Brownfield areas and housing value: Evidence from Milan

by
Lucia Gibilaro
University of Bergamo
E-mail lucia.gibilaro@unibg.it
Tel. +39 0352052675
Fax +39 0352052549

Gianluca Mattarocci
(corresponding author)
University of Rome 'Tor Vergata'
-mail gianluca.mattarocci@uniroma2.it
Tel. +39 0672595903
Fax +39 062040219

Version: January 2018

Brownfield areas and housing value: Evidence from Milan

ABSTRACT

The existence of brownfield areas inside a city has negative effects on the real estate market due to the decrease of the demand for real estate assets nearby for both the prices and rents. The impact could be different on the basis of the different type of real estate investment considered and normally the impact is expected to be higher for residential assets.
The paper evaluates the economic effect of abandoned real estate in the city of Milan for the time period 1993-2016 and shows that the city is characterized by a concentration of abandoned/dismissed assets in some city districts. Using standard hedonic models, the paper shows that the existence of brownfield areas nearby a real estate asset affects negatively its price and the negative contribution on price could be even higher than some district/building features.

1. Introduction

The value of housing units depends on the asset characteristics and the set of amenities available for users that may affect the willingness to pay for a buyer (i.e. Rosen, 1974). The role of location and amenities on the market price of an house is not independent with respect to the buyer's preferences and location choices for individuals changes over his/her life cycle (Van Duijn, and Jan Rouwendal, 2012).
During the last decades, there was a significant increase of constraints applied for every real estate unit inside the downtown and the quality and features of the existing houses cannot be adjusted to the needs of the demand and the new quality standards offered by the market. Government has adopted subsidizing policies especially for middle class individual in order to support them for investing in new residential units outside the inner city and support the growth of the city and the creation of (temporary) job in the construction industry.
The increase of sprawling represents an unavoidable effect of the Government policy that cause a change in the neighbourhood life cycle moving from the full occupancy to the downgrading and the thinning out of the city (Hoover and Vernon, 1959). The existence of vacant areas contributed to the neighbourhood and business district decline that undermines market demand and have a potential negative effect on the household wealth (Accordino and Johnson, 2000). Existing owners revise downward their economic expectation for the value of their real estate assets and lose any incentive for sustaining costs related to ordinary and extraordinary maintenance and the average condition of all buildings in the area start declining (e.g. White, 1986).
The existence of brownfield areas in a city requires to plan an intervention by the public authority in order to avoid the negative effects in the long run related to their concentration outside the downtown. In fact in such scenarios the demand of real estate in the city centre is expected to decrease over time due to the increase of the quality of transportation that reduces the transportation cost for individuals and increase the probability of having new dismissed areas (BenDor, Metcalf e Paich, 2011). The reduction of the demand nearby brownfield areas has a potential effect on the price and rent for the housing sector bure there are no empirical evidences on the economic losses for owners nearby derelict or abandoned areas or properties.

Literature show that real estate markets are affected by foreclosures of abandoned houses and the impact is economic significant even in a one block distance due to the effect on the demand for all neighbourhood properties (Immergluck and Smith, 2005). The main explanation of the negative effect related to abandoned houses on the average value of houses in the neighbourhood is related to the expected change in the average income of the population in the area that is expected to decrease because the property will be sold at a discount and so also poorer citizens may decide to move into the neighbourhood (e.g. Baxter and Lauria, 2000). The aim of the paper is to measure the effect of derelict or abandoned areas before their sales on the housing prices and considers its implication for citizen wealth and the value of real estate assets. Results obtained show that brownfield areas are not concentrated in the suburbs and may affect significantly the quality of life for citizens living nearby the downtown and the price of the buildings in the city districts react to the existence of abandoned or derelict areas/buildings.
The paper presents a literature review on the benefits and cost for real estate developers and for citizens in the area related to a requalifying investment with respect to starting green-field projects (section 2). The empirical analysis considers the municipality of Milan and evaluates the impact of brownfield areas on prices and rents in the housing sector in the neighbourhoods (section 3). The last section (section 4) summarizes results and evaluate the implication of brownfield areas on an urban planning perspective.

