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Do they get high? The effects of Amsterdam's coffeeshops on Air Bnb renting prices

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coffeeshops on Air Bnb renting prices**

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Resumo

A questão das drogas hoje em dia possui impacto massivo em praticamente todas as sociedades. Ela possui influências profundas no cotidiano das pessoas e um ubíquo crescimento no consumo. Esse estudo visa investigar se a venda *de facto* legal de maconha influencia preços de imóveis. Avaliando como esses preços mudam nos dá uma noção tanto das externalidades envolvidas no processo de venda, quanto de como as pessoas se sentem com relação a elas. Organizamos um painel com dados georeferenciados de apartamentos do Air Bnb ofertados em Amsterdam, de Maio de 2014 à Julho de 2017. Durante esse período, diversos coffeeshops foram fechados devido a nova legislação local. Nós estimamos que este fechamento, quando ocorrido a menos de 250m de um apartamento, diminui o preço do aluguel, em média, em quase 3%, e não possui influências significantes para maiores distâncias.

Palavras-chaves: Economia Urbana, drogas, cannabis, modelos hedônicos; políticas de drogas.

Abstract

The drug issue has a massive impact on almost every society nowadays. It has deep influences in people's quotidian and an almost ubiquitous growth in consumption. This study aims at assessing whether the *de facto* legal sale of cannabis influences real estate prices. Evaluating how these prices change gives us some notion of the externalities involved in those sales and how people regard it. We organized a panel with georeferenced data from Air Bnb lodgings offered in Amsterdam, from May 2014 until July 2017. During this period, several coffeeshops were closed due to new legislation. We estimate that losing the closest coffeeshop, when it is within a 250m radius from the lodging, decreases the renting price, on average, on 3%, and when it is farther has no significant impact.

Key-words: Urban economics; drugs; cannabis; hedonic models; drug policy.

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1 Introduction

It is widely known that the selling and consumption of cannabis and some of its derivatives are tolerated in the Netherlands. This is a consequence of several policy reforms dated from the seventies that aimed to reduce harm instead of reinforce repression on drugs.

Starting in 2011, another round of policy reforms took place, whose objective was to diminish the exposure of minors to cannabis and other substances. From that moment onwards, it was advised to not allow coffeeshops - stores where cannabis is sold under regulation - within 250m from schools of any sort. In Amsterdam these closures happened from 2014 to 2017, in three stages. Therefore, we make use of this exogenous shock to the stock of coffeeshops in Amsterdam to assess whether their very presence exerts any influence over the price of Air Bnb's rentings.

Several studies aim at analyzing whether this heterodox approach to the drug issue renders profound differences in the behaviour towards drugs, usually comparing drug consumption between Netherlands and similar countries (Simons-Morton *et al*, 2010; Van Ours, 2001; Sandwijk, 1995) . In this study, we assess the externalities of coffeeshops in the city and, by extension, of the policy itself, bringing the debate to the economic field.

We analyze the behaviour of prices from Air Bnbs that had the closest coffeeshop to their location closed. To do that, we create a dummy variable for having lost the closest coffeeshop. Since our data keeps track of time, we are able to assign 1 to a lodging after having actually lost the closest coffeeshop and 0 to those periods before that. That being said, we can track the price behaviour of those lodgings before and after the change in the stock of coffeeshop. We found that having lost the closest coffeeshop situated in small distances decreases the price of the lodging in the subsequent periods.

Together with this analysis, we also study the relationship between the inverse distance from the closest coffeeshop to the lodging and the log price. We indeed see a concave function of distance in relation to price. It not only suggests a similar relationship between coffeeshops and Air Bnb prices as the previous approach but also adds the idea

that these effects may fade away for bigger distances.

These findings are corroborated by a standard hedonic price model, in which the presence of a coffeeshop can be seen as an amenity, specially for the Air Bnb case, and the consumers are interested in touristic attractions. Our results also go along with Alonso-Muth-Mills models of land price, adapted to a city with two centres of interest, the business district and the touristic centre.

We believe that this work contributes to the literature by adding externality measures of *de facto* legal cannabis sale and how the Air Bnb market reacts. Previous works have been done on budgetary and consumption consequences (Miron, 2005; Sickles and Taubmann, 1991; Bretteville-Jensen and Jacobi, 2011) and surveys on people's opinion on the matter (Jacobi and Sovinsky, 2016), but drug analysis are still a recent field.

This work is organized as follows: Section 2 gives a brief overview of the drug literature and the drug policy pursued by the Dutch authorities. Section 3 explains the hedonic price model and urban price equilibria. Section 4 exposes the data and section 5, the methodology. Section 6 brings the results and section 7 concludes.

2 Prohibition and the Dutch Policy

2.1 Overview of prohibition

Drugs are reported to be part of social activities since the development of writing and recording abilities. Drug prohibition may be seen as a modern event, considering that most prohibitions were stated around the 1900's. The reasons to such actions are many, among them one may find public health, safety and moral issues, together with prejudice and religious beliefs (Miron and Zwiebel, 1995).

As a beginning, we can see that prohibition alone was not capable of, by itself, extinguish completely the drug consumption. Records of drug use make us believe that there will always exist a group of consumers, whose size depends on a wide range of variables, e.g. police enforcement, culture and age. Within this group of consumers, one can find two starkly different subgroups of consumers, recreational consumers and abusive consumers – or addicted.

Once we have at least two different sorts of behaviour, we cannot look at drug consumption and consider it as a homogeneous issue. If, on one hand, recreational users tend to react to policies and to the market in the same manner as consumers from legal markets do, on the other hand abusive users may not respond to incentives as would be expected. Abusive users tend to respond as if they have a completely inelastic demand for the drug, in a way that fulfilling their need for the drug ends being the priority.

Due to this pathological need and understanding its consequences and complexity, several entities/organizations – such as United Nations, World Health Organization and the Dutch government – have been proposing alternatives to tackle the drug issue. In the beginning of most prohibitions, all actions that concerned an illegal drug were suitable for legal punishment, be that consumption, production or distribution. During the 1990's, a movement of decriminalization of consumption of marijuana took place in specific countries. The major objectives of this approach are to stop punishing "the victims"; diminish the pressure on the penitential system as well as enable treatment to whoever may be suffering

from the use or abuse of certain substances – generally, cannabis.

2.2 Dutch Policy

Drugs in the Netherlands are tackled by several different laws that work together. Among them, the principal law is the Opium Act (Opiumwet), first written in 1919, being that the result of the Opium Convention, held in 1912 in The Hague (EMCDDA Report, 2014).

Starting around 1975, the Dutch government modified the way they tackled the drug issue, focusing more on harm reduction rather than combating drug consumption. The Opium Act received numerous amendments that culminated in the general drug policy that we face today. It was after these amendments in 1976 that the State started to recognize different levels of risk to different groups of drugs. Thus, at the moment, the dutch law has different treatment to drugs recognized as having unacceptable risks - the so called 'hard drugs' - and cannabis products - referred usually as 'soft drugs'.

The Dutch drug policy basis itself on two main ideas: the combat of public nuisance and the protection of public health. In the Opium Act Directive (Opiumwet) in order at the moment, the drug policy's objectives are described as followed "The Dutch drug policy is aimed to discourage and reduce drug use, certainly in so far as it causes damage to health and society, and to prevent and reduce the damage associated with drug use, drug production and drugs trade." (EMCDDA Report, 2014).

The drug policy as a whole works in a rather decentralized manner, giving significant freedom to local authorities to put in practice the recommendations as they believe it best fits their community, as can be seen in the Article 13a of the Opium Law. The mayor is empowered with the ability to give permits to establishments work as coffeeshops (which will be explained later in this text) as well as to decide when to close them or to force them to stop the cannabis related activities. At a local level, the drug policy is orchestrated by tripartite consultations, which is formed by the mayor, the chief of police and the chief public prosecutor.

The Opium Law creates two groups of drugs. Group I gathers substances whose effects are believed to present unacceptable risks. Group II gathers substances whose effects are considered of lesser harm. The latter are Cannabis, tranquilizers and barbiturates; while the former are opiates, codeine, amphetamines and LSD.

In the Netherlands, the possession of small quantities is regarded as low priority. The possession of up to 0.5 gram of any substance of Group I will generally not lead to a prosecution, even though the drug will be confiscated. When regarding substances of Group II, the possession of up to 5 grams is tolerated, even though it might be confiscated by the authorities. In 2012, the Opium Act Directive was revised, such that it does no longer state that any possession up to 5g will lead to a police dismissal, but instead it leaves the possibility of an arrest and prosecution, depending on the circumstances. (Country Drug Report 2017)

As a consequence of the harm-reduction policy, emerged in the Netherlands the “coffee-shops”, places where the selling and consumption of cannabis and cannabis related products are tolerated, under certain conditions and restrictions. Under the Article 13a of the Opium Law, the mayor is entitled with the power to close any coffeeshop that disobeys any or these restrictions.

