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PROPERTY PRICE AND ANTI-SOCIAL BEHAVIOUR: AN EMPIRICAL STUDY OF NORTHERN IRELAND

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Abstract. This study examines the impact of anti-social behaviour (ASB) on property prices. By analysing over 14,500 market transactions in Northern Ireland, we find that the prevalence of ASB within a neighbourhood exerts a direct and negative influence on house prices, albeit with diminishing effect at the margin. Furthermore, the dampening effects of ASB are more pronounced in districts characterised by higher population density, proximity to the capital city (Belfast), and lower property values. A thorough analysis of district-level data across a wide range of statistical indicators further indicates that the adverse impact of ASB on property prices is most acute in areas marked by social and economic deprivation, including factors such as income, employment, education, and access to services. Lastly, our submarket analysis suggests that the apartment sector and public housing are disproportionately affected by ASB in terms of price depreciation compared to other property types.

Keywords: property price, anti-social behaviour, hedonic modelling, Northern Ireland, housing market.

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1. Introduction

Anti-social behaviour (ASB) poses a significant challenge in built environments, particularly within urban residential property markets, where factors such as high population density, the close proximity of dwellings, diverse socioeconomic demographics, and frequent tenant turnover intensify its visibility and impact. Broadly defined as actions that cause harassment, alarm, or distress to others, ASB encompasses a wide array of activities, from noise disturbances to vandalism and violence (Anti-social Behaviour, Crime and Policing Act 2014, the U.K.). The presence of ASB in a neighbourhood can lead to declining property values, create an inhospitable living environment, and deter potential buyers and traders, thereby exerting a negative impact on the real estate market. Studies have shown that areas with elevated levels of ASB generally experience stunted community development as prospective homebuyers and investors are dissuaded by the perceived risks associated with such neighborhoods, including diminished quality of life and safety concerns (Bannister & Kearns, 2013). Consequently, understanding the dynamics of ASB is essential for real estate stakeholders, including homebuyers, property developers, and urban planners, as it plays a pivotal role in shaping housing supply and demand as well as market performance.

In the U.K., ASB has developed into a notable societal issue that cannot be disregarded, particularly within the urban centres of major cities with high population density. Although the Anti-social Behaviour Act 2003 and subsequent legislative measures have been implemented to mitigate the detrimental effects of ASB on communities, its persistence continues to challenge policymakers (Home Office, 2014). Despite these legislative efforts, the enduring prevalence of ASB underscores the difficulties in effectively curbing its impact, rendering it a pervasive and complex problem for those tasked with developing and enforcing policy (Home Office, 2014). The linkage between ASB and real estate markets can indeed be understood through the concept of "stigma" associated with certain neighbourhoods. As Gibbons (2004) observed, areas burdened with high levels of crime and ASB often develop a negative reputation, resulting in reduced demand for housing and, consequently, shrinking property values. For

instance, neighbourhoods in major cities such as London, Liverpool, Birmingham, Glasgow and Cardiff that are notorious for heightened ASB levels generally exhibit lower property values compared to adjacent areas with more favourable reputations (Atkinson & Flint, 2004). The fear of crime and social issues in these neighbourhoods not only depresses property prices but also influences long-term investment decisions, as developers may be hesitant to invest in areas where disruptive activities and social disorder are prevalent (Cozens et al., 2001).

Appositely, the impact of ASB on real estate markets is not confined to the United Kingdom; analogous patterns are evident on an international scale. In the United States, research has demonstrated that communities characterised by high crime rates and visible socially disruptive activities experience not only declining property values but also a diminished volume of real estate investment in the long run (Lynch & Rasmussen, 2001). Similarly, in Australia, ASB has been correlated with housing instability and the disintegration of community cohesion, resulting in undesirable outcomes for the housing market (Mazerolle & Ransley, 2006). In both contexts, the influence of ASB on real estate is moderated by factors such as the degree of social cohesion, local governance structures, and the effectiveness of law enforcement. Waiton (2010) also posits that the presence of ASB can in many instances initiate a "spiral of decline" within neighbourhoods, where the interplay between falling property values and escalating ASB exacerbates the deterioration of the area. These international comparisons underscore that, although the specific manifestations of ASB may differ across regions, its detrimental effects on real estate markets constitute a global phenomenon.

The role of urban planning and policy-making in mitigating the effects of ASB on the real estate market is of paramount importance. In the U.K., strategies aimed at addressing ASB have generally encompassed a range of social measures, including community policing, public space protection orders, and urban regeneration initiatives (Hancock & Matthews, 2013). These interventions are designed not only to suppress ASB but also to enhance the appeal of affected areas to prospective property buyers and investors. Nonetheless, the efficacy of such measures remains a subject of debate. Some researchers contend that whilst urban regeneration can yield short-term increases in property values, it may simultaneously displace existing residents and fail to address the root causes of ASB, such as poverty, discrimination and social exclusion (Lees, 2008). Similar critiques have been raised in other international contexts, where urban renewal efforts intended to curb ASB have occasionally resulted in gentrification and the further marginalisation of vulnerable populations (Smith, 2002). Consequently, a nuanced approach that carefully balances the imperatives of market stability with considerations of social equity is essential in effectively addressing the impact of ASB upon the real estate market.

Despite the considerable insights into the prevalence and policy implications of ASB within the housing literature, the subjectivity of its perception (Nixon et al., 2003; Mackenzie et al., 2010) and the paucity of evidence-based research into its underlying social constructs and economic effects on society underscore the need for further investigation into whether ASB exerts a negative knock-on effect on real estate asset pricing. Moreover, the perceived severity of ASB is highly contingent upon its scale, distribution and the characteristics of the affected neighbourhood (Prior, 2009). A pertinent inquiry centres on how, and to what extent, ASB influences asset values across communities or neighbourhoods of varying socioeconomic statuses and characteristics. These questions remain largely underexplored in the housing literature due perhaps to (1) the lack of readily available data on reported ASB incidents and (2) the fact that ASB predominantly occurs within social housing, where market-based pricing of externalities is non-existent, rendering quantitative assessments of its true economic impacts on resident well-being difficult, if not impossible.

In order to address this gap in the literature, this paper seeks to empirically examine the effects, if any, of ASB on property prices. By leveraging data from the residential property market and socioeconomic conditions in Northern Ireland, this novel study offers quantitative assessment regarding the influence ASB exerts on real estate asset values, while accounting for property and neighbourhood-specific attributes.

The subsequent sections of this paper are structured as follows: Section 2 provides a literature review of ASB in Northern Ireland and elsewhere, with particular emphasis on the relationship between ASB and societal dynamics, complemented by relevant government and industry data. Section 3 details the methodology employed in this study, which utilises hedonic regression valuation techniques to analyse property pricing. Several hedonic models are developed to ascertain whether, and to what extent, ASB acts as a negative economic externality in the context of property price determination, with a focus on a spectrum of property-level attributes, property types, and neighbourhood-specific characteristics within the Northern Ireland sample. Section 4 presents descriptive statistics of the sample data. Section 5 presents the empirical findings, followed by a discussion in Section 6. Section 7 concludes the study.

2. Literature review

ASB in Northern Ireland

ASB in Northern Ireland is a pressing issue that has garnered considerable attention, deeply intertwined with the region's historical and socio-political context, particularly the enduring legacy of the Troubles. The Troubles, a protracted and violent conflict from the late 1960s until the signing of the Good Friday Agreement in 1998, deeply fractured communities along sectarian lines, resulting in profound and lasting disruptions to social cohesion, which continue to manifest in persistent patterns of anti-social

activities and behaviours. The complex nature of ASB in this region is further compounded by factors such as entrenched communal divisions, social deprivation, and the lingering influence of paramilitary organisations. According to the Northern Ireland Policing Board (2020), ASB accounts for a substantial proportion of crime in Northern Ireland, with over 60,000 incidents reported annually between 2018 and 2020. This equates to approximately 30% of all recorded crime in the region, underscoring the prevalence of ASB in Northern Ireland's communities. This figure is significantly higher than the UK average, where ASB typically accounts for around 20% of recorded crime (Home Office, 2023).

