IMPACTS OF AN IRON AND STEEL PLANT ON RESIDENTIAL PROPERTY VALUES

CELIA BILBAO-TERO

FUNDACIÓN DE LAS CAJAS DE AHORROS
DOCUMENTO DE TRABAJO
Nº 339/2007

De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISBN: 84-89116-07-5

La serie **DOCUMENTOS DE TRABAJO** incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros.
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Impacts of an iron and steel plant on residential property values

Celia BILBAO-TEROL

University of Oviedo. Department of Economics. Av. Del Cristo, no number. Postcode 33006. Oviedo, Asturias, Spain. Tel: +34985103722. Fax: +34985104871. E-mail: cbilbao@uniovi.es.

The author would like to thank funding provide by the research Proyect MEC-04-SEJ2004-08253.
The author is grateful to the anonymous referee for their helpful suggestions and comments.

Abstract.

The purpose of the research is to evaluate the effects on environmental quality caused by an integrated iron and steel plant located in the outskirts of Gijón, a city in the north of Spain. To carry this out, the method of Hedonic Prices is applied to the environmental field. The method relates the prices of dwelling units with their characteristics, including the environmental ones. This method allows to identify the "price" that consumers pay for the quality of the environment where their house is located. The results indicate that the effects of the plant on the value of the properties are significant. Decreases in the plant's production, the installation of contamination-reducing technology or the dismantling of the plant would lead to an increase in the value of the dwellings. The nearest ones to the factory would be the most favoured. Not accounting for environmental benefits could give rise to erroneous decisions when negotiating a possible restructuring of the industry.

Keywords: hedonic prices, housing, polluting industry, iron and steel plant, environmental quality.

JEL: D62, H21.

1. Introduction

The goal of this study is to evaluate the effects on environmental quality caused by an integrated iron and steel plant located in the outskirts of Gijón, a city in the north of Spain. The main obstacle to achieving this objective is that while environmental quality is undoubtedly valuable, there are no market prices for it. However, different methods exist in the economic literature which try to correct this deficiency, such as hedonic pricing, travel costs, damage avoidance cost or contingent valuation[1].

In this study the method of hedonic prices (Rosen, 1974) is applied. This method is based on the relation which exists between some heterogenous private goods and public goods. In our case, the heterogenous private good, comprising a multitude of characteristics or attributes, is the house, and the public good is the quality of the environment. One of the characteristics of each house is its environmental surroundings. Thus, when consumers choose their house, they also implicitly choose the environmental quality that they desire and pay a price for this.

The hedonic pricing technique takes account of the implicit price of environmental characteristics. The main advantages of the hedonic method with respect to other methods of valuation are the following (Gómez, 1996):

- Firstly, it is an indirect method, that is to say, it is based on what people reveal through their behaviour and not on what people declare in an interview, a survey or some type of laboratory experiment. This avoids possible biases in the survey or in the experiment.

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[1] Surveys of these methods include Freeman III (2003) and Johansson (1993).

- On the other hand, unlike other indirect methods, such as the travel costs, which try to place a value on a particular asset such as, for example, a natural park, the hedonic method tries to put a value on attributes or characteristics of the assets.

- Thirdly, it is the only method that allows the valuation of local public goods, defined as those goods whose benefit is related to the occupation of a particular geographic space.

Many studies have been conducted using the hedonic pricing method to evaluate environmental externalities, beginning in the 1960s with the work of Ridker (1967) on air pollution. This gave rise to a multitude of studies, among the most important of which were Brookshire et al. (1982), Graves et al. (1988), Ohsfeld and Smith (1990), Smith and Deyak (1975) and Smith and Huang (1995) on air quality, Benson et al. (1998), Bourassa et al. (2004), and McLeod (1984) on the impacts of views, Espey and Lopez (2000), McMillan (1979), McMillan et al. (1980) and Nelson (1978) on noise, Hughes and Sirmans (1992) on traffic noise, Gayer et al. (2000) on enviromental risk, Luttik (2000) on landscape and water quality, Anderson and Cordell (1988), Bengoechea-Morancho (2003), More et al. (1988), Powe et al. (1995), Tajima (2003), Tyrväinen (1997), and Jim and Chen (2005) on urban green spaces.

