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Highlights

- Hedonic pricing analysis with GIS applied to industrial sites in tourism destinations
- The presence of an industrial site (i.e repellent public good), still operating or not, near to a hotel, negatively affects the hotel rates.
- This effect can be compensated by the presence of an attractive public good which validate economic policies in order to develop attractions based on industrial legacy.
- The spatial model take into account the spatial autocorrelation

Industrial legacy and tourism: an application of spatial hedonic pricing analysis to the case of hotel rooms in Nord-Pas de Calais, France

Abstract

Most of the articles in the literature based on hedonic analysis focus on the private characteristics provided by accommodations. And if the area where is located the hotel is taken into account with the identification of public good, it is exclusively on the positive side. The use of Geolocalized Data Information (GIS) with a hedonic analysis permits to measure both negative and positive effects on prices. The aim of this article is to provide an indirect assessment of the detrimental impact of industrial legacy on the tourism attractiveness of a region by studying its effect on hotel rates. The hedonic method has been used to decompose hotel prices in Nord-Pas de Calais, an old industrial region in north of France, into the implicit prices of a set of attributes, both private and public, including the repellent public attributes inherited from the industrial past of that region.

Keywords: pricing; hedonic functions; hotels; Nord-Pas-de-Calais; public goods; tourism

JEL classifications: C21, D40, H41, L83.

1. Introduction

For the politic maker, historic heritage can be an underlying resource to attract tourists, giving rise to the so-called heritage tourism (Garrod and Fyall, 2000; Poria, Butler, and Airey, 2003; Worden, Hitchcock, King, and Parnwell, 2010). Heritage is usually defined as whatever a given area has inherited from history, 'which can mean anything from historic buildings, to art works, to beautiful scenery' (Yale, 1991). Physical remains from the industrial past like facilities (e.g. factories, mills, forges, etc.), machinery, architecture, housing and industrial landscapes have sometimes become the key motivators for visitation to a destination. They serve as core resource for a distinctive subset of the field of heritage tourism, namely the industrial heritage-based tourism (Conlin and Jolliffe, 2010; Jones and Munday, 2001; Xie, 2006).

Industrial legacy can also be a serious impediment to the development of tourism. First, the development of industrial activities, at least until quite recently, has been generally done

without any concern for environmental issues and has led to serious environmental degradation and scenery spoiling. The closing down of old industries has resulted in the emergence of numerous industrial wastelands and brownfield sites contaminated with hazardous substances, pollutants or contaminants. Second, former industrial areas are seriously handicapped by a poor image and bad reputation associated with hard work, tough living conditions, workers' misery and social struggles (European Parliament, 2013). The combination of both the environmental hazards and rough social conditions as a strong repellent factor for many kinds of tourism.

All these environmental, aesthetical and psychological burdens may more than offset the historical and nostalgic attractiveness of old industrial remains and eventually deter the tourism development of a region. The effect of industrial legacy on tourism attractiveness is difficult to estimate, but an indirect assessment can be made by using the hedonic price method (Rosen, 1974). This is the aim of this article. According to the hedonic hypothesis, some products are viewed as a bundle of characteristics or attributes, each of which brings consumers some degree of satisfaction or dissatisfaction. Tourism products, especially accommodation, belong to this category. They can be considered as bundles of various attributes, both private (star rating, room service, bar, availability of sport facilities…) and public (available amenities, landscapes, quality of the environment, brand image…) (Rigall-I-Torrent and Fluvià, 2007). The observed price of any such product, e.g. hotel rates, is the sum of the unobserved prices of the bundle of attributes associated with it. The hedonic method allows one to estimate the implicit price of each characteristic which can be interpreted as the marginal value that consumers attach to this characteristic. If industrial legacy is a source of antagonistic public attributes, this method enables us to estimate their implicit prices and to know how tourists value each of them. By evaluating their contribution to the hotel rates, we can thus obtain an assessment of the impact of industrial legacy on tourism attractiveness of a region.

The hedonic price method has already been used in tourism for analysing the impact of various private and public attributes on the price of different types of accommodation (Andersson, 2010; Chen and Rothschild, 2010; Espinet, Saez, Coenders, and Fluvià, 2003). However, the focus has been put so far on private attributes and on beneficial public attributes. The influence of adverse public attributes, or 'public bads', has not yet been considered, except for crowdedness and congestion (Alegre, Cladera, and Sard, 2013; Rigall-I-Torrent and Fluvià, 2011). This article is the first in the hedonic literature in tourism to explicitly tackle the impact of unambiguous repellent public attributes (e.g. brownfield sites, slag heaps, industrial seaports). Moreover, we provide a strong validation of economic policies which try to compensate this effect by the inclusion of tourism attraction in the same area. Such an analysis should be of high interest to both hotel managers and policymakers, especially in regions belonging to Europe's 'Rustbelt', since tourism is often viewed as one of the conservation and regeneration tools which may help the process of economic restructuring of old industrial regions (Hospers, 2002; European Parliament, 2013). As underlined by Xie (2006), developing industrial heritage needs comprehensive tourism planning, and this article's analysis can provide valuable information for the design and implementation of such a planning process.

The study was conducted on hotel rates in Nord-Pas de Calais (NPdC), an old industrial region in north of France. NPdC became the second leading industrial region of France during the 19th century, specialized in 'smokestack' industries such as coal, steel and textiles. Like other forerunners of the Industrial Revolution, it was severely hit by industrial decline from the 1970s and joined the so-called 'Europe's Rustbelt'. NPdC is an ideal case study as it still has a lot of material vestiges from its industrial past, related to both productive activity (mining plants, factories, port installations) and scenery (mining villages, working-class housing, industrial landscapes), which create a large potential for industry heritage tourism. At the same

time however, the region has a great potential for other types of tourism (cultural and historical tourism, leisure and beach tourism, business tourism) which may be hurt by the remains and damage of this industrial past.