2.3 Coffeeshops and tourism

The drivers and motivations of a trip can be as numerous as the destinations itself. Many destinations are known for their food, beer or wine and these motivations are widely discussed and researched. The use of drugs, however, still does not receive the same amount of attention as others, but it also provokes significant changes in the host areas (Matczak and Przemysław, 2016) . Drug tourism can take several forms, varying from Americans and Europeans seeking guidance and clarity with South American ayahuasca to young adults traveling short periods solely for entertainment.

As can be seen in other touristic segments, drug tourism tends to shape the destination’s structure. The act of selling the drug comes with a series of "by-product"

activities, such as receiving the tourists and advertising and delivering the product. Bearing this in mind, it is understandable that facilities in regions that explore this kind of tourism adapt themselves to nurture their business.

Even though the profile of drug tourists is heterogeneous, as argued by Matczak and Przemysław (2016), the diversity range narrows when regarding the Netherlands. In the Dutch scenario, albeit hard drugs are still present among the objectives of some tourists, the greatest share of tourists seeks cannabis products. The proportion of tourists that have cannabis as a main purpose of their trip in Amsterdam, for instance, ranges from one quarter to one third (Chatwin, 2016; Hoffmann, 2014; Amsterdam's Tourism Office) . The major attractivenesses of the Netherlands are the possibility of consuming cannabis legally, the quality and price of the product and its central position in Europe, which facilitates the visit to a significant number of tourists from outside of Europe as well as Europeans.

Notwithstanding, stimulating drug tourism is not a part of the drivers of the Dutch drug policy. Thus, the levels of nuisance linked to tourists served as additional motivation to the reforms which made the drug laws stricter, such as the creation of the "Weed-pass" - wietdpas (Drug Report 2014, Chatwin, 2016). It is worth noting that since it is the Mayor's decision whether to apply or not the stricter rules, it may be inferred that the levels of nuisance and their perception varied from city to city, as well as the degree in which they afflicted the citizens.

3 Theory

3.1 The Hedonic Price Model

What defines the price of a determined item can be a rather intriguing question in an environment where heterogeneous agents and goods are ubiquitous. When products come with an infinitude of characteristics, it is not hard to expect that changes in these characteristics may lead to changes in the final price. In the literature, Court (1939) is sometimes seen as the first to introduce this approach, being the "father" of the hedonic price models, working with the automobile industry. He understood that the demand for automobiles could not be explained by a single variable, thus, included dry weight, wheelbase and horse power to the hedonic model that envisaged explain the price formation in that industry.

In spite of previous works, Rosen (1974) is regarded as a seminal work on the field of hedonic models. Rosen formalized the concept and origin of the hedonic price function, utilizing profit-maximizing firms and utility-maximizing consumers.

As a start, Rosen (1974) works with assumptions in line with perfect competitive markets: consumers and firms have no market power; large number of firms and consumers; all consumers have knowledge regarding all varieties of the differentiated products and; switching costs are negligible. Rosen (1974) considers a row vector of K characteristics of the i th product, $z_i = (z_1, \dots, z_k)$. A large number of distinct products exists, guaranteeing a spectrum of products to enable marginal analysis. The market price of each of the differentiated products depends on its characteristics, such that these prices can be represented by a hedonic price function $p(z_1, \dots, z_k)$. The utility derived from the consumption of $z = (z_1, \dots, z_k)$ is given by $U = U(x; z_1, \dots, z_k; \alpha)$, being α a taste parameter and x a composite good whose price is normalized to 1. The consumer maximizes his utility respecting the budget constraint $y = x + p(z)$ - y is income - which gives the following first order conditions $\partial p / \partial z_k = p_{zk} = U_{zk} / U_x$, $k = 1, \dots, K$. Thus, the consumer will maximize his utility when he is indifferent between processing the purchase of the composite good or

switching to a product with an additional unit of any attribute k and paying the associated implicit price p_{zk} .

Rosen (1974) defines the bid function $\theta = \theta(\mathbf{z}; u, y, \alpha)$, which is the amount the consumer is willing to pay for \mathbf{z} given a fixed level of utility and income. Again, we have optimality when $\theta(\mathbf{z}^*; u, y, \alpha) = p(\mathbf{z}^*)$ and $\theta_{zi}(\mathbf{z}^*; u, y, \alpha) = p_i(\mathbf{z}^*)$, $i = 1, \dots, n$.

For the firms side, we have $M(\mathbf{z})$ representing the amount of goods produced with characteristics \mathbf{z} . $C(M, \mathbf{z}, \beta)$ represents the cost to produce M units with \mathbf{z} characteristics for the firm β . The cost function is assumed to be convex on M and z . Firms maximize $\pi = M(\mathbf{z})p(\mathbf{z}) - C(M, \mathbf{z}, \beta)$ with respect to M and \mathbf{z} . At the optimum, we must have $p(\mathbf{z}) = C_M$, as well as the marginal revenue of any attribute being the same as the marginal cost of adding it to each unit produced, that is $p_{zk}(\mathbf{z}) = C_{zk}/M$. Similar to the bid function, we have the *offer function* $\phi = \phi(z_1, \dots, z_k, \pi, \beta)$, which is the price a firm is willing to offer the characteristics \mathbf{z} and still maintain the profit π . Defining the indifference surfaces in the price characteristics space, we must have ϕ satisfying the following : $\pi = M\phi - C(M, \mathbf{z}, \beta)$ and $C_M(\mathbf{z}, \beta) = \phi$. Due to the convexity of the cost function, we have the unitary marginal implicit cost increasing in each characteristic, $\phi_{zk} = C_{zk}/M$, $k = 1, \dots, K$, and positive. Hence, we have the firm's offer function increasing in z_k .

Thus, as stated before, the consumer maximizes his utility when

$$\theta(\mathbf{z}^*; u, y, \alpha) = p(\mathbf{z}^*)$$

and $\theta_{zk}(\mathbf{z}^*; u, y, \alpha) = p_i(\mathbf{z}^*)$, $i = 1, \dots, n$ and the firms maximize profits when

$$p(z^*) = \phi(z^*_1, \dots, z^*_k, \pi, \beta)$$

and $p_{zk}(z^*) = \phi_{zk}(z^*_1, \dots, z^*_k, \pi, \beta)$. Therefore, when

$$\theta_{zk}(\mathbf{z}^*; u, y, \alpha) = p_i(\mathbf{z}^*) = \phi_{zk}(z^*_1, \dots, z^*_k, \pi, \beta)$$

, we have a trade being occurred. Bearing this in mind, when we observe a market transaction for a product with \mathbf{z} characteristics at a price $p(\mathbf{z})$, it means that the marginal bid of the consumer and the marginal offer of the firm are equivalent to the implicit

marginal hedonic price for each characteristic of the vector \mathbf{z} . Therefore, once in possession of the pair $p(\mathbf{z}), \mathbf{z}$, one can retrieve the marginal implicit prices for each characteristic, $\hat{p}_{zk}(\mathbf{z})$, by determining the hedonic price function $\hat{p}(\mathbf{z})$. With this technique, researches are able to assess which characteristics add or decrease the value of a specific product, as well as, with a certain further manipulation, extract the demand function for each characteristic.

For our analysis, we include several other attributes that are extrinsic to the apartment or lodging itself - those will be made clear in section 5. Even though they are extrinsic, it is expected that they also play a paramount role in the price decision of an Air Bnb. One can find in the literature the usage of distance from the house to the first point of interest - in our study, the coffeeshop - in order to assess externalities (Dröes and Koster, 2016) ; the location and proximity to touristic places (Zhang, Ye and Law, 2011; Bull, 1994; Thrane, 2007) ; as well as criminality in the region impacting house prices (Besley and Mueller, 2012; Gautier, Siegmann and Van Vuuren, 2009).

3.2 Spatial Urban Equilibria

It is quite ubiquitous the differences in the intensity of land use between city centres and suburbs. Apart from some exceptions, cities are organized with tall buildings near the centre whereas the suburbs rely with smaller constructions with even gardens and unconstructed areas. To that extent, it was created a few formal models that explained this behaviour to facilitate the understanding of urban structures (Brueckner, 1987).

Brueckner (1987) exposes a model derived from the works of Alonso (1964), Mills (1967) and Muth (1969). It is constructed over the observation that the different costs in commuting within an urban area must be balanced by the costs of living space, which is the compensation to suburban residents that face higher commuting costs. In his model, Brueckner (1987) works with a stylized city where all residents commute to the Central Business District (CBD) through a dense radial road network. Commuting has a cost per mile t , meaning that living x miles away from the CBD would render a commuting

cost of tx . He works with identical agents sharing the same tastes and income. The quasi concave utility function is given by $v(c, q)$, where c is the consumption of non housing goods and q is the consumption of housing space - for the simplicity of this model, houses are characterized solely by their living space, whereas in reality they have innumerable features. The price c is assumed to not vary spatially, while p , the rental price, varies with location.