2. Literature review

The choices of developing new urban areas through greenfield projects compared to the recovery of abandoned urban areas are characterized by different costs for the real estate developer. Urban recovery operations have higher and less predictable costs and execution times than real estate properties in ex-novo areas, and the relevance of this difference increases with the costs of land reclamation and the constraints imposed by the administration and community for the implementation of urban recovery interventions (Amekudzi, Attoh-Okine and Laha, 1997). The development of new areas, on the other hand, allows to cut the cost of the intervention and potentially maximize profit margins also in relation to the smaller constraints on the construction of new buildings in areas previously not intended for development (Lubell, Feiock and Ramirez de la Cruz, 2009) and, unlike urban recovery operations, the project is not affected by possible sustainability and consistency problems with the pre-existing urban context (Dixon, 2007).
Construction companies active in urban regeneration operations suffer, at least in the same way as other conditions, a higher rationing of capital by intermediaries, which may not allow the development of a number of projects. Brownfield investments are considered by lenders very opaque and the choice to grant credit for such transactions exposes to, ceteris paribus, a higher risk of counterparty default (Wernstedt, Meyer, and Alberini, 2006). The potential benefits for builders stemming from the development of new areas need to be matched with the needs of the community, which in many cases can benefit more from recovery interventions of abandoned areas than from the development of new urban projects in previously unoccupied areas (De Sousa, 2003).
The main factors to be considered are:

- the mobility planning;
- the public health;
- the security;
- the employment impacts;
- the provision of basic public services.

The choice to carry out urban redevelopment interventions has potentially positive externalities for the community in organized and efficient urban contexts where it has been planned to develop a range of collective mobility services. The choice not to widen excessively the urban area and to exploit

abandoned areas in a rational way can increase the convenience of using public transport instead of private vehicles and lessen the problems of traffic congestion and pollution (Northridge et al ., 1999). In addition to these profiles related to the mobility of individuals, the concentration of communities in limited areas improves the accessibility of some collective services for which the delivery time has a significant impact on its effective effectiveness (i.e. first-aid services). The choice of performing urban regeneration also allows to limit, coeteris paribus, land use and minimizes the potentially negative effects of excessive use of land for the development of real estate projects and potential damage to the ecosystem (Edgens and Staley, 1999).

Removing degraded areas has positive effects on the quality of public health not only for potential environmental pollution resulting from abandoned buildings featured on previous and non-ecologically compatible technologies. Redevelopment measures for abandoned buildings, though more expensive than greenfield development projects, should therefore consider potential positive externalities linked to the choice of demolishing and re-qualifying structures that could potentially cause damage to the community over time (Greenberg et al. , 2001).

Urban regeneration interventions reduce the number of abandoned real estate units that may have adverse effects on the value of the area, depending on the greater risks associated with area degradation and increased crime. In fact the existence of brownfield or abandoned areas is normally perceived as "no-man's lands" which, by discouraging residential interaction, reduce pedestrian presence and increase crime by making criminals feel safer (Troy and Groove, 2008). The presence of abandoned properties is so assumed as closely linked with urban degradation and crime, although it is not the only condition necessary for the development of such social problems that may affect the community (Ross and Mirowsky, 1999).

Real estate development projects determine short-term growth in jobs related to the urban recovery project that normally require a wide range of diversified skills to accomplish the intervention. At the end of the recovery process, conditions can also be created for a stable growth in the level of employment for service activities for the developed properties and these benefits are reflected in a higher volume of revenue from the collection of taxes (Turvani and Tunin, 2009).