On the methodological side, a geographical information system (GIS) has been used in order to obtain the distance of hotels to the amenities. Geolocalized data proved to provide more accurate information than the dummy variables usually used in the literature as threshold and distance effects on hotel prices may differ from one amenity to another. By using GIS data, we are also able to measure and to compare results of the presence of repellent public good and to identify the effects due to the decision to construct an attractive public goods in the same area. Moreover, given the spatial nature of the framework, we took into consideration the possibility that exogenous spatial factors jointly influence the prices of nearby hotels (Balaguer and Pernías, 2013). Therefore, a specific method has been used to prevent effects caused by heteroskedasticity and spatially autocorrelated disturbance terms.

The article is divided in five sections, in addition to this introduction. Section 2 presents the analytical setting underlying the hedonic method. Section 3 gives a brief description of the region of Nord-Pas-de-Calais and shows the data and the model specifications. Section 4 gives the results and interpretations. The main conclusions are set out in a final section.

2. Framework analysis

Hedonic price models (Rosen, 1974) allow to estimate the implicit prices of a product's characteristics and their contribution to the overall price of this product. As a tourism product (a tour-operator package holiday, a stay in a hotel room, a ski lift, etc.) can be considered as a collection of objectively measured attributes, this method has been used to study the determinants of tourism prices (Alegre et al., 2013; Papatheodorou, 2002; Thrane, 2005).

However, until recently, attention has been paid exclusively to private (intrinsic) attributes of the product (star category, swimming pool, parking place, air-conditioning… in the case of a stay in a hotel room) rather than on its public attributes (scenery, available amenities, cultural facilities, brand image…), even if the importance of locational characteristics on tourism prices has been recognized for a long time (Bull, 1994). Rigall-I-Torrent and Fluvià (2007, 2011) made a substantial contribution to the hedonic pricing literature in tourism by explicitly integrating public attributes into the analysis, both theoretically and empirically. We adopt and complete their approach by adding unambiguous repellent factors (e.g. brownfield sites and slag heaps) into the list of public attributes.

Thus, a one-night stay in a hotel room is regarded in the present study as a vector (i.e. a collection) of both private attributes and public attributes. Public attributes are composed of three subcategories: attractive public attributes (for example, proximity to the beach, scenery, availability of entertainment sites), repellent public attributes (for example, the proximity to brownfield sites, slag heaps, industrial ports or plants) and network externalities (for example, job density, proximity to shopping malls, hotel partnerships). The latter subcategory of public attributes is based on the idea that the satisfaction obtained from a hotel room by tourists also depends on the availability of complementary goods and services provided by nearby businesses, such as restaurants, pubs or shopping centers, or by partnerships concluded by the hotel (Rigall-I-Torrent and Fluvià, 2011).

A one-night stay in a hotel room can therefore be represented by the following vector:

$$h = \left(c_1, c_2, \dots c_N, a_1^j, a_2^j, \dots a_B^j, r_1^j, r_2^j, \dots, r_G^j, k_1^j, k_2^j, \dots, k_M^j\right) \quad (1)$$

where h is a one-night stay in a hotel room, c_n is the measured value of the hotel's private attribute n (n=1…N); a_b^j is the measured value of the attractive public good b in location j (b=1…B); r_g^j is the measured value of the repellent public good g in location j (g=1…G); and k_m^j is the measured value of the network externality m in location j (m=1…M).

Following Rosen (1974), the equilibrium price for a night in a hotel room can be expressed as a combination of the implicit prices for the private and public attributes included in the overnight and thus as a function of all these attributes:

$$p(h) = p\left(c_1, c_2, \dots c_N, a_1^j, a_2^j, \dots a_B^j, r_1^j, r_2^j, \dots, r_G^j, k_1^j, k_2^j, \dots, k_M^j\right) \quad (2)$$

The partial derivative of $p(h)$ with respect to any attribute (e.g. $\partial p(h)/\partial c_2$) gives the implicit price of this attribute.

3. Presentation of the region and the data

3.1. The Nord Pas-de-Calais region

Nord-Pas de Calais (NPdC) has been chosen as the basis for this study because of both its rich industrial past and its great potential for various types of tourism. NPdC is the northernmost region in France, on the border with Belgium, and is located in Northern Europe's former coal belt. As a forerunner of the Industrial Revolution, it has inherited many material vestiges in the form of mining plants, factories, housing and scenery (industrial architecture, slag heaps, etc.), creating a real potential for industry heritage tourism. However, as is usual for regions belonging to 'Europe's Rustbelt', NPdC has also inherited serious environmental issues and scenery degradation. For example, 641 sites are at present officially registered as actually or potentially contaminated because of industrial activity, accounting for 14% of all polluted sites in France and ranking NPdC second among the most polluted regions in the country (BASOL database, 2014). Considering all former industrial sites leads to a total of 16 800 sites that may be contaminated throughout the 12 414 km² of the region. 74 industrial facilities are classified as Seveso (i.e establishments displaying major technological and environmental hazards) representing 6.7% of total Seveso sites in France. Former mining activity has resulted in 874 identified mine shafts and is the source of specific hazards (firedamp, subsidence, landslide, slag heaps combustion and explosion risk, flood-risk areas, etc.) which still need

surveillance and preventive action (Baudelle, 1996). The mining and industrial past is also responsible for a negative image of the region (the 'Black Country') and enduring stereotypes: generalized poverty, permanent economic decline, alcoholism, hard living conditions in foggy and dark mining villages, illiteracy, etc. (Cegarra, 2003)

All these burdens can seriously handicap the development of tourism, especially since NPdC has proved to be endowed with many valuable tourism attractors related to its rich historical past, natural resources and special geographical location. Called a "fatal avenue" by General de Gaulle (a Lille native) due to its strategic position in Europe, the region has always been one of the most fought-over regions in Europe and was a special theatre of military operations during the two World Wars. These factors have resulted in numerous historical sites (for example, the battlefields of Bouvines and Azincourt, military cemeteries and memorials, the twelve Vauban citadels, etc.). Moreover, the sandy beaches of the 'Côte d'Opale', the numerous nature reserves, parks, marshlands and forests make the region an attractive leisure destination. All these tourism assets are accentuated by a strategic geographical position as 100 million potential tourists are located within a radius of 300 km.