The trends in ASB in Northern Ireland have shown some fluctuations in recent years, with certain areas experiencing spikes in incidents, particularly in urban centres such as Belfast and Londonderry. For example, data from the Police Service of Northern Ireland (PSNI) indicated that in 2019, Belfast alone recorded over 15,000 incidents of ASB, making it one of the highest in the region. Youth-related ASB is particularly concerning, with young people often involved in activities such as vandalism, graffiti, and underage drinking. The Community Safety Board (2019) reported that 40% of ASB incidents in Northern Ireland involved individuals under the age of 18, reflecting broader concerns about youth disengagement and the lack of recreational opportunities in deprived areas. Furthermore, there has recently been an alarming trend of ASB linked to bonfires and other cultural expressions, which often escalate into more serious offenses, including intimidation.

Sectarianism continues to be a significant driver of ASB in Northern Ireland. Incidents of sectarian harassment, intimidation, and violence are often classified under ASB, contributing to the enduring tensions between communities. The Northern Ireland Executive's 2016 report on ASB highlighted that approximately one-fifth of ASB incidents had a sectarian motive, illustrating the continued impact of historical divisions on contemporary social behaviours. These incidents are more common during the marching season, when tensions between communities tend to escalate (Jarman, 2020). The Northern Ireland Housing Executive (NIHE) has also observed that sectarism-related ASB often leads to housing instability, as individuals and families are forced to move due to harassment or threats, further exacerbating social divisions and community fragmentation (Shuttleworth & Lloyd, 2013).

In addition to sectarianism, socio-economic factors play a crucial role in the prevalence of ASB in Northern Ireland. Areas with high levels of poverty, unemployment, and social exclusion are disproportionately affected by ASB. For instance, the Northern Ireland Multiple Deprivation Measure (2017) found that areas such as West Belfast, North Belfast, and parts of Londonderry consistently rank among the highest for ASB incidents, correlating with high levels of deprivation. These areas are characterised by inadequate housing, limited access to public services, and high unemployment rates, all of which contribute to a sense of disengagement among residents, particularly young people (Knox, 2011). This has led researchers to argue that tackling ASB in Northern Ireland requires not just policing and punitive measures but also more comprehensive social interventions aimed at addressing underlying causes such as poverty and inequality (Haydon & Scraton, 2000).

Paramilitary influence is another critical factor in understanding ASB in Northern Ireland. Despite the peace process and the disbandment of many paramilitary groups, their influence persists in certain communities, often manifesting as so-called "punishment attacks" and other forms of vigilante justice, which are classified as ASB by law enforcement agencies (Monaghan, 2008; Home Office, 2014). The PSNI reported that in 2020, there were over 90 incidents of paramilitary-style attacks, a significant portion of which were categorised as ASB. These attacks are often seen as a means for paramilitary groups to maintain control over their communities, particularly in areas where there is distrust of the police and formal justice systems. In a multitude of cases, the presence of these groups complicates efforts to address ASB, as community members may be reluctant to report incidents due to fear of retribution or because they view the paramilitaries as a more effective means of dealing with crime than the official channels (Monaghan, 2008).

Efforts to address ASB in Northern Ireland have been multifaceted, involving both law enforcement and community-based approaches. The introduction of the Anti-Social Behaviour (Northern Ireland) Order 2004 was a significant step in providing law enforcement with tools such as ASBOs (Anti-Social Behaviour Orders) to tackle persistent offenders. However, the effectiveness of ASBOs has been widely debated, with some research suggesting that they merely displace the problem rather than resolve it (Crawford, 2009). Community-based initiatives, such as the Northern Ireland Executive's Community Safety Strategy (2012–2017), have emphasised the importance of preventative measures, including youth engagement programmes, mediation services, and the promotion of community cohesion (Topping, 2008). These initiatives have shown some success in reducing ASB in certain areas, but challenges remain, particularly in addressing the deep-seated social and economic issues that underpin much of the ASB cases in Northern Ireland.

The influence of neighbour quality and ASB on property valuation

The quality of neighbours has long been recognised as a critical factor in residential property valuation. For example, Nordvik and Osland (2017) found that neighbour quality significantly affects homebuyers' willingness to pay for housing in Norway. Expanding on this, Bonakdar and Roos (2023) employed an agent-based model to demonstrate that homebuyers prefer to live among neighbours who share similar socioeconomic attributes, such as income, education, and ethnicity. Their findings suggest that neighbourhood affluence is positively correlated with

property prices, while an increase in the proportion of residents from certain ethnic groups tends to have the opposite effect. However, many of these studies primarily use neighbourhood composition as a proxy for neighbour quality, without directly addressing the specific impact of ASB on property values.

The relationship between ASB and home prices remains largely underexplored, despite the evident interest it holds for researchers, real estate professionals, and industry practitioners. While Sakkers (2002) established that positive neighbourly relations can enhance property values, the empirical effects of ASB on housing prices have not been fully examined. Braakmann (2012) sought to fill this gap by analysing the impact of street-level ASB on property prices in England and Wales. Utilising non-parametric regional time trends and fixed-effects models, his research revealed that a marginal increase in ASB resulted in an approximate 1% reduction in housing prices on the affected street. Furthermore, he estimated that each ASB incident costs society between £30,472 and £34,528. Similarly, Seo (2018) investigated the discounting effect of neighbourhood disorder in the United States, focusing on the difference between listed and final selling prices. However, Seo's study was limited to physical disorder, such as graffiti, leaving other forms of ASB unexamined. In the context of Northern Ireland, Besley and Mueller (2012) empirically demonstrated that, in Belfast, where socially undesirable effects such as violence were most pronounced, the estimated change in house prices ranged from 8% to 14.5%. Conversely, McCord et al. (2024) showed that in Northern Ireland, neighbourhoods deemed desirable in terms of the living environment could result in property value increases of up to 7.3%, after controlling for property-specific factors.

Practitioners within the valuation profession also acknowledged the detrimental impact of ASB on property values. Simpson (2013) revisited a Halifax Bank survey from 2010, which involved 2,000 British homeowners and identified aggression, violence, and noise pollution as the main forms of ASB affecting housing prices. Simpson observed that living in a nuisance-prone neighbourhood could decrease property values by an average of £31,000. Similarly, Harris (2022) reported that noisy neighbourhoods could reduce home values by approximately £27,367. Marsden (2018), in a review of a market survey, highlighted that the most common ASB-related neighbour disputes involve noise (e.g., shouting, loud music), pet-related issues (e.g., fouling, barking), and public hygiene concerns (e.g., rubbish left in gardens). These forms of ASB, according to Marsden, have detrimental effects on both residents' wellbeing and property values. More recently, Build (2022) emphasised that nuisance neighbours can tarnish a neighbourhood's reputation, leading to a broader depreciation in property values.

In addition to the direct negative impact of ASB on property values, legal costs associated with neighbour disputes may also indirectly influence property pricing. Fleming (2025) noted that such legal expenses, although not rigorously studied in the literature, can be significant. Real estate practitioners, including Hemingway (2022), share the view that properties adjacent to nuisance neighbours are more difficult to be sold, even when prices are reduced. As a result, sellers often bear the financial burden of their neighbours' disruptive behaviours (Hannah, 2012).

To optimise outcomes and mitigate the effects of ASB, legal measures are frequently augmented with mandatory clauses in residential tenancy agreements. These may include provisions such as introductory or probationary tenancies and compulsory lease termination (Clean, 2003; Hunter et al., 2005; Flint & Nixon, 2006; Prior, 2009; Yau, 2014). Furthermore, ASB-focused incentive programs and community initiatives aimed at enhancing neighbourhood quality have been implemented in both Singapore and the U.K. Examples include garden vouchers, priority maintenance services, Neighbourhood Watch schemes, and mutual aid promotions (Lupton et al., 2003; Jacobs et al., 2005; Sagar, 2005; Williamson et al., 2006; Home Office, 2022). These interventions collectively contribute to fostering a more cohesive and harmonious living environment, thereby indirectly bolstering property values and marketability.

