# How local policy impacts the supply and price of short-term rentals.

## A case study on the municipality of Groningen.

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**A Master's Thesis Submitted to the Faculty of Spatial Sciences**

**University of Groningen**

In Partial Fulfillment of the Requirements for the Degree of:

**Master of Economic Geography**

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Date of Submission: 02-07-2024 (DRAFT)

Word count: 10183

**Abstract**

The rapid growth of online short-term rental (STR) platforms, such as Airbnb, has substantially transformed urban housing markets, impacting housing affordability and availability. This thesis examines the impact of the 2023 municipal policy in Groningen, the Netherlands, which limits the tourist rental of private residences to 30 nights per year. Utilizing theories of housing market dynamics and urban economic impacts of short-term rentals, this study employs a Difference-in-Differences (DiD) methodology to analyze the effects on the supply and price dynamics of STRs, utilizing data from Airbnb across multiple municipalities for comparative analysis. The findings indicate that the policy led to a marginal but statistically significant increase in the average daily revenue (ADR) of STR properties in the municipality of Groningen. Additional research revealed that the anticipated decrease in the number of properties available for rental periods exceeding 30 nights was minimal, indicating substantial non-compliance among hosts. These results underscore the complexities of STR market regulation and highlight the necessity for robust enforcement mechanisms. The study contributes to Economic Geography, Urban Studies, and Housing Policy by providing insights into the interplay between local policy and STR markets, informing future policy development to prevent exacerbating housing affordability issues.

**Abbreviations and Key Terms**

**STR**: Short Term Rental
**BnB**: Bed and breakfast
**DiD**: Difference-In-Difference (Analysis)
**ADR**: Average Daily Revenue (USD)
**USD**: United States Dollar
**H1 / H2 / H3**: Hypothesis 1, 2 or 3.

# Introduction to the Research

The growth of online short-term rental (STR) platforms such as Airbnb has revolutionized the housing market, providing homeowners with new opportunities to monetize their properties. Due to the substantial financial returns, particularly during periods of high demand, property owners opt to rent out their homes through STR platforms such as Airbnb. Unlike the long-term rental market, which is subject to various rent control regulations (Rijksoverheid.nl, 2024), STRs provide greater flexibility and potential for higher earnings. This economic incentive results in a preference for STRs over LTRs, diminishing long-term rental property supply. This phenomenon has introduced significant challenges for urban housing markets, including rising rent prices and reduced availability of long-term housing (Furukawa & Onuki, 2022; Chen, Wei, & Xie, 2019; Li, Kim, & Srinivasan, 2020; Duso, et al. 2020; Wachsmuth, 2018). This research investigates the impact of the 2023 municipal policy in Groningen. By comparing the supply, price, and composition of types of property of STRs before and after the policy implementation, this study aims to provide a comprehensive analysis of its effects on the local housing market.

**Overview of the 2023 Municipal Policy**

On January 1, 2023, the Municipality of Groningen implemented a policy limiting the tourist rental of private residences to a maximum of 30 nights per year (Groningen.nl, 2023). This measure aims to prioritize properties for long-term residential use, and in this way, mitigate the effects of the housing crisis by encouraging the availability of homes for long-term rentals. The policy mandates that property owners register their rentals and include the registration number in advertisements on platforms such as Airbnb. Non-compliance can result in fines, ranging from 450€ to 22.500€ (Groningen.nl, 2023). Exceptions exist for bed and breakfasts and properties in the former municipality of Ten Boer, and the policy also outlines registration procedures and the requirement to pay tourist tax. The full details of this policy and its various components are discussed later in this research.

**Academic and Societal Contributions**

This thesis contributes to multiple fields, including Economic Geography, Urban Studies, and Housing Policy, by examining the intersection of local regulations and the dynamics of short-term rental markets. It extends existing literature in urban economics and housing policy, providing an empirical analysis of regulatory impacts on supply and pricing dynamics in short-term rental markets. Previous research highlights the impact of short-term rentals on long-term rentals and the housing market as a whole (Furukawa & Onuki, 2022; Chen, Wei, & Xie, 2019; Li, Kim, & Srinivasan, 2020; Duso, et al. 2020; Wachsmuth, 2018). These studies have shown that the increasing presence of short-term rentals can significantly contribute to rising house prices, while effective policy implementation has the potential to mitigate these effects, thus easing market tensions. Policy evaluation research has been conducted in Berlin, Lisbon, Los Angeles, and Denmark (Adam, 2021; Duso et al., 2020; Almeida, Oliveira, & Silva, 2021; Garz & Schneider, 2023). While there is extensive research on short-term rentals, studies evaluating Dutch policies are limited. Notable exceptions include Amsterdam, whose unique context is not representative of other Dutch regions. With 26 regions recently implementing similar policies (Toeristischeverhuur.nl, 2024), this thesis examines these regulations in Groningen, making it timely and relevant for Dutch cities and regions. Societally, this research addresses broader concerns about housing affordability and urban planning in the context of

the sharing economy. By providing insights into how local policies affect short-term rental markets, this research aims to inform effective policymaking, ensuring that the rising popularity of short-term rentals does not undermine housing accessibility and community cohesion. Groningen's housing market, characterized by a large student population and high demand for rental properties, offers a unique context for examining the impacts of STR regulations. The severity of Groningen's housing shortage is highlighted by the multiple instances where students have been forced to sleep in tents due to the unavailability of rooms (The Northern Times, 2022; NOS, 2018; Ukrant, 2021). This underscores the real-world relevance of the problem and the necessity for effective policy solutions.

**Research Question and Hypotheses**

To assess the impact of the 2023 municipal policy on short-term rentals in Groningen, this research aims to address the following question:

- *How does the municipal policy of 2023 impact the supply and price of short-term rentals in the municipality of Groningen, in comparison to the year before?*

To systematically structure this investigation, three hypotheses were formulated based on a review of relevant literature. These hypotheses are designed to explore the anticipated effects of the policy:

- Hypothesis 1 (H1): *Short-term rental prices will increase due to reduced supply, negatively affecting the availability, and positively affecting the cost, of properties.*
- Hypothesis 2 (H2): *The 30-night restriction embedded in this policy will reduce the number of properties available for rental periods exceeding 30 nights.*
- Hypothesis 3 (H3): *The requirement for a bed and breakfast setting for rentals beyond 30 nights embedded in this policy will lead to a decrease in the number of properties listed as 'Entire home/apartment'*

These hypotheses are derived from the analysis of existing studies on short-term rental markets, housing policy, and urban (housing) economics, providing a foundation for investigating the policy's impact.

**Thesis Structure**

The thesis is structured as follows: The literature review explores the existing body of research on the impact of STRs on housing markets, highlighting issues such as affordability, displacement, and various regulatory responses. The section on policy implications examines the Dutch Housing Act and the role of municipal governments in housing regulation, with a particular focus on the strategies adopted by Groningen and Amsterdam. The data and methodology section describes the sources of data, the variables used in the analysis, and the Difference-in-Differences (DiD) methodology employed to evaluate the impact of the policy. The results section presents the findings of the DiD analysis, detailing the effects of the policy on STR prices and availability, as well as further analysis on adherence to the policy. Followed by the discussion that interprets the results, compares them with findings from similar studies, and suggests policy implications based on the study's outcomes. Lastly, the research reflects on its limitations.

# Literature Review

This literature review aims to provide a comprehensive understanding of the factors influencing the short-term rental (STR) market. By examining the dynamics of housing markets, the Dutch Housing Act, the role of municipal involvement, and related policy implications, this review establishes a foundational framework for analyzing the 2023 municipal policy in Groningen.

## Dynamics of the Housing Market: Short and Long-term Rentals

Understanding the housing market's dynamics, particularly the distinction between short-term and long-term rentals, is essential for evaluating the impact of STR policies. Due to the growth of online Short-term housing rental (STRs) platforms like Airbnb, which give homeowners the chance to host guests periodically, STRs and their impact on the housing market have gained significant importance in academic and policymaking circles (Koster, van Ommeren, and Volkhausen, 2021). While Airbnb and other short-term rental platforms can bring attention and money to neighborhoods, they can also cause disruptions to the traditional lodging industry and initiate gentrification processes; the affordability and availability of housing are put at risk when residential properties are converted into vacation rentals (Nieuwland and van Melik, 2018). Besides gentrification, Li, Kim, and Srinivasan (2022) highlight how the direct reduction of long-term housing supply as a factor that pressures affordable housing. This is especially the case in cities where Airbnb is popular due to high levels of tourist attraction (Franco, Carlos Daniel Santos, and Longo, 2019). Duso et. al. (2020) further argue that, besides the differences between cities, within cities, the impact STRs have on rental prices is more prevalent in Airbnb listings that are rented out for a greater portion of the year, something which may stimulate greater speculation and thus produce negative externalities in these markets. Research has also found that these markets can create additional negative externalities, including noise, nuisance, and decreased (perceived) safety as a result of tourists persistently occupying residential buildings (Williams, 2016; Filipinas and Horton, 2014; Koster, van Ommeren, and Volkhausen, 2021; Almeida, Oliveira, and Silva, 2021). Boutsioukis, Fasianos, and Petrohilos-Andrianos (2019) use the terminology of ‘touristification’ while describing the disruption of local communities that STRs bring. Moreover, Almeida, Oliveira, and Silva, (2021) highlight that outside of social impact, STRs harm the financial playing field by utilizing unfair competition practices and tax evasion by hosts. Unfair competition practices include operating without adhering to the same regulations and tax obligations that apply to traditional lodging businesses, giving non-compliant hosts an economic advantage. This advantage stems from their ability to compete with lower prices, as they incur lower operational costs by evading tax payments or regulatory fees.[1]

[1] While this is undoubtedly an important factor in shaping the macroeconomic characteristics of these markets, a detailed exploration of this issue is beyond the scope of this work.

Evaluating the potential impact of short-term rentals on local real estate markets requires an understanding of the relative elasticities of supply and demand in response to price changes. Neo-classical economics theorizes that market forces-driven interactions naturally lead to an equilibrium price, reflecting efficient market conditions (de Vries and Boelhouwer, 2005). However, this approach assumes that markets are perfectly competitive and that both supply and demand are unrestricted, which is clearly not the case in the housing market. Moreover, it overlooks externalities, failing to consider how goods and services might impact local environments and economies adversely (de Vries and Boelhouwer, 2005). Both arguments highlight the imperfection of free markets, suggesting that prices established under these conditions may not always be justifiable, indicating a need for market intervention to enhance functionality and achieve optimal results. Within international literature, two schools of thought are dominant. One school argues that price equilibrium often emerges within the existing housing stock, implying that additional supply rarely impacts price developments (de Vries and Boelhouwer, 2005). This phenomenon is particularly pronounced in countries with limited building land and tightly regulated housing and house-building sectors, such as the Netherlands. In such contexts, housing supply constraints make prices less responsive to increases in supply (de Vries and Boelhouwer, 2005). In these cases, constrained supply exacerbates affordability issues, as the fixed number of available properties, and corresponding increases in demand, prompt price increases.

The second school argues that the introduction of new housing considerably influences market conditions. It contends that, in robust housing markets, construction costs will primarily determine house price trends. Given the housing supply's inelasticity—largely attributed to the lag between initiating construction and the availability of new housing—it can take several years for the supply to adjust adequately. The theory underlying this supply-directed strategy is that, over time, the cost of newly constructed housing will equal its manufacturing costs, eventually leading to more stable and predictable housing prices (de Vries and Boelhouwer, 2005). One issue here is that the local spatial planning policy frequently causes significant disruptions to the supply and demand dynamics in housing markets, which leads to supply not being available at the appropriate time or location (Cheshire, 2018; McGuinness, Greenhalgh, and Grainger, 2018; de Vries and Boelhouwer, 2005). An example of such disruption is the 30-night rent restriction policy by the municipality of Groningen on STR's. Due to this policy constraining the supply of STRs, it is expected that short-term rental prices may increase, provided that demand remains constant, affecting the availability and cost of properties offered on the STR market. This dynamic leads to Hypothesis 1: *short-term rental prices will increase due to reduced supply, negatively affecting the availability and positively affecting the cost of properties.* Spatial policy implications on long-term rentals are interconnected with policy implementations of short-term rentals due to their shared dynamics in wider housing markets (Colomb & Souza, 2021). Here, the regulation of one can heavily impact the other's market and *vice versa*, necessitating urban planning to consider these interdependencies. This will be delved deeper into in the following section.