Urban recovery interventions reduce the costs associated with delivering public services to the community for local government through a concentration of activities in the central areas. The choice to de-localize out of the original urban core requires new administrative costs related to the provision of infrastructure (roads, sewers, water, electricity, etc ...) necessary to access the new developed areas and the provision of basic services accessible to people who will reside in new developed areas (schools, hospitals, public transport, etc ...). Sprawling costs may be untenable for consolidated economies where the budget available to the administration to deliver the service is expected to remain stable or decrease over time (Burchell et al., 1998).

The measurement of the impact of abandoned buildings on the real estate market may be affected by endogeneity issues because on the basis of the proxy used for measuring the housing disinvestment there could an endogeneity issue with respect to market features (Simons, Quercia and Maric, 1998).

3. Empirical analysis

3.1 Sample

The analysis of the abandoned and/or derelict buildings considers buildings that are chronically vacant and uninhabitable units whose owner is not actively searching to bring them back to the market (e.g. Keenan, Lowe and Spencer, 1999). Data are collected from the survey promoted by the Municipality of Milan related to all brownfield areas in the city (Table 1).

Table 1. Brownfield areas in the city of Milan

Type of Assets			Distance from the CBD			
	N°	%		N° units	Average size	Overall size
Retail	10	5.81%	≤ 0.5 km	1	14,616.82 m^2	14,616.82 m^2
Residential	40	23.26%	≤ 1 km	1	14,616.82 m^2	14,616.82 m^2
Offices	31	18.02%	≤ 2 km	9	3,608.51 m^2	32,476.55 m^2
Industrial	60	34.88%	≤ 3 km	34	3,001.33 m^2	102,045.32 m^2
Rural buildings	31	18.02%	≤ 4 km	57	4,709.45 m^2	268,429.02 m^2
			≤ 5 km	91	13,638.99 m^2	1,241,147.85 m^2

Source: Municipality of Milan data processed by the authors

Milan has a lot of brownfield areas (172) and most of the abandoned areas were previously production sites or residential units (respectively 23.26% and 34.88%). Derelict areas and abandoned areas are not strictly in the downtown are prevalently located not so far away from the downtown (in 5 km distance from the city center) and, as expected, the bigger brownfield areas are located outside the city (more than 5 km from the downtown).

Information about derelict land or property are supplemented with data about prices for each area in Milan for the time period 1993-2016 (half year frequency) using a proprietary database on housing transaction provided by Camera di Commercio di Milano, Monza-Brianza e Lodi e FIMAA Milano Monza & Brianza (Table 2).

Table 2. Average price per square meter statistics for residential real estate in Milan classified on the basis of the distance from the CBD