Building upon the work of Braakmann (2012), which investigates the price effects of non-property crime, including anti-social behaviour (ASB), in regions of England and Wales, the present study extends the analysis to Northern Ireland. A key advancement of this study lies in the dataset, which captures not only street-level ASB but also ASB occurring at the household level. Furthermore, while Braakmann (2012) focuses on the average price effect per ASB incident, our analysis goes further by examining how the negative impact of ASB on property prices varies across multiple dimensions, including property type, socioeconomic context, urban density, and other relevant factors.

3. Methodology

Since the seminal contributions of Lancaster (1966) and Rosen (1974), who theorised property price can be explained by assuming housing as a differentiated good, there has been an extensive amount of studies in the literature that are based around the hedonic methods. Indeed, a large volume of these studies have sought to explore the effect of an array of economic, social and environmental externalities on the price determination process of real estate. For instance, whether these have had detrimental impacts such as air pollution (Kim et al., 2003; McCord et al., 2018), crime (McIlhatton et al., 2016), pandemics (McCord et al., 2022; Ngo et al., 2023), government policies (Haran et al., 2019; Lo et al., 2024) and congestion (Hou, 2017) or positive consequences as a result of improved accessibility (Martinex & Viegas, 2009), market transparency (Lo et al., 2022a, 2022b), macroeconomic environment (Lo et al., 2022c), energy efficiency (McCord et al., 2018, 2020) and view (Hui et al., 2007).

Building upon this established research trajectory, the present study develops a series of hedonic regression models aimed at assessing the implicit pricing effects of ASB and a broad range of housing attributes, neighbourhood characteristics, property types, and socio-economic attributes on residential real estate in Northern Ireland. The general form of the hedonic regression model utilised in this study can be expressed as follows:

$$\mathrm{Ln}\left(Price\right)_i = c + \alpha \times ASB + \sum_{j=1}^{m} \beta_j S_j + \sum_{k=1}^{n} \gamma_k LGD_k + \sum_{p=1}^{r} \gamma_p PT_p + \sum_{q=1}^{s} \mu_q T_q + \sum_{u=1}^{v} \mu_u Z_u + e, \quad (1)$$

where: Ln(*Price*) is the natural logarithm of the transaction price for the subject property *i*; *c* is a constant term; *ASB* denotes the intensity of ASB within the district, measured as the number of ASB incidents per 1,000 population[1]. $\sum_{j=1}^{m} S_j$ encompasses a bundle of property-level and structural attributes, such as property size, age of the building, availability of on-site parking, energy performance certificate score, and the condition of the building's exterior; *LGD* represents a set of dummy variables denoting the local government district of the property; PT_p denotes a set of dummy variables for property type, with five types examined in the study: detached, semi-detached, terraced, apartment, and townhouse; T_q denotes the time of the transaction, defined on a quarterly basis; *e* is the stochastic term; *Z* is a spectrum of socioeconomic indicators to measure the quality of neighbourhood. Furthermore, interaction terms are incorporated where appropriate to examine whether the independent variables exert differential effects on property prices with respect to *ASB*. The analysis is structured across three stages, each designed to evaluate the impact of ASB on property prices relative to a particular group of independent variables or attributes.

Stage 1: Property and neighbourhood level attributes

Stage one seeks to establish the relationship between ASB and property prices through Model 1 and examines whether there is an increasing or diminishing marginal effect of ASB on property prices by incorporating an interaction term (Model 2). These models serve as the base cases of the analysis, as they do not yet account for specific property or neighbourhood-induced effects on pricing related to ASB. The analysis then explores whether property prices are influenced by the interaction between ASB and population density (Model 3) and whether the effect of ASB is more pronounced for properties that are more sought-after in the market in terms of pricing (Model 4). Model 5 investigates whether there is a statistically significant difference in the influence of ASB between privately built and publicly built housing. Lastly, Model 6 examines whether properties located in Belfast, the capital city of Northern Ireland, are more susceptible to the effects of ASB.

Stage 2: Property types

Stage two investigates the differential impact of ASB across various property types by utilising five hedonic models (Models 7 to 11), each tailored to a specific property type. Prior research on the housing market in Northern Ireland has indeed identified substantial distinctions between property types, revealing that the market is somewhat compartmentalised, with different drivers influencing prices and rents across these categories (McCord et al., 2019; Lo et al., 2021, 2023). We posit that the effect of ASB on property prices will vary according to these types, given the differences in residential density, tenant composition, and the propensity for certain property types–particularly apartments and, to a lesser extent, townhouses—to experience higher levels of ASB. This is largely due to the presence of communal areas that may act as focal points for anti-social activities.

Stage 3: Socioeconomic measures

The final stage concentrates on exploring the potential link between ASB and a range of socioeconomic indicators, Z_u. In this study, Z_u represents the rank of the Super Output Area (SOA)[2] in which the subject property is located, relative to all SOAs in the sample, based on their socioeconomic quality. The SOAs are ranked in ascending order of socioeconomic desirability according to metrics such as income level, employment rates, educational attainment, degree of accessibility, security (proxied by crime rates), and overall multiple deprivation (Models 12–17). In this ranking system, a less economically or socially desirable SOA is ranked higher. For instance, an SOA with the highest average income level would be ranked first on the income metric, while the safest SOA would be ranked last on the crime metric.

[1] In this study, ASB is operationalised as a single aggregate variable, defined by the number of incidents per 1,000 population within a locality. While this approach allows for a broad analysis, it limits the conceptual depth of the study by not accounting for the heterogeneity of ASB. ASB is a complex and context-dependent phenomenon, and aggregating it into a single metric without considering its type, severity, or spatial distribution may conceal significant variations in its impact on property prices. This simplification, while useful given the constraints of data availability, represents a limitation of the study. The lack of more detailed, disaggregated ASB data at a finer level of resolution prevented a deeper analysis. Future research could address this issue by incorporating more granular ASB data, enabling a more nuanced understanding of how different forms of ASB influence property values in diverse contexts.

[2] In Northern Ireland, SOAs are small geographical units used for statistical purposes, designed to support the publication of detailed census and other statistical data. SOAs typically consist of between 200 and 1,000 people, ensuring that they are small enough to provide localised data while still maintaining confidentiality. These areas are used to break down data from larger administrative units, such as electoral wards or districts, into finer, more detailed segments. SOAs are particularly useful for analysing socio-economic trends, local population characteristics, and resource allocation at a granular level.

To summarise, neighbourhood and housing characteristics are included as control variables to account for the influence of both local environmental factors and property-specific features on property prices. Neighbourhood characteristics, including ASB, income levels, degree of accessibility and crime rates, are represented as aggregated variables at the neighbourhood level, while housing characteristics, including size, age, and location, are captured at the property level. These variables were combined to account for both micro-level attributes of individual properties and broader macro-level factors influencing the housing market, similar to approaches used by Cheshire and Sheppard (2002), who incorporate both neighborhood and housing characteristics to study the influence of location on property values.

To explore the interaction between ASB and housing market characteristics we included linear interaction terms (e.g. ASB × Density) to capture the non-linear relationships between ASB and neighbourhood attributes. These interaction terms assume that the effect of one variable on property prices may vary depending on the level of another variable, reflecting the complexity of the relationship between different property attributes, as emphasized by Can and Megbolugbe (1997) that these factors interact in more complex ways rather than in an additive manner. Similar approaches are used in Braakmann (2012), who models the interaction between crime rates and neighborhood characteristics to understand their combined effect on house prices. Indeed, this methodology follows the tradition of using interaction terms to capture complex social phenomena, as demonstrated by Anselin (1988), who incorporated interactions between housing and neighborhood factors to model housing market dynamics. While these interactions are a simplification of the complexities of real-world social phenomena, they provide useful insights into the relationships between different factors influencing property prices.