Since individuals are identical, equilibria must yield the same utility level for all agents, which we will call u . The budget constraint is $pq + c = y - tx$, being y the income. Thus, individuals face the following maximization problem

$$\max_q v(y - tx - pq, q) = u \quad (3.1)$$

By equation (1) we have the following first order conditions (where subscript denotes partial derivatives)

$$\frac{v_2(y - tx - pq, q)}{v_1(y - tx - pq, q)} = p \quad (3.2)$$

Concomitantly, the solution must be such that the bundle affords utility u , thus

$$v(y - tx - pq, q) = u \quad (3.3)$$

Equation (2) together with (3) yields us the solutions for q and p , depending on the parameters of the model: x, y, t and u . For our study, it is interesting to see the relationship between x and p and q and x , which can be retrieved by totally differentiating (2) and (3). With these relationship we can better understand, within an urban area, the spatial behaviour of prices and housing consumption. The totally differentiation of (3) yields:

$$-v_1(t + \frac{\partial p}{\partial x}q + p\frac{\partial q}{\partial x}) + v_2(\frac{\partial q}{\partial x}) = 0 \quad (3.4)$$

From (2) we have $v_2 = pv_1$, then

$$\frac{\partial p}{\partial x} = \frac{-t}{q} < 0 \quad (3.5)$$

From (5) we can see that the price of housing space decreases with the increase of distance x . By this expression we see that individuals are willing to live farther from the centre if they are "compensated" with a smaller price for their space. This is the most important conclusion from this model to our study. In our study, as will be seen, we include in the model the distance to both the Historical Centre as well as to the CBD of Amsterdam, both major points of interest to people who visit the city, in order to capture the premium for staying closer the points of interest.

3.3 The supply side

In our study, we shall use Rosen's (1974) approach to model the behaviour of Air Bnb's supply. Given the nature of this business, in which an individual rents his own apartment, we will consider the supplier as having three options: (i) he can rent his apartment through the Air Bnb platform; (ii) he can establish a standard renting contract and rent the apartment for the whole month as usual; (iii) he can opt to not rent the apartment and live in it. Apart from (iii), in both other situations the individual will, then, incur in extra housing costs for himself, $C_{h\beta}$, since he must have a place to live.

The cost function is $C_i(M_i(\mathbf{z}), \mathbf{z}, \beta)$, being $M_i(\mathbf{z})$ the quantity of periods offered with characteristics \mathbf{z} , with $i \in \{a, m\}$, a denoting renting through Air Bnb and m renting monthly as usual. β represents the firm, which in this case is the owner. The vector \mathbf{z} includes all characteristics of the lodging, both intrinsic and extrinsic to it. The extrinsic characteristics are those that the owner cannot change, such as distance to touristic attractions or criminality levels in the vicinity. Intrinsic characteristics, on the other hand, are those that the owner can modify, such as decoration, furniture, etc. Depending on the renting format chosen, the owner faces $p_a(\mathbf{z})$, the price for the Air Bnb format, or $p_m(\mathbf{z})$, the price for the monthly one. Both prices are a function of the house characteristics.

Additionally, since most owners do not outsource the negotiations nor reception of guests, an effort parameter will also be part of the Air Bnb profit structure, $e_{a\beta}$. Therefore, the individual faces the following profit function:

$$\pi = \max \left\{ M_a(\mathbf{z})[p_a(\mathbf{z}) - e_{a\beta}] - C_a(M_a, \mathbf{z}, \beta) - C_{h\beta}; M_m(\mathbf{z})p_m(\mathbf{z}) - C_m(M_m, \mathbf{z}, \beta) - C_{h\beta}; 0 \right\} \quad (3.6)$$

It is straightforward to see that if neither $M_a(\mathbf{z})[p_a(\mathbf{z}) - e_{a\beta}] - C_a(M_a, \mathbf{z}, \beta) - C_{h\beta} > 0$ nor $M_m(\mathbf{z})p_m(\mathbf{z}) - C_m(M_m, \mathbf{z}, \beta) - C_{h\beta} > 0$ holds, the owner will prefer to use that lodging to live in instead of renting. Thus, in order to opt to offer in the Air Bnb platform, one must have

$$M_a(\mathbf{z})[p_a(\mathbf{z}) - e_{a\beta}] - C_a(M_a, \mathbf{z}, \beta) > M_m(\mathbf{z})p_m(\mathbf{z}) - C_m(M_m, \mathbf{z}, \beta)$$

The owner optimizes with respect to the number of periods offered, M_i , and to the intrinsic characteristics $z_j, j = 1, \dots, k$. Thus, the first order conditions are as follow:

$$M_i : \begin{cases} p_a(\mathbf{z}) = C_a(M_a^*, \mathbf{z}, \beta) + e_{a\beta}, i = a \\ p_m(\mathbf{z}) = C_m(M_m^*, \mathbf{z}, \beta), i = m \end{cases} \quad (3.7)$$

$$z_j : \frac{\partial p_i(\mathbf{z}^*)}{\partial z_j} = \frac{\partial C_i(M_m^*, \mathbf{z}^*, \beta)}{\partial z_j} \frac{1}{M_i} \quad (3.8)$$

With the optimal levels of \mathbf{z} and M found in (7) and (8), we find the profit levels of each renting modality and then it is straightforward to know whether the owner will offer the lodging with the platform Air Bnb or not.

4 The Data

4.1 The Airbnb data

Airbnb is a platform that enables private owners of a house or an apartment to rent their places as if they were a hospitality service provider, it is an online marketplace that allows people to lease short term lodging or vacations. The company itself does not own any lodging, being only a connection between lodging suppliers (the home owners) and lodging seeker (the visitors and/or guests). For every accommodation that is rented through this platform, Airbnb receives a percentage of the price charged by each supplier. Home owners have total freedom to choose how, when and for how much they are going to rent their lodging. To do that, they must create a profile at Airbnb and make an announcement for each accommodation, in which they fill in the lodging characteristics - how many bathrooms, bedrooms, beds, rooms, etc - and set the price and the rules - whether they offer breakfast, accept pets, offer city tours, etc. Since in this process we have two private agents interacting, many suppliers require to contact them before being allowed to rent the lodging on the website, in order to verify that the visitor is someone of trust. Therefore, the system relies considerably on reputation, both for the supplier and the visitor, which is constructed through reviews after one rents a place.

The data used in this study is collected through web scrapping from the website of Airbnb itself, made publicly available by the own company. This means that all information available for each accommodation depends on the proprietor to have filled in correctly the accommodation's characteristics. Due to the great importance of reputation in this market, it is understood that suppliers have no incentive to lie about the house characteristics, since it would probably aggrieve their guests and jeopardize future leasing.

The data used is provided by "Tom Slee" and "Inside Airbnb", both sympathizers of the "Open data 'movement' " that claim to have no connection to Airbnb or any other company and work on donation basis. The data was collected at several different moments, from May 2014 until July 2017, having no clear season pattern, relying on the programmer's

availability, such that we may consider those dates as being randomly assigned. The data sets provide several information of each lodging regarding room's and host's identification numbers; location (zip code, neighborhood, latitude and longitude); price; quantity of beds, bedrooms and bathrooms; number of reviews; overall satisfaction; if the host is a super host; and other informations such as the room's description and if the profile has a picture.

The data collected and used in the work regards renting prices, and not the sale price, which is seen as the value of the house. In the literature, however, the renting price can, indeed, be seen as a representation of the sale price of the house, since it can be understood that the sale price is a sum of the renting price and that the rent-price ratio is somewhat stable in the short run - which is the time length of our analysis (Campbell *et al*, 2009; Davis, Lehnert, & Martin, 2008).

Regarding the Air Bnb, there are 38.255 unique lodgings in the data set, observed at different periods. Due to availability issues and to avoid losing a significant amount of observations, this work shall use an unbalanced panel. In total, we have 222.2264 observations along 16 periods, starting on July 2014 and going until July 2017. The sampling of July 2014, the smallest sample, has 6.840 observation, whereas the last sample, July 2017, has 18.732 different lodgings. This is understood as a consequence of the constant growth in use and popularity of the platform.

As can be seen in the following table, the bulk of the lodgings is of medium size, aiming for two people or small groups of travelers. This may be a safer strategy for the supplier, since it is easier to find groups of 2 to 4 people than groups of 10, or even a structural constraint, given that in Amsterdam it is not easy to find apartments or studios big enough to host more than 8 people, specially close to the centre.