## Policy implications

### Historical Context and Evolution of the Dutch Housing Act

The Dutch Housing Act is central to housing policy in the Netherlands, offering historical context and outlining current aims. The Act's focus on affordable housing, diversity, and reduced spatial segregation is crucial for understanding municipal interventions in these markets. The Dutch Housing Act of 1901 laid the foundation for social housing and housing associations, holding the government and municipalities accountable for providing affordable housing, promoting diversity, and reducing spatial segregation (Priemus, 2006). Over time, these policies evolved, reflecting socioeconomic shifts and the history of the welfare state. Currently, housing associations manage around 75% of rental properties and comprise 37% of the overall housing stock (Priemus, 2010). Unlike the United States, for example, which emphasizes homeownership (Landis & McClure, 2018), Dutch policies have traditionally focused on providing affordable rental housing for low- and moderate-income families (Boelhouwer, 2016). Recent policies, however, have led to increased house price gains and rental yields, contributing to the rising popularity of landlordism in the Netherlands.[2] The 2015 Housing Act introduced further changes to re-regulate the housing market post-2008 financial crisis (van Gent & Hochstenbach, 2019). Key provisions include income eligibility guidelines for 90% of housing association stock and a universal maximum on social housing rent prices (Rijksoverheid.nl, 2024). In the free market sector, while direct rent price limitations are absent, restrictions on rent increases are enforced (Rijksoverheid.nl, 2024).[3] Annual evaluations and revisions of the Housing Act ensure its continued relevance and effectiveness.

### Role of (Dutch) Municipalities in Housing Regulation

Municipalities hand-tailor approaches to regulation for each region-specific goals and challenges. The municipalities of Amsterdam and Groningen, for example, tackle urban housing through targeted strategies, with the former rejuvenating its rental market for middle-income residents and the latter addressing student housing pressures through regulatory measures and active involvement in development (Hochstenbach and Ronald, 2020; Gemeente Groningen, 2024; Groningen.nl, 2024). These approaches reflect the different challenges faced by each municipality and highlight the municipalities' pivotal roles in promoting balanced urban development. By examining local regulations on STRs, student housing, and middle-income rentals, we can understand the scope and limitations of municipal actions.

Making use of its 80 percent land ownership, the municipality of Amsterdam is coordinating a focused revival of the private rental market with an eye toward accessibility and affordability (Hochstenbach and Ronald, 2020). In this revival, the focus is on fostering housing solutions for middle-income classes through for example coordinated (re) construction of dwellings to be purposed for the target demographic, or by stimulating housing associations to rent out a greater proportion of stock to the middle class. This roll-out of market-based rentals is thought to be a means of a way to compensate for the successful, state-led low-cost social renting developments (Hochstenbach and Ronald, 2020) in which the middle class was not a priority, illustrating how state and municipal visions complement each other while collaborating with the housing association.

[2] Similar to patterns in the UK (Hochstenbach, Wind, & Arundel, 2021)
[3] Similar restrictions can be observed in Ireland (Conor O'Toole, Martinez-Cillero, & Ahrens, 2021)

Due to Groningen's large student population, which has a distinctive influence on the city's housing market, creative municipal initiatives are required to guarantee balanced urban growth. Student households, households of which all members are students, make up 25% of the total households (CBS, 2018), the highest share in the whole country. In response to the escalating demand for student housing, the city's housing dynamics are characterized by a noticeable change toward a concentration of landlord-owned property within the city (Hochstenbach, Wind, and Arundel, 2021). The University of Groningen's international appeal in recent years further compounds the pressure that students inflict on the housing market, as currently 25% of the University's students and nearly 50% of its staff are from abroad (Berkel and Termeer, 2021).

Since 2008 (Gemeenteraad Groningen, 2013) the municipality of Groningen invoked a zoning restriction allowing a maximum of 15% of the houses per street to be used for 'independent room rental' to ensure a balanced coexistence of students and non-student residents. In 2019 the municipality opted for a stricter streamlining of new students' housing to the market by mandating landlord permits for each student housing provider, both private and commercial (Gemeente Groningen, 2019). Similarly, the municipality of Amsterdam implemented a strict maximum of independent room rental properties per neighborhood in conjunction with a landlord permit requirement (Overheid.nl, 2024). Acknowledging the pressure the universities put on Groningen, the municipality is involved in, and stimulates, multiple building projects to provide solutions for student housing (Gemeente Groningen, 2024; Groningen.nl, 2024).

**Municipal Regulation of Short-term Rentals**

The Municipality of Groningen has implemented regulations for the tourist rental of private residences and houseboats (Groningen.nl, 2023), becoming the 16th municipality to join the national list of municipalities that adopted similar policies (Toeristischeverhuur.nl, 2024). Active from January 1, 2023, renting out residential properties to tourists is limited to 30 nights per year due to the rising popularity of STR platforms and the national housing shortage (Groningen.nl, 2023). In Groningen, a growing number of residences are being rented out to tourists year-round, making these properties unavailable to renters. Furthermore, the municipality states that it is counter-productive in creating a sense of community and is prone to causing nuisances (Groningen.nl, 2023). Both arguments are found frequently in existing literature (Filippas and Horton, 2014; Almeida, Oliveira, and Silva, 2021; Boutsioukis, Fasianos, and Petrohilos-Andrianos, 2019).

The 30-night rule includes registration requirements[4], fines for non-compliance[5], and exceptions for the Ten Boer region where no housing shortage exists (Groningen.nl, 2023). If the total days rented per year exceed the 30-night limit, hosts will face fines of 450 euros per night, capped at 12,000 euros.[6] The clear-cut 30-night limit and accompanying fines contribute to the formulation of Hypothesis 2: *The 30-night restriction will reduce the number of properties available for rental periods exceeding 30 nights*.

An exception to the 30-night rule is created for properties that meet municipality requirements to be characterized as "Bed and Breakfasts (BnB)" (Groningen.nl, 2023).[7] One such criterion is that the host

[4] Eligible hosts must register their property at the national tourist rental registry (Registratie Toeristische Verhuur) for free and display the registration number in their listing
[5] Renting without a registration number will result in a fine of 500 euros.
[6] The host must record and report the number of rental nights to The Northern Tax Office and is responsible for proving this information (Groningen.nl, 2023).

and guests must stay in the same building, a restriction that limits individuals from renting while on vacation or renting multiple properties simultaneously. This leads to Hypothesis 3*: The requirement for a bed and breakfast setting for rentals beyond 30 nights embedded in this policy will lead to a decrease in the number of properties listed as 'Entire home/apartment'*

Similar restrictions can be observed in municipalities that have adopted the national registration number requirement (Toeristischeverhuur.nl, 2024). For example, the municipality of Amsterdam adheres to even stricter rules. The same 30-night limit is put in place with the additions to acquire a permit from the municipality, reporting of each different renting period, restriction on the maximum number of guests at a time, and notably higher fines starting at 8700 euros (Amsterdam, 2024a; Amsterdam, 2024b). The Municipality has similar exemptions where the BnB requirements are again stricter than in Groningen (Amsterdam, 2024c).

What provides major challenges to STR regulation in the housing market are rapid technological innovations that fuel and enable platforms like Airbnb to exist and evolve (Jefferson-Jones, 2015). Different tactics, visions, priorities, and implementations have been observed globally, succeeding to various degrees. In Paris, one of the biggest markets for Airbnb with over 60,000 listings in 2015 saw the implementation of a policy prohibiting STR hosts from listing more than one residence with fines of up to 25,000 euros. Nonetheless, the number of STR hosts that had more than one listing has kept rising (Adam, 2021). In the United States, some of the strictest regulations on STRs have been put in place by the City of Santa Monica in California with most notably an extra 14% occupancy tax on STRs (Adam, 2021). Even more directly, the city of Lisbon has implemented a ban on new applications for short-term rentals in certain districts (Almeida, Oliveira, and Silva, 2021). Additionally, Barcelona has announced plans to implement a city-wide ban on all short-term rentals (Carey, 2024).[8]

In 2018, Denmark negotiated a data-sharing agreement with Airbnb to share income data with the tax agency (Garz and Schneider, 2023), comparable to the EU's DAC7 directive[9] which mandates platforms to exchange data about sales of products and services (Europa.eu, 2021). This agreement led to a 14% decrease in hosts listing their residences and an 11% increase in listing prices. Most exits were from single-property hosts, while multi-property hosts increased bookings, hinting at the commercialization of the STR market in Denmark (Garz and Schneider, 2023). The 2016 zero-tolerance ban on renting out entire apartments in Berlin, with fines of up to 100,000 euros (Adam, 2021), has shown a significant impact on the long-term rental market as it deeply affected commercial listings specifically (Duso et al., 2024). Duso et al., (2024) mark listings as 'commercial' when the availability of a listing is over 180 days per year while generating more revenue than the long-term rental revenue of a similar property. They specifically highlight the importance of tackling commercial listings, as they are more likely to reduce the long-term rental supply (Duso et al., 2024). However, specifically targeting those commercial listings was not the focus point of the 2018 policy implementation in Berlin, which followed up on another 2016 policy, and where the Danish data-sharing agreement may have achieved the opposite (Garz and Schneider, 2023; Duso et al., 2024).

In the regions where policy measures have been implemented, further challenges arise when considering successfully implementing and enforcing the new policies (Adam, 2021). Where Airbnb

[7] The BnB owner should be registered with the National Chambers of Commerce, the BnB location should comply with the 'Destination Plan' (Bestemmingsplan) or 'Management Regulation' (Beheersverodering), and breakfast should be provided. Another exemption allows renting properties for at least 4 consecutive months, with renters registering in the 'Basic Register of Persons' (Basisregister Personen).
[8] Announced june 21st, 2024.
[9] EU Council Directive 2021/514, commonly referred to as DAC7

used to conceal listing data and rely on hosts and guests to adhere to region-specific laws and regulations (Adam, 2021), the DAC7 directive gaining a complete foothold in Europe might assist in monitoring and enforcing active regulation. Another outcome of the DAC7 Act could be similar to what happened in Denmark, where income data transmission results in possible further commercialization of short-term rental markets. However, since the DAC7 directive was only implemented on January 1, 2023, its full potential has not yet been realized (Merkx, Janssen, & Leenders, 2022).

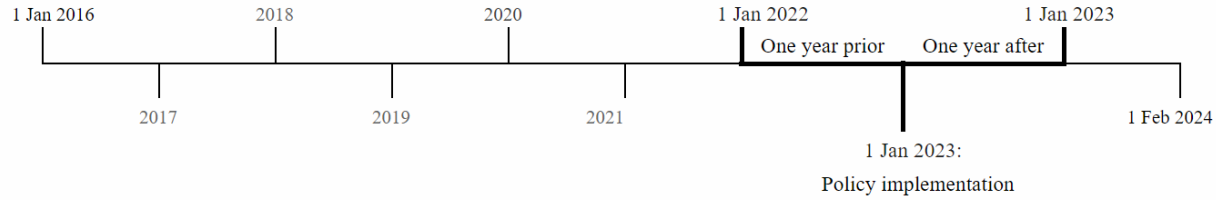
This literature analysis covers key factors affecting the short-term rental market, including housing market dynamics, the Dutch Housing Act, and municipal involvement. Market dynamics explore the effects of supply and demand on housing affordability and availability. The Dutch Housing Act provides necessary context on national regulations, while municipal involvement highlights local strategies and challenges. These insights guide the study's methodology, which uses a Difference-in-Differences (DiD) approach to analyze changes in supply and pricing before and after the policy implementation in Groningen. The next section will detail this methodology and its application to test the study's hypotheses.