The hedonic regression equations in this study are estimated using Ordinary Least Squares (OLS) technique. To ensure the robustness of the results, the Breusch-Pagan-Godfrey test is conducted to check for heteroskedasticity. Furthermore, to minimise the risk of multicollinearity within the models, only one parameter of interest is included in each equation alongside the control variables. Variance inflation factor (VIF) tests are employed to confirm that the key variables are not correlated with other regressors. The variables examined in this analysis are detailed in Table 1. By systematically examining the relationship between ASB and property prices through these three stages, this study provides a comprehensive understanding of how ASB interacts with various housing attributes and socioeconomic factors to influence residential real estate markets in Northern Ireland.

Table 1. Key variables examined in the study

Variable	Description	Unit of measurement
Ln(Price)	Natural logarithm of the property transaction price	ln(Pound Sterling)
ASB	Number of ASB cases within the SOA of the property, measured on a per 1,000 population basis	Ratio
Age	Age of the property	Years
Size	Size of the property	m^2
Parking	Availability of on-site parking space, which is equal to one when such space is available, 0 otherwise	Dummy variable
Rural	Equal to one if the property is located in a rural area, zero otherwise	Dummy variable
Private	Equal to one if the property is privately built, zero otherwise	Dummy variable
Density	The population density of the SOA of the property, measured by number of residents divided by size of the SOA	Population/hectare
Belfast	Equal to one if the property is located in Belfast city, zero otherwise	Dummy variable
Time	The quarter in which the property transaction took place	Dummy variable
LGD	Local government district in which the property is located. In total, ten LGDs are defined in our study, namely (i) Ards and North Down, (ii) Armagh City, Banbridge and Craigavon, (iii) Antrim and Newtownabbey, (iv) Belfast, (v) Causeway Coast and Glens; (vi) Derry City and Strabane, (vii) Fermanagh and Omagh, (viii) Lisburn and Castlereagh, (ix), Mid and East Antrim, (x) Mid Ulster, (xi) Newry, Mourne and Down	Dummy variable
EPC	The energy performance certificate score of the building, ranging from A to E, which A being the most energy efficient	Dummy variable
Exterior	The general structural condition of the exterior walls of the property defined	Dummy variable
Property type	Property type of the property: Detached, semi-detached, terrace, apartment and townhouse	Dummy variable
Socioeconomic indicator (*Z*)	*Z* is a set of socioeconomic indicators, measuring the neighbourhood quality of the property by ranking all SOAs with respect to their (i) degree of multiple deprivation (MDM), (ii) residents' income level, (iii) residents' education level, (iv) employment rates, (v) degree of accessibility and (vi) crime rates. According to the definitions by Northern Ireland Statistics and Research Agency, a SOA that is ranked first with respect to a given *Z* is considered the least favourable than other SOAs in terms of living conditions	Rank (= 1, 2, 3, … *n*)

4. Data and descriptive statistics

The sample data for residential market transactions was obtained from various local real estate agencies in Northern Ireland, covering the period from the first quarter of 2018 to the second quarter of 2022. This dataset includes sales prices alongside detailed property-level information such as building age, property size, address, property type, Energy Performance Certificate (EPC) scores and building conditions. This data was then merged with a dataset from the Northern Ireland Statistical and Research Agency, which provides Super Output Area (SOA)-level information on ASB and socioeconomic characteristics, as outlined in Section 3. In total, approximately 14,500 transaction observations were utilised for the Hedonic regression modelling.

Table 2. Composition of the sample

Property type	Detached	Semi-detached	Terraced	Apartment	Townhouse
	4018 (29.28%)	4990 (36.36%)	3571 (26.02%)	520 (3.79%)	626 (4.56%)
Belfast	Within Belfast	Outside Belfast			
	6231 (42.91%)	8290 (57.09%)			
Private vs public	Private	Public			
	12,200 (84.02%)	2321 (15.98%)			
Energy Performance Certificate	A	B	C	D	E
	11 (0.08%)	335 (2.31%)	11,943 (82.26%)	2,226 (15.33%)	4 (0.03%)
Geography	Rural	Urban			
	1649 (11.76%)	12377 (88.24%)			

Table 3. Descriptive statistics

Aggregate					
Variable	Average	Median	Q1	Q3	Stand. Dev.
Property price (£)	193,900	162,000	119,500	230,000	145,124
ASB (per 1000 pop.)	26.51	21.10	14.22	33.10	19.98
Submarket (property type)					
Detached					
Property price (£)	292,394	250,000	190,000	345,000	194,025
ASB (per 1000 pop.)	18.69	15.00	10.90	22.10	13.07
Semi-detached					
Property price (£)	173,908	149,940	131,000	199,950	89,880
ASB (per 1000 pop.)	23.87	19.7	14.00	31.00	15.56
Terraced					
Property price (£)	116,392	104,000	81,000	135,000	104,795
ASB (per 1000 pop.)	39.15	32.6	23.2	46	25.95
Apartment					
Property price (£)	143,613	129,250	94,950	169,950	92,866
ASB (per 1000 pop.)	31.39	25.4	16	40.3	23.06
Townhouse					
Property price (£)	176,391	153,000	125,950	208,000	92,286
ASB (per 1000 pop.)	25.99	20.7	14.8	31.8	17.72
Belfast					
Property price (£)	192,864	152,000	110,500	230,000	140,701
ASB (per 1000 pop.)	30.59	25.6	16	39.7	20.87
Non-Belfast					
Property price (£)	196,433	167,000	125,000	231,500	148,3666
ASB (per 1000 pop.)	24.07	18.6	13	30.4	19.02
Private					
Property price (£)	205,757	167,500	125,000	247,500	143,315
ASB (per 1000 pop.)	24.66	20.2	12.2	30.1	20.85
Public					
Property price (£)	185,144	159,950	115,000	220,000	148,490
ASB (per 1000 pop.)	26.18	22.1	13.7	32.6	18.01

Table 2 summarises the composition of the dataset. The majority of the observations are either detached (29.28%), semi-detached (36.36%), or terraced (26.02%) properties, with apartments and townhouses accounting for only 3.79% and 4.56% of the sample, respectively. In addition, 88.24% of the properties are located in urban areas, with 42.91% situated within the Belfast local government district. Notably, a significant proportion of the properties (84.02%) were privately built. Regarding EPC scores, 82.26% of the observations achieved an average energy efficiency rating of C, with an additional 15.33% receiving a D rating.

Table 3 provides descriptive statistics of the sample data at both aggregate and submarket levels, focusing on ASB intensity and property prices. The average and median house prices in Northern Ireland are approximately £193,900 and £162,000, respectively, indicating a market skewed towards lower-priced housing. The average ASB intensity is 26.51 incidents per 1,000 population per year, with the top 25% most ASB-affected SOAs exceeding 33.10 incidents.

Submarket-level analysis reveals a strong negative correlation between property prices and ASB. For instance, terraced housing exhibits the highest average ASB intensity (39.15 incidents) and the lowest average property price (£116,392). Conversely, detached houses, which command the highest average price (£292,394), are the least affected by ASB, with an average intensity of 18.69 incidents. Other property types fall between these two extremes in terms of both ASB intensity and property prices.

Furthermore, the data shows a notable difference between SOAs in Belfast and those in other regions, with Belfast averaging 30.59 ASB incidents compared to 24.07 in other areas, despite generally higher house prices in Belfast. Publicly-built residential properties also tend to experience higher ASB rates compared to privately-built ones. The average and median ASB figures for publicly-built properties are 26.18 and 22.1, respectively, whereas the corresponding figures for privately-built properties are 24.66 and 20.2.

Our correlation analysis, presented in Table 4, further supports the negative relationship between property prices and ASB, as evidenced by a correlation coefficient of –0.24. This finding provides initial evidence that ASB activity within a neighbourhood may depress property values. Additionally, the analysis indicates a positive correlation between ASB and population density, suggesting that ASB is more prevalent in overcrowded neighbourhoods. Finally, all socioeconomic ranks, except for accessibility, show a negative correlation with ASB, indicating that areas affected by ASB generally have poorer socioeconomic conditions.