Therefore, it is not surprising that tourism activity has become a significant activity for Nord-Pas de Calais region. According to the French Ministry for the Economy and Finance (Direction générale des entreprises, 2016), NPdC is ranked 9th among the 22 French metropolitan administrative regions for tourism employment, and tourism provides as many jobs in this region as the car industry or the insurance and financial industries. The 6.3 million overnight stays in hotels accounted for 2.6% of total overnight stays in France in 2015, i.e. more than Corsica and half the total of Paris and its suburbs. However, despite these results, there is a general agreement that the region's tourism potential is underexploited. One major reason could be the damage caused by its industrial and mining past.

3.2. Data collection and selected variables

Several sources were used to build a comprehensive database on the NPdC region hotels for year 2013: the NPdC regional tourism committee (Comité régional du tourisme, CRT thereafter) for information on hotels, a phone survey for hotel prices, Google Maps and NPdC geographic information and spatial analysis system (SIGALE) for location information and the French national institute of statistics and economic studies (INSEE) for socio-economic information. Only officially rated hotels were kept for the study, which gives an initial sample of 414 hotels. Non-rated hotels were discarded from the sample since, according to the NPdC CRT, they have an erratic activity, a rather short life and display too poor quality for being influenced by usual attributes. These are the main reasons why the CRT gathers information on rated hotels only: name and address, star-rating (from one to five stars), participation to a hotel partnership ('club hôtelier'), room equipment (TV, air conditioning, Wi-Fi, etc.), activities (golf, spa…). After discarding rated hotels with missing data (often due to a non-response from the hotels), the final sample reduced to 337 hotels, which accounts for about 81% of the initial sample.

As the information gathered and provided by the CRT was incomplete, a phone survey was conducted to get missing information, especially on hotel rates. The prices of a double room during peak season and off-peak season have been chosen as dependent variables. The choice of the double room rates permits to use a standard rate as it is the more common product. "Peak season" is the maximum price (in a period with a high demand, as holidays) and "off-peak season" is the minimum price (low demand) for the same room. Notice that, as usual in the hedonic pricing literature on hotel rates, the prices used in our empirical study are not transaction prices, but prices displayed in hotel brochures. Effective transaction rates paid by tourists as resulting from yield management, last minute or age-based discounts, cannot materially (and for reason of confidentiality) be collected. However, the use of displayed prices

is acceptable, as suggested by (Rigall-I-Torrent and Fluvià, 2011), since it can reasonably be assumed that they correctly reflect "expected" prices paid by tourists. Moreover, the market for hotel rooms in Nord-Pas de Calais is competitive and therefore, it is very unlikely that displayed prices systematically diverge from equilibrium market prices.

One problem with price hedonic method is that it offers few theoretical guidelines for selecting independent variables (Andersson, 2000). In the present study, the selection of hotel attributes, both private and public, followed the two-steps procedure indicated by Espinet et al. (2003). First, the examination of the NPdC CRT database and interviews with professionals of the sector led to the identification of 40 private (hotel-related) attributes. The two same sources were completed by the NPdC geographic information and spatial analysis system (SIGALE) and by the INSEE database to define 16 public (attractive, repellent and network-related) attributes. Obviously, these lists are too large to be used in any manageable statistical model. Therefore, a second step is needed in order to select the more relevant and significant variables. This was done on the basis suggested by Espinet et al. (2003), especially by taking into account the opinions expressed by professionals of the sector and experts of the NPdC CRT, the availability of reliable information for all hotels, statistical significance in exploratory analyses (based on stepwise procedure) and real variation of attributes across hotels[1]. This process left us with the following independent variables. In addition, this step was also conducted to limit and control the possible presence of multicollinearity. To avoid problems resulting from multicollinearity, a variance inflation factor (VIF) was used. The VIF for variable h is given by $VIF(j)=1/(1-R^2(j))$, where R(j) is the coefficient of the multiple correlation between the h variable and the other explanatory or independent variables. A higher value of VIF represents a higher degree of correlation. All the final estimations present VIF values less than 10.

3.2.1. Private attributes

[1] Preliminary results are available upon requests

- Hotel star rating. In France, there is an official star-rating classification for hotels at the national level. Hotel rating is carried out every five years by accredited inspection bodies using a five-star system defined by Atout France, the France tourism development agency. This system is based on a list of specified requirements (Atout France, 2009) which involve many important hotel's private attributes (room surface, quality of room furniture, presence of flat screen TV, Wi-Fi access, private car parking, disability access, types of breakfast, etc.). Star rating can therefore be reasonably chosen as a synthetic index of the hotel's overall intrinsic quality as based on private characteristics. This is in line with prior research (Aguiló, Alegre, and Riera, 2001; Papatheodorou, 2002) and empirical practice: for example, Balaguer and Pernías (2013) and Becerra, Santaló and Silva (2013) used star rating classification as a measure of vertical differentiation in the hotel industry in Spain. Moreover, using hotel star rating alone instead of using a list of private attributes including the star rating itself, as often done in the literature, allows to avoid two problems. First, considering simultaneously the effects of both private attributes and hotel star rating on hotel prices in a regression model would lead to a specification error because the hotel star rating variable would become an endogenous explanatory variable (Thrane, 2005). Second, using hotel star rating alone reduces the possibility of multicollinearity between explanatory variables, which is a common problem arising in hedonic price models. Hotel star rating was included in the regression as dummy variables: Two stars, Three stars, Four of five stars. These dummy variables were coded 1 when the number of stars of the hotel reported by the NPdC CRT was respectively two, three and four or five. The reference group is made up of one star hotels.
- Bar, golf and air conditioning. These private attributes were added to the list of independent variables as they are not, or only very partially, considered by the official

hotel star rating. These dummy variables were coded 1 when the NPdC CRT indicated that a bar is available at the hotel, located near a golf course or when air conditioning is available in the room.