May 2014

| n° | Accommodates | Beds | Bathrooms |
|-------|--------------|------|-----------|
| n°=1 | 0.02 | 0.47 | 0.91 |
| n°=2 | 0.47 | 0.29 | 0.06 |
| n°=3 | 0.11 | 0.09 | 0.01 |
| n°=4 | 0.26 | 0.09 | 0 |
| n°>=5 | 0.15 | 0.06 | 0 |
| n°=0 | 0 | 0 | 0.02 |

percentage of each quantity

Figure 1

December 2016

| n° | Accommodates | Beds | Bathrooms |
|-------|--------------|------|-----------|
| n°=1 | 0.02 | 0.53 | 0.93 |
| n°=2 | 0.53 | 0.27 | 0.05 |
| n°=3 | 0.09 | 0.08 | 0.01 |
| n°=4 | 0.28 | 0.07 | 0 |
| n°>=5 | 0.08 | 0.05 | 0 |
| n°=0 | 0 | 0 | 0.01 |

percentage of each quantity

Figure 2

July 2017

| n° | Accommodates | Beds | Bathrooms |
|-------|--------------|------|-----------|
| n°=1 | 0.02 | 0.55 | 0.94 |
| n°=2 | 0.54 | 0.26 | 0.05 |
| n°=3 | 0.08 | 0.08 | 0 |
| n°=4 | 0.3 | 0.07 | 0 |
| n°>=5 | 0.06 | 0.04 | 0 |
| n°=0 | 0 | 0 | 0.01 |

percentage of each quantity

Figure 3

These tables also point in the direction that the profile of the lodgings supplied as Air Bnb did not change drastically throughout these years. Therefore, we may understand that there was an increase in the number of lodgings and hosts, be that due to a growing popularity of Air Bnb Company or be that due to other reasons, but the lodgings remained with the same characteristics, on average. It is worth noting that since the size of the lodging as well as the quality of the facilities are not observed, variables such as number of bathrooms, beds, bedrooms, how many accommodates and location are the attributes taken into consideration to observe changes in lodgings' trend.

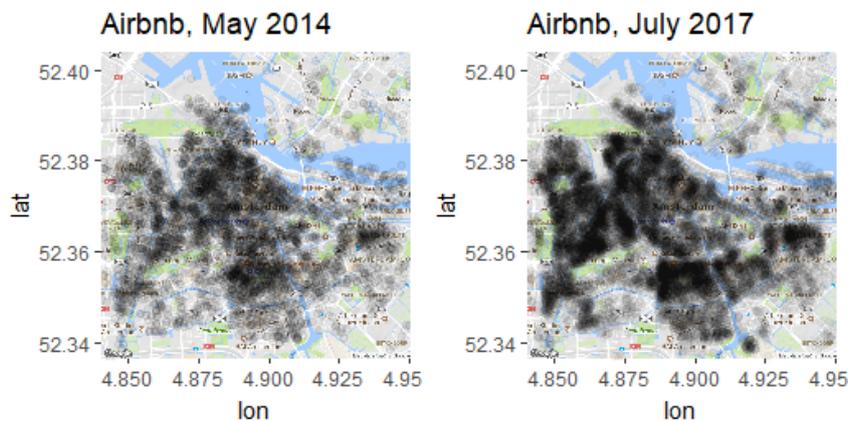
When observing the number of lodgings per neighborhood, there is a clear concentration in the historical centre and nearby neighborhoods, such as Centrum Oost, Centrum West and Oud West. Concomitantly, Zuidas presents a small number of lodgings, similar to other suburb areas. This corroborates with the idea that tourists prefer to remain close to the site with biggest number of attractions.

Figure 4 – Number of Lodgings per Neighborhood

| | | |
|------------------------|------------------------------|-------------------------|
| Bijlmer Centrum | Bijlmer Oost | Bos en Lommer |
| 224 | 219 | 1777 |
| Buitenveldert / Zuidas | Centrum Oost | Centrum West |
| 567 | 4027 | 5461 |
| De Aker / Nieuw Sloten | De Baarsjes / Oud West | De Pijp / Rivierenbuurt |
| 242 | 6171 | 4882 |
| Gaasperdam / Driemond | Geuzenveld / Slotermeer | Ijburg / Eiland Zeeburg |
| 99 | 411 | 670 |
| Westpoort | Noord-West / Noord-Midden | Noord Oost |
| 24 | 2907 | 362 |
| Noord West Oostelijk | Havengebied / Indische Buurt | Osdorp |
| 386 | 1867 | 318 |
| Oud Noord | Oud Oost | Slotervaart |
| 922 | 2145 | 889 |
| Watergraafsmeer | Westerpark | |
| 980 | 2704 | |

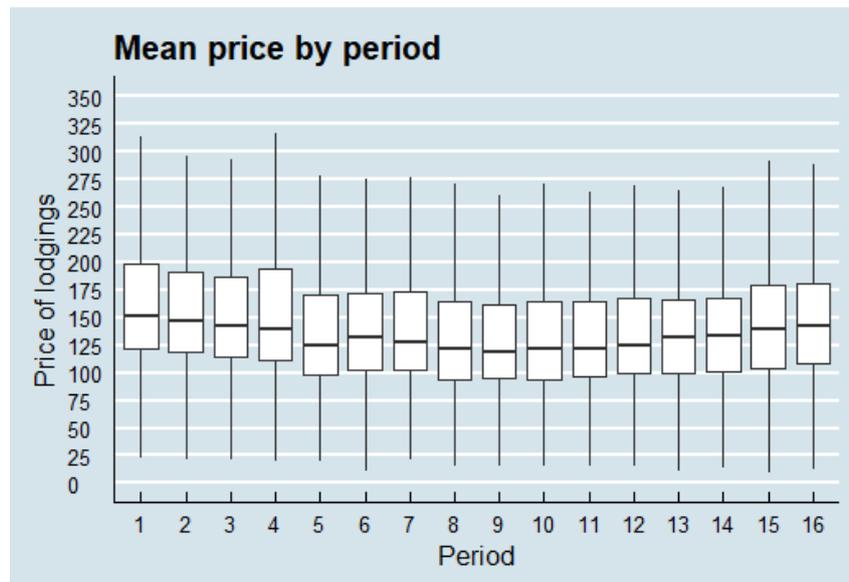
The two following maps in Figure 5 show the location of each lodging in the data set. Comparing the two maps, we can see that the distribution of lodgings through the neighborhoods remained stable. A difference is that the lodgings present themselves more concentrated.

Figure 5 – Airbnbs in May 2014 and July 2017



Along with lodgings characteristics and location, it is interesting to verify if there was any clear change in the trend of lodgings' price. The Figure 6 plots a boxplot for the price of each period within the data. By this visualization, there is no evident change in the price mean or variance. It can be noticed changes in the number and scale of outliers, but they are not likely to represent any shift in lodgings trends or any exogenous influence.

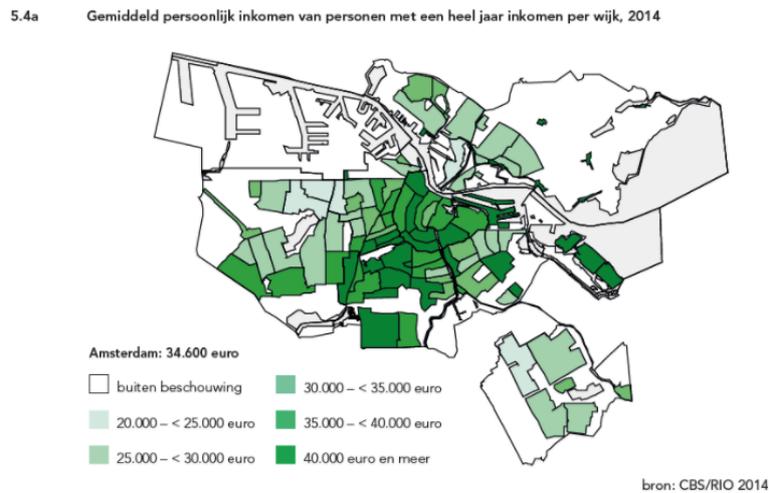
Figure 6 – Mean price of Airbnb’s lodgings, by period



The following map illustrates the average income distribution per neighborhood in the city of Amsterdam. The map is provided by the website of the municipality of Amsterdam. It can be seen that the neighborhoods with higher income tend to be in the corridor between Amsterdam’s city centre, *Centrum*, and the new developing business area, *Zuidas*. This is somewhat expected, since *Centrum* is historically the attractive area for a variety of businesses as well as an aspired area. On the other hand, Zuidas has been receiving numerous incentives by the government to transform itself in a dynamic and prosperous business center.

This "duality" in city centres poses an interesting question to this research due to the fact that we utilize data of Air Bnbs. On one hand, visitors and tourists, in general, travel to visit the historical and cultural city centre, which is the area where one can find most of the touristic attractions of a city. On the other hand, residents and travelers on work may prefer to stay closer to their workplaces instead of monuments, to save in commuting time - as modeled in the Alonso-Muth-Mills Model. This points in the direction of two different objective functions for each profile, the resident/worker and the tourist.

Figure 7 – Income per neighborhood in Amsterdam



The Municipality of Amsterdam provides information about the lines and stops of the public transport. The following map shows the stops of the Tram and metro lines of the city. Public transport is an important variable for tourists, since most of them rely solely on them for their transport around the city. Public transport is also of utter importance for residents. This variable shall be used as the distance to the closest public transport stop.