Table 4. Correlation analysis

	Price	ASB
ASB	–0.23976	1.00000
Density	–0.23766	0.372488
Income rank	0.269692	–0.33513
Employment rank	0.406457	–0.44976
Education rank	0.482588	–0.46102
Accessibility rank	–0.13940	0.390209
Crime rank	0.271278	–0.59419
MDM rank	0.385611	–0.58832

5. Empirical findings and discussion

The findings from the fixed effects hedonic analysis is presented in three parts. First we examine the effect of ASB at the general level accounting for housing attributes and locational dummy variables and develop a series of interaction terms to further account for, isolate and determine whether urban population density, property value and public housing have an impact upon the nature and level of the effect (Models 1–6). Secondly, we develop a series of property type models (Models 7–11), to examine ASB and scrutinise and distill whether there is a differential effect on property prices. Lastly, we specify a number socioeconomic ranking models which are based on the ranking of multiple deprivation measure (Model 12) and the underpinning domains of deprivation such as income, employment, education, access and crime (Models 13–17) to establish whether deprivation impacts on house prices with respect to ASB. Indeed, this approach aligns with McCann (2013), who suggested that socio-economic factors, such as income and employment levels, influence residential preferences and the value placed on neighbourhoods affected by ASB.

Overall, the initial hedonic base models (Models 1 and 2) and property attribute models (Models 3–6) in Table 5 show adjusted R^2 values ranging between 63.1% and 82.3% indicating the coefficients to explain between 63% and 82% in the variation of sales price, with the coefficients displaying the expected sign, statistical significance and reasonable level of magnitudes. For instance, an increase in property size increases the price of the dwelling with one additional square metre of living space increases the price by between 0.51% and 0.84% (Models 1–6). Similarly, the age of the property comprises a value significant effect ranging between 0.009% and 0.057%, and if the property is privately built this exhibits a positive effect ranging between 5.9% and 16.8% across the models (Models 1–6). Inspection of the rural coefficient also reveals a negative and statistically significant effect ranging between 3.99% and 8.75%, inferring that rural properties are lower in value relative to their urban counterparts. This finding resonates with the work of Braakmann (2012), who observed that urban areas tend to experience a greater depreciation in property values due to factors like social disorder, a conclusion that is particularly relevant in the context of ASB.

Turning to the parameter of interest, namely ASB, the base models (Models 1 and 2) reveal that ASB tends to depress house prices, demonstrating that when the number

Table 5. Housing attribute models

	Model 1 (Base)	Model 2 (Base 2)	Model 3 (Density)	Model 4 (Property price)	Model 5 (Private)	Model 6 (Belfast)
Constant	10.79874 (0.132176)***	11.18415 (0.130570)***	11.18743 (0.130277)***	11.39189 (0.092940)***	11.31744 (0.128098)***	11.17922 (0.130478)***
ASB	–0.003930 (0.000164)***	–0.009514 (0.000366)***	–0.008774 (0.000376)***	–0.182533 (0.001480)***	–0.009762 (0.000455)***	–0.008565 (0.000417)***
ASB × ASB		4.83×10^{-5} (2.81×10^{-6})***	5.22×10^{-5} (2.84×10^{-6})***	4.48×10^{-5} (2.00×10^{-6})***	4.86×10^{-5} (2.84×10^{-6})***	4.61×10^{-5} (2.85×10^{-6})***
Age	0.000901 (0.000118)***	0.002997 (0.000507)***	0.002931 (0.000506)***	0.002727 (0.000361)***	0.002858 (0.000507)***	0.002771 (0.000509)***
Age × Age		-1.42×10^{-5} (3.80×10^{-6})***	-1.30×10^{-5} (3.80×10^{-6})***	-1.47×10^{-5} (2.71×10^{-6})***	-1.28×10^{-5} (3.80×10^{-6})***	-1.28×10^{-5} (3.81×10^{-6})***
Size	0.005028 (6.64×10^{-5})***	0.008369 (0.000173)***	0.008245 (0.000173)***	0.005017 (0.000126)***	0.008363 (0.000173)***	0.008346 (0.000173)***
Size × Size		-8.31×10^{-6} (3.90×10^{-7})***	-8.12×10^{-6} (3.90×10^{-7})***	-3.92×10^{-6} (2.80×10^{-7})***	-8.31×10^{-6} (3.90×10^{-7})***	-8.27×10^{-6} (3.90×10^{-7})***
Parking onsite	0.085923 (0.010863)***	0.063596 (0.010765)***	0.054154 (0.010803)***	0.027686 (0.007667)***	0.064033 (0.010774)***	0.060777 (0.010773)***
Rural	–0.071657 (0.010610)***	–0.087541 (0.010440)***	–0.088568 (0.010417)***	–0.039933 (0.007440)***	–0.088370 (0.010449)***	–0.079871 (0.010557)***
Private	0.138356 (0.024704)***	0.124989 (0.024144)***	0.134252 (0.024116)***	0.059928 (0.017191)***	0.168379 (0.028833)***	0.124831 (0.024126)***
ASB × Density			-3.74×10^{-5} (4.60×10^{-6})***			
ASB × Price				0.014814 (0.000125)***		
ASB × Private					0.001227 (0.000446)***	
ASB × Belfast						–0.001432 (0.000302)***
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
LGD Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Property Type Dummies	Yes	Yes	Yes	Yes	Yes	Yes
EPC Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Ext Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Obs	14,521	14,521	14,521	14,521	14,521	14,521
R^2	0.632006	0.651338	0.652927	0.823421	0.651520	0.651877
Adj R^2	0.630862	0.650181	0.651752	0.822823	0.650340	0.650698
F	552.4417	563.2336	555.5791	1377.164	552.1440	553.0134
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: LGD = Local government district; EPC = Energy Performance Certificate; Ext = Condition of external repair. *** indicates 1% statistical significance.

of ASB cases per 1,000 population increases by 10%, property prices tend to decrease between 0.39% and 0.95% depending on whether marginal effects are accounted for. This result is consistent with the findings of Besley and Mueller (2012), who found that violence and other socially undesirable effects in Belfast resulted in a reduction of house prices by 8–14%. As observed in Model 2, a diminishing marginal effect of ASB on price is also detected as indicated by the positive sign of the squared term on ASB. This diminishing effect suggests that, as the level of ASB rises, the impact on prices becomes less pronounced, similar to the results of Seo (2018), who found that neighbourhood disorder showed decreasing returns in its influence on housing prices as disorder increased. When further accounting for urban (neighbourhood) density and its interaction term with ASB (Model 3), the results suggest that neighbourhoods of a higher living density tend to have a stronger impact of ASB on house prices, i.e., property values in more densely populated neighbourhoods are more affected by the levels of ASB. In a similar vein, the interaction term between price and ASB (Model 4) exhibit properties of lower value to be more affected by ASB, with a more pronounced negative price effect stemming from ASB being observed in public estates/properties than in the private counterparts (Model 5). In addition, the results show that in terms of property pricing, the capital city of Northern Ireland, Belfast, is more affected by ASB as displayed by the negative and statistically significant coefficient on ASB × Belfast (Model 6). This finding aligns with Besley and Mueller (2012), who highlighted that the effects

of ASB are more pronounced in urban centres such as Belfast, where population density and social heterogeneity likely exacerbate the effects of ASB.

Table 6 exhibits the role of ASB by property type (Models 7–11). The findings reveal that amongst all property types, apartments seemingly are the most affected by ASB (–1.307, $p < .001$), followed by semi-detached, terraced, townhouse and detached with an ASB-induced property price discount ranging between 0.66% to 1.13%. This finding suggests that this may be largely due to the effect of density, the concentration of younger people gathering in more urbanized areas or "hot spots" of highly concentrated space and the potential inter-heterogeneity in areas or surrounding areas and how the neighbourhood structure is defined. This is concomitant with the findings of Ceccato and Wilhelmsson (2011) who observed that adjacency to public places can impact upon, and reveal signs of physical and social disorder in which environmental cues translate into weakened social ties among residents, a negative demand for housing in an area and a negative effect on property prices. Indeed, of particular note, Ceccato and Wilhelmsson (2011) observed vandalism to have a significant and independent effect on apartment prices in Stockholm municipality indicating that the effects of crime vary by housing type and have differential effects on house prices.