The effects of polluting industries have also been the subject of study. Notable among these are the studies by Folland and Hough (2000) and Gamble and Downing (1982) on proximity to a nuclear power station, those by Brasington and Hite (2005), Dale et al. (1999), Hite et al. (2001), Ihlanfeldt and Taylor (2004), Ketkar (1992), Kiel and Zabel (2001), Kohlhase (1991) and Michaels and Smith (1990) on discharges from polluted sites, the study of nuclear waste by Gawande and Jenkins-Smith (2001) and that of Letombe and Zuindeau (2005) on a lead production plant. However, there are no significant studies about the effects on environmental quality caused by iron and steel industries.

A representative sample of prices of new houses together with their characteristics for the city of Gijón in 2002 establishes the relation between house prices and their environmental surroundings. The results indicate that the environmental variables used (distance to the iron and steel plant and atmospheric contamination) exert a significant influence on house values. Improvements in these variables such as, for example, reductions in the production of the plant, reductions of emissions of polluting substances or increases in the distance to the plant would lead to a revaluation of the properties.

In the following section we describe the history of the factory and its surroundings. We then explain the theorical foundations of the hedonic pricing method, the empirical model used, and the results obtained. Finally, the main conclusions of the study are described.

2. The industry and its surroundings

Gijón is a city located on the shore of the Bay of Biscay in the northern Spanish region of Asturias and has a population of 275830 inhabitants according to the latest census. It has a strong metallurgical tradition that goes back to the 19th century but the city’s modern iron and steel industry began in 1957 with the construction of an integrated iron and steel plant by the private company UNINSA (Iron and Steel Industries Union). The new factory was located 7 kms away from Gijón´s centre of population and 3 kms away from the seaport. It began to produce steel in 1971, with production reaching 1800000 tons in 1973.

In 1973 the factory was taken over by the public company ENSIDESA (National Iron and Steel Company). During the 1980s ENSIDESA underwent a series of rationalizations, with reductions of production and cutbacks in the workforce in all their factories including the one in Gijón. It began to be privatized in the middle of the 1990s, a process which ended in 2002. At the present time it belongs to the Arcelor Mittal group.

During the negotiations in the successive rationalizations, neither management nor unions considered the environmental benefits obtained by the reduction in production[2]. This was in spite of the fact that the iron and steel industry is one of the most damaging to the environment, not only due to the high amount of polluting substances that it generates but also to the problems of water contamination generated by disposal of residues. Integrated iron and steel plants produce large amounts of polluting agents, with the main ones being particles (dust, smoke, fog, and fly ash), gases (SO_2, CO, NO_2, fluorides) and red smoke (iron oxides). With regard to water contamination, the main problem is the spillage of oils, dissolved metals, emulsions, soda caustic and acids to the water. These polluting agents have very damaging effects on human beings, being especially related to heart and respiratory problems. They have damaging effects on buildings and historical monuments, as well as on the green belts surrounding cities.

Not including the effects that a possible reduction in production has on the environment during negotiations can lead to erroneous decisions being taken from the economic point of view. Thus, the hedonic pricing method which we use in this study allows us to evaluate, in monetary terms, the environmental effects produced by a reduction in production or a dismantling of the polluting industry.

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[2] Unfortunately there is not information about the amounts of polluting substances produced by the industry.

3. Methodology

The analysis provided is based on the proposals of Lancaster (1966). In this framework, utility is not directly derived from goods, but from their intrinsic characteristics or attributes. This specific feature is considered in our analysis. The most common application of this approach is the so-called Hedonic Prices Method[3] (Rosen, 1974). The Hedonic Price Method is an approach for estimating the implicit prices of the characteristics that differentiate closely related products belonging to the same product class.