# Data and Methodology

**Data**

To analyze the impact and effectiveness of the STR policy implemented by the Municipality of Groningen, listing data from AirDNA is used. AirDNA is a commercial data provider that scrapes information about STR properties from platforms such as Airbnb, with an externally reported accuracy of 97.5% on the active supply of vacation rentals (Airdna, 2024). Monthly data is used, ranging from 2016 until February 2024. Whereas previous studies opted for quarterly data (Garz and Schneider, 2023), monthly data was preferred for this study as it provides a greater level of observable variance and detail. This dataset provides insights into the dynamics of the STR market, and related variables, over nine years. The main focus of the analysis is between January 1, 2022, and December 31st, 2023, providing oversight of a period of one year before and one year after the policy implementation on January 1, 2023. Taking one-year periods before and after facilitates an analysis of the main restrictions: the 30-night limit. A schematic of the timeline can be observed in Figure 1 below. Properties were chosen as the unit of observation, as opposed to hosts, due to the policy targeting restriction of properties and not hosts specifically.

**Figure 1**: Timeline of Dataset.




*(Source: Author)*

### Variable definitions

The dependent variable is the average daily revenue of a property in USD (ADR_USD). US Dollars are the standard currency used by AirDNA. Keeping the values in USD ensured consistency, prevented conversion errors, and minimized additional issues resulting from USD/EURO exchange rate fluctuations in 2022 and 2023. Furthermore, values in USD might be more relatable to a wider audience and allow for easier comparison to different studies and datasets. Although inflation was considered as a factor, it was not further adjusted for in this analysis. Since the comparison was made between regions within the same country, the impact of inflation would be consistent across these regions, effectively canceling each other out in the comparative analysis. To ensure data accuracy, the dataset was filtered to retain only properties that are actively rented. Observations with values of zero for ADR_USD, indicating no bookings, were omitted

Several control variables are incorporated to isolate the impact of the policy intervention on ADR_USD. An overview of these variables can be observed in Table 2. The analysis includes control variables: The number of Bedrooms per property, Occupancy Rate, Listing Type, and Property Category. Bedroom numbers typically correlate with higher rental rates due to the additional space and capacity for guests (Shokoohyar, Sobhani, & Sobhani, 2020; Deboosere et al., 2019). The Occupancy Rate, a numerical variable ranging from 0 to 1, is calculated by dividing the number of booked days by the number of available days. It signifies the demand for the property, with a higher rate indicating greater demand and allowing hosts to charge higher prices (Gede, Diah, & Ni Made Suastini, 2023; Deboosere et al., 2019). Listing Type (e.g., Entire home/apartment) varies in terms of privacy and amenities, affecting rental prices accordingly (Deboosere et al., 2019). Property Category categorizes properties based on inherent differences in space, luxury, and amenities. The Property Category variable was created to address multicollinearity issues that arose from the original property type variables.[10] An overview of this categorization can be seen in Table 1 below. Additionally, the model includes host-specific fixed effects in the form of the Host ID that is attached to each property (Airbnb_Host_ID). This approach controls for unobserved heterogeneity related to individual hosts, such as host-specific practices, reputation, and other characteristics that could influence the average daily revenue of rental properties.

**Table 1**. Catagorization of Property Type

| Property Category | Included Property Types |
|---|---|
| Hotel Lodging | Hotel, Boutique hotel, Hostel, Serviced apartment, Guest house, Guest suite |
| House Cabin | House, Cabin, Bungalow, Chalet, Cottage, Farmhouse, Tiny house, Townhouse |
| Special Accommodation | Boat, House boat, Yurt, Tipi, Tent, Treehouse |
| Unique Exotic | Castle, Earth house, Dome house, Lighthouse, Island |
| Temporary Mobile | Camper/RV, Campsite, Caravan, Bus, Mobile home |
| Apartment Condo | Apartment, Condominium (condo), Loft |
| Other Types | Other, Place, Resort, Nature lodge, Vacation home, Villa |

*(Source: Author)*

[10] This issue was addressed by calculating Variance Inflation Factor (VIF) values in R, which indicated high multicollinearity among the original property type variables.

**Descriptive statistics**

Table 2 shows the results of the descriptive statistics for short-term rental properties listed on Airbnb. The sample consists of 45,747 listings. This table demonstrates key statistics of the properties analyzed. On average, properties accrue $136 per night and typically feature more than one bedroom. Specifically, the average daily revenue (ADR_USD) is $136.23, with considerable variability as indicated by the standard deviation of $127.74, ranging from $1 to $2,744. Properties generally have 1.85 bedrooms, though this also varies widely (standard deviation of 1.57), with some properties having up to 40 bedrooms. Occupancy rates are robust, averaging 66.9%, but there is a notable range from 3.2% to 100%, indicating varied usage patterns. The distribution of property categories shows that nearly half are classified as houses or cabins (49.7%). Listing types reveal that the majority of listings (74.3%) are entire homes/apartments, suggesting a preference for privacy and exclusivity among short-term rental guests. Private rooms account for 25.3% of the listings, while hotel rooms and shared rooms are rare. The Municipal distribution (City) includes 37.0% of listings in Eindhoven, 5.1% in Enschede, 47.8% in Groningen, and 10.0% in Leeuwarden.

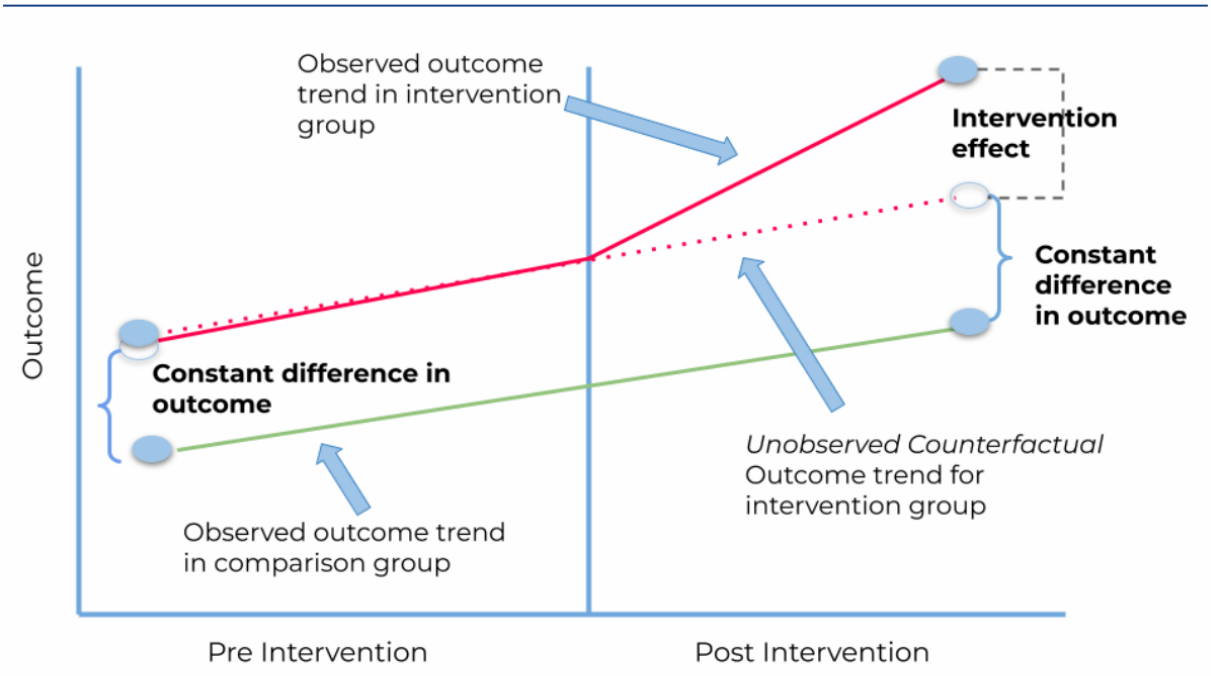
**Table 2**. Key Variables.

| | Mean / Proporion of sample (%) | Variable definition |
|---|---|---|
| **Numerical Variables** | | |
| Average Daily Revenue | 45747 | 136,25 | Average Daily Revenue of a property, measured in US Dollars. |
| Bedrooms | 45747 | 1,85 | Number of bedrooms of a property. |
| Occupancy rate | 45747 | 0,67 | Occupancy rate of a property. Listed days / Booked days. Value between 0 and 1 |
| **Type of Property Category** | | | Categorical variable indicating the propery catagory of the accomodation. |
| Apartment Condo | 10662 | 23,31% | |
| Hotel Lodging | 4035 | 8,82% | |
| House Cabin | 22743 | 49,71% | |
| Other Types | 5956 | 13,02% | |
| Special Accommodation | 1484 | 3,24% | |
| Temporary Lodging | 670 | 1,46% | |
| Unique Exotic | 137 | 0,30% | |
| **Listing Type** | | | Categorical variable indicating the type of listing the property is listed under. |
| Entire Home/ Appartment | 33985 | 74,29% | |

## Empirical Methodological Approach

Empirical research in economics and other disciplines has extensively used natural experiments to evaluate treatment effects in the absence of real experimental data (Meyer, 1995; Abadie, 2005). Mere comparison of results from before and after the policy implementation may be influenced by other elements like concurrent events or temporal trends. In cases where only an isolated group is affected by the treatment, an unaffected control group that is subject to similar forces and factors can be identified and used in a comparison to identify the effect of the intervention. This idea of deploying panel data, which are repeated observations on the same object, in a comparison forms the basis of the so-called Difference-in-Difference (DiD) method (Yeon, Hyoung Ju Song, and Lee, 2020). Figure 2 illustrates the Difference-in-Difference (DiD) methodology to isolate the effect of a specific intervention on two groups. In this illustration, the green line represents the control group (e.g., Leeuwarden), and the red line represents the treatment group (Groningen). The vertical blue line indicates the moment of the intervention. The treated group refers to those affected by the intervention, while the untreated group remains unaffected. If the intervention had no effect, the trend lines for both groups would remain parallel. Any divergence in these trends after the intervention suggests an impact attributable to the policy.

**Figure 2**: Visualization of a Difference-in-Difference Analysis




*(Source: Figarri Keisha, 2022)*

One advantage of the quasi-experimental DID method over a time-series analysis is that it allows for a valid comparison between two cases where only one is affected by treatment (Yeon, Hyoung Ju Song, and Lee, 2020). It is therefore a useful tool for evaluating the impact of governmental policies. In this analysis, the treatment group is identified as the Municipality of Groningen, with the control groups selected as Eindhoven, Leeuwarden, Enschede, and an average of all three. These regions were chosen based on their comparable characteristics and the requirement that they are not subject to a similar policy. A series of models are run – one for each control group. A comparison of the differences between the groups will highlight the impact of the policy. The standard model equation for the Difference-in-Difference analysis can be observed in the equation below, followed by its explanation.

$$Y_{it} = \alpha + \beta_1 Post_t + \beta_2 Treat_i + \beta_3 (Post_t \times Treat_i) + X_{it} + \varepsilon_{it}$$

In this model, **Yit,** the dependent outcome variable, represents the Average Daily Revenue in US Dollars of property *i* in month *t*. **αi** is the intercept term combined with the fixed effects, which together form the baseline level of the variably Y when all other predictors are 0. **Post** is a binary dummy variable representing the time period, where a value of 1 is assigned to the observation in the period post-treatment (2023) and 0 is assigned to the pre-treatment period (2022). **Treat** represents a dummy variable that is assigned a value of 1 if the observations belong to the treatment group (Groningen) and 0 if they belong to a control group (Eindhoven, Leeuwarden, Enschede, or All combined). **Post x Treat** is the interaction term between the time period and the treatment group. The term indicates the treatment group's differential impact following the implementation of the policy. It calculates the difference in the outcome variable's changes over time between the treatment and control groups. **X** is a vector of control variables, which may affect the outcome variable Y but are not directly related to the underlying research question. Including these helps to account for factors outside the policy influencing the outcome of the model. More details on these variables are in the following section. **ϵ** represents the error term. This captures residual components that influence the dependent variable but are not included in the model. Table 3 was created to establish an overview of the DID model identification.