Figure 8 – Metro and Tram lines



4.2 The coffeeshops

As mentioned previously in the text, coffeeshops are places where selling and consuming soft drugs are tolerated in the Netherlands. These shops run as any other commercial establishment, but following also some restrictions regarding to whom they can sell, how much and where. In order to open a coffeeshop, it is necessary to receive a permit issued by the mayor, who has the power to issue new permits or cancel existing ones whenever he believes necessary.

As stated in the text, since 2008 the cannabis regulation has been under reform, what resulted in the closure of coffeeshops in several municipalities in the Netherlands. In 2011, the mayor of Amsterdam opted to follow the instruction that no coffeeshop should remain closer than 250m from a school. The sponsors of this action argue that this proximity may expose children to soft drugs and increase its consumption among young adults. In Amsterdam no new permit has been issued in the last years, such that since 2011 the number of coffeeshops decreased monotonically (Bieleman et al. 2013) .

In order to give enough time for the coffeeshop owners to restructure their businesses, the closure of these establishments was scheduled in three different phases. Initially, these three phases were 1. 1st of July 2014; 2. 1st of January of 2015 and; 3. 1st of January 2016. However, due to legal issues and re-measurement of distances, the list of the coffeeshops to be closed changed, as well as the date for the last phase, which passed from 1st of January of 2016 to 1st of January of 2017.

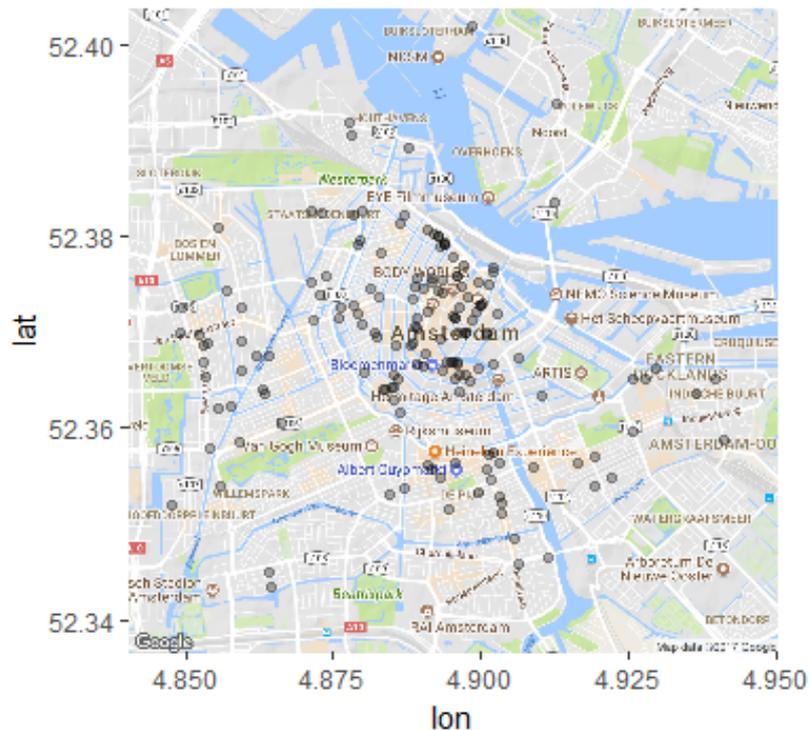
The location of schools can be seen as orthogonal to the positioning of coffeeshops and Airbnb's lodgings. In the same manner, the 250m rule is exogenous to the decision of opening a cannabis commercial establishment. Therefore, the closure of coffeeshops in Amsterdam can be seen as an exogenous shock to the stock of coffeeshops in the city.

The data for the location of coffeeshops was gathered searching their websites and crossing their addresses with Google Maps. Given the fact that it was not entirely clear whether some coffeeshops were actually closed or not, we checked their social media to verify their working status. In this way, we accounted for 169 open coffeeshops at the

moment. In July of 2014, 10 coffeeshops were closed, followed by 4 coffeeshops in 2015 and 8 coffeeshops in 2017.

The following image represents the location of each coffeeshop working at the moment. It is noticeable that there is a higher concentration of them around the historical centre. This suggests that the choice of their location was not completely exogenous. The location decision could have been led by other activities in the city at the moment of their permit issues and opening or could be even a consequence of a mayor's decision at that time, as it is known that some mayors have preferences regarding reallocating some coffeeshops in their city.

Figure 9 – coffeeshops in Amsterdam today



5 Methodology

In order to better assess the possible influence of coffeeshops on the AirBnbs, we shall use a set of econometrics models and analyze them together. In the housing industry literature, it is usual to have only one or two observations of each lodging, making a Difference in Difference model one of the best tools to analyze changes in the environment surrounding them (as is explained and done in Dubé et al. (2014) and in Döes and Koster (2014)).

While it is hard to obtain several observations of selling transactions of the same apartment or house, our data base follows a significant amount of lodgings through time, due to the fact that they are recurrently being offered on the Airbnb platform. Therefore, to profit from this particularity, we will adopt a fixed effects model to this study, making use at first of all our data, thus an unbalanced panel with 16 periods and 181891 observations.

It is customary in the spatial econometrics literature to understand that closer agents exert a bigger influence than farther ones. Bearing this distance relation mind, we create dummies to account for changes in the closest coffeeshop due to the closings effectuated in 2014, 2015 and 2017, since the purpose of this work is to study the possible effect of coffeeshops on their surroundings. We believe that if lodgings are affected by the presence of coffeeshops, the closest coffeeshop, on average, will be the one that influences the most.

Therefore, we run an hedonic model together with the treatment for changing the closest coffeeshop and other spatial variables as follows :

$$\log(\text{price}_{it}) = \alpha + \delta \text{FirstCS}_{it} + \beta x_i + \gamma z_{it} + \theta_t + \eta_i + \varepsilon_{it} \quad (5.1)$$

FirstCS_{it} accounts for the lodging i having lost the closest coffeeshop in period t ; the vector x_i contains all attributes of lodging i , such as the quantity of reviews, bathrooms, bedrooms, beds, how many it accomodates and whether it is a Super Host or not. The spatial characteristics are within the vector z_{it} , such as quantity of touristic attractions within 2000m, distance to closest public transport station, average household income for

the neighborhood, crime index for the neighborhood, distance to Business Centre and distance to Historic Centre. θ_t captures the period fixed effects and η_i the neighborhood fixed effects. ε_{it} is an identically distributed error term.

The existence of a coffeeshop, similarly as many other amenities such as bars or even express roads, may have different predominant impacts depending on how far or how close it is to the property. As we are using AirBnb data, it is expected that the price of the lodgings react to tourists' preferences significantly as well as any ameliorations in the area's conditions, such as level of nuisance or noise, among other things. This fact makes mandatory to analyze also the influence of the first coffeeshop at different distances. The following model controls for this particularity:

$$\log(\text{price}_{it}) = \alpha + \delta \text{FirstCS.250}_{it} + \beta x_i + \gamma z_{it} + \theta_t + \eta_i + \varepsilon_{it} \quad (5.2)$$

Now, FirstCS.250_{it} accounts for those lodgings i that lost in period t the closest coffeeshop, being that this coffeeshop was within 250m in $t - 1$. In this way, we can separate the effect of closing a near coffeeshop from the effect of farther ones.

Accordingly, it is interesting to assess the type of effect when this coffeeshop is not in such short distance. For that, we also run this model with dummy for those who lost the closest coffeeshop being between 250m and 500m from the lodging and also for between 500m and 1000m, as follows:

$$\log(\text{price}_{it}) = \alpha + \delta \text{FirstCS.500}_{it} + \beta x_i + \gamma z_{it} + \theta_t + \eta_i + \varepsilon_{it} \quad (5.3)$$

$$\log(\text{price}_{it}) = \alpha + \delta \text{FirstCS.1000}_{it} + \beta x_i + \gamma z_{it} + \theta_t + \eta_i + \varepsilon_{it} \quad (5.4)$$

$$\log(\text{price}_{it}) = \alpha + \delta \text{FirstCS.1500}_{it} + \beta x_i + \gamma z_{it} + \theta_t + \eta_i + \varepsilon_{it} \quad (5.5)$$

FirstCS.1500_{it} is a dummy for having lost the closest coffeeshop, given that this coffeeshop was farther than 1500m from the lodging.

6 Results

In this section we shall discuss the results of the models exposed in the previous section. The following table contains the coefficients and standard deviation in brackets of each variable described in the previous models. Columns (1) to (5) presents the results of models (1) to (5), respectively. To simplify the visualization, the coefficients and standard deviations for the neighborhood and time fixed effects were omitted.