3.2.2. Public attributes

Public attributes are composed of three subcategories: network externalities, attractive public attributes and repellent public attributes.

3.2.2.1. Network externalities

Recall that the satisfaction obtained from a hotel room by tourists is assumed to depend also on the availability of complementary goods and services provided by nearby businesses. Three variables were selected.

- 'Club hôtelier' membership. This variable indicates a hotel partnership which allows to share clients, communication, services like booking, catering, etc. This dummy variable was coded as 1 when the NPdC CRT reported that the hotel is part of such a 'club hôtelier'.
- Distance to a shopping mall. Only shopping malls whose size was at least 10,000 m^2 were retained.
- Job density by town. This variable is defined as the number of jobs divided by the administrative surface of the town (number of jobs per square kilometer). Data come from the NPdC geographic information and spatial analysis system (SIGALE) and from the INSEE database. The job density by town captures the positive impact that economic vitality can have on the attractiveness of hotels through a better availability of public facilities and numerous shopping and entertainment opportunities it creates in the areas where hotels are located. All these goods and services are complementary to a hotel stay and thus can make a substantial difference when tourists choose a hotel (Balaguer and

Pernías, 2013; Rigall-I-Torrent and Fluvià, 2011). Moreover, economic activity stimulates the demand for hotel accommodation through business tourism.

Three categories of job density were identified in order to capture the intensity of the effect of economic activity: 'low job density', when the jobs density by town is less or equal to 1000 per km^2; 'medium job density', when the job density by town is between 1000 and 4000 per km^2; 'high job density' when the job density by town is more than or equal to 4000 per km^2. The reference group is made up of the 'high job density' group. In the estimation, we added the two others categories of job density with the inclusion of two dummies variables.

3.2.2.2. Attractive public goods

Two variables were selected.

- Distance to the beach. This control variable was included because location near beaches was shown to influence hotels' strategy and pricing policies (Espinet et al., 2003; Rigall-I-Torrent et al., 2011).
- Distance to tourist attractions. The twenty most visited attractions in the NPdC in 2013 were selected as the major region's tourism endowments (Comité régional du tourisme, 2014).

3.2.2.3. Repellent public goods

Three variables were selected.

- Distance to slag heaps (mountains of mining residuals). There are about 340 slag heaps in NPdC. They are usually viewed, together with mining villages, as one of the most typical symbols of the mining and industrial past of the France's 'Black Country', and are most often associated with the negative image of the region.

- Distance to brownfield sites (closed and contaminated industrial sites, physically still present). As shown in subsection 3.1., brownfield sites are among the most problematic legacies to the region of its industrial past.
- Distance to the port of Dunkerque. The sea port of Dunkerque was chosen as potentially repellent public good for tourism as it is the third biggest industrial and commercial port in France, spreading over 7000 hectares and containing several industries (petrochemical, iron and steel plants), and a lot of terminals and warehouses dedicated to a large variety of products (for example, petrochemicals, grains, steel, coal).

The influence of most public attributes on a hotel's rates depends on their distance to the hotel. To determine the most significant distance, we first created a geographic information system. We manually input the physical addresses of hotels and all public attributes concerned by distance (attractive, repellent and presence of shopping malls) in MapInfo Professional software and computed the geographical Euclidean distance based on GPS coordinates between each hotel and all these public attributes. We then tested different levels of distance for each public attribute and selected the most significant one. All the selected distances appear in the estimation. Eventually, we used a dummy variable coded as 1 when the distance to the public attribute was less than or equal to the selected distance. The choice to use dummy variable is motivated by two reasons. First, all the relation have not the same specification (some are quadratic, some are linear, etc.). Second, the threshold changes between the variables (the size and so the visual impacts differs among slag heaps and brownfield for example). The use of dummy variable help to simplify and to compare the results obtained.

Hotels are found all over the region, but they are concentrated on the coast and in the higher population density zone of Nord-Pas de Calais, namely, Lille (see Figure.1). Table A.1 in the appendix reports some descriptive statistics for all the variables considered in the study.

4. Specification and estimation results

4.1. Model specification

The question of the relevant functional form for the regression model has been a matter of preoccupation for a long time in the price hedonic literature since there is no theoretical guidance on the best functional form (Andersson, 2000; Rasmussen and Zuehlke, 1990). We used a Box-Cox transformation to choose the specification, as usually recommended (Spizer, 1984). This test showed that, with our data, the log-linear form is the best specification (see table A.2, in appendix). Accordingly, the dependent variable is the natural logarithm of the price of a double room while the independent variables enter the regression additively.

Two regression models were estimated, one for the peak season and one for the off-peak season:

$$log(P_i) = \mu + \sum_n \beta_n c_{in} + \sum_b \zeta_b a_{ib} + \sum_g \delta_g r_{ig} + \sum_m \gamma_m k_{im} + \varepsilon_i \qquad (4)$$

where $log(P_i)$ is the logarithm of the price of a one-night stay in hotel *i*'s double room (peak season and off-peak season) as explained in section 3.2; c_{in} is the n^{th} private attribute of hotel *i*; a_{ib} is the b^{th} attractive public good attribute related to the location of hotel *i*; r_{ig} is the g^{th} repellent public good attribute related to the location of hotel *i*; k_{im} is the m^{th} networking attribute of hotel *i*; β, ζ, δ and γ are the estimated parameter vectors; and ε_i is a random error term, independent and identically distributed with zero expectation and constant variance.

