



## ANALYSIS

# The impact of air pollution and noise on the real estate market. The case of the 2013 European Green Capital: Nantes, France



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## ABSTRACT

In this paper, we aim to demonstrate the way air pollution and noise may affect the well-being of the inhabitants of Nantes, France, designated the European Green Capital in 2013. We use a database compiling certain attributes of the houses that exchanged hands and their price. In order to understand the complex relationships that can exist between explanatory variables and housing price, we consider not only the direct effects of air pollution and noise on the price of around 3000 houses sold in Nantes and its metropolitan area from 2002 to 2008, but also the way some location attributes of the dwellings may affect air pollution and noise. We demonstrate that even if air pollution may be affected by some location characteristics of the house, this variable has no significant impact on the price, in the end. Noise is affected by the location of the house and exerts some significant effect on housing price. However, whilst air pollution does not impact at a global level, people who have lived in an air polluted county before coming to Nantes are sensitive to air quality, whereas those who come from a low air polluted county tend to choose low noise exposure dwellings.

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## 1. Introduction

Air and noise pollution can be considered as two environmental variables that may affect the well-being of inhabitants.<sup>1</sup> There is a large body of evidence about the health impacts of pollution: on the one hand, air pollution has adverse effects on the respiratory and cardiovascular systems as well as a range of other side effects (WHO, 2013); on the other hand, noise exposure can induce hearing impairment, hypertension, annoyance and stress, sleep disturbance, and decreased school performance (Passchier-Vermeer and Passchier, 2000). Because they apply to specific geographical contexts, such annoyances can be assessed by the depreciation we observe on the real estate market. The effects of noise exposure as well as air pollution on housing values are still of interest, even if largely explored (Anselin and Le Gallo, 2006; Bajari et al., 2012; Nelson, 2008).

In this paper, we concentrate our analysis on Nantes, France's sixth largest city. Even if its environmental conditions are as a whole

acceptable, due to windy weather linked to its proximity to the Atlantic coast, Nantes is characterized by contrasted environmental conditions regarding noise and air pollution, according to which part of the city is being observed. Over the last two decades, the city of Nantes has developed several policies to make its environment cleaner.<sup>2</sup> Priority was given to a sustainable transport policy, especially public transport, walking and cycling. For instance, Nantes was the first city in France to re-introduce the electric tramway, in 1985. The policy of city-center development aims at minimizing car transport and increasing pedestrian areas. Furthermore, in 2010/2011 long-term noise policies were implemented.

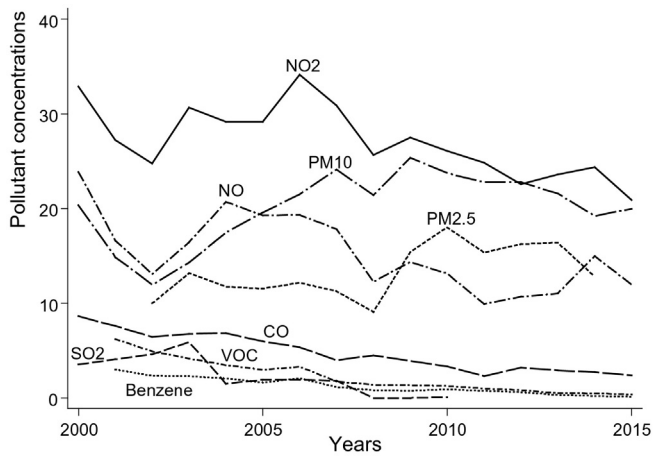
As a result of this overall strategy, the levels of most of the main air pollutants have fallen since 2000 (Fig. 1), according to the regional agency for air quality (Airpl). Most air pollution indicators (for instance, Carbon monoxide or benzene) remain at levels below the limits set by the European Directive (Directive 2008/50/CE) or the World Health Organization (WHO, 2006). Particulate matter, both between 2.5 and 10  $\mu\text{m}$  (PM<sub>2.5</sub> and PM<sub>10</sub>) have been relatively stable since 2000. However, some marked differences exist and remain between the different

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<sup>1</sup> Concerning air pollution, see Evans et al. (1988), Lercher et al. (1995), Forsberg et al. (1997), Klaeboe et al. (2000), Ambrey et al. (2014). For noise, see Lercher and Kofler (1996), Klaeboe et al. (2000).

<sup>2</sup> The city of Nantes adopted an air quality management plan in 2002, and a climate plan in 2007 whose objective is to reduce greenhouse gas emissions by 30% in 2020 and by 50% in 2025.



**Fig. 1.** Annual air pollutant concentrations in Nantes ( $\mu\text{g}/\text{m}^3$ , except for CO) Note: Carbon Monoxide (CO) is in  $100 \mu\text{g}/\text{m}^3$ ; VOC: Volatile Organic Compounds (here BTEX). The annual average values are based on the mean values of active measurement stations at this moment: for instance, 13 stations were used for  $\text{PM}_{10}$  in 2015. Source: <http://www.airparif.org/>.

districts of the city.<sup>3</sup> Furthermore, people can be affected by air pollution even if the levels of pollution comply with current WHO guidelines (Lercher et al. 1995).

Noise disturbance is a negative externality mainly due to transport and this especially occurs in cities near main road transport arteries (OECD, 2001; WHO, 1999). People respond differently to noise disturbance, although they generally tend to be affected negatively when noise levels reach a certain threshold (Dekkers and van der Straaten, 2009). In Nantes, noise exposure reveals a similar contrasted pattern according to the dwelling location.<sup>4</sup>

Beyond the policies implemented at the public level, the objective of this paper is to study whether the prices of dwellings are influenced by air pollution and noise. Nantes is a city where employment growth is superior to population growth (INSEE, 2014).<sup>5</sup> The aim is to question whether inhabitants coming to Nantes consider air quality and noise as potential determinants of their housing location and as factors of their willingness to pay a premium for their dwellings.