**Table 3**. Difference-in-Difference identification.

| | **Pre-intervention (t = 2022, T = 0)** | **Post-intervention (t = 2023, T = 1)** | **Time difference** |
|---|---|---|---|
| **Treatment group** | T1 | T2 | T2-T1 |
| (Groningen, D = 1) | β0 + β1 + γ | β0 + β1 + β2 + β3 + γ | β2 + β3 |
| **Control group** | C1 | C2 | C2-C1 |
| (Eindhoven, Enschede, Leeuwarden, ALL, D = 0) | β0 + γ | β0 + β2 + γ | β2 + β3 |
| **Group difference** | D1(T1-C1) | D2(T2-C2) | D2-D1 |
| | β1 | β1 + β3 | β3 |

*(Source: Author)*

**Robustness and Sensitivity Analyses**

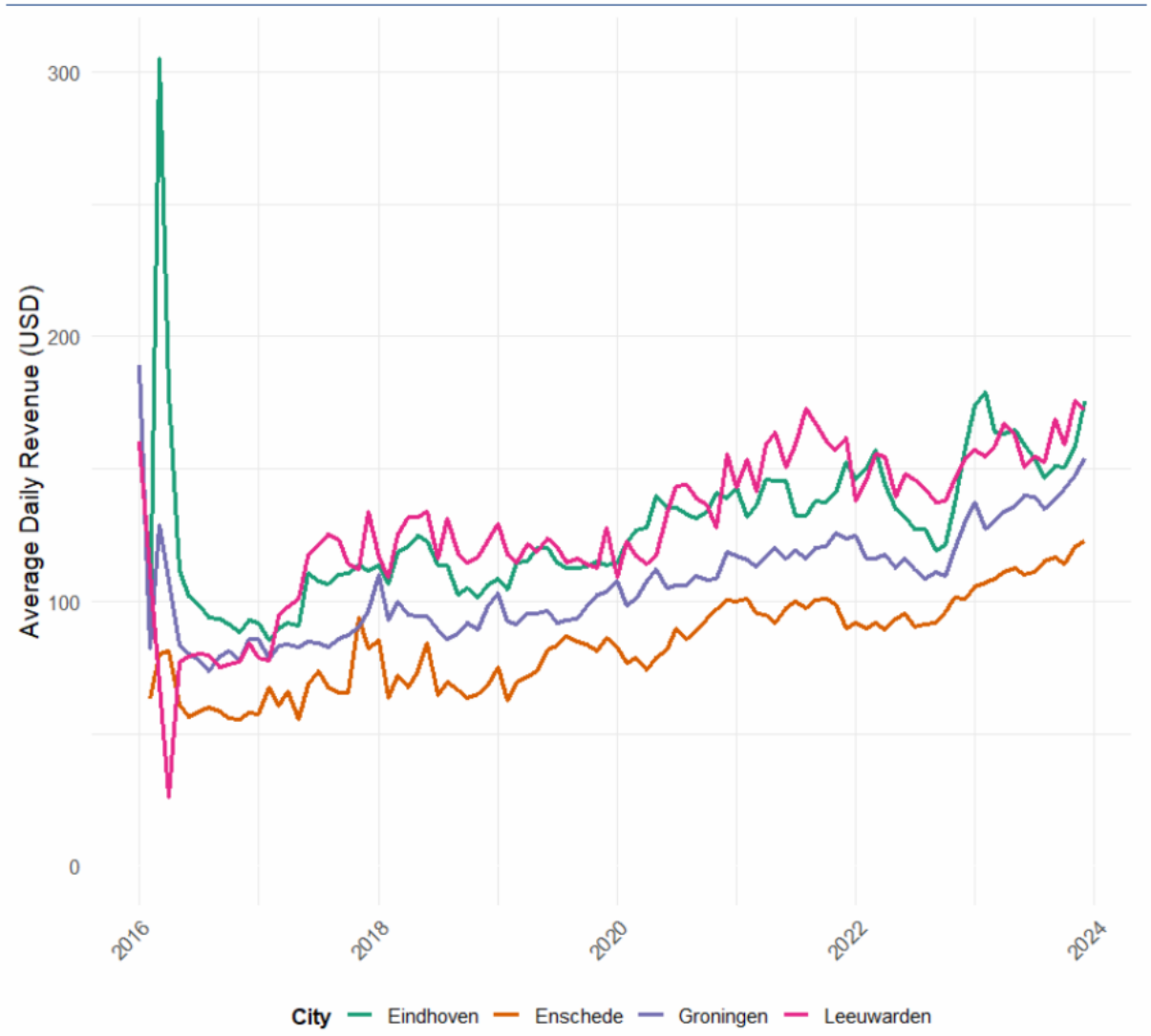
Several measures were implemented to ensure the robustness of the DiD models. The parallel trends assumption was thoroughly examined through visualizations, and event-study plots, providing a comprehensive assessment of trend consistency between treatment and control groups. By including three regions instead of just one, the analysis offered a broader comparative perspective and reduced the likelihood of region-specific biases. A test variable encompassing all three regions further enhanced result reliability. Control variables were identified and the models were tested both with and without their inclusion, ensuring that the observed effects confounded by other factors were limited. Additionally, a property's attached Host ID (Airbnb_Host_ID) was included as a fixed effect to control for unobserved heterogeneity related to individual hosts.

**Assessing Parallel Trends Assumptions**

A key principle of the Difference-in-Differences (DiD) method is the parallel trends assumption. This assumption states that treatment and control groups would follow parallel trends in the absence of treatment (Ryan, Kontopantelis, and Burgess, Jr, 2018). Ensuring the data is in line with the assumption ensures that any observed differences in outcomes in the comparison of treatment and control groups can be credited to the treatment and not pre-existing trends.

Figure 3 was created to visually analyze parallel trends. Based on observation, the trends indicate no immediate concern regarding the assumption of parallel trends, as all trends follow a similar rising pattern throughout the observed years with minor fluctuations. The reference line is that related to Groningen, Enschede is the most reliable comparison, with trends in volatility and smoothness virtually identical to those of Groningen. Eindhoven is likely the next best comparison, exhibiting a slightly more volatile and less smooth trend than Groningen. Both Groningen and Eindhoven experienced a notable jump towards the end of 2022, followed by a decline and subsequent rise. Leeuwarden, while generally similar to Groningen, may be marginally less comparable than the other two cities, with a relatively steep increase observed in 2021. Overall, the trends appear consistent, and there is no concern in relation to the parallel trends assumption. Further statistical analysis on this assumption is displayed in the section ‘Results’ below.

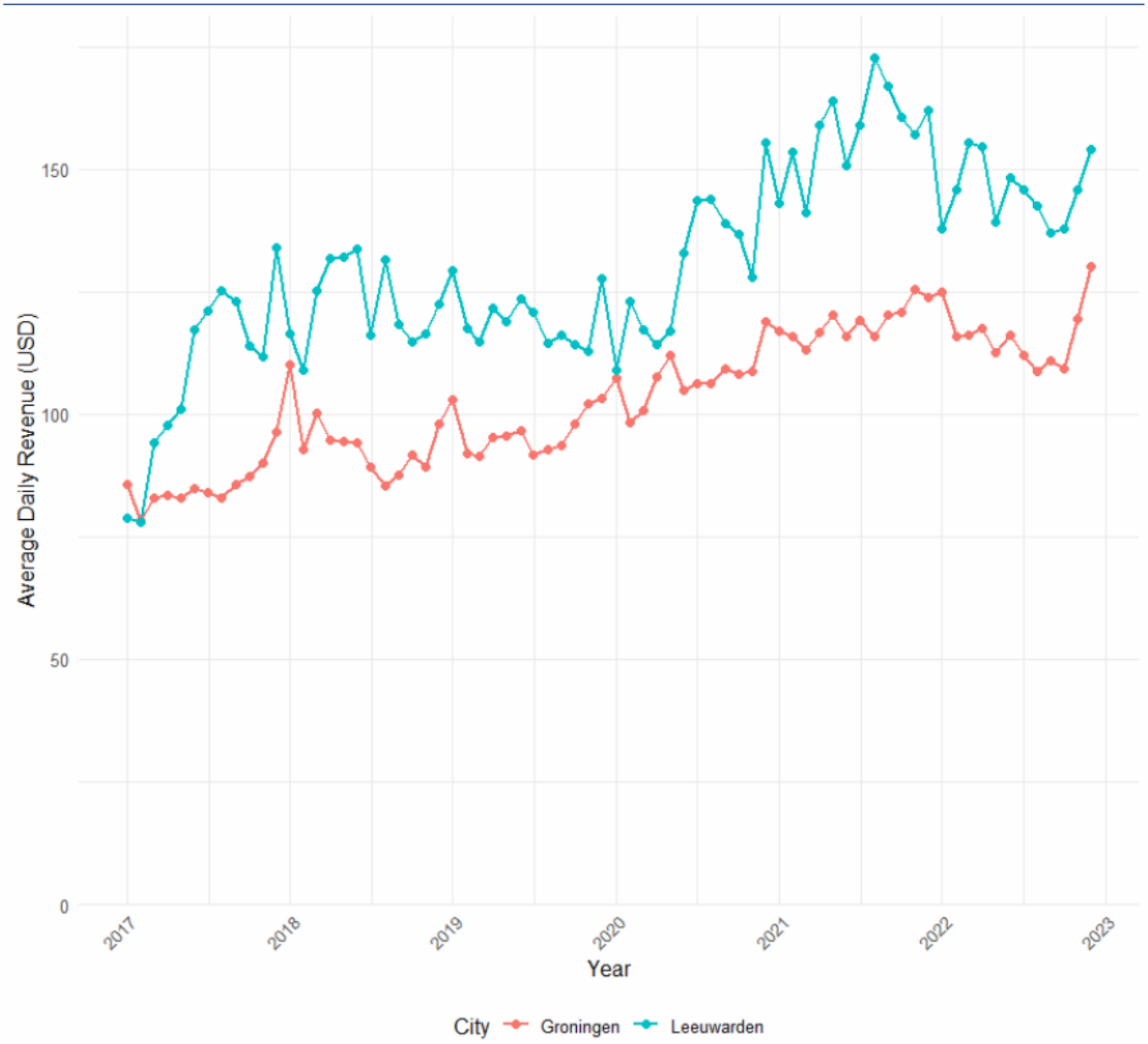
**Figure 3**: Graph displaying the Average Daily Revenue (USD) for each Municipality (City)




*(Source: Author)*

A visual analysis of the trends in Groningen and Leeuwarden from 2017 to the end of 2023 showed similar trends with some deviations, especially in 2021, which can be observed in Figure 4 below. However, visual analysis alone is insufficient to confirm or deny parallel trends. The observed trends will undergo statistical testing, with results presented in the results section of this research. The analysis excluded 2016 due to its limited observations as can be seen in Figure 3. Trends were tested from 2017 onwards, as this offered a more reliable and steady sample.