The hedonic approach, regards a good as a set of attributes or characteristics and considers the good's value as a function of its attributes. The value of each characteristic is called its implicit (or hedonic) price, because it cannot be observed in a real market. Hedonic prices can be estimated, however, by analyzing the market prices of a good that has different attributes. The hedonic approach is defined as a method of revealing these implicit prices. The mapping which determines the market price of a good through these attributes is called the hedonic price function. As an economic method, this approach has very appealing characteristics because it is based upon revealed preferences of consumers and producers in actual markets. This section outlines Rosen´s model and applies it to housing[4].

The approach assumes that differences in property prices are due to different housing characteristics. Accordingly, property prices should reflect the extra money that people are willing to pay for greater size, greater quality of the house or for better

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[3] The origin of the hedonic prices method is found in the investigations by Court (1939) and Griliches (1971) for the automobile sector, but studies usually begin by referring to the work of Rosen (1974) since this gives microeconomic foundations to the method.

[4] Before the seminal article by Rosen (1974), the hedonic technique had already been applied to the house market in numerous studies. Some examples of these applications can be found in the survey made by Ball (1973).

environmental quality, e.g. a house near a public park. In this way, people can choose the level of consumption of local public goods through their choice of a jurisdiction to reside in; and the housing market functions also as a market for the purchase of local public goods.

More formally, let $\mathbf{z}= (z_1, z_2,\ldots,z_n)$ be a vector of housing characteristics (size, quality, location, environment, age, etc.). The components of **z** are objectively measured in the sense that all consumers' perceptions of the amount of characteristics embodied in each housing are identical, though consumers of course may differ in their subjective valuations of alternative packages. It is assumed that a sufficiently large number of houses are available so that choice among various combinations of **z** is continuous for all practical purposes. The price of a house is given by hedonic price function:

$$\mathrm{p}(\mathbf{z}) = \mathrm{p}\,(z_1, z_2,\ldots,z_n)$$

where $z_1, z_2,\ldots,z$ are the characteristics of the house.

The partial derivates of price with respect to the previous variables are implicit or hedonic prices:

$$\frac{\partial \mathrm{p}(\mathbf{z})}{\partial z_i} = \mathrm{p}_{\mathrm{i}}(z)$$

This price provides information on the marginal willingness-to-pay price for an additional unit of each characteristic. As a result, the implicit price of individual characteristics can be deduced.

The hedonic method has a two-step approach that consists of the estimation of a system of demand and/or supply equations. Because of the demanding data requirements and the econometric problems associated with the second step[5], most empirical studies have used only the first step of the hedonic regression model (Bengoechea-Morancho, 2003; Jim and Chen, 2005; Luttik, 2000; McMillan et al., 1980; Michaels and Smith, 1990; Tyrväinen, 1997; Willis and Garrod, 1993).

In this study we estimate the price hedonic function only. Our objective is to analyze the impact of the polluting industry on the values of the dwelling without making any type of welfare analysis.

4. Estimation and Results

The hypothesis of this study is that dwelling values are reduced by the contamination produced by the plant. That is, houses nearer the industry and/or that undergo a greater atmospheric contamination have a lower price, ceteris paribus, than those that are further from the industry or whose environment is less contaminated.

The relation between the price of the house and the quality of its environmental is established using a hedonic price function, which requires data on the prices of houses and the characteristics of these houses. Our data has been supplied by the real estate agency Foro Consultores Inmobiliarios S.L. (Real Estate Consultants Agency). The agency conducted market research on new apartment buildings in the city of Gijón during the months of May and June of 2002. A representative random sample of 166 apartments was selected from a total of 3501 new apartments[6].