Equation (3) can be written in a matrix form:

$$log(P) = \mu.\mathrm{e} + \mathrm{C}\beta + \mathrm{A}\zeta + \mathrm{R}\delta + \mathrm{K}\gamma + \varepsilon \qquad (5)$$

We know from the literature on spatial econometrics (Anselin, 1988; Gelfand, Diggle, Fuentes, and Guttorp, 2010) that equation (4) cannot be estimated consistently using standard ordinary least squares (OLS) if there is spatial dependence. And spatial dependence is very likely to occur in tourism, especially in the case of hotels, given the importance of the spatial dimension in this activity. Exogenous spatial factors can jointly influence the prices of closely located

hotels and their pricing strategies (Balaguer and Pernías, 2013). Higher room prices in a particular area could lead to higher prices in a neighboring area. Hence, spatial autocorrelation phenomenon should be explicitly accounted for in the model. Moreover, spatial autocorrelation can also be caused by a misspecification of the model, omitted variables or when there are unobservable common shocks affecting neighboring hotels (such as shocks on local costs, e.g. property tax, urban rents…). As such, it can be considered as a useful diagnostic tool helping to detect some misspecification and to improve the quality of the model.

Econometrically, we have to test for the existence of spatial auto-correlation and to use the appropriate specification and estimation procedure. Different types of specification can be used to take into account the spatial effect in the model (SAR or SARMA). We select the spatial error model (SEM) for estimation. It supposes that the error term ε in equation (4) can exhibit spatial dependence too, i.e. it can be correlated across hotels. When there is spatial error dependence, the error vector ε follows the relationship:

$$\varepsilon = \lambda W \eta + u \tag{6}$$

where W is the weighted matrix based on Euclidean distance decay such as W_{ij}/d_{ij}, and d_{ij} is the distance between hotels i and j. λ represents the intensity of spatial autocorrelation among errors and u is a well-behaved error vector. Spatial error dependence is likely to arise either when the error term ε includes omitted variables that are also spatially dependent or when neighboring hotels are affected by unobservable common shocks. Note that in the presence of spatial dependence, OLS have to be substituted by other estimation techniques, either the maximum-likelihood (ML) estimation method or the instrumental variables (IV) estimation method. Finally, as we explained at the subsection 3.2, the results are not biased by a presence of multicollinearity.

4.2. Estimation results

Our estimation strategy is as follows. First, we estimate the model without taking into account the possibility of spatial dependence using OLS (see. Eq. (4)). The results of this estimation are shown in Table 2, columns 1 and 2. Second, we perform five appropriate non-Trobust and robust spatial tests based on the Lagrange Multiplier (LM) (see. Table 1). The SARMA test allows us to test the general hypothesis of the presence of spatial autocorrelation. Following the Moran index, the comparison of the significance levels of LMlag (for autoregressive or lag endogenous variable), LMerr (for spatial autocorrelation errors) and their robust versions (RLMlag and RLMerr) shows some spatial autocorrelation due to residuals rather than to the lagged endogenous variable. Therefore, we select the spatial error model (SEM) for estimation. As standard OLS cannot be used, we choose a non-linear optimization routine –the maximum likelihood (ML) estimation approach– in order to get unbiased and consistent estimators of the parameters in equations (4) and (6). This method has been preferred to the IV method as it does not require finding reliable instruments. The estimation results using ML are shown in Table 2, column 3 for peak season and column 4 for off-peak season. Note that, since the spatial autocorrelation term is significant and strong, the SEM model has more explanatory power than the OLS model and provides better estimates. Using these results, we also calculate the linear variations for the selected variables on hotel prices. The results are contained in Table 3.

The results have to be interpreted with reference to the first line of Table 3. According to the SEM model and given the selected reference group, the average price of a double room in a one star hotel located in a high job density area with no other attribute is €61.25 in peak season and €46.29 in off-peak season.

As expected, the private attributes (hotel star rating, bar, golf and air conditioning) have positive and highly significant effects on the hotel rates. In particular, the category of a hotel strongly influences its price. A two-star hotel can set a price €24.12 higher than a one-star hotel in peak season with otherwise identical characteristics, whereas a four or five-star hotel can charge €83.35 more. All effects are more important during the peak season, as the demand is higher and the occupancy rates rise.

Among public attributes, variables related to network externalities are in most cases significant at the standard levels. Being part of a 'Club hôtelier' partnership allows hotels to set higher prices, especially in peak season. This can be viewed as an implicit fee charged to customers for a particular service. According to the NPdC CRT, overbooked hotels redirect customers to hotels belonging to the same 'Club hôtelier', saving them additional searching costs.

The proximity of a large shopping mall, extending over at least 10,000 m², has a negative coefficient, even though statistically significant only in off-peak season. Although shopping tends to be part of any travel experience, big shopping facilities, provided in NPdC mainly in the form of hypermarkets, are clearly not valued by tourists when located in close proximity. This negative effect is probably aggravated by their usual location in the outskirts of the city.

Job density matters a great deal. Being located in a low or medium job density area drives the price of hotels down by a substantial amount relative to a high job density area, by almost 30% in peak season and 13% in off-peak season, *ceteris paribus* (see Table 2). This can be viewed as the result of differences in tourism demand intensity mainly attributable to two factors. First, as they are often located in cities, high job density areas concentrate public facilities, offer a wide range of entertainment activities and catering services, and provide a retail environment which is better adapted to the kind of shopping experience sought by tourists

than hypermarkets (UNWTO, 2014). Second, business tourism, which can be a large contributor to the demand for hotel rooms, is often concentrated in these areas. According to the CRT, in 2015 business tourism was responsible for 57% of overnight stays in Lille, the economic and administrative capital of NPdC. Moreover, combined with higher occupancy rates, the traditional lower own-price elasticity of demand for business tourism (Peng, Song, Crouch, and Witt, 2015) may contribute to explain the ability of hotels located in a high job density area to raise peak season prices much more than hotels located in a low or medium job density area.