**Figure 4**. Graph displaying the Average Daily Revenue (USD) for Groningen and Leeuwarden



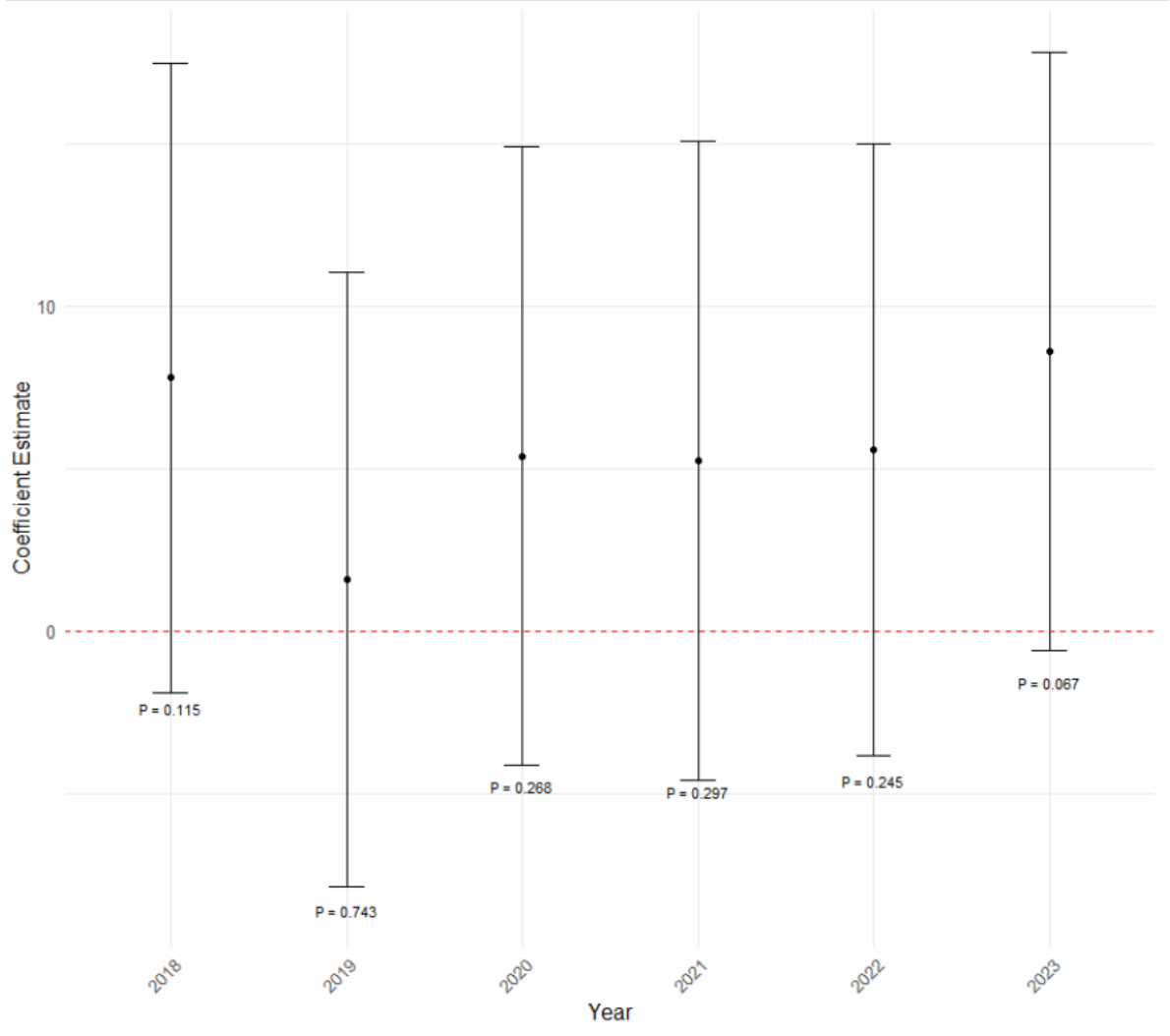

*(Source: Author)*

# Results

To further determine if the data adheres to the parallel trends assumption, and to provide a more objective and measurable method compared to visual analysis, event-study plots of ADR_USD coefficients from 2017 to 2023 were created. These plots, with 95% confidence intervals, evaluate the relationship between groups over time and the impact of interventions relative to 2017 as the reference point, hereby identifying pre-treatment trends in the coefficients.

The event-study plots for Groningen vs. Enschede (Figure 5) support the parallel trends assumption. The event-study plot for Groningen vs. Enschede supports the parallel trends assumption. Coefficients from 2018 to 2023 are not statistically significant, with confidence intervals intersecting the red line at zero, indicating no significant differences at the 5% level. This consistency suggests comparable pre-treatment trends in Groningen and Enschede, aligning with previous visual evidence (Figure 3).

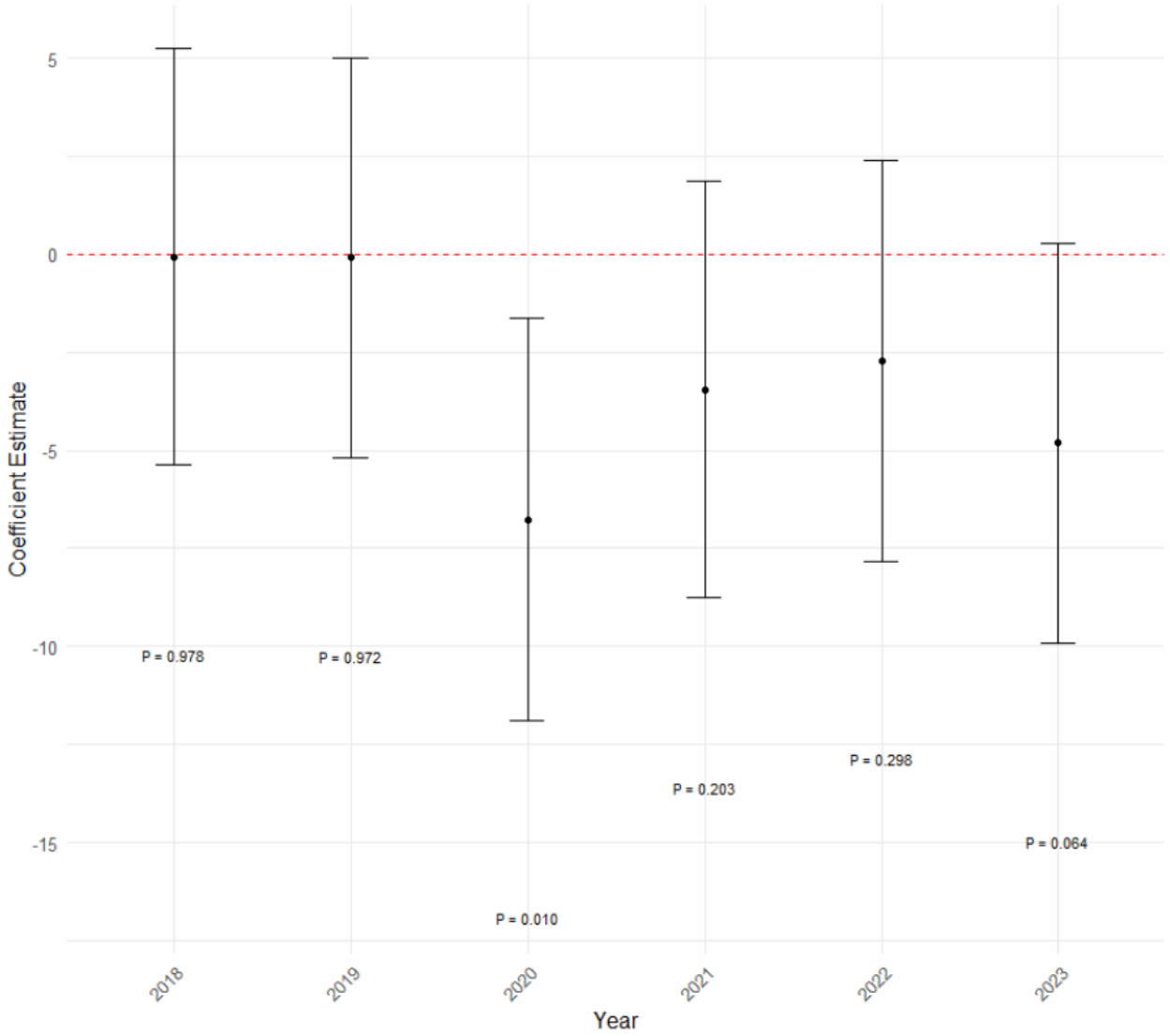
**Figure 5**: Event-Study Interaction Terms Groningen vs. Enschede




*(Source: Author)*

The plot for Groningen vs. Eindhoven (Figure 6) also mostly supports the parallel trends assumption, with most coefficients close to zero and statistically insignificant. However, 2020 shows a significant deviation (-6.76, P = 0.00958), indicating a divergence in trends. Despite this outlier, the general trend remains consistent, not undermining the overall parallel trends assumption. Visual inspection of ADR_USD trends (Figure 3) shows similar patterns for both cities, with the 2020 outlier not prominently visible.

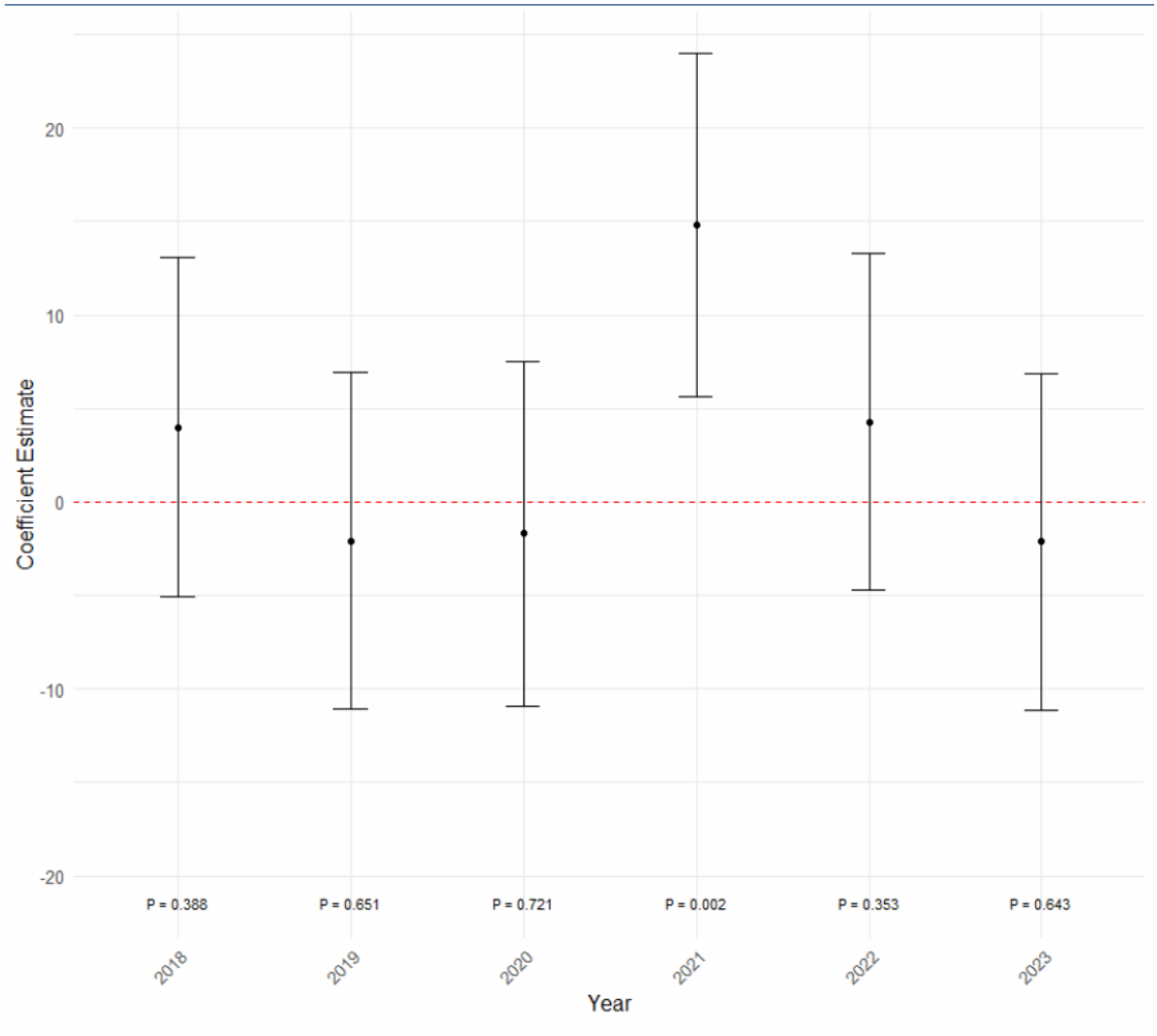
**Figure 6**: Event-Study Interaction Terms Groningen vs. Eindhoven




*(Source: Author)*

In the Groningen vs. Leeuwarden plot (Figure 7), coefficients before January 2023 are generally close to zero and statistically insignificant for 2018, 2019, 2020, 2022, and 2023. This supports the parallel trends assumption. An outlier in 2021 shows a significant coefficient (14.8, P = 0.002), indicating a notable difference in trends for that year. This aligns with visual data (Figure 4) showing a steep rise in Leeuwarden's average daily revenues in 2021.