Table S1

| | (1) | (2) | (3) | (4) | (5) |
|--------------------------|------------------------------|------------------------------|------------------------------|-----------------------------|------------------------------|
| <i>FirstCS</i> | -0.0256261 (0.0031063)*** | | | | |
| <i>FirstCS.250</i> | | -0.0101351 (0.0037827)*** | | | |
| <i>FirstCS.500</i> | | | -.060056 (0.0055329)*** | | |
| <i>FirstCS.1000</i> | | | | 0.0359672 (0.0102255)*** | |
| <i>FirstCS.1500</i> | | | | | -0.0063942 (0.0196323) |
| Reviews | -0.0018538 (0.0000256)*** | -0.0018527 (0.0000256)*** | -0.0018528 (0.0000256)*** | -0.001852 (0.0000256)*** | -0.0018522 (0.0000256)*** |
| Accommodates | 0.1463937 (0.0009537)*** | 0.1464671 (0.0009538)*** | 0.1462918 (0.0009536)*** | 0.1465034 (0.0009538)*** | 0.1464695 (0.0009538)*** |
| Bathrooms | 0.0783698 (0.0026194)*** | 0.0784664 (0.0026199)*** | 0.0787552 (0.002619)*** | 0.0785524 (0.0026197)*** | 0.0785423 (0.0026199)*** |
| Beds | 0.0369233 (0.0009761)*** | 0.0367637 (0.0009761)*** | 0.0371062 (0.0009763)*** | 0.036703 (0.0009763)*** | 0.0367732 (0.0009762)*** |
| Super Host | 0.0528826 (0.0036028)*** | 0.0527119 (0.0036034)*** | 0.0531424 (0.0036025)*** | 0.0527463 (0.0036033)*** | 0.0527159 (0.0036035)*** |
| Quantity Attractions | 0.0194988 (0.0004688)*** | 0.0192712 (0.0004686)*** | 0.0195299 (0.0004683)*** | 0.0192015 (0.0004673)*** | 0.0191741 (0.0004676)*** |
| Dist to Public Transport | 0.0000538 (2.77e-06)*** | 0.0000526 (2.77e-06)*** | 0.0000528 (2.77e-06)*** | 0.0000521 (2.77e-06)*** | 0.0000524 (2.77e-06)*** |
| Income | -0.0133411 (0.004255)*** | -0.0116788 (0.0042509)*** | -0.0128328 (0.0042509)*** | -0.0100825 (0.0042747)** | -0.0116844 (0.0042512)*** |
| Criminality | 0.0013887 (0.0003712)*** | 0.001357 (0.0003712)*** | 0.0013742 (0.0003711)*** | 0.0013412 (0.0003712)*** | 0.0013506 (0.0003712)*** |
| Dist to CBD | -0.0000249 (1.68e-06)*** | -0.0000238 (1.68e-06)*** | -0.0000242 (1.67e-06)*** | -0.0000229 (1.68e-06)*** | -0.0000236 (1.68e-06)*** |
| Dist to Historic Centre | -0.0000287 (2.17e-06)*** | -0.0000287 (2.17e-06)*** | -0.0000285 (2.17e-06)*** | -0.000029 (2.17e-06)*** | -0.0000286 (2.17e-06)*** |

Statistical significance represented by *, **, *** for 10%, 5% and 1%, respectively.

Our main variable of interest is the *FirstCS*. It captures the influence of coffeeshops accounting for an exogenous change in the closest coffeeshop to each lodging. As can be seen, for the first model, this variable is significant at the 1% level, indicating that indeed coffeeshops have some sort of influence on their surroundings. Its coefficient being -0.025626 indicates that losing the closest coffeeshop in at least one of the phasing out affects negatively the prices of AirBnb lodgings nearby, in other words, the propinquity of a cannabis shop to a lodging may push its price upwards.

The variable *FirstCS* alone gives no insight, however, on whether this effect is the same for all lodgings independent on how far they are from a coffeeshop. Model (2) aims at studying the impact on properties utterly close to a coffeeshop. Again, the coefficient of *FirstCS.250* presents the same signal, -0.0101351 , as *FirstCS* and is significant at 1%

level. If we bear in mind that the majority of AirBnb's guests are tourists and assuming that they are quite sensitive to distances, it is not surprising that establishments in the very vicinity of a lodging present a positive impact - possibly due to the facility in access - greater than the possible negative impact of nuisance. The variable *FirstCS.500*, accounting for those lodgings that lost their closest coffeeshop in the range between 250m and 500m, still represents properties fairly close to the shops and falls in the same case as *FirstCS.250*.

While *FirstCS.250* and *FirstCS.500* indicates a negative impact of the closings, *FirstCS.1000* shows a positive outcome for the reduction of coffeeshops. For the lodgings situated between 500m and 1000m from a closing coffeeshop, it may be that the reduction in the local nuisance - among other possible negative characteristics considered by local inhabitants as related to coffeeshops - presents itself stronger than the fact of not being fairly close to such a shop anymore. This variable will be further investigated in the next subsection.

For the properties considerably far from those coffeeshops forced to close, the present result indicates that the closure had no significant effect over them. These lodgings are accounted by *FirstCS.1500*, which did not present any statistical significance. Indeed a quite far coffeeshop does not seem to play a major role in the decision of the tourist regarding renting or not a specific lodging. Even though insignificant, the negative sign may create some confusion on the reader. We believe that this is due to the small number of observations having this dummy equal to one, which are all situated in the same blocks that already had a smaller average price before the closings.

All the other variables' signs go along with estimations from other studies. Criminality seems to increase price, but it is likely that this is due to criminality being higher in places with more tourists - specially when considered that pickpocketing is one of the most common crimes in Amsterdam. Reviews' sign is negative, we believe that guests that had an unpleasant experience are more inclined to leave reviews than those who had good experiences. Super Host is positive as expected, since there may be a premium for being

certified as a good host.

6.1 Robustness

In order to verify the results of the last regressions, one can observe other features linked to the closure of coffeeshops as well as gather additional data that, if pointing in the same direction, brings more robustness to the findings here presented. Thus, we shall run the same models, but this time making use of robust errors to within-cluster correlation - being the cluster the zip code. In addition, we also ran a model with the inverse distance to the closest coffeeshop; analyzed the spatial distribution of the lodgings that lost the closest coffeeshop and the relative presence of lodgings in the areas surrounding these former coffeeshops.

6.1.1 Robust errors to within-cluster correlation

Due to the nature of the Air Bnb market, it is possible that some spatial dependence exists in the data. When pricing an apartment, one may take into consideration several attributes of the region, which are shared by all hosts that rests in this vicinity. Therefore, it becomes important to account for this correlation when studying the results.

In the data set, there is information regarding the Zip Code of the lodgings. We grouped, then, the observations in clusters by Zip Code and ran the errors accounting for this within correlation. The following table presents the results.

Table S2

| | (1) | (2) | (3) | (4) | (5) |
|--------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| <i>FirstCS</i> | -.0298573 (.0127362)** | | | | |
| <i>FirstCS.250</i> | | -.0139994 (.0121009) | | | |
| <i>FirstCS.500</i> | | | -.0604493 (.0270693)** | | |
| <i>FirstCS.1000</i> | | | | .0249649 (.0306726) | |
| <i>FirstCS.1500</i> | | | | | -.0133565 (.0441944) |
| Reviews | -.0018655 (.000093)*** | -.0018644 (.0000933)*** | -.0018646 (.0000933)*** | -.0018637 (.0000935)*** | -.0018637 (.0000935)*** |
| Accommodates | .1453267 (.0061633)*** | .1453955 (.0061606)*** | .1452445 (.0061815)*** | .1454193 (.0061598)*** | .1453989 (.0061626)*** |
| Bathrooms | .1453267 (.0188628)*** | .0817537 (.0188666)*** | .0820933 (.0188877)*** | .081866 (.0188639)*** | .0818536 (.0188668)*** |
| Beds | .0371235 (.0072961)*** | .0369536 (.0073933)*** | .0372773 (.0072126)*** | .0369232 (.0073952)*** | .0369663 (.0073962)*** |
| Super Host | .0518021 (.0121033)*** | .0515886 (.0121082)*** | .052049 (.0121792)*** | .0516116 (.012128)*** | .0516046 (.0121313)*** |
| Quantity Attractions | .0199395 (.002058)*** | .0196957 (.0020261)*** | .019937 (.002053)*** | .0195895 (.0020038)*** | .0195635 (.0020056)*** |
| Dist to Public Transport | .0000519 (.0000115)*** | .0000506 (.0000115)*** | .0000507 (.0000115)*** | .00005 (.0000115)*** | .0000503 (.0000115)*** |
| Income | -.013842 (.0025217)*** | -.0176169 (.0025886)*** | -.0184006 (.0024203)*** | -.0169218 (.0026648)*** | -.0176516 (.0025847)*** |
| Criminality | .0012071 (.0006835)* | .0011719 (.0006816)* | .0011903 (.000684)* | .0011576 (.000681)*** | .0011651 (.000681)* |
| Dist to CBD | -.0000243 (7.09e-06)*** | -.000023 (6.97e-06)*** | -.0000233 (7.01e-06)*** | -.0000222 (7.03e-06)*** | -.0000227 (6.98e-06)*** |
| Dist to Historic Centre | -.0000274 (9.05e-06)*** | -.0000274 (9.04e-06)*** | -.0000272 (9.06e-06)*** | -.0000276 (9.06e-06)*** | -.0000274 (9.05e-06)*** |

Statistical significance represented by *, **, *** for 10%, 5% and 1%, respectively.