The data set comprises the following information: price before taxes; number of rooms; floor area; location; whether or not the residence has a garage; whether or not it

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[5] About the problems and solutions to the second stage analysis, there are studies by Follain and Jiménez (1985), Palmquist (1991), Freeman III (2003) and Ekeland et al. (2002, 2004).

[6] For more information about the methodology used in the market study, is found "Market study for new houses in the city of Gijón" Foro Consultores Inmobiliarios S.L. (2002).

has a lumber room; the floor on which the residence is located; and certain characteristics related to the quality for each residence of the sample including whether or not it has a swimming pool (Q_{SW}) , gardens (Q_G), sports areas (Q_{SP}), equipped kitchen (Q_K), entry video-phone (Q_{VI}) and satellite dish (Q_{SA}).

The next step is to define the variables that are included in the hedonic equation. With regard to the independent variables, that is to say, the characteristics of the flat, we wish to include a reduced number of these characteristics but with the condition that the dwelling is described correctly (Butler, 1980). The independent variables of the hedonic equation are classified in four groups:

- Variables that measures the size of the flat: due to the high correlation between the floorspace of the house in square metres (S_A) and the number of rooms[7] (S_R), a new variable, average size of the rooms, (S_M), is created. It is defined as the result of dividing square metres by the number of rooms. Number of rooms (S_R), and the dummy variables garage (S_G) and lumber room (S_L) are also included.

- Variables that measures the quality of the house. Due to the existence of high correlations between these variables (see appendix) a measure of quality is constructed (Q). To do so, a point is given for each one of the quality-related characteristics that the house has. Thus, if the house has an entry video-phone, swimming pool and gardens, the quality variable is assigned a value of three points. The floor on which the apartment is located (Q_H) is also included as a quality variable.

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[7] See appendix.

- Variables related to the location of the flat. Two variables are included. The first one is the distance in metres from the house to the city centre (D_C), and the second one is the distance in metres from the house to the nearest beach[8] (D_B).

- Variables related to the environmental surroundings of the flat. Two variables that try to measure the detrimental effects of the industry on the value of the flat are included. The first one is the distance in metres from each apartment to the factory (E_F), where we expect that the shorter the distance to the plant, the lower the value of the apartment. This variable provides direct information on the effects of the industry on the value of the properties. The second variable is an index of air pollution of the zone in which the dwelling is located (E_A). In order to construct this index we start from the information collected by the four automatic atmospheric contamination measurement stations located in four different places in the city[9]. The stations daily measure particles suspended in the atmosphere (A_P), sulfur dioxide (A_S), nitrogen dioxide (A_N), carbon monoxide (A_C) and lead ($\mathrm{A_L}$). The previous variables are highly correlated as can be observed from the correlation matrix that appears in the appendix. For this reason we construct an index of atmospheric contamination by adding the average of the standardized annual values of each one of the atmospheric polluting agents. It is standardized by dividing each value between the sample highest value. The greatest the contamination of the zone, the greatest the value of the index and the smallest value of the dwelling, ceteris paribus. This variable does not directly relate the effects of the industry with the value of the dwellings, since atmospheric contamination is not caused solely by the iron and steel industry but also by road traffic and other industries of the

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[8] There are three beaches in the town.

[9] One can see Local Observatory nº 16. Gijón City council for information on the environmental stations.

zone as well[10]. Nevertheless, we assume that a reduction of the emissions of polluting agents on the part of the iron and steel industry has positive effects on the atmosphere.

The dependent variable is the sale price in euros of the dwelling excluding taxes, (P).

Two assumptions have to be made: the first one is that the entire urban area can be treated as a single market; and the second is that the housing market is at or near equilibrium (Palmquist, 1991; Parsons, 1986).