**Figure 7**: Event-Study Interaction Terms Groningen vs. Leeuwarden




*(Source: Author)*

External factors, such as unique economic events or market disruptions specific to Leeuwarden and Eindhoven, could have influenced ADR_USD trends in the deviating years. Recovery from the COVID-19 pandemic might also explain these anomalies. Despite these deviations, the overall trend remains upward and consistent with other regions and periods (Figure 3). A more comprehensive analysis can be achieved by considering the practical implications of deviations, rather than focusing solely on statistical testing. If a minor statistical inaccuracy does not affect the economic interpretation, it is less concerning, especially in event-study plots, which are criticized for their sensitivity to the number of pre-treatment periods and sample selection (Garz and Schneider, 2023). Hence, the outliers are treated as outliers and the assumption of parallel trends is upheld.

**Main Analysis: Difference-in-Differences Models**

If the treatment exerted a significant effect on the dependent variable, one would expect the event study plot to illustrate this through significant coefficients emerging post-treatment (i.e., in 2023). The plots do not indicate this. Indeed, the coefficients one year post-treatment are statistically insignificant, implying that the treatment (policy) had little discernable effect on the average daily revenues of Airbnb properties. To explore this question further, Difference-in-Differences techniques were employed. The Difference-in-Differences (DiD) analysis compared the Municipality of Groningen (treatment group) to Enschede, Eindhoven, and Leeuwarden or all three combined (ALL) (control groups) using variations of the same model, with and without control variables.

For the Groningen/Leeuwarden model, the interaction term coefficient is 7.8980 and is highly significant ($p < 0,01$). This suggests that the policy implementation in Groningen is associated with an increase in average daily revenue by approximately $7.90 compared to Leeuwarden, indicating a positive impact of the policy. In the Groningen/Eindhoven model, the interaction term coefficient is 4.1454, also significant ($p < 0,01$), indicating an increased average daily revenue by about $4.15 compared to Eindhoven. The Groningen/Enschede model exhibits the highest interaction term coefficient at 12.8481 ($p < 0,01$), indicating the most substantial positive impact of the policy, increasing average daily revenue by approximately $12.85 compared to Enschede. Lastly, the Groningen/ALL model shows an interaction term of 6.0092 ($p < 0,01$) suggesting a moderately positive impact of the policy when considering all control regions together.

These results provide evidence in support of Hypothesis H1: *Short-term rental prices will increase due to reduced supply, negatively affecting the availability and positively affecting the cost of properties*. The significant positive interaction terms across all models indicate that the policy implementation has led to an increase in average daily revenues, although marginally. Approximately increases of 5.8% for Groningen/Leeuwarden, 3.1% for Groningen/Eindhoven, 9.6% for Groningen/Enschede, and 4.4% for Groningen/ALL. These results however do not provide evidence for anything concerning reduced supply.

The multiple R-squared values indicate that the models with control variables included generally fit the data well, though the fit varies slightly across different region comparisons. The Groningen/Leeuwarden model, with an adjusted R-squared of 0.816, demonstrates the highest goodness of fit among the models analyzed. Given this, the Groningen/Leeuwarden model will be the main focus in the following explanation of the DiD model's outcomes.

**Table 4**. Results Difference in Difference

| | Model Significance | Interaction Term Significance | Adjusted R-Squared |
|---|---|---|---|
| **Municipality of Groningen +** | | | |
| Eindhoven | *** | 0,41 | 0,016 |
| Eindhoven including control variables | *** | 0,004651 ** | 0,770 |
| Enschede | *** | 0,51 | 0,015 |
| Enschede including control variables | *** | 1.23e-06*** | 0,763 |
| Leeuwarden | *** | 0,10 | 0,014 |
| Leeuwarden including control variables | *** | 5.40e-05 *** | 0,816 |
| ALL | *** | 0,88 | 0,013 |
| ALL including control variables | *** | 1.71e-06 *** | 0,804 |

***p < 0,01, **p < 0,05, *p <0,1

*(Source: Author)*

In the Groningen/Leeuwarden model (Table 5), various property types significantly influence ADR. House Cabin properties exhibit a significant positive impact on ADR (19.4544, $p < 0,01$), indicating these properties command higher rates, approximately $19.45 more than the reference category, Apartment Condo. Conversely, Other Types have a significant negative impact on ADR (-10.4927, $p < 0,01$), reflecting lower ADRs by approximately $10.49. Temporary Mobile accommodations show a significant negative impact on ADR (-34.1487, $p < 0,01$), reflecting lower ADRs by approximately $34.15. The number of bedrooms (Bedrooms) remains a strong positive predictor of ADR across all models. In the Groningen/Leeuwarden model, each additional bedroom increases ADR by approximately $16.70 (16.6997, $p < 0,01$). This effect is even more pronounced in other models, such as the Groningen/Eindhoven model, where each additional bedroom increases ADR by approximately $34 (33.9660, $p < 0,01$). Listing types significantly influence ADR across all models. In the Groningen/Leeuwarden model, Private rooms are associated with a decrease in ADR by approximately $55.90 (-55.8987, $p < 0,01$) compared to entire homes/apartments. Shared rooms exhibit an even larger negative impact, reducing ADR by approximately $104.10 (-104.0979, $p < 0,01$). Comparing these results to the Groningen/Enschede model, Private rooms show a similar significant negative impact on ADR, decreasing it by approximately $54.41 (-54.4054, $p < 0,01$). Shared rooms in the Groningen/Enschede model also demonstrate a substantial negative impact on ADR, decreasing it by approximately $81.76 (-81.7604, $p < 0,01$). The occupancy rate consistently exhibits a significant negative effect on ADR across all models. In the Groningen/Leeuwarden model, the coefficient is -51.6395 ($p < 0,01$), suggesting that higher occupancy rates are associated with lower daily rates, likely reflecting pricing strategies aimed at maximizing occupancy rather than revenue per day. This effect is similarly observed in other models, such as -15.5363 ($p < 0,01$) in the Groningen/Eindhoven model.

**Table 5.** Difference-in-Differences Analysis Municipality of Groningen vs. Leeuwarden Models

| Term | Model 1 Estimate (SE) | | Model 2 Estimate (SE) | |
|---|---|---|---|---|
| Treatment | -29,426 (2,729) | *** | 5,097 (5,146) | |
| Time | 15,999 (3,557) | *** | 11,7148 (1,763) | *** |
| Interaction | 6,390 (3,913) | | 7,898 (1,956) | *** |
| Occupancy Rate | | | -16,357 (1,516) | *** |
| Bedrooms | | | 16,700 (0,424) | *** |
| **Property Category** | | | | |
| Apartment Condo (reference) | | | | |
| Hotel Lodging | | | 5,983 (3,539) | |
| House Cabin | | | 19,454 (2,675) | *** |
| Other Types | | | -10,493 (3,139) | *** |
| Special Accommodation | | | 5,554 (4,587) | |
| Temporary Mobile | | | -34,149 (6,472) | *** |
| Unique Exotic | | | -59,454 (13,529) | *** |
| **Listing Type** | | | | |
| Entire home/Appartment (reference) | | | | |
| Hotel room | | | 15,733 (25,074) | |
| Private room | | | -57,623 (2,646) | *** |
| Shared room | | | -77,397 (8,711) | *** |

Standard errors in parentheses ***p < 0,01, **p < 0,05, *p <0,1

Model 1 = Groningen / Leeuwarden without control variables and fixed effects

Model 2 = Groningen / Leeuwarden including control variables and fixed effects

*(Source: Author)*

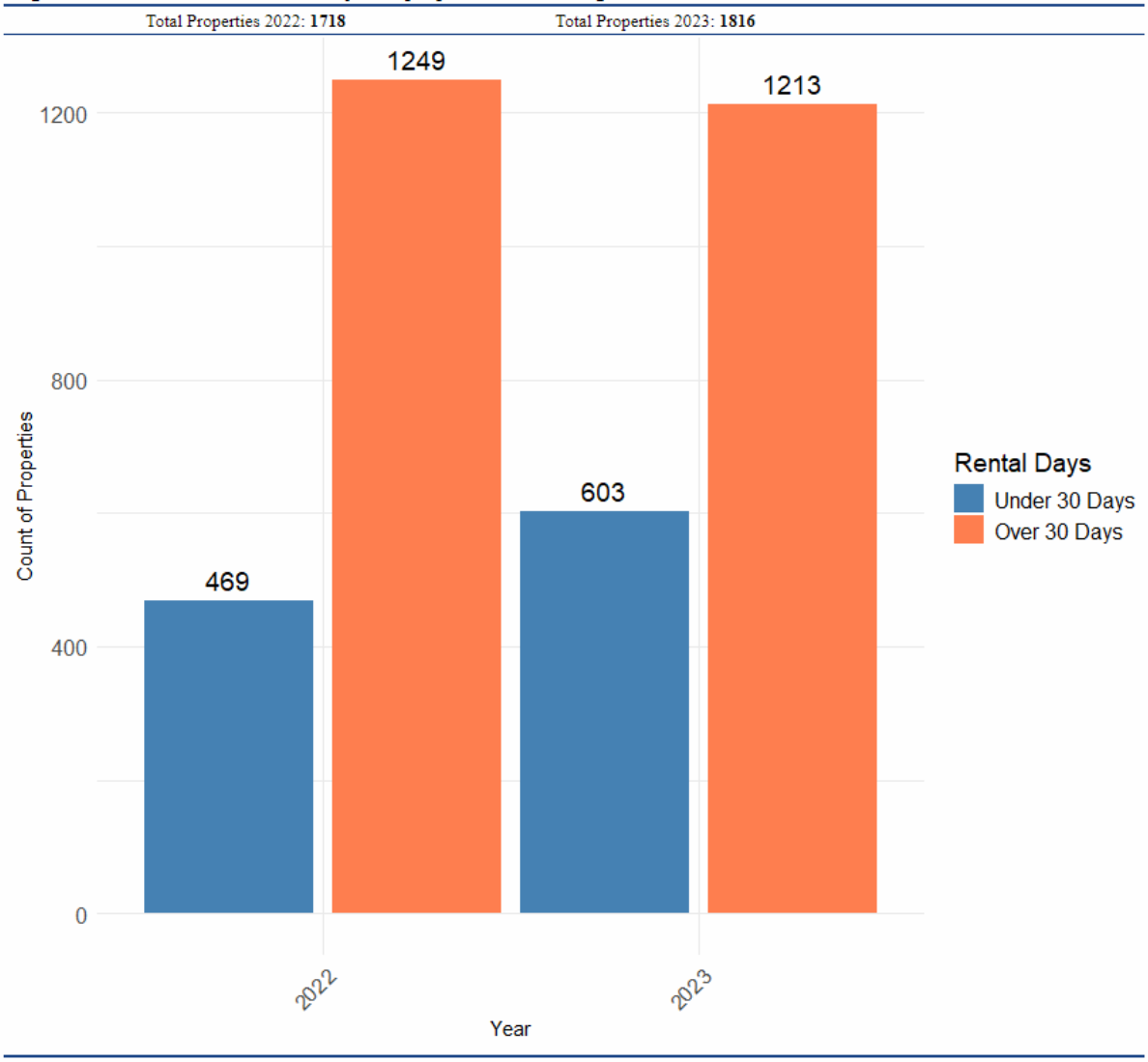
**Additional Analysis: Policy Compliance**

The event-study plots did not show significant changes, suggesting that the policy implementation did not lead to abrupt shifts in average daily revenue (ADR). Although the DiD models all indicated some change, the increases in ADR were minimal in terms of percentage change. Specifically, the observed percentage increases were approximately 5.8% for Groningen/Leeuwarden, 3.1% for Groningen/Eindhoven, 9.6% for Groningen/Enschede, and 4.4% for Groningen/ALL. These modest changes suggest that the policy's impact on ADR was relatively small and may not have effectively altered market dynamics as intended. These underwhelming results possibly indicate limited adherence to the policy. Previous research has shown that similar policy restrictions were only limitedly adhered to (Garz and Schneider, 2023), further supporting the need for additional analysis.