For our purpose, we use the Perval notaries' database linking the price of 2969 houses that were exchanged in Nantes and its metropolitan area (Nantes *Métropole*) in 2002, 2006 and 2008 respectively, with their intrinsic and extrinsic attributes (location and environmental quality). We consider the facts that firstly, air pollution and noise exposure variables may directly affect the price of a dwelling in local contexts and secondly, that some location characteristics of the dwelling may simultaneously affect air and noise pollution levels. Furthermore, the impacts of these two annoyances are usually studied separately.<sup>6</sup> To our knowledge, very few studies concern the influence of noise and air pollution together on the prices of dwellings.<sup>7</sup>

We show the existence of a positive but weak relationship between noise and air pollution. Moreover, despite the fact that location

<sup>3</sup> For instance, the annual average level of  $\text{NO}_2$  varies according to the district from  $10.53$  to  $42.41 \mu\text{g}/\text{m}^3$  in 2008 (Eval-PDU project, 2012).  $\text{PM}_{10}$  exhibit a similar and contrasting pattern, whereas  $\text{PM}_{2.5}$  are above the WHO Air Quality Guideline in almost all districts of the city.

<sup>4</sup> The mean noise exposure varies from around  $5$  to  $75 \text{ dB(A)}$ , with  $65 \text{ dB(A)}$  the daily value threshold before noise annoyance becomes noticeable (WHO, 1999). Around  $25\%$  of dwellings are above this level.

<sup>5</sup> According to INSEE (2014), Nantes has the second employment growth at the country level (the first for the executives and managers) and the third population growth of the country between 2006 and 2011.

<sup>6</sup> An exception is Klaeboe et al. (2000), but the aim of the paper is to assess the combined effects of noise and air pollution on annoyance.

<sup>7</sup> See for instance Le Boennec and Sari (2015), but they use a spatial model approach and the impact of location characteristics on air and noise variables is not taken into account.

attributes affect air pollution levels, these levels do not in turn exert any significant influence on the price of houses that were exchanged in Nantes and its metropolitan area. We emphasize a different result considering noise pollution: it can be affected by some location characteristics of the house purchased, and it simultaneously constitutes a real estate depreciation factor. However, whilst the air pollution variable does not exert any effect at a global level, people who had lived in an air polluted county ('département') before coming to Nantes appear to be sensitive to air pollution level. Furthermore, people who come from a low air polluted county choose low noise exposure dwellings. Finally, the importance given to air quality when a house is being purchased tends to increase in line with the age of the inhabitants as well as their previous pollution experience.

This paper is structured in the following manner: in Section 2 we present the assumptions. Section 3 is dedicated to the data and the methodology we use, namely a simultaneous equation model. In Section 4, we discuss our results and Section 5 is devoted to our concluding remarks.

## 2. Research Hypothesis

The way environmental variables may affect the well-being of the inhabitants of some local territories may be assessed by the hedonic pricing method. According to Rosen (1974), housing price depends on intrinsic attributes of the dwelling (number of rooms, living surface area) and extrinsic ones, such as proximity to public transport, sources of amenities and pollution. The real estate market indirectly provides a monetary value of these attributes. However, the results that may be observed when using the hedonic pricing method appear to be strongly contrasted depending on the variables and the context (Cavailhès, 2005). Whereas intrinsic attributes prove to exert comparable effects on the price of the dwellings regardless of the geographical context, this is no longer the case for location or environmental characteristics.

Concerning noise pollution, a large body of literature indicates that noise exposure has a detrimental impact on housing values.<sup>8</sup> For example, the drop in prices is also about  $0.5\%$  per additional decibel emitted by the rail network in Seoul, Korea (Chang and Kim, 2013). Similarly, apartments located in peaceful districts of Paris are worth  $1.5\%$  more on average (Bureau and Glachant, 2010). However, depending on the context, the level of noise exposure does not always constitute a significant variable, such as in Grenoble, France (Saulnier, 2004) and in the majority of the 287 French urban centers studied by Cavailhès (2005).

In hedonic studies, air quality variables often play ambiguous roles. Decker et al. (2005) highlighted the negative impact of high concentrations of restricted pollutants in Nebraska. Still, the same pollutants were not significant in Massachusetts (Bui and Mayer, 2003). Saulnier (2004) did not find any significant relationship between rents and  $\text{NO}_2$  levels in Grenoble. This absence of a significant link was generalized by Cavailhès (2005), who found a reduced and possibly zero influence of air pollution on rents in the urban centers studied.

We analyze housing transactions taking place in Nantes *Métropole*, an urban community grouping together 24 communes of the Loire-Atlantique region. It contains around 600,000 inhabitants, half of whom live in the central city of Nantes. At a national level, Nantes *Métropole* is one of the most attractive places to live in the country: its population grew by 4500 inhabitants each year between 2008 and 2012 (compared with + 6000 inhabitants between 1999 and 2007, according to the National statistical institute). Over the past decade, around one third of newcomers have come from Paris and the Parisian metropolitan area, being characterized by its stronger pollution levels (INSEE, 2014). Nantes was designated the "European Green Capital" in 2013 thanks to its good environmental results.

<sup>8</sup> See Taylor et al. (1982), Hughes and Sirmans (1992), Theebe (2004), Dekkers and van der Straaten (2009), Chen and Haynes (2015). Furthermore, see Nelson (2008) for a review of hedonic property value studies of transportation noise.

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