	Distance CBD < 0.5 km			Distance CBD < 1 km			Distance CBD < 5 km		
	NH	EH	OH	NH	EH	OH	NH	EH	OH
1993	5680.00	5162.50	4777.50	4273.57	3607.50	3174.64	2947.87	2384.73	1790.12
1994	4431.67	3960.00	3228.33	3904.67	3328.33	2908.33	2693.68	2200.84	1654.61
1995	4130.00	3571.25	2937.50	3775.94	3207.81	2746.88	2653.70	2162.08	1630.92
1996	3746.25	3280.00	2763.75	3562.81	2958.75	2597.50	2528.54	2057.24	1556.81
1997	3565.00	3085.00	2588.75	3435.00	2826.25	2478.13	2453.23	1980.57	1507.23
1998	3633.75	3060.00	2570.00	3509.38	2881.25	2521.56	2480.00	1981.15	1512.42
1999	3803.75	3165.00	2731.25	3683.13	3006.56	2630.00	2599.27	2051.88	1591.65
2000	4343.75	3511.25	3105.00	4202.19	3331.88	2997.50	2933.54	2303.02	1801.42
2001	5021.25	4131.25	3820.00	4842.81	3821.25	3527.50	3351.47	2614.17	2051.35
2002	5525.00	4618.75	4250.00	5487.50	4292.19	4003.13	3821.61	2926.82	2303.19
2003	5900.00	4937.50	4612.50	6062.50	4653.13	4321.88	4140.89	3144.27	2470.38
2004	6300.00	5212.50	4925.00	6490.63	4956.25	4659.38	4486.98	3373.44	2668.46
2005	6712.50	5562.50	5325.00	6971.88	5334.38	5040.63	4765.63	3610.42	2882.50
2006	7062.50	5787.50	5600.00	7250.00	5550.00	5282.81	4910.68	3725.26	2997.50
2007	7537.50	6056.25	5850.00	7565.63	5821.88	5528.13	5073.70	3861.46	3102.31
2008	7675.00	6150.00	5962.50	7671.88	5900.00	5575.00	5124.74	3894.27	3106.15
2009	7662.50	6100.00	5925.00	7715.63	5915.63	5557.81	5173.96	3889.84	3081.73
2010	7962.50	6400.00	6187.50	8056.25	6139.06	5731.25	5328.68	3978.91	3124.81
2011	9687.50	7400.00	6525.00	8767.86	7053.13	5984.38	5746.51	4598.70	3268.65
2012	9812.50	8125.00	6550.00	8821.43	7353.13	5978.13	5983.70	4991.93	3294.19
2013	10637.50	8012.50	6412.50	8921.43	7568.75	5881.25	5891.58	4913.02	3175.96
2014	10337.50	7837.50	6275.00	9150.00	7400.00	5768.75	5969.53	4798.44	3106.15
2015	9950.00	7587.50	6125.00	8940.63	7209.38	5665.63	5878.39	4713.54	3059.23
2016	9875.00	7537.50	6200.00	8893.75	7178.13	5700.00	5857.81	4698.18	3052.88

Notes: NH = New houses, EH = Existing houses, and OH = Old houses
Source: Camera di Commercio di Milano, Monza-Brianza e Lodi e FIMAA Milano Monza & Brianza data processed by the authors

The average price per square meter paid for new houses is always higher than any other type of residential units and results are even stronger when the distance with respect to city center increases. In the time period considered existing houses are experiencing an higher growth of the average price over time with respect to old houses and this difference is even higher for areas significantly far away from the downtown.

3.2 Methodology

The analysis of the impact of derelict and/or abandoned areas on housing market is performed by considering the price dynamics nearby this type of buildings (e.g. Immergluck and Smith, 2005). For each city district, a distance proxy is constructed by considering the standard Euclidean distance measures that compares the centre of city area with the longitude and the latitude of brownfield area. In formulas:

$$Distance_{it} = \sqrt{(Lgtd_{BFA} - Lgtd_{AreaCenter})^2 + (Lat_{BFA} - Lat_{AreaCenter})^2} \quad (1)$$

where $Lgtd_{BFA}$ and Lat_{BFA} are the longitude and the latitude of all brownfield areas and $Lgtd_{AreaCenter}$ and $Lat_{AreaCenter}$ are the longitude and latitude of the centre of the city area as defined by the Municipality.
The analysis of brownfield areas impact on the price and rent for residential real estate is analysed by considering the concentration of derelict lands or properties in the area. The proxies constructed are:

$$\%NBrownfield_i^{\alpha km} = \frac{N°Brownfield\ areas_i^{\alpha km}}{\sum_{i=1}^{n} N°\ brownfield\ areas_i{}^{\alpha km}} \quad (2)$$

$$\%SizeBrownfield_i^{\alpha km} = \frac{M^2Brownfield\ areas_i^{\alpha km}}{M^2Buildings_i^{\alpha km}} \quad (3)$$