The primary analysis focused on evaluating the impact of the policy in Groningen, which restricts homeowners from renting out their property for a maximum of 30 nights. This policy, effective from January 1, 2023, includes an exemption for hosts who convert their property into a bed and breakfast, providing breakfast and residing in the same building. To assess adherence to this rule, a dummy variable was created for all properties in Groningen, indicating whether the property was rented out for more or less than 30 nights for both 2022 and 2023. Figure 8 below was generated to visualize this data. Blue indicates properties under 30 nights, orange indicates over 30 nights with on the left the data for 2022 and on the right for 2023.

In 2022, 72.7% of properties in Groningen were rented out for more than 30 nights (1,249 out of 1,718 total properties). In 2023, this percentage decreased to 66.8% (1,213 out of 1,816 total properties), representing a decrease of 5.9 percentage points. This change indicates that the 30-night restriction may have influenced a reduction in the proportion of properties rented out for more than 30 nights, as well as a slight reduction in the absolute amount of properties rented out over 30 nights. Indicating that Hypothesis 2: *The 30-night restriction is expected to reduce the number of properties available for rental periods exceeding 30 nights*, has supporting evidence in the form of a minimal absolute decrease in properties rented out for periods exceeding 30 nights. The increase in the total number of properties (from 1,718 to 1,816) complicates the straightforward narrative of supply reductions leading to higher prices and provides direct evidence against the statement on supply of Hypothesis 1: *Short-term rental prices will increase due to reduced supply, negatively affecting the availability and positively affecting the cost of properties.* While the absolute number of properties rented out for over 30 nights decreased, the overall increase in total listings suggests that new properties have entered the market. Despite this, the interaction terms from the DiD analyses, still support H1. This suggests that even with the overall increase in total properties, the policy’s constraints on extended rentals have likely contributed to higher prices. This is due to a shift in rental patterns and availability. One potential explanation for this phenomenon is that hosts, aware of the limitations on the number of nights they can rent out their properties, aim to optimize their earnings by targeting high-demand periods with higher prices, compensating for the reduced rental duration.

**Figure 8:** Distribution of Rental Days for properties in Groningen




*(Source: Author)*

Examining the changes in total properties listed across the municipalities from 2022 to 2023 (Table 6), Leeuwarden experienced a 0.9% decrease, Enschede saw a 2.3% increase, Eindhoven had a 3.7% increase, while Groningen, the only region affected by a restricting policy, saw the highest change with a 5.7% increase. Furthermore, analyzing the total reservation days and total revenue per municipality provides additional insights (Table 6). In Groningen, total reservation days decreased by 11.2% from 2022 to 2023. In contrast, Eindhoven experienced an 8.2% increase, Enschede saw a 16.0% increase, and Leeuwarden experienced a 3.9% decrease. The decrease in Groningen's reservation days, whereas other municipalities without such restrictions saw increases or smaller decreases, hints at Groningen being affected by the policy.

Originally, supply in H1 was defined as the number of properties listed. However, one could argue for a connection between supply and the total number of reservation days, which reflects how intensively listings are used. In Groningen, total reservation days decreased by 11.2% from 2022 to 2023, despite an increase in listings. This suggests the policy reduced 'effective supply', rather than just supply. Reflecting on H1: *Short-term rental prices may increase due to reduced supply,* this connection supports the hypothesis. The decrease in reservation days indicates a reduction in effective supply, leading to higher prices as hosts adjust their strategies.

Additionally, the financial impact of these dynamics is evident in the total revenue figures (Table 6). Groningen's total revenue increased by 7.3% from 2022 to 2023. Comparatively, Eindhoven's revenue increased by 27.8%, Enschede by 38.1%, and Leeuwarden by 10.5%. The relatively modest revenue increase in Groningen, despite a reduction in reservation days, supports the notion that higher prices compensated for fewer bookings. This suggests that while the policy may have effectively reduced the number of reservation days in Groningen, it did not significantly constrain the market's overall financial performance. The increased total revenue, despite fewer reservation days, further indicates that hosts may have adjusted their pricing strategies by targeting high-demand periods with higher prices, thereby compensating for the reduced rental duration, as previously mentioned.[11]

**Table 6**: Change in Total properties, Reservation Days, and Total Revenue (USD) per municipality 2022-2023

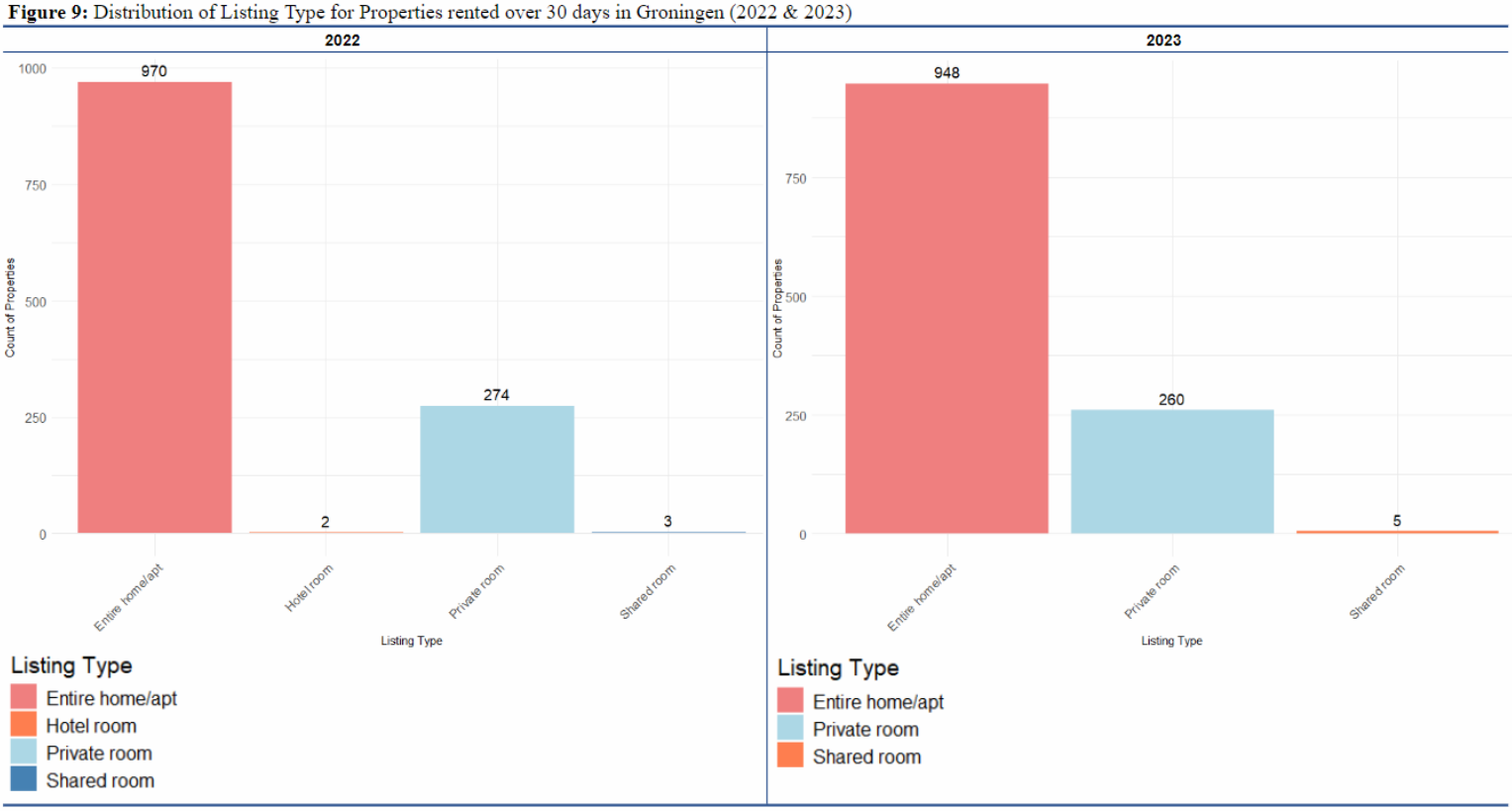
| **Municipality** | Total Properties 2022 - 2023 Change in % | Total Reservation Days 2022 - 2023 Change in % | Total Revenue (USD) 2022 - 2023 Change in % |
|---|---|---|---|
| Eindhoven | 3,68 | 8,22 | 27,78 |
| Enschede | 2,30 | 15,96 | 38,12 |
| Groningen | 5,70 | -11,14 | 7,30 |
| Leeuwarden | 0,93 | -3,96 | 10,45 |

*(Source: Author)*

To further understand the impact of the policy on the STR market, it is essential to examine the types of properties being rented out for over 30 nights. All properties rented out for over 30 nights were categorized by listing type and visualized in Figure 9 below. For properties listed as 'Entire home/apartment,' 77.6% were rented out for more than 30 nights in 2022 (970 out of 1,249 properties), compared to 78.2% in 2023 (948 out of 1,213 properties), showing a minimal percentage increase and a low absolute decrease, despite the policy. Notably here, is that only one exemption in the policy allows for entire home/apartment rental for more than 30 nights, which is for hosts interested in long-term renting to single tenants. They are required to rent their property for at least four consecutive months to the same guest, making them less relevant to the short-term rental market. Interestingly, properties listed as 'Private room' saw a decrease in absolute numbers, from 274 in 2022 to 260 in 2023. These results provide a slight validation of Hypothesis 3: *The requirement for a bed and breakfast setting for rentals beyond 30 nights embedded in this policy will lead to a decrease in the number of properties listed as 'Entire home/apartment'*

[11] The absolute numbers on total properties, reservation days, and revenue have been intentionally omitted in the discussion and Table 6 to adhere to the data agreement with AirDNA, ensuring that detailed proprietary information is not disclosed.

**Figure 9:** Distribution of Listing Type for Properties rented over 30 days in Groningen (2022 & 2023)




(Source: Author)

The only exemption present that allows for a renting period over 30 nights would be in a Private room, that is within or adjacent to the living area of the host. However, determining the reasons for this decline is challenging due to the dynamic nature of the market, with hosts frequently entering and exiting. Additionally, in the categorization of properties by Listing Type, there is no precise way to verify that they are true to reality and certainly breaking the policy. Creative ways to advertise accommodation as a complete property while 'being present' and thus adhering to the rules are possibly being exploited. Furthermore, the lack of larger change in the market could also be attributed to the relative novelty of the policy and its evolving nature, as evidenced by the policy documentation undergoing at least three (small) revisions since the commencement of this research. Despite these uncertainties, the high number of properties rented out over 30 nights while being classified as an Entire home/apartment indicates non-adherence and is enough to make a strong argument that the policy is not being followed by a large proportion of hosts.