The choice of functional form in hedonic pricing method has been a major concern due to the lack of guidance from economic theory about the intricate relationship between housing price and its multiple attributes. Functional forms for the hedonic price function that have been proposed in the literature include the linear (De Borgert, 1986; King 1976; Parsons 1986), the quadratic (Witte et al. 1979), the log-linear (Nelson, 1978), the semi-log (Palmquist, 1984), and the Box-Cox transformation (Blomquist and Worley, 1981; Goodman, 1978; Goodman and Kawai, 1984; Linneman, 1981; Quigley, 1982). In recent years a number of nonparametric approaches have been proposed (Ekeland et al. 2002, 2004). It is believed that Box-Cox transformations and nonparametric approaches could yield a better fit of the data than other transformations. Nevertheless, this requires complicated transformation processes which could introduce more random errors and for this reason that the search was restrictive to the four forms most frequently used: linear, log-lin, lin-log and log-linear.

The estimed equations are the following ones:

- linear model,

$$P = \alpha_0 + \alpha_1 S_R + \alpha_2 S_M + \alpha_3 S_G + \alpha_4 S_L + \alpha_5 Q + \alpha_6 Q_H + \alpha_7 D_C + \alpha_8 D_B + \alpha_9 E_F + \alpha_{10} E_A + v_{\mathrm{i}}$$

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[10] Unfortunately, we lack of traffic density data for each town area.

- log-lin model,

$$\ln P = \alpha_0 + \alpha_1 S_R + \alpha_2 S_M + \alpha_3 S_G + \alpha_4 S_L + \alpha_5 Q + \alpha_6 Q_H + \alpha_7 D_C + \alpha_8 D_B + \alpha_9 E_F + \alpha_{10} E_A + v_{\mathrm{i}}$$

- lin-log model,

$$P = \alpha_0 + \alpha_1 S_R + \alpha_2 \ln S_M + \alpha_3 S_G + \alpha_4 S_L + \alpha_5 Q + \alpha_6 Q_H + \alpha_7 \ln D_C + \alpha_8 \ln D_B + \alpha_9 \ln E_F + \alpha_{10} \ln E_A + v_{\mathrm{i}}$$

- log-linear model,

$$\ln P = \alpha_0 + \alpha_1 S_R + \alpha_2 \ln S_M + \alpha_3 S_G + \alpha_4 S_L + \alpha_5 Q + \alpha_6 Q_H + \alpha_7 \ln D_C + \alpha_8 \ln D_B + \alpha_9 \ln E_F + \alpha_{10} \ln E_A + v_{\mathrm{i}}$$

where v_i is the term of habitual error, α_0 is the constant and the α´s are the coefficients of variables.

The estimation method is ordinary least squares (OLS) and the software LIMDEP is used.

The log-linear model was found to be the best model on the basis of the summary statistics, and we only report the results for this specification[11]. The results of the other functional forms are available on request to the author.

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[11] The results of the other functional forms are available on request to the author.

Table 1. Results of regression of log-linear model.

Variables	Coefficient	t-ratio$^{a)b)}$
α_0	11.1	8.2***
S_R	0.30	8.75***
S_M	0.59	2.12**
S_G	0.09	2.4**
S_L	0.02	0.47
Q	-0.003	-0.21
Q_H	0.04	3.84***
D_C	-0.17	-5.2***
D_B	-0.14	-6.1***
E_F	0.25	2.7***
E_A	-0.90	-2.75***
R^2Adj.	76.2	
F -RATIO	53.91	
(p) –Value	0.000	

a)***Significant at 1% level, **Significant at 5% level. b) Heteroskedasticity-robust estimates (White Method). All variables are in natural log form, except the dummy and ordinal variables, n=166.

The results are, in principle, satisfactory, and the effectiveness of the Rosen (1974) method is shown, confirming the existence of an implicit market for house characteristics, including environmental ones. The model explains a high percentage of the price of the house, which indicates that the functional form and the characteristics included are reasonable. The set of explanatory variables account for 76% of the price variable and the F-ratio test indicates that the model fits properly. All the coefficients have the expected signs and are significant at the conventional levels, except for the lumber room and the quality. Maybe the non meaningfulness of the lumber room is due to the small data variation, since 166 out of 143 houses have got lumber room. As far as quality is concerned, perhaps something similar does happen since every house is new. Therefore, their quality level is all alike.