We can see that *FirstCS* is still significant at the 5% level, as well as *FirstCS.500*, corroborating the idea that even accounting for spatial correlation the coffeeshops exert influence on real estate prices. Again, we have the *FirstCS.1500* being negative, which is consequence of a small number of apartments already situated in a depreciated area.

6.1.2 Distribution of lodgings

In order to discard the hypothesis of *FirstCS* actually capturing some other effect different from the closure of coffeeshops, we analyze graphically the distribution of the lodgings. Therefore, the following figure shows their distribution throughout the city of

Amsterdam.

Figure 10 – Distribution of lodgings within 250m from a closed coffeeshop

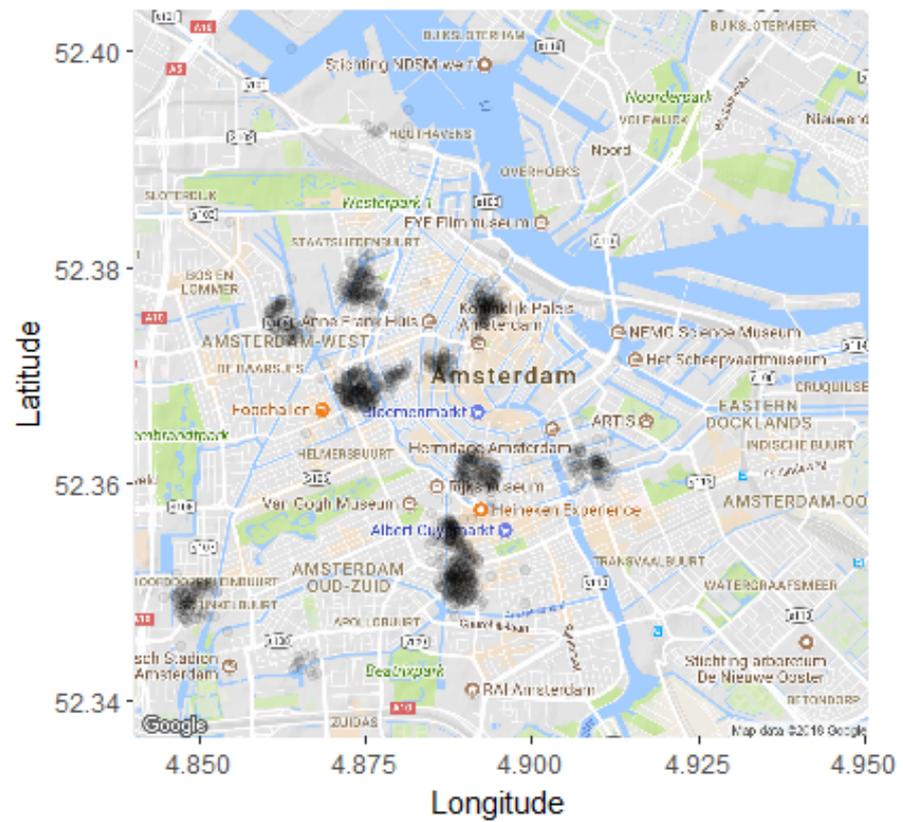
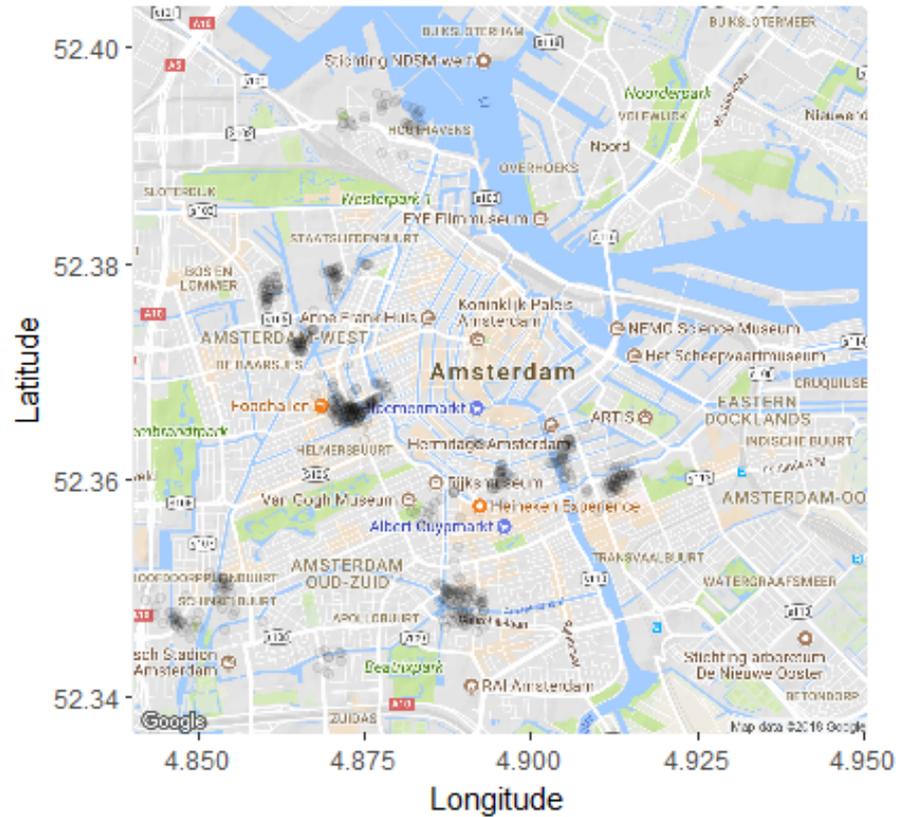


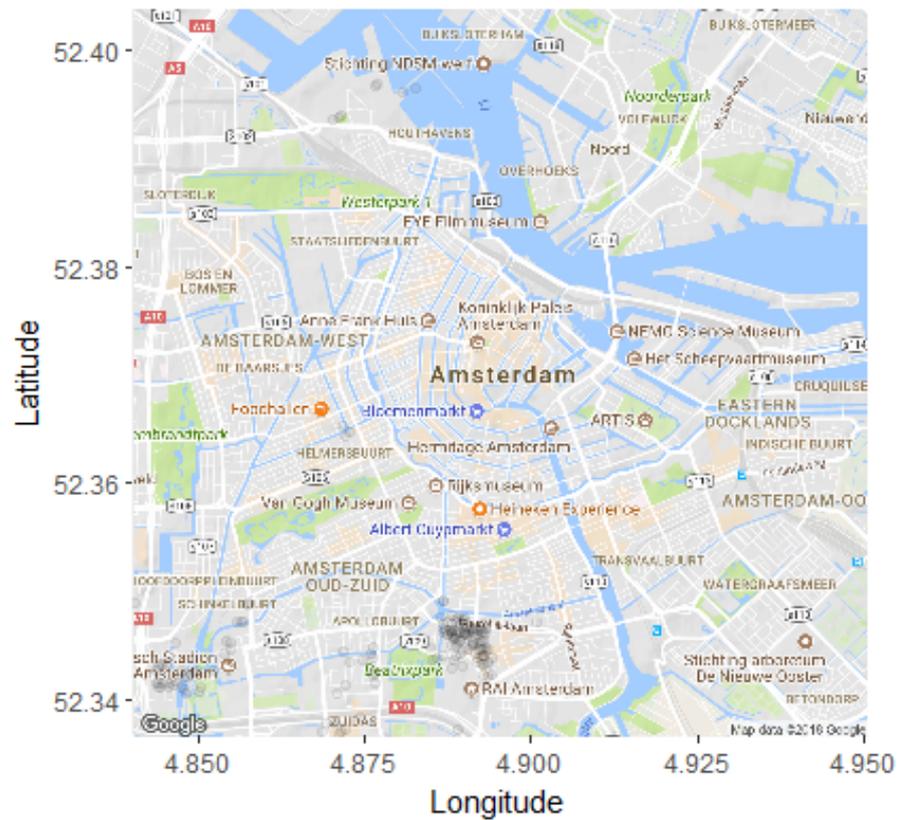
Figure 11 – Distribution of lodgings within 250m from a closed coffeeshop



By these two maps of the city of Amsterdam, one can conclude that it is unlikely that our variables are capturing some other effect that is not the closure, given the fairly widespread presence of such lodgings and the exogeneity of this pattern.

