors of the coefficient estimates for heteroscedasticity, resulting in more reliable hypothesis tests and confidence interval.

Table 2 provides regression results analysed to explore the determinants of the natural logarithm of the rateable value per square meter (£/m²) for all railway arches commercial property and each different type of commercial property: Industrial, Retail & Service, and Office. The R-squared values for the models, which measure the proportion of variance explained, are 0.4100 for all commercial properties, 0.4506 for industrial, 0.4126 for retail and service, and 0.5494 for office properties, indicating reasonable explanatory power. A comparable study of industrial property by Beekmans et al. (2014) also have overall explanatory power of 0.370 (adjusted R^2), while Johnson, D. et al. (2023) found models with explanatory power ranging from 0.1775 to 0.657 for the four models they estimated.

The socio-economic variables indicate that lower deprivation levels and greater employment density are associated with lower rateable values, while higher rail passenger numbers are associated with slight increases in rateable values. Population density effects vary by property type, with industrial properties benefiting slightly from higher density, while office properties see minor decreases in rateable values. These findings highlight the nuanced impacts of socio-economic factors on property values across different railway arch commercial properties.

Table 2. Estimation result

	Dependent Variable: Natural logarithm of rateable value per sqm (£/m2)							
	Model 1 All Commercial		Model 2 Industrial		Model 3 Retail & Service		Model 4 Office	
Variables	Coefficient	%Value	Coefficient	%Value	Coefficient	%Value	Coefficient	%Value
Socio-Economic Variables (G)								
IMD	-1.23E-02 **	-1.23%	-2.84E-02 ****	-2.80%				
employment_density	-7.74E-07 **	-0.000077%	-8.30E-07 *	-0.00008%				
population_density			9.40E-06 ****	0.00094%			-1.53E-05 **	-0.0015%
rail_passenger	8.43E-09 ****	0.00000084%	6.03E-09 ****	0.00000060%	1.21E-08 ****	0.00000121%		
Accessibility Variables (A)								
num_bus_stop								
num_tram_stop	3.16E-02 ****	3.21%			5.21E-02 ****	5.35%	4.83E-02 **	4.95%
num_bike_station	1.69E-02 ****	1.70%	2.41E-02 ****	2.44%	4.91E-03 **	0.49%		
dist_rail_station	-1.00E-04 **	-0.010%	-8.31E-05 ***	-0.008%	-2.36E-04 ****	-0.02%	-1.45E-04 ***	-0.014%
dist_airport	4.57E-06 ****	0.00046%	4.37E-06 ****	0.00044%	4.58E-06 ****	0.00046%	1.92E-06 *	0.00019%
dist_town_centre			7.15E-05 **	0.0072%			1.14E-04 *	0.011%
dist_enterprise_zone	-6.13E-06 **	-0.00061%	-6.62E-06 **	-0.00066%				
Place Quality Variables (P)								
rail_noise	4.87E-03 ****	0.49%	7.04E-03 ****	0.71%	4.21E-03 **	0.42%		
road_noise	-5.02E-03 ****	-0.50%	-4.45E-03 ***	-0.44%	-5.25E-03 ***	-0.52%		
dist_green_space							-1.58E-03 **	-0.16%
num_green_space	-3.73E-03 ****	-0.37%	-7.31E-03 ****	-0.73%				
Building Char. Variables (B)								
area	-4.25E-04 ****	-0.043%	-4.29E-04 ****	-0.043%	-4.41E-04 ****	-0.044%		
retail_service								
industry	-8.45E-02 ****	-8.11%						
_cons	4.041728 ****		3.946723 ****		3.915281 ****		5.160713 ****	
Number of obs.	2,162		1,151		910		101	
R-squared	0.41		0.4506		0.4126		0.5494	

**** Significant at 0.001 level; *** Significant at 0.01 level; ** Significant at 0.05 level; * Significant at 0.10 level

Accessibility variables demonstrate distinct trends across different commercial property types. Proximity to tram, metro, or underground stops consistently enhances property values, with positive effects observed across various models. Similarly, closer distances to railway station entrances increase property values for all types. The number of bike-sharing docking stations also positively influences values, reflecting the growing importance of sustainable transport. In contrast, proximity to bus or coach stops does not show significant impacts, aligning with the notion that excessive bus stops might lead to noise and traffic disturbances. Distance from enterprise zones consistently reduces property values, emphasizing their attractiveness due to economic incentives. Mixed effects are seen with town centre proximity, indicating varying preferences among property types. These findings underscore the crucial role of accessibility in determining commercial property values.

Place quality variables reveal clear trends across different commercial property types. Rail noise exposure positively impacts rateable values for commercial and industrial properties, suggesting that proximity to railways, despite the noise, may enhance attractiveness due to logistical advantages. In contrast, road noise consistently reduces property values, likely due to the negative effects of traffic and pollution. Proximity to green spaces has a significant positive effect only for office properties, which value closeness to such amenities, while its effect is not significant for railway arches used as industrial or retail & service spaces. The number of green space access points within 500 meters negatively affects commercial and industrial properties, potentially due to constraints on developable land or stricter zoning regulations. These findings highlight the nuanced role of environmental and locational factors in determining commercial property values.

The building characteristics variables exhibit clear and consistent trends across different commercial property types. Larger property sizes are consistently associated with lower rateable values per square meter, likely due to economies of scale. Industrial properties have significantly lower rateable values compared to other property types, reflecting market realities.

The significant positive constants across all models indicate that office properties have the highest baseline rateable values, followed by retail and service, with industrial properties having the lowest. These findings underscore the importance of building attributes in determining commercial property values.

When compared to Johnson, D. et al. (2023), who investigated conventional commercial properties, both studies agree on the negative impact of total area on property values. However, Johnson's research did not consider the number of bike-sharing docking stations, which was found to be significant in this study. Furthermore, while Johnson identified a positive relationship between IMD and property values, this study reveals a negative relationship for railway arches, indicating different impacts of socio-economic factors. These discrepancies underscore the necessity for property-specific valuation models.

4 CONCLUSION

This study identifies several key factors affecting railway arch property values. Socio-economic factors, accessibility, and place quality strongly influence property values. Proximity to transit and enterprise zones boosts values. Rail noise enhances values, but road noise and large property sizes reduce them.

Urban regeneration strategies in the UK should focus on improving accessibility, addressing socio-economic disparities, and optimizing the development of railway arches. Future research should address data limitations by incorporating more precise location details, larger sample sizes, and qualitative insights to better understand the factors influencing railway arch property values.

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