The positive signs of the coefficients indicate that the market favorably values an increase of the characteristic, and vice versa for negative. Thus, a flat with three rooms will have a higher price than another one with two rooms, ceteris paribus. Whereas an apartment located 1000 metres away from the town centre has a lower value than a similar apartment located 900 metres away.

As a log-linear functional form is used, the coefficients of continuous the variables are elasticities, maintaining all the other characteristics constant. Thus, if the average size of the rooms increases by 10%, the price of the flat rises by 5.9% ceteris paribus. Similarly, the price increases by 2.5% when the distance from the plant increases by 10%, maintaining all the other characteristics constant.

On the other hand, if the distance from the city centre increases by 10%, the price of the flat falls by 1.7% ceteris paribus. When the dwelling is located 10% further away from the nearest beach, its price falls by 1.4%. The apartment price diminishes by 9% when the atmospheric contamination increases by 10% since the coefficient is negative.

In the case of the discrete variables, the estimated coefficient is interpreted as a multiplying coefficient, after exponent. For example, the existence of a garage means that the price of the flat is multiplied by 1.09 ceteris paribus. Similarly, an increase in the floor level on which the dwelling is located multiplies the price of the dwelling by 1.04, ceteris paribus. Finally, the price of an apartment increases a 35% when it has got one more room.

The variables that contribute most to the price of the dwelling are those that measure the size of the dwelling and the atmosphere quality. The first ones are related to the basic necessity of lodging. Once this necessity is satisfied, the characteristics most valued by the market are the one related to the environmental surroundings[12]. Environmental improvement will produce significant increases in the prices of the dwelling, capitalizing the benefit of the improvement in their value**.** Thus, we can change the characteristics to see how the prices of the dwelling change.

In table 2 the variations in the price of a flat with standard characteristics are calculated by increasing the distance from the factory[13].

The change in the distance variable could be achieved by a policy of relocating the industry, by reducing its size or by dismantling it completely.

Table 2. Variation of the price before changes in the distance

Distance (m)	Price (€)	Dwelling price increase (%)
500	179046	
1000	212989	18.95
1500	235625	31.6
2000	253469	41.56
2500	268069	49.72
3000	280660	56.75
4000	301643	68.47

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[12] Bilbao, C. (2001) and Bilbao, A., Bilbao, C. and Labeaga, J.M. (2005) also obtain similar results as far as the importance of the variables is concerned for the town of Gijón. Unfortunately, comparisons cannot be made since the variables and the years are different from this work´s.

[13] The characteristics of the standard house are the averages of the characteristics in the sample. The standard house has 72 square metres, four pieces with an average size of 16,26 metres, a garage and storeroom, a quality index of 2, is on a second floor, is situated 1600 metres away from the town centre, 1300 metres away from the nearest beach, 5400 metres away from the factory and it has an of atmospheric pollution index of 4.46. The simulation uses the values of the standard apartment characteristics except for the distance to the iron and steel plant, for which a value of 500 metres is used.

As can be observed in table 2, the increases in the price of the flat as it is moved further from the plant are quite high. Proximity to the plant is valued in a very negative way by the market. Any policy of increasing the distance to the plant or dismantling the plant must take into account the environmental gain that is materialized in the price of the flat. For example, a policy that moved the plant 2000 metres further from the town centre would increase the value of the apartments by 40%.

It is also observed how the price of the flat increases at a decreasing rate as we move away from the plant. This means that the flats next to the factory are those that would be more favoured by an increase in the distance to the factory, a reduction in its size or its complete dismantling. The area nearest to the factory is that which suffers the highest environmental and aesthetic impact in the whole city. It is logical that it is in this area that any measure of environmental improvement will produce the greatest benefits. On the other hand, it is an area where there is a lot of building land which has not been very attractive until now due to the characteristics of the area. The recuperation of this land would probably activate construction activity. This would reduce the excess of housing demand in the town.