Our estimations also indicate that the proximity of attractive public goods generally enables hotels to charge higher prices. This is especially the case for tourist attractions during both peak and off-peak seasons. Having a beach close by example also exerts a positive, significant and important influence on hotel rates, but only during the peak season. For the off-peak season, the coefficient has a negative sign, although not significant. This negative effect may be explained by the bad weather conditions usually prevailing in winter by the English Channel, which may lead travellers to prefer a hotel set back from the seaside.

Lastly and importantly for our purpose, all variables aimed at capturing the adverse effects of the region's industrial legacy on the hotel rates display the expected negative sign and are significant for the peak season. While the close presence of a slag heap or of a brownfield site exerts comparable effects (with an average drop in the price from 5.3% and 6.6% for slag heap and from 7.4% and 8.5% for brownfields), the proximity of the Dunkerque seaport has a much stronger repulsive influence on travellers (from 12.8% and 15.1%). This could be due to the difference of scale of these variables, since the actively operating Dunkerque seaport extends over 7000 hectares and thus acts as a larger source of nuisances. Note that the repulsive influence of the seaport seems to vanish in off-peak season, becoming statistically non-significant. As local people form the bulk of tourists at this time (La Voix du Nord, 2014),

hotels are likely to be used mostly by tourists motivated either by some specific aspects of that city or by non-leisure purposes, such as business, hence by tourists with low own-price elasticity of demand. Actually, off-peak season turns out to be less sensitive to 'public bads' as only brownfield sites exert a statistically significant negative effect on hotel rates.

Finally, even though the test on spatial autocorrelation between hotel prices has led us to select a SEM model, note that both specifications give rise to similar results. Moreover, the coefficient of lambda is not significant, *ceteris paribus*.

5. Conclusion and discussion

While being a potential tourism attractor for a region through the so-called industrial heritage-based tourism, industrial legacy can also be a serious impediment to the development of other forms of tourism and to the overall tourism attractiveness of the region. The aim of this article is to provide an indirect assessment of the detrimental impact of industrial legacy on tourism attractiveness by studying its effect on an easily measurable factor, i.e. hotel rates. The hedonic method has been used to decompose hotel prices in Nord-Pas de Calais, an old industrial region in north of France, into the implicit prices of a set of attributes, both private and public, including the repellent public attributes inherited from the industrial past of the region. This is the first article in the hedonic literature in tourism to evaluate the effect of these adverse public factors. We also took into account the presence of potential spatial autocorrelation between hotels rates and used geolocalized data to better deal with the variability of threshold and distance effects.

After controlling for the usual hotel private attributes, network externalities and attractive public goods, including tourism attractions, our analysis shows that the inherited adverse public attributes have a significant negative impact on hotel rates, especially during the

peak season. In other words, consumers attach negative marginal values to the visible evidence of industrial legacy, suggesting an adverse influence on tourism attractiveness.

However, the implicit price of some of these adverse public attributes is in the same order of magnitude as the implicit price of a tourist attraction. The proximity of a brownfield site or a slag heap decreases the hotel rates during the peak season by respectively 6.7% and 7.7% whereas the presence of a tourism attraction increases them by 6.9% (see. Table 2). For example, In other words, having an attractive public attribute close by could alleviate, or even compensate for, the presence of an adverse public attribute inherited from the industrial past. The dissatisfaction caused to consumers by any of these inherited 'public bads' could well be offset by the satisfaction provided by a new exploited tourism resource. This result leads to a conclusion of particular interest to hotel managers and public sector policymakers. It suggests that some room is available for public policy to compensate for the damage caused to the region's attractiveness by its industrial legacy. It gives some rationale to local regeneration initiatives of the kind of the opening in Lens, a former coal-mining town, of a satellite branch of the Louvre Museum (the Louvre Lens art museum) in 2012 on an ancient mine yard surrounded by slag heaps and mining villages. On average, in this city of Lens for a hotel close to a slag heap, the hotel rates decrease by 5 € compared to identical hotels in another city, cetirus paribus. According to our estimate, the presence of this museum can be to increase the price of 5 €, which can neutralize the effect of the repulsive public good. This project was explicitly seen by the authorities as a tool for reviving the area and modernizing the region's image, following the example of the Tate in Liverpool, the Guggenheim Museum in Bilbao and the Pompidou-Metz Museum in Metz, the capital city of Lorraine, another region belonging to France's rustbelt. Our results support the relevance of this type of policy, at least for NPdC, and more generally of any policy related to a strategy of counteracting inherited 'public bads' through the creation of new attractive public attributes or the enhancement of existing ones. In

that respect, transforming the region's numerous historical and industrial legacies into valuable resources for many forms of tourism (legacy tourism, memorial tourism, historic tourism, warfare tourism, industrial heritage tourism) is confirmed to be an excellent option for the region and should be reinforced (see, for example, the museum La Piscine of Roubaix, the mining site of Wallers-Arenberg, the ski-resort on a slag heap in Noeux-les-Mines, the mining historic center of Lewarde, the Remembrance Trails of the Great War, the V2 rocket launching site at Helfaut, etc.) Site labelling and certification can be a powerful tool for such a strategy as they may provide a cultural attractiveness to scorned inherited sites, helping to erase the usual perception of their supposed or real unpleasant features. The inscription in 2012 of the mines of the Nord-Pas de Calais region to the list of UNESCO World Heritage Sites as 'a living and changing landscape' falls into this category. Site labelling and certification can also give more visibility to existing tourism resources, contributing in another way to counteract inherited 'public bads'. For example, evidence shows that Dunkerque, whose industrial seaport was found to have such a negative effect on hotel rates, benefited in terms of tourist frequentation from having its belfry (Beffroi de Saint-Eloi) included in the 23 belfries from the Nord-Pas-de-Calais and Picardy regions added in 2005 by UNESCO to the list of the World Heritage Sites (La Voix du Nord, 2014). Moreover, we support with our analysis that a destination have to create marketing strategies in order to promote this industrial legacy. The originality to use it, in a positive way and not in an undergone way, can develop new tourism market opportunities. For example, in the slag heap of Noeux-les-Mines, it is possible to practice artificial ski.