Examination of the role of deprivation and its domains and the effects of ASB on house prices are presented in Table 7. As observed in Model 12 which takes into account the headline measure of multiple deprivation ranking, the effects of ASB on house price are more significant in neighbourhoods of higher multiple deprivation scores. This finding is in line with Knox (2011), who argued that higher levels of deprivation correlate with increased ASB, and suggests that deprived areas are more vulnerable to the negative price effects of ASB. Further isolating the effects of ASB on house prices applying the separate domains of deprivation (Models 13–17) reveals that the effects of ASB on house price are more significant in lower-income neighbourhoods and in neighbourhoods comprising higher unemployment rates. Moreover, the results show the effects of ASB on house price are more significant in neighbourhoods of lower educational attainment, reduced accessibility to services and in neighbourhoods which constitute higher crime rates. These results align with Haydon and Scraton (2000), who noted that socio-economic factors, such as poverty and inequality, exacerbate ASB in Northern Ireland, contributing to its

Table 6. Property type models

	Model 7 (Detached)	Model 8 (Semi Detached)	Model 9 (Terraced)	Model 10 (Apartment)	Model 11 (Townhouse)
Constant	11.43231 (0.218770)***	10.48241 (0.191199)***	10.95269 (0.156221)***	11.50655 (0.223572)***	10.53464 (0.201467)***
ASB	–0.006672 (0.000834)***	–0.011330 (0.000732)***	–0.007973 (0.000642)***	–0.013072 (0.002463)***	–0.006937 (0.001467)***
ASB × ASB	2.65×10^{-5} (7.97×10^{-6})***	6.88×10^{-5} (7.21×10^{-6})***	4.01×10^{-5} (4.21×10^{-6})***	0.000104 (2.39×10^{-5})***	1.80×10^{-5} (1.28×10^{-5})
Age	0.006723 (0.000856)***	0.000851 (0.000923)	–0.002881 (0.001315)**	–0.005064 (0.002595)**	0.003915 (0.002399)*
Age × Age	-3.41×10^{-5} (6.40×10^{-6})***	9.60×10^{-6} (7.21×10^{-6})	1.90×10^{-5} (9.28×10^{-6})**	6.06×10^{-5} (1.95×10^{-5})***	-2.86×10^{-5} (1.86×10^{-5})
Size	0.007221 (0.000264)***	0.010776 (0.000460)***	0.008178 (0.000864)***	0.007011 (0.001226)***	0.011030 (0.000841)***
Size × Size	-6.12×10^{-6} (5.23×10^{-7})***	-1.40×10^{-5} (1.28×10^{-6})***	-5.60×10^{-6} (3.44×10^{-6})*	-1.96×10^{-5} (3.97×10^{-6})***	-1.50×10^{-5} (2.39×10^{-6})***
Parking onsite	–0.011208 (0.043728)	0.063166 (0.030378)**	0.027108 (0.014338)*	–	0.091669 (0.029170)***
Rural	–0.079585 (0.015479)***	–0.107333 (0.021478)***	–0.050162 (0.027596)*	0.044664 (0.083693)	–0.019899 (0.038885)
Private	–0.008144 (0.089321)	0.231046 (0.046031)***	0.070744 (0.036865)**	0.275627 (0.076130)***	0.277295 (0.067088)***
Time Dummies	Yes	Yes	Yes	Yes	Yes
LGD Dummies	Yes	Yes	Yes	Yes	Yes
EPC Dummies	Yes	Yes	Yes	Yes	Yes
Ext Dummies	Yes	Yes	Yes	Yes	Yes
Obs	4,018	4,990	3,571	520	626
R^2	0.523332	0.471448	0.379724	0.492908	0.790389
Adj R^2	0.518053	0.466960	0.372340	0.461798	0.777955
F	99.13489	105.0602	51.42368	15.84406	63.56403
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: LGD = Local government district; EPC = Energy Performance Certificate; Ext = Condition of external repair. *, **, *** indicate 10%, 5% and 1% statistical significance respectively.

Table 7. Socioeconomic ranking models

	Model 12 (MDM)	Model 13 (Income)	Model 14 (Employment)	Model 15 (Education)	Model 16 (Access)	Model 17 (Crime)
Constant	11.36294 (0.126073)***	11.30127 (0.128444)***	11.31977 (0.126192)***	11.34182 (0.125968)***	10.81866 (0.132222)***	10.97523 (0.083030)***
ASB	–0.013723 (0.000376)***	–0.013102 (0.000393)***	–0.012840 (0.000368)***	–0.012497 (0.000364)***	–0.005718 (0.000502)***	–0.010956 (0.000384)***
ASB × ASB	5.20×10^{-5} (2.71×10^{-6})***	5.20×10^{-5} (2.71×10^{-6})***	4.49×10^{-5} (2.72×10^{-6})***	4.14×10^{-5} (2.72×10^{-6})***	4.82×10^{-5} (2.85×10^{-6})***	5.57×10^{-5} (2.86×10^{-6})***
Age	0.001584 (0.000491)***	0.002053 (0.000500)***	0.002412 (0.000490)***	0.001954 (0.000490)***	0.000785 (0.000122)***	0.002597 (0.000505)***
Age × Age	-3.94×10^{-6} (3.68×10^{-6})	-3.94×10^{-6} (3.68×10^{-6})	-1.05×10^{-5} (3.68×10^{-6})***	-8.68×10^{-6} (3.67×10^{-6})***	-1.42×10^{-5} (3.81×10^{-6})***	-1.04×10^{-5} (3.80×10^{-6})***
Size	0.007935 (0.000167)***	0.008168 (0.000170)***	0.008002 (0.000168)***	0.007704 (0.000168)***	0.005029 (6.64×10^{-5})***	0.008321 (0.000170)***
Size × Size	-7.59×10^{-6} (3.77×10^{-7})***	-8.00×10^{-6} (3.84×10^{-7})***	-7.71×10^{-6} (3.77×10^{-7})***	-7.26×10^{-6} (3.77×10^{-7})***	-8.30×10^{-6} (3.90×10^{-7})***	-8.15×10^{-6} (3.76×10^{-7})***
Parking onsite	0.037509 (0.010415)***	0.037509 (0.010415)***	0.055876 (0.010401)***	0.036991 (0.010409)***	0.086069 (0.010858)***	0.054918 (0.010735)***
Rural	–0.057876 (0.010111)***	–0.057876 (0.010111)***	–0.067325 (0.010103)***	–0.061424 (0.010095)***	–0.064312 (0.010782)***	–0.082464 (0.010363)***
Private	0.030205 (0.023468)	0.030205 (0.023468)	0.035640 (0.023485)	0.042281 (0.023409)***	0.133855 (0.024722)***	0.107201 (0.024071)***
ASB × Z	2.47×10^{-6} (7.50×10^{-8})***	2.47×10^{-6} (7.50×10^{-8})***	2.24×10^{-6} (6.94×10^{-8})***	2.62×10^{-6} (7.90×10^{-8})***	4.79×10^{-7} (1.27×10^{-8})***	1.24×10^{-6} (1.03×10^{-8})***
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
LGD Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Property Type Dummies	Yes	Yes	Yes	Yes	Yes	Yes
EPC Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Ext Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Obs	14521	14521	14521	14521	14521	14521
R^2	0.675570	0.675570	0.674713	0.675966	0.651339	0.654687
Adj R^2	0.674471	0.674471	0.673611	0.674868	0.650158	0.653566
F	614.9659	614.9659	612.5683	616.0784	551.7033	583.8237
Prob(F)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Notes: LGD = Local government district; EPC = Energy Performance Certificate; Ext = Condition of external repair. *** indicates 1% statistical significance.

more severe effects on property values. Viewed from another perspective, high-income households appear willing to pay a price premium to distance themselves from areas affected by anti-social behaviour and its associated activities. This observation aligns with the conceptual argument put forth by McCann (2013), who suggests that income-based residential segregation emerges as affluent individuals increasingly cluster within certain neighbourhoods, driven not only by considerations such as commuting costs and proximity to employment centres but also by the desire to secure a safer and more desirable living environment.