It is also possible to simulate how the price of the standard apartment varies due to reductions in atmospheric contamination through, for example, a reduction in factory production or the installation of anticontamination equipment. We start by assuming a apartament with standard characteristics except for the atmospheric pollution maximum index. Table 3 presents the results.

Table 3. Variation of the price before changes in atmospheric contamination.

Contamination reduction (units)	Price (€)	Dwelling price increase (%)
	308584	
0.1	314581	1.94
0.2	320840	3.97
0.3	327387	6.09
0.4	334201	8.3
0.5	341328	10.61

The price of the flat increases at an almost constant rate as contamination is reduced. Decreases in atmospheric contamination will therefore benefit all areas of the city in a similar way. If a measure that reduced the contamination index by 0.1 were implemented (for example, through a reduction of the production of the factory) the price of the new flat would increase by 1.94%. Prices would increase by 6% if is the contamination index was reduced by 0.3 units and by 8.3% if the reduction were 0.4 units and so on.

This is, of course, a partial equilibrium analysis. Other effects that a reduction of the production of the factory would produce have not been considered. For example, closing the plant might result in significant loss of jobs and reduction in demand for dwelling in the city.

5. General discussion and conclusions

On many occasions it is important to know how individuals value environmental quality, such as for example, when it is necessary to decide on the creation of a green area or the dismantling of a polluting industry. Not taking into account the effect of these types of actions on the welfare of the consumers can result in erroneous decisions being taken from the economic point of view.

This work has evaluated the effects that an iron and steel plant has on the price of new apartment, applying the hedonic pricing method (Rosen, 1974) to the environmental field. The method has shown to be effective in carrying out this type of valuation. Many studies have been conducted using the hedonic pricing method to evaluate environmental externalities. However, there are no significant studies about the effects on environmental quality caused by iron and steel industries.

The results indicate that the industry exerts very negative effects on the environment that are reflected in the prices of the surrounding dwellings. Therefore, any measure aimed at reducing the contamination of the industry, increasing its distance from the city centre or dismantling the plant will produce an increase in the quality of the environmental that will be transmitted to house prices. In addition**,** the flats nearest to the factory are those that would benefit most from an improvement in the environment. The recovery of the area surrounding the industry would not only produce great benefits for already built dwellings but it would also activate construction in a city with a shortage of dwellings.