**Discussion: Interpretation of Results, Comparative Analysis, and Policy Implications**

The results of this study provide valuable insights into the impact and effectiveness of the short-term rental policy implemented by the Municipality of Groningen. The policy, which restricts properties from being rented out for more than 30 nights per year, was hypothesized to influence average daily revenue by reducing the supply of available properties. The Difference-in-Differences analysis, comparing Groningen with Enschede, Eindhoven, Leeuwarden, and an average of all three combined indicates that the policy led to marginal increases in ADR. Specifically, the interaction term coefficients in the DiD models suggest increases of approximately $7.90 for Groningen/Leeuwarden ($p < 0,01$), $4.15 for Groningen/Eindhoven ($p < 0,01$), $12.85 for Groningen/Enschede ($p < 0,01$), and $6.00 for Groningen/ALL ($p < 0,01$).

These findings support Hypothesis H1: *short-term rental prices will increase due to reduced supply, negatively affecting the availability and positively affecting the cost of properties*. The policy implementation appears to have resulted in a slight increase in ADR across all models. Nonetheless, evidence against this hypothesis has also been found, as the increase in supply suggests that the policy may not have effectively reduced the number of available properties. Originally, supply in H1 was defined as the number of properties listed. However, considering the total number of reservation days possibly provides a better measure of 'effective supply'. In Groningen, total reservation days decreased by 11.2% from 2022 to 2023, despite an increase in listings. This suggests the policy reduced effective supply, leading to higher prices as hosts adjusted their strategies. The robustness of these results is supported by the high significance levels of the interaction terms and the consistent goodness-of-fit measures across the models. However, the percentage changes in ADR, ranging from 3.1% to 9.6%, suggest that the policy's overall impact on market dynamics was relatively modest.

In terms of policy compliance, the analysis of properties rented out for more than 30 nights, proportional to all properties, revealed a minimal decrease from 72.7% in 2022 (1,249 out of 1,718) to 66.8% in 2023 (1,213 out of 1,816). This supports hypothesis H2: *the 30-night restriction will reduce the number of properties available for rental periods exceeding 30 nights*. However, the persistence of a high percentage of 'Entire home/apartment' listings rented out for more than 30 nights suggests that many hosts may not be fully complying with the policy. The negligible decrease in the absolute number of 'Entire home/apartment' listings indicates that hypothesis H3: *The requirement for a bed and breakfast setting for rentals beyond 30 nights embedded in this policy will lead to a decrease in the number of properties listed as 'Entire home/apartment'*, holds true but not up to the expected extent. These findings align with the literature, such as Nieuwland and van Melik (2018), who observed that regulatory measures frequently fall short due to enforcement challenges and the complexities of market dynamics. Similar shortcomings have been documented in other regions, where analyses revealed discrepancies between expected outcomes and actual results due to non-compliance among apartment owners (Garz and Schneider, 2023). In cities with high tourist attraction, STRs exacerbate housing supply issues, a trend that persists despite regulatory attempts (Franco, Carlos Daniel Santos, & Longo, 2019). STRs directly reduce the long-term housing supply, thereby increasing pressure on affordable housing (Li, Kim, & Srinivasan, 2022). This issue is particularly relevant in cities like Groningen, which has a significant student population and high demand for housing (CBS, 2018; Berkel & Termeer, 2021). The high housing demand from students further intensifies the impact of STRs on the local housing market, exacerbating supply constraints (Hochstenbach, Wind, & Arundel, 2021). Considering this, the municipality's relatively ineffective attempt to ease the pressure that short-term rentals place on the extremely high demand for housing is particularly concerning.

Given the significant challenges associated with the current short-term rental (STR) policy, it is imperative to consider more effective and feasible implementations to address the high housing demand in Groningen. Enhancing enforcement mechanisms, such as implementing stricter penalties for non-compliance, increasing monitoring efforts, and conducting regular audits of STR listings, is crucial. Although substantial fines are currently in place, further increasing them would likely be ineffective without robust enforcement. The existing fines, set at 450 euros per day, already exceed the potential financial benefits of violating the regulations. The focus should thus be on enforcement to ensure the effectiveness of these measures. Leveraging advanced data analytics and forming partnerships with STR platforms like Airbnb to facilitate data sharing can significantly improve compliance rates (Garz & Schneider, 2023).

A relevant example of effective enforcement can be found in the agreement between Airbnb and the Danish government, where Airbnb shares the income details of hosts directly with tax authorities. This collaboration has resulted in a 14% decrease in the number of hosts listing their properties, indicating improved regulatory compliance over the current Groningen policy (Garz & Schneider, 2023). Implementing a similar approach in Groningen could enhance transparency and accountability, ensuring that hosts adhere to the STR regulations more effectively. This is already partially set in motion by the EU implementation of the DAC7 directive on platforms such as Airbnb, which could be built and improved upon.

Additionally, linking the process of acquiring a registration number from the national government with an educational component could enhance policy effectiveness. Prospective hosts should complete a form outlining non-adherence consequences and pass a test confirming their understanding of the rules. This would ensure hosts are informed and accountable. While this promise does not guarantee compliance, it will aid in prosecuting rule-breakers. This study's examination of the registration number acquisition process revealed no such educational or acknowledgment requirements. Introducing this step could improve STR policy adherence by ensuring hosts are aware of their obligations and the repercussions of non-compliance. Combined with enhanced enforcement mechanisms, this procedural improvement could significantly boost regulation compliance in Groningen.

**Conclusions and Policy Recommendations**

This research set out to investigate the impact of the 2023 municipal policy in Groningen on the supply and price of short-term rentals (STRs). By comparing the market dynamics in Groningen before and after the policy implementation, relative to these same dynamics in non-treated control areas, the study aimed to elucidate the effectiveness of regulatory measures in addressing the challenges posed by STRs on urban housing markets. The findings from this research offer insights into the interplay between local policy and the STR market, contributing both to academic discourse and practical policy-making.

The results from the Difference-in-Differences (DiD) analysis revealed that the 2023 policy implementation had a marginal but statistically significant impact on the average daily revenue (ADR) of STR properties in Groningen. Specifically, the policy led to minor increases in ADR across all models, thereby supporting the hypothesis that STR prices would rise due to the reduced supply induced by the policy, although this is only visible in ‘effective’ supply rather than actual supply. This aligns with theoretical expectations and empirical evidence from previous studies, which have

demonstrated that restrictive STR policies can drive up prices by limiting the availability of rental properties (e.g. Franco, Carlos Daniel Santos, and Longo, 2019; Garz and Schneider, 2023; Li, Kim and Srinivasan, 2022)
However, the anticipated reduction in the number of properties available for short-term rental periods exceeding 30 nights was not fully realized. Despite a slight decrease in properties rented out for over 30 nights, a substantial proportion of hosts appeared to circumvent the policy, continuing to list entire homes or apartments beyond the stipulated limit. This non-compliance suggests that the policy's enforcement mechanisms may be inadequate, highlighting a critical area for improvement. The persistence of non-compliant listings underscores the complexities involved in regulating STR markets and the necessity for robust monitoring and enforcement strategies.

The policy's limited effectiveness in significantly altering market dynamics and compliance behaviors points to several implications for urban housing policy. Enhanced enforcement measures through a stricter and more comprehensive monitoring system, are imperative to ensure adherence to regulations. Collaborations with STR platforms, such as Airbnb, for data sharing, as seen in the Danish scenario, could be instrumental in increasing compliance and transparency(Garz & Schneider, 2023). Furthermore, integrating educational components in the registration process could foster greater awareness and accountability among hosts.

Academically, this work extends the literature on urban economics and housing policy by providing empirical evidence on the regulatory impacts of STR markets. It demonstrates how the DiD methodology can be used to evaluate policy interventions and offers an analytical framework that can be adapted to other contexts. From a societal perspective, this research tackles urgent issues related to housing affordability and availability, especially in urban areas with high demand and constrained housing supply, such as Groningen.. The findings of this study provide critical lessons not just for Groningen, but for the entire Netherlands. Effective policymaking and stringent enforcement are essential to mitigate the adverse impacts of STRs on the housing market. As the nation grapples with one of its most pressing issues—the housing crisis—it is crucial to learn from such policy implementations. Future research should continue to explore innovative and enforceable strategies that ensure housing availability and affordability. Through informed and adaptive policies, it is possible to alleviate the housing challenges that this densely populated country faces, paving the way for a more sustainable and equitable urban future.

**Study Limitations**

Effective supply: During the later stages of this research, the concept of "effective supply" emerged as a crucial factor. Unlike regular supply, which merely counts the number of listings, effective supply considers the degree of availability of properties. From the literature review, it was found that the term "effective supply", or a similar term for its meaning, is not widely present, indicating a gap in the current research. Future studies should incorporate this concept to enhance the understanding of STR markets.

Distinction between Normal and Commercial renters: Other research identifies the difference between normal renters and commercial renters on platforms like Airbnb, arguing that commercial renters do the most damage and need to be targeted first by the policy (Duso et al., 2024; Garz & Schneider, 2023). A limitation of this research is that it does not differentiate between these types of renters, potentially overlooking some nuances in these market dynamics.

Short Timeframe: The analysis is constrained by a relatively short timeframe following the implementation of the policy. This limited period will, as a result, fail to capture the long-term effects of the policy on the STR market. Indeed, it is unclear whether the short-term and long-term effects of such policies on local housing markets are the same. Future studies should, therefore, extend the timeframe of study to provide a more comprehensive evaluation of policy impacts.
Data Limitations: The study relies on data from AirDNA, which, while comprehensive, may not capture all STR activity accurately, as it only collects data from one platform: AirB&B. Employing data from additional platforms (i.e., Booking.com) may provide a more complete picture of the STR market. Additionally, this research does not incorporate qualitative data from Airbnb hosts, such as their awareness and perception of the new policy. Engaging with hosts through surveys or interviews could provide deeper insights into compliance behaviors and the challenges they face, thus enriching the analysis with a more nuanced understanding of policy impacts.

Policy Exemptions: There is another exemption for properties rented consecutively for a minimum period of 4 months, where the renter must register at the municipality in the Basic Register of Persons (Basisregister Personen). This is shortly touched upon in this research, however, how this exemption impacts the results of this work is not investigated thoroughly. This aspect is highly complex, as verifying continuous occupancy by the same individual over such a period poses great challenges. A brief examination of the datasets provided minimal results for properties that were rented out for more than 28 days per month, more than four times a year. Let alone consecutively by the same renter. Due to this, this endeavor is left for future research.

Exclusion of Nijmegen: Nijmegen was initially available for analysis but was excluded due to numerous technical issues encountered while merging datasets. Despite recognizing the potential value of including Nijmegen, the decision was made to leave it aside to avoid inconsistencies and biases in the data. Future research should integrate Nijmegen or similar regions to enhance the robustness of the findings.

**Ethical Considerations: Discussion of ethical issues and their resolution.**

The data used in this study is proprietary and obtained from AirDNA under a confidentiality agreement. Consequently, the raw data cannot be shared publicly. To address privacy concerns, all results have been aggregated, ensuring that specific properties and hosts cannot be identified. Additionally, AirDNA has reviewed this thesis to confirm that all data disclosure rules were adhered to, maintaining the integrity and confidentiality of the information used in the analysis.

**Conflicts of interest**

The authors state that none of the work described in this publication appears to have been influenced by any known competing financial interests or personal ties.

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