Robustness check[3]

As a robustness check for potential spatial autocorrelation in property prices, as well as omitted variables that could bias our results, we developed three spatial lagged models[4] (SLMs) (Models 18–20) to incorporate a spatial lag (SL) term, $\sum_{j=1}^{m}\ln\left(Price\right)_j$, in order to account for spatial dependence in housing prices (Equation (2)). The spatial lag (SL) captures the price effects of neighbouring properties, *j*, sold within two months of the subject property's transaction. *m* is the number of prior transactions. *w* is the spatial weight that governs the structure of the spatial dependence, defined as 1/d, where d represents the

[3] We thank an anonymous reviewer for their valuable feedback on the robustness of our empirical models, particularly regarding potential spatial autocorrelation/dependence in property prices, endogeneity, and omitted variable bias.

[4] According to Anselin (1988), spatial lag models address omitted variable bias by incorporating the spatial dependence between observations, where the value of the dependent variable in one location may be influenced by values in neighbouring locations. By including a spatially lagged dependent variable, the model controls for unobserved factors that are shared across properties, thus reducing the potential for omitted variable bias that arises from ignoring spatial correlations (LeSage & Pace, 2009). This approach ensures that the effects of local unobserved factors, which might affect both the dependent variable and independent variables, are captured, leading to more accurate and unbiased estimates.

Table 8. Results of robustness models

	Model 18 (SLM 1)	Model 19 (SLM 2)	Model 20 (2SLS)
Constant	9.234866 (0.098423)***	10.03455 (0.122770)***	11.65343 (1.53242)**
ASB	–0.002611 (0.000755)***	–0.004122 (0.000978)***	
ASB × ASB		3.42×10^{-5} (1.61×10^{-6})***	
$\widehat{ASB}$			–0.004934 (0.000723)**
$\widehat{ASB}\times\widehat{ASB}$			3.72×10^{-5} (1.43×10^{-6})***
Age	0.001332 (0.000051)***	0.002344 (0.000007)***	0.002423 (0.000126)***
Age × Age		-1.11×10^{-5} (3.01×10^{-6})***	-1.24×10^{-5} (1.72×10^{-6})***
Size	0.004137 (6.23×10^{-5})***	0.006478 (0.000154)***	0.005343 (0.000243)***
Size × Size		-5.21×10^{-6} (2.82×10^{-7})***	-2.66×10^{-6} (1.23×10^{-7})***
Parking onsite	0.077516 (0.019778)**	0.075456 (0.006855)***	0.043993 (0.009233)***
Rural	–0.043112 (0.009224)***	–0.064521 (0.008455)***	–0.068233 (0.008433)***
Private	0.163219 (0.022415)***	0.138541 (0.012894)***	0.112243 (0.015488)***
SL Term	1.418073 (0.057915)***	1.219452 (0.048232)***	1.218323 (0.048482)***
Time Dummies	Yes	Yes	Yes
LGD Dummies	Yes	Yes	Yes
Property Type Dummies	Yes	Yes	Yes
EPC Dummies	Yes	Yes	Yes
Ext Dummies	Yes	Yes	Yes
Obs	13,421	13,421	13,421
R^2	0.693112	0.715510	0.703323
Adj R^2	0.690094	0.711445	0.700238
F	651.3461	655.3474	647.5213
Prob(F)	0.000000	0.000000	0.000000

Notes: ** and *** indicate 5% and 1% statistical significance respectively.

Euclidean distance between property i and property j. Ω is a coefficient to be estimated, representing the weighted average effect arising from the spatial dependence of neighbouring properties. Models 18 and 19 are reformulations of Models 1 and 2, respectively, which account for the spatial dependence of property prices.

$$\mathrm{Ln}\left(Price\right)_i = c+\Omega\sum_{j=1}^{m} w\ \mathrm{ln}\left(Price\right)_j+\alpha\times ASB+\sum_{j=1}^{m}\beta_j S_j+ \sum_{k=1}^{n}\gamma_k LGD_k+\sum_{p=1}^{r}\gamma_p PT_p+\sum_{q=1}^{s}\mu_q T_q+\sum_{u=1}^{v}\mu_u Z_u+e, \quad (2)$$

We further develop Model 20, which follows a two-stage least squares (2SLS) regression approach to address potential endogeneity in the relationship between ASB and property prices. In the first stage, we regress ASB (the endogenous variable) on an instrumental variable– previous ASB values in 2010 – and a set of control variables abovementioned. The instrumental variable, previous ASB, is assumed to be correlated with current ASB but not directly with property prices, making it a valid instrument. The predicted values of ASB from this first-stage regression, $\widehat{ASB}$, are used as the instrumented variable in the second-stage regression. In the second stage, we estimate the effect of ASB on property prices by regressing the natural logarithm of property prices on the predicted values of ASB (from the first stage) and other control variables. This two-stage approach allows us to isolate the exogenous variation in ASB, removing any bias that may arise from simultaneity or omitted variable bias in the relationship between ASB and property prices. Table 8 presents the results for the three robustness models. For Models 18 and 19, we observe that the estimates for the main variables, including ASB, ASB × ASB, and other control variables, remain largely consistent with those of the non-spatial models (Models 1 and 2) in terms of both the signs and magnitudes of the coefficients. Additionally, both the R^2 and adjusted R^2 values show a moderate improvement with

the incorporation of the spatial lag terms, which exhibit a positive and statistically significant coefficient, indicating spatial dependence in property prices. Lastly, Model 20 presents the results of the 2SLS model. The coefficients on the predicted values of ASB (i.e., $\widehat{ASB}$) as well as its squared terms exhibit values and statistical significance consistent with those of the non-2SLS models, thereby confirming the robustness of our results.

6. Discussion

The findings of this study provide robust empirical evidence that ASB exerts a significant and negative influence on residential property prices in Northern Ireland, after accounting for property-level and temporal attributes. These findings resonate with the established literature, which has long identified a negative relationship between socially undesirable behaviours and property values (e.g., Braakmann, 2012). Through the application of hedonic regression models, the analysis demonstrates that areas with higher incidences of ASB experience notable depreciation in property values, a trend that largely aligns with previous studies conducted in the U.K. and internationally. Specifically, the results underscore that the impact of ASB on property prices is neither constant nor linear across different spatial and socioeconomic settings of the property market. Instead, it is highly dependent on a variety of property-level and district-specific factors. As Bonakdar and Roos (2023) highlighted, the influence of neighbour quality on property prices varies significantly depending on the characteristics of both the property and the neighbourhood. This variability suggests that ASB's effect is, contrary to common perceptions, multifaceted, influenced by the characteristics of individual properties and the broader social and economic context of the neighbourhoods in which they are situated. For instance, while all property types experience depreciation in response to ASB, the magnitude of this effect varies significantly, highlighting the complex nature of ASB's impact on housing markets. This complexity was also observed by Marsden (2018), who noted that common ASB-related neighbour disputes, such as noise and public hygiene issues, are more likely to reduce property values in urbanised settings with higher density, a point that is central to our study's findings.

One of the pivotal findings of this study is that the adverse impact of ASB on property values is markedly more pronounced in urban areas, with Belfast emerging as a particularly affected locale. This is in line with the arguments made by Besley and Mueller (2012), who found that urban environments, particularly those with high population densities and historical socio-political divisions, tend to experience greater negative effects from ASB. Urban environments, defined by higher population densities and pronounced social heterogeneity, exhibit a heightened vulnerability to the pernicious effects of ASB. In Belfast, the city's diverse demographic fabric–comprising varied religious, cultural, and educational backgrounds–serves as a potential catalyst for ASB. The social tensions and frictions that naturally arise from these differences may exacerbate levels of social disorder, thereby amplifying the prevalence and intensity of ASB. This dynamic underscores the complex interplay between urban diversity and social cohesion, suggesting that the negative externalities of ASB in cities like Belfast are deeply intertwined with the broader sociocultural landscape. Consequently, addressing ASB in such contexts requires a nuanced understanding of the underlying social dynamics that fuel these behaviours.