However, the current study has some limitations which should be kept in mind. First, it has been conducted for a specific point in time, not for a period. Temporal data could reveal that the negative effects of industrial legacy might have been stronger ten or fifteen years ago, when the local strategy of creation or enhancement of attractive public attributes, especially based on historic and industrial legacy, was at an early stage. Second, the study specifically

focused on hotel rates whereas other forms of accommodation, especially camping, are widely used in the NPdC region. However, data on the latter dramatically lack. Third, the effects on prices of yield management and, more importantly, of the online reservation platforms have not been taken into account. And as a matter of fact, effective prices can seriously diverge from declared prices, which were chosen as the dependent variable in our study due to data availability. Nevertheless, our results can be interpreted as averages. Moreover the market power of online reservation platforms has been recently restricted by the legislation to the benefit of the hotels which are now in a better position for negotiating rates.

Nevertheless, we argue that the use of GIS data with a hedonic model has a powerful scientific potential. For example, with this type of method, it is possible to accurately measure the price decline, based on the problems of insecurity / crime in a sector for the tourism industry. It is also possible to search the optimal distance of a hotel, in terms of price, for its location near a tourist attraction (beach, museum, etc.). The effect of the quality of the environment can also be measured with this form of methodology. However, this search potential requires an improvement in the speed of data collection. The huge improvement in computer programming should help to solve this point.

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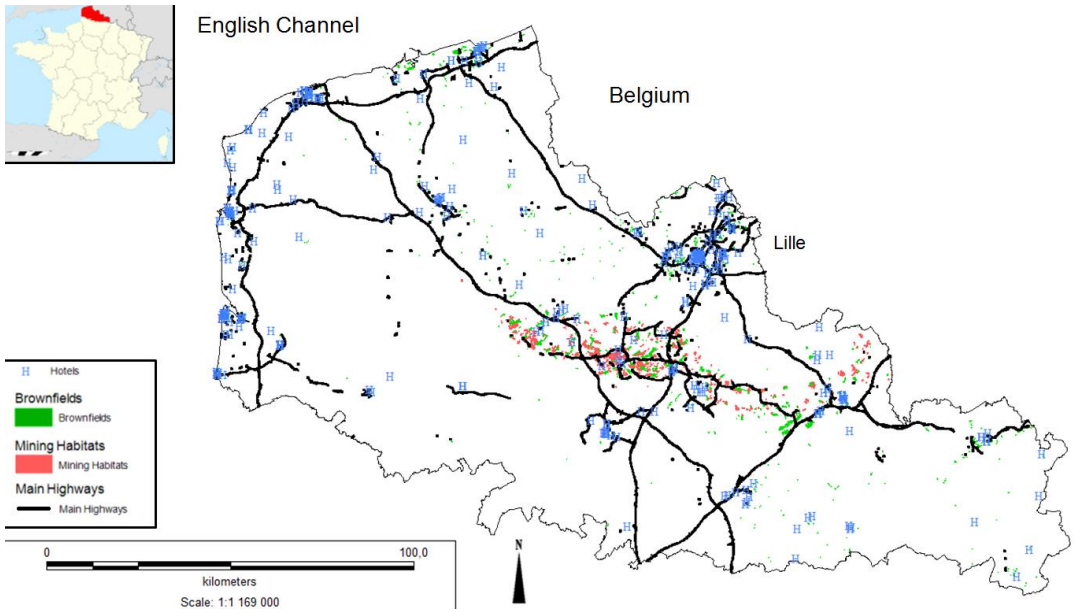
Tables and Figures:

Figure 1. Geographical repartition of hotels in the Nord-Pas de Calais region.



Source: based on the authors' survey.

Table 1. Lagrange multiplier tests.

	Distance matrix		Neighbour matrix	
	PS	OS	PS	OS
I's Moran	0.0680	0.0108	0.1300	0.0716
	(<.0001)	(0.1888)	(<.0001)	(<.0001)
LMerr	9.2236	5.123	2.8185	9.6646
	(0.0023)	(0.0236)	(0.0931)	(0.0018)
LMlag	7.2485	0.443	2.5315	3.1095
	(0.0070)	(0.5057)	(0.1116)	(0.0778)
RLMerr	2.8165	6.6642	0.7501	6.7663
	(0.0933)	(0.0098)	(0.3864)	(0.0092)
RLMlag	0.8414	1.9842	0.4632	0.2112
	(0.359)	(0.1589)	(0.4961)	(0.6459)
SARMA	10.065	7.1072	3.2816	9.8758
	(0.0065)	(0.0286)	(0.1938)	(0.0071)

p-value in brackets
PS stands for peak season, OS stands for off-peak season
Source: The authors, based on authors' survey.