However, unfortunately, this is not the case for the variable *FirsCS.1000*. Even though the closure was an exogenous shock that happened in several places of the city, the lodgings that actually are situated 1000m from the former coffeeshops and have no other coffeeshop closer are not plenty, leaving us with a sample of only quite concentrate apartments. The next map shows their positioning in the city of Amsterdam.

Figure 12 – Distribution of lodgings within 1000m from a closed coffeeshop



In addition to their spatial concentration, these lodgings are situated in a location with higher prices. Thus, we cannot affirm with certainty, differently from *FirsCS.250* and *FirsCS.500*, that *FirsCS.1000* captures the closure's effect and not this locality's particularity.

6.1.3 Distance to the first coffeeshop

Together with analyzing the behaviour of losing the closest coffeeshop, we also study the relationship between the inverse distance to the closest coffeeshop and the prices offered by the Air Bnbs. The following table presents the results.

Table S3 – Inverse Distance

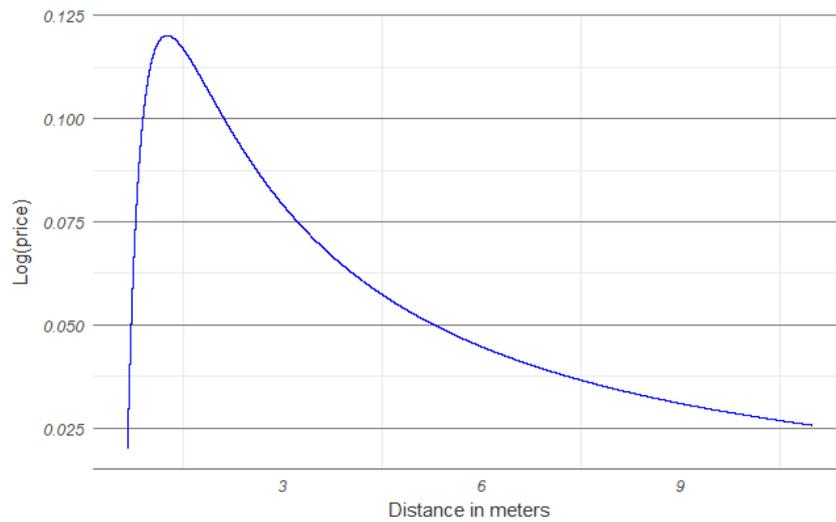
| | Coefficients | Standard Errors |
|--------------------------|--------------|-----------------|
| Distance ($1/m$) | .2988473 | (.0744533)*** |
| Distance ($1/m^2$) | -.1858221 | (.0725102)** |
| Reviews | -.0018651 | (.000026)*** |
| Accommodates | .1453784 | (.0009786)*** |
| Bathrooms | .0819693 | (.0026749)*** |
| Beds | .0370108 | (.0009973)*** |
| Super Host | .0515421 | (.0036689)*** |
| Quantity of Attractions | .0195123 | (.0004797)*** |
| Dist to Public Transport | .00005 | (2.93e-06)*** |
| Income | -.0119321 | (.0042514)*** |
| Criminality | .0011665 | (.0003942)*** |
| Dist to CBD | -.0000226 | (1.72e-06)*** |
| Dist to Historic Centre | -.0000272 | (2.23e-06)*** |

Statistical significance represented by *, **, *** for 10%, 5% and 1%, respectively.

As is explicit in the table, due to the negative sign for the inverse squared distance, we have the intensity of the effect changing according to the distance between the two agents. The following graph depicts this relationship in function of the distance, evidencing the distance in which we find the strongest influence. Here, we have the biggest influence around 2m and this influence becoming neglectful to big distances.

It is worth noting that since the platform Air Bnb, to protect its users' privacy and security, does not provide the exact geographical coordinates of each lodging, this estimations are intended to study whether the influence becomes milder or not, instead of estimating a precise radius for the greatest effect.

Figure 13 – Relationship between distance and price

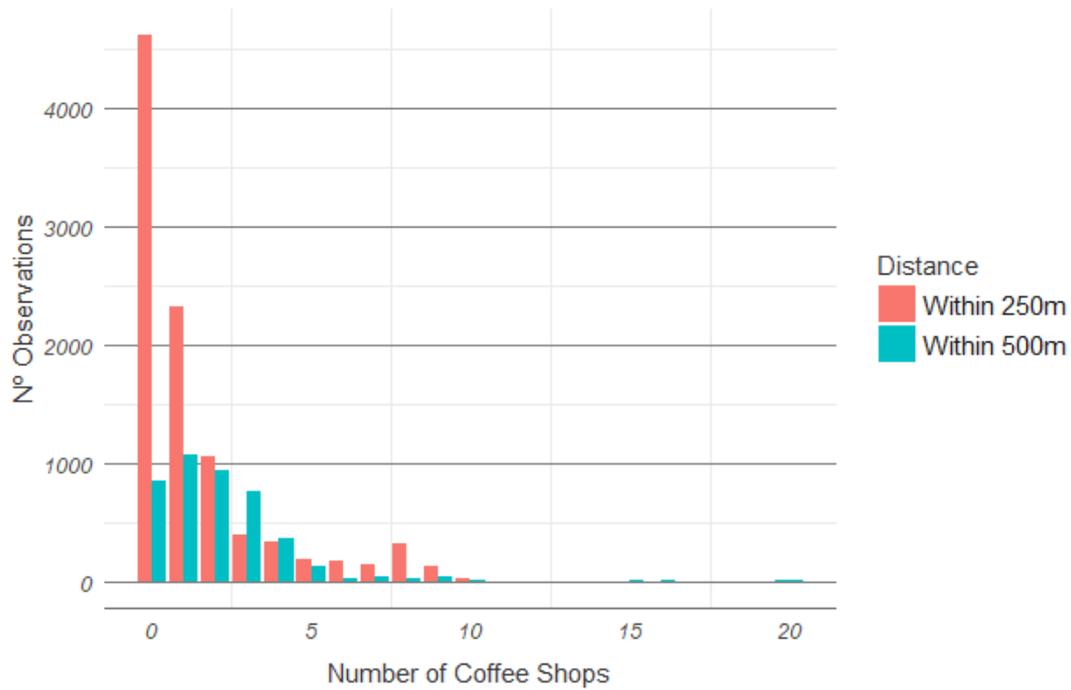


6.1.4 Presence of coffeeshops after closures

Our main variable of interest is the *FirstCS* - Closest coffeeshop. Although we believe that the closest is the coffeeshop that would exert the biggest influence on the lodgings' price, if an apartment still has several others coffeeshops in the vicinity, we can expect the influence of this closed coffeeshop to be milder, since this influence could still be coming from the remaining ones.

Bearing this in mind, we analyze how many coffeeshops still remain in the vicinity after the closure. The following graph depicts the number of observations that still had X coffeeshops within the 250m and 500m radius, after the closure of the closest coffeeshop.

Figure 14 – Occurrences of lodgings with X coffeeshops in the vicinity



One striking feature of this graph is the number of observations that have actually no coffeeshop, or only one, within the given radius. This fact adds up evidence to the hypothesis that it is, indeed, the closure the main driver of the effect captured in the regressions. Since the number of establishments within the 500m radius is also small, we can also discard the possibility of it being a matter of cut off point.

7 Conclusion

In this study, we analyzed the relationship between the *de facto* legal sale of cannabis and renting prices of apartments from the Air Bnb platform. We made use of a panel data starting from May 2014 and going until July 2017, during which it was held in the city of Amsterdam the closure of several coffeeshops. Since these closures were defined following a rule based on the positioning of schools, we considered this an exogenous shock to the stock of coffeeshops in Amsterdam.

First, we analyze the variable *FirstCS*, which is a dummy variable equals to 1 if the lodging lost its closest coffeeshop and zero otherwise. As can be seen in Table 1, this variable presented itself negative and statistically significant, as well as when robust errors to Zip Code clusters were used. Afterwards, we continued the analysis of the influence of the first coffeeshop, but controlling its distance. The variables *FirstCS.250* and *FirstCS.500* - the later for the lost coffeeshop being situated between 250m and 500m and the former, for less than 250m - also presented negative and significant values. These results point in the direction that a fairly close coffeeshop increases the renting price of the Air Bnbs.

If on one hand, we have evidence enough to believe that the coffeeshop increases the renting price of nearby Air Bnb's lodgings, on the other hand it seems that we still do not have enough evidence to support the idea that a coffeeshop depreciates the area, as is suggested by *FirstCS.1000*. This phenomenon, then, is still to be tested in a further study, tackling this issue differently.

The findings of this study suggest that, for the city of Amsterdam, the *de facto* legalization of cannabis actually has a positive externality. This result puts new evidences to the debate of drug laws and policies, a matter that still lacks data and research.

In order to have a better notion of the coffeeshop's externalities, further research should be done, preferably, them, with data on apartments beind rented or sold in a regular manner, that is, not in the Air Bnb platform. This would represent with a better accuracy how the residents feel towards the existence of such establishments.

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