The differential impact of ASB on various property types is another noteworthy finding. Apartments, in particular, are more adversely affected by ASB in terms of property valuation, whereas detached houses experience the least impact. Several factors may explain this disparity. As Ceccato and Wilhelmsson (2011) pointed out, apartment buildings are more susceptible to the negative effects of social disorders due to shared spaces that foster communal disturbances, such as noise nuisance, pets' barking, and public hygiene concerns. Apartments typically have more communal areas, such as shared hallways, staircases, and outdoor spaces, which can serve as hotspots for ASB. Moreover, issues like noise nuisance, pets' barking, and defecation are more common and noticeable in apartment settings due to the closer proximity of housing units. The lower tolerance levels for such disturbances among apartment dwellers, combined with the higher visibility of ASB in these settings, likely contribute to the more substantial price reductions observed in apartment markets. In contrast, detached houses, often located in less dense and more socially stable and prestigious areas, are less exposed to these issues and therefore less impacted by ASB.

Privately built houses also display a markedly greater resilience against the price-depressing effects of ASB compared to their publicly developed counterparts. This could be attributed to better management practices and strategies typically employed in private developments. Such developments usually have access to more substantial resources and possess stronger incentives to proactively address and mitigate issues related to ASB. Conversely, public housing estates, frequently situated in socioeconomically disadvantaged areas, are often hindered by insufficient social infrastructure and underfunded management, which impairs their ability to effectively counteract the adverse consequences of ASB. This observation underscores the pivotal role that governance and management practices within housing developments play in determining the extent to which ASB can influence property values. Therefore, the resilience of privately built homes against ASB-induced price depreciation may be indicative of superior governance structures that prioritise the maintenance of property value and community well-being.

The study further elucidates the subtle interconnection between ASB and the social and economic characteristics of neighbourhoods. This is in line with the literature on socio-economic segregation and residential preferences. As McCann (2013) suggests, high-income households tend to avoid areas with higher levels of ASB, driving a form

of residential segregation based on safety concerns and neighbourhood desirability. ASB is intricately linked with various indicators of socioeconomic disadvantage, such as poverty, educational attainment, and crime rates, underscoring the broader structural and contextual factors that precipitate its occurrence. In communities marked by heightened deprivation, the prevalence of ASB tends to be proportionately more pronounced, thereby compounding the multifaceted challenges already confronting these areas. This finding is consistent with Knox (2011), who demonstrated that the socio-economic conditions of a neighbourhood–specifically, high levels of poverty and unemployment–are key factors that increase the prevalence of ASB.

The spatial coalescence of ASB with other social and economic adversities indicates that any effective strategy for addressing ASB must adopt a geographically comprehensive and integrative approach. This is a critical point, highlighted by Topping (2008), who argue that addressing ASB requires not just reactive measures, but proactive interventions targeting the root causes of social inequality and deprivation. Such interventions should extend beyond merely targeting ASB in isolation and must also engage with the underlying socioeconomic conditions that, in many instances, foster its emergence. By addressing the root causes, rather than just the symptoms, a more sustainable and impactful resolution to ASB can be achieved, ultimately contributing to the broader social and economic revitalisation of affected communities.

7. Conclusions

In conclusion, this study has provided a comprehensive examination of the impact of anti-social behaviour on property prices, offering new insights into the economic implications of ASB within the housing market. Through the application of hedonic regression models, we have empirically demonstrated that ASB acts as a significant negative externality, leading to a measurable depreciation in property values across different regions of Northern Ireland. This investigation is of originality, being one of the first to empirically quantify the relationship between ASB and property prices using actual market data–a contribution that fills a notable gap in the existing housing literature.

One of the key conclusions drawn from this study is that the relationship between ASB and property valuation is dynamic and not stationary. Unlike structural features of a property, which are relatively fixed and observable, ASB is a phenomenon that can fluctuate over time and across space. As such, it is crucial not to view ASB in isolation but rather within the broader socioeconomic context of the neighbourhood. Our findings indicate that the impact of ASB on property prices varies significantly across different property types and neighbourhoods, reflecting the complex interplay between ASB and the social and economic characteristics of the areas in which it occurs.

For instance, apartments and properties in densely populated urban areas are particularly vulnerable to the price-depressing effects of ASB, while detached houses in more affluent and less dense areas are less affected. This variation underscores the importance of considering both property-specific and neighbourhood-level factors when assessing the economic consequences of ASB. It also highlights the need for a more nuanced understanding of the ASB-price relationship, one that recognises the heterogeneity of the housing market and the diverse ways in which ASB can manifest.

From a policy perspective, the findings of this study carry important implications. Policymakers and real estate practitioners must not overlook the economically damaging effects that ASB can have on society. Although ASB may not be as easily observable or quantifiable as other factors influencing property prices, this does not diminish its economic significance. As evidenced by our study, a 10% escalation in ASB can precipitate a 1% decline in property values–a significant impact with far-reaching implications for both the societal and economic landscape. The fact that ASB remains an under-researched phenomenon, often concealed from prospective buyers, further underscores the necessity of addressing this issue. Pertinently, its pervasive yet understated influence on property markets demands greater scholarly attention and more proactive measures to mitigate its detrimental effects.

In addition, we contend that a clearer conceptualisation of the ASB-price relationship, alongside statistically robust assessments, could enhance market transparency and reduce information asymmetry between buyers and sellers. Unlike physical defects in a property, which are typically visible during inspections, ASB is often "hidden" and can have a spatiotemporal dimension. For example, a potential homebuyer may not notice that a neighbouring property is the source of frequent noise disturbances if they only visit during quiet periods. By improving our understanding of how ASB affects property values, the market can become more informatinally efficient and equitable, ensuring that buyers are better informed and that the true costs of ASB are reflected in property prices.

Lastly, despite the significant contributions of this study, certain limitations warrant careful consideration. The exclusive focus on Northern Ireland, while yielding valuable insights, may constrain the generalisability of the findings to other regions with differing historical, economic, and cultural contexts. Future research should aim to investigate the relationship between ASB and property prices across a broader spectrum of geographical settings, thereby validating and extending the current findings. Secondly, further inquiry is necessary to explore the specific types of ASB that affect property prices. In our analysis, ASB is quantified by the number of incidents within a given geographic area, which serves as a somewhat crude measure of ASB intensity. However, ASB is a heterogeneous phenomenon, encompassing a wide range of activities, each varying in severity, from minor nuisances such as noise disturbances to more severe acts verging on criminal behaviour, such as intimidation or near-assault. Aggregating it without considering variations in type, severity, or

spatial context may obscure significant differences in how various forms of ASB impact property values. Future research should, therefore, aim to address this limitation by incorporating more granular data, such as disaggregated measures of ASB, to better capture the complexities of its effects on property prices. By disaggregating ASB into specific activities, we could assess their differential impacts on property markets, offering valuable insights for policymakers and urban planners. In addition, the temporal dynamics of ASB and its long-term effects on property prices warrant further exploration. Understanding how ASB patterns evolve over time, particularly in relation to macro-political and economic shifts, and the mechanisms through which ASB influences housing demand and prices–especially in the context of government interventions–will be crucial for informing more effective policy responses.

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Author contributions

DL and MM conceived the study and were responsible for the design and development of the data analysis. DL, MM and JM were responsible for data collection. DL was responsible for data analysis and data interpretation. DL, YH and YY were responsible for the literature review. DL, YH and MM wrote the first draft of the article. MH, TA, YY, JM and LAH were responsible for validation and editing.

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