Appendix

Table A.1. Correlation matrix for listed variables

	P	S_R	S_A	S_G	S_L	Q_{SW}	Q_G	Q_{SP}
P	1.0000	0.5119	0.6329	-0.0149	-0.0211	0.1334	0.0369	-0.0313
S_R	0.5112	1.0000	0.8808	0.1938	0.1467	0.0751	0.1300	0.0876
S_A	0.6329	0.8808	1.0000	0.3001	0.0676	0.1802	0.1961	0.0945
S_G	-0.0149	0.1938	0.3009	1.0000	0.2930	0.2129	0.2910	0.2050
S_L	-0.2107	0.1467	0.0676	0.2930	1.0000	0.1264	0.1728	0.1217
Q_{SW}	0.1334	0.0751	0.1802	0.2129	0.1264	1.0000	0.7313	0.6605
Q_G	-0.0369	0.0876	0.0945	0.2049	0.1217	0.6604	0.7042	0.7042
Q_{SP}	-0.0031	0.0876	0.0946	0.2050	0.1217	0.6605	0.7042	1.0000
Q_K	0.1272	0.0327	0.0796	0.1755	-0.1310	0.1029	0.1407	0.0991
Q_{VI}	0.0874	0.1788	0.2092	0.3718	0.1618	0.2273	0.2269	0.2999
Q_{SA}	0.0643	0.1912	0.2102	0.4620	0.2146	0.2207	0.4014	0.2007
Q	0.1438	0.1746	0.2207	0.4226	0.2169	0.6661	0.7290	0.7071
Q_H	0.2307	0.1313	0.1563	-0.0989	-0.0634	-0.0832	-0.1146	-0.1164
D_C	-0.4224	0.0662	0.0517	0.4403	0.4117	0.0389	0.1070	0.0768
D_B	-0.3415	0.1347	0.0974	0.3961	0.4181	0.1294	0.2285	0.2005
E_F	0.3647	0.0470	0.1200	-0.0332	-0.1310	0.3843	0.2370	0.1736
E_A	-0.1446	-0.0940	-0.2120	-0.3459	-0.2003	-0.6564	-0.5588	-0.4141
A_P	0.1655	-0.1224	-0.1942	-0.3905	-0.1381	-0.0070	-0.1483	-0.0956
A_S	0.0365	-0.0562	-0.1387	-0.3383	-0.2858	-0.4726	-0.4013	-0.2975
A_N	-0.0714	-0.0062	-0.0634	-0.1660	-0.2167	-0.5183	-0.3723	-0.2830
A_C	-0.0887	-0.0999	-0.2180	-0.3858	-0.2304	-0.6140	-0.5389	-0.3978

A_L	-0.3719	-0.0127	-0.0465	0.1333	0.1788	-0.3435	0.2300	-0.1765

	Q_K	Q_{VI}	Q_{SA}	Q	Q_H	D_C	D_B	E_F
E_A	-0.1565	-0.2882	-0.3079	-0.5298	0.0097	-0.2733	-0.1740	-0.4281
Q_K	1.0000	0.1672	0.2202	0.2848	-0.0084	-0.0084	-0.0925	0.0641
Q_{VI}	0.1672	1.0000	0.4470	0.6280	0.0660	0.0864	0.2775	0.1028
Q_{SA}	0.2202	0.4470	1.0000	0.6446	-0.0080	0.2466	0.2200	-0.0615
Q	0.2848	0.6280	0.6446	1.0000	-0.0388	0.0854	0.2213	0.2076
Q_H	-0.0084	0.0660	-0.0080	-0.0388	1.0000	0.0360	-0.0083	-0.0974
D_C	-0.0084	0.0864	0.2466	0.0854	0.0360	1.0000	0.4132	-0.5015
D_B	-0.0925	0.2775	0.2200	0.2213	-0.0083	0.4132	1.0000	0.0582
D_F	0.0641	0.1028	-0.0615	0.2076	-0.0974	-0.5015	0.0582	1.0000
A_P	-0.0478	-0.1762	-0.3360	-0.1557	-0.0366	-0.4055	-0.5665	0.3008
A_S	-0.1524	-0.1810	-0.3206	-0.3866	-0.0445	-0.5993	-0.0714	0.0050
A_N	-0.1362	-0.1216	-0.1703	-0.3511	-0.0200	-0.3745	0.1797	-0.2108
A_C	-0.1600	-0.2847	-0.3460	-0.5139	-0.0051	-0.3799	-0.2185	-0.3045
A_L	0.0013	-0.1146	0.1438	-0.2017	0.1025	0.6710	0.0781	-0.8536

	A_P	A_S	A_N	A_C	A_L	E_A
E_A	0.2188	0.8618	0.8139	0.9866	0.2067	1.0000
A_P	1.0000	0.2800	-0.1976	0.3449	-0.5266	0.2188
A_S	0.2800	1.0000	0.8822	0.9103	-0.2673	0.8618
A_N	-0.1976	0.8822	1.0000	0.7937	0.0531	0.8139
A_C	0.3449	0.9103	0.7937	1.0000	0.0516	0.9866
A_L	-0.5266	-0.2673	0.0531	0.0516	1.0000	0.2067

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