Table 2. Estimation results based on the ordinary least squares method (OLS) and on the spatial error model (SEM)

	OLS		SEM	
Variable	PS	OS	PS	OS
Constant	4.113***	3.846***	4.115***	3.835***
	(0.0643)	(0.0584)	(0.0703)	(0.0694)
Two stars	0.331***	0.311***	0.332***	0.306***
	(0.0444)	(0.0403)	(0.0431)	(0.0389)
Three stars	0.640***	0.571***	0.645***	0.571***
	(0.0524)	(0.0476)	(0.0505)	(0.0454)
Four or five stars	0.855***	0.850***	0.859***	0.840***
	(0.0686)	(0.0623)	(0.0667)	(0.0600)
Bar	0.124***	0.123***	0.123***	0.119***
	(0.0307)	(0.0279)	(0.0298)	(0.0269)
Air conditioning	0.143***	0.0845***	0.139***	0.0913***
	(0.0354)	(0.0322)	(0.0341)	(0.0306)
Golf	0.199***	0.185***	0.181***	0.167***
	(0.0617)	(0.0561)	(0.0597)	(0.0537)
“Club hôtelier” membership	0.0846***	0.0445*	0.085***	0.053**
	(0.0298)	(0.0270)	(0.0293)	(0.0266)
Less than 500 meters from a shopping mall	-0.0407	-0.0522*	-0.0457	-0.0592**
	(0.0309)	(0.0281)	(0.0303)	(0.0274)
Low job density	-0.309***	-0.147***	-0.313***	-0.139**
	(0.0496)	(0.0451)	(0.0580)	(0.0588)
Medium job density	-0.287***	-0.153***	-0.286***	-0.137**
	(0.0528)	(0.0480)	(0.0601)	(0.0598)
Less than 200 meters from a beach	0.258**	-0.0173	0.245**	-0.0343
	(0.104)	(0.0943)	(0.1006)	(0.0904)
Less than 1 km from a tourist attraction	0.0776**	0.0685**	0.069*	0.0615*
	(0.0372)	(0.0338)	(0.0375)	(0.0344)
Less than 5 km from a slag heap	-0.0889**	-0.0385	-0.077*	-0.0589
	(0.0410)	(0.0373)	(0.0476)	(0.0475)
Less than 1 km from a brownfield site	-0.0680**	-0.0639**	-0.0675**	-0.0547**
	(0.0286)	(0.0260)	(0.0292)	(0.0270)
Less than 5 km from Dunkerque seaport	-0.164**	-0.0391	-0.137*	-0.0197
	(0.0722)	(0.0656)	(0.0805)	(0.0779)
Lambda			0.2542	0.38515
			(0.1486)	(0.1273)
Observations	337	337	337	337
R-squared	0.668	0.629		

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1
PS stands for peak season, OS stands for off-peak season
Source: The authors, based on authors’ survey.

Table 3. Estimation results on the linear variation of prices (in euros)

	OLS		SEM	
Variable	PS	OS	PS	OS
Reference	**61,13**	**46,81**	**61,25**	**46,29**
Two stars	+23,98***	+17,07***	+24,12***	+16,57***
Three stars	+54,8***	+36,04***	+55,49***	+35,65***
Four or five stars	+82,61***	+62,7***	+83,35***	+60,94***
Bar	+8,07***	+6,13***	+8,02***	+5,85***
Air conditioning	+9,4***	+4,13***	+9,13***	+4,43***
Golf	+13,46***	+9,51***	+12,15***	+8,41***
“Club hôtelier” membership	+5,4***	+2,13*	+5,43***	+2,52**
Less than 500 meters from a shopping mall	-2,44**	-2,38	-2,74	-2,66**
Low job density	-16,25***	-6,4***	-16,46***	-6,01**
Medium job density	-15,25***	-6,64***	-15,24***	-5,93**
Less than 200 meters from a beach	+17,99**	-0,8	+17**	-1,56
Less than 1 km from a tourist attraction	+4,93**	+3,32**	+4,38*	+2,94*
Less than 5 km from a slag heap	-5,2**	-1,77	-4,54*	-2,65
Less than 1 km from a brownfield site	-4,02**	-2,9**	-4**	-2,46**
Less than 5 km from Dunkerque seaport	-9,25**	-1,79	-7,84*	-0,9
Lambda			+17,73	+21,75
Observations	337	337	337	337

*** p<0.01, ** p<0.05, * p<0.1
PS stands for peak season, OS stands for off-peak season.
Source: The authors, based on authors’ survey.

Appendix

Table A.1 : Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Expected sign
Star1	337	.1238938	.3299474	0	1	Ref
Stars2	337	.5752212	.4950401	0	1	+
Stars3	337	.2212389	.4156946	0	1	+
Stars4/5	337	.0737463	.2617439	0	1	+
Bar	337	.6468843	.478649	0	1	+
Golf	337	.0534125	.2251889	0	1	+
Air conditionning	337	.2195846	.4145808	0	1	+
"Club hotelier" membership	337	.5103858	.5006355	0	1	+
Shopping mall	337	.3510324	.4779986	0	1	+
Low jobs density	337	.6371681	.4815277	0	1	-
medium jobs density	337	.2418879	.4288598	0	1	-
High jobs density	337	.120944	.3265441	0	1	Ref
Beach hotel	337	.0176991	.1320503	0	1	+
Distance Tourist attraction	337	.2153392	.4116651	0	1	+
Distance Slag Heaps	337	.1415929	.3491475	0	1	-
Distance Brownfields	337	.4070796	.4920162	0	1	-
Distance Dunkerque Seaport	337	.0383481	.192319	0	1	-

Table A.2: Tests on the Box-Cox transformations

Prices on peak season

Test H0	Restricted log-likehood	LR Statistics Chi2	P-Value (Prob > chi2)
$\lambda = 1$	-1492.761	55.34	0.000
$\lambda = 0$	-1467.9418	5.70	0.017
$\lambda = -1$	-1548.0578	165.93	0.000

Prices on off peak season

Test H0	Restricted log-likehood	LR Statistics Chi2	P-Value (Prob > chi2)
$\lambda = 1$	-1400.0461	60.13	0.000
$\lambda = 0$	-1371.4789	3.00	0.083
$\lambda = -1$	-1443.9906	148.02	0.000