where the index (2) assumes values from 0 to 1 and higher values are associated with city areas with an higher number of derelict lands or properties nearby. The index 3 evaluates the impact of the brownfield areas with respect to the size of existing buildings in the area and it varies from 0 to 1. Fr both the indexes, in order to define the neighbourhood the analysis considers different distances from the centre of the urban area (α varies from 1 to 10 km).
Formula (2) and (3) are used in order to classify city areas in four quartiles on the basis of the percentage of brownfield areas in the neighbourhoods and present some summary statistics on the prices and evaluate if the concentration of derelict lands or properties has an impact of the demand and supply for housing ownership.
In order to measure the contribution of brownfield areas proximity on the rent and prices for the housing sector, the analysis considers the hedonic price model proposed by Rosen (1974) and evaluates the price effect net with respect to any effect related to different unique feature of each real estate unit. In formulas:

$$P_{it} = \alpha + \lambda_i DistCBD_i + \sum_{k=1}^{m} \beta_i^k F_{it}^k + \varepsilon_{it} \quad (4)$$

$$P_{it}^j = \alpha + \lambda_i DistCBD_i + \tau_i \%NBrownfield_{it}^{\alpha km} + \sum_{k=1}^{m} \beta_i^k F_{it}^k + \varepsilon_{it} \quad (5)$$

$$P_{it}^{j} = \alpha + \lambda_i DistCBD_i + \tau_i \%sizeBrownfield_{it}^{\alpha km} + \sum_{k=1}^{m} \beta_i^k F_{it}^k + \varepsilon_{it} \quad (6)$$

where the price (P_{it}) per square meter are regressed with respect to the housing features (F_{it}^k), the distance from the Central Business District $(DistCBD_i)$ and the percentage of derelict lands or abandoned properties in α km from the district centre $(\%NBrownfield_i^{\alpha km}\ and\ \%SizeBrownfield_{it}^{\alpha km})$. In order to check the robustness of results all the three models (4, 5, and 6) are performed by considering a distance that varies from 1 to 5 kilometers.
The independent variables consider the distance from the central business district $(DistCBD_j)$ and a set of other district's features. On the basis of the information available for each area, the control variables on the district features are the following:

$Quality\ high_{jt}$= a dummy that assumes value one if the price is related to outstanding quality houses in the district;
$Quality\ medium_{jt}$= a dummy that assumes value one if the price is related to average quality houses in the district;
$Quality\ low_{jt}$= a dummy that assumes value one if the price is related to poor quality houses in the district;
$New\ Construction_{jt}$= a dummy that assumes value one if the price is related to new houses;
$Existing\ construction_{it}$= a dummy that assumes value one if the price is related to existing houses;
$Old\ costruction_{jt}$= a dummy that assumes value one if the price is related to old and not refurbished houses;
$Distance\ Airport_{jt}$= minimum distance of the city district with respect to one of the airports of the city (Linate or Malpensa);
$Distance\ Train\ Station_{jt}$= Minimum distance of the city district with respect to the train stations served by high speed train services (Stazione Centrale, Cadorna or Garibaldi);
$Distance\ Universities_{jt}$= minimum distance of the city district with respect to the nearest (public or private) university in the city[1];
$Green\ Areas_{jt}$ = dummy variable that assume value one if the district has a public green area available for citizens;
$Schools_{jt}$= number or schools in max one kilometer distance from the center of the district;
$Commercial\ activities_{jt}$= n° of square meters used for commercial activities in the district with respect to the overall number of square meters available in the city;
$Metro\ station_{jt}$= number of metro lines servicing the district;
$Population_{jt}$= percentage of people living in the area with respect to the population of the Milan area;
$Foreigners_{it}$= percentage of foreigners living in the district with respect to the overall population of the district.

The analysis is perfomed by using a panel regression analysis with variable effects for the time period 1993-2016.

[1] Universities considered are Università degli Studi di Milano, Università degli Studi di Milano Bicocca, Politecnico di Milano, Università Commerciale Luigi Bocconi Milano, Università Cattolica del Sacro Cuore, Libera Università di Lingue e Comunicazione IULM, Libera Università Vita Salute S. Raffaele Milano, Accademia di Brera, and Conservatorio di Milano.

Table 3. Price statistics and the amount of brownfield areas in the neighbourhood

Areas were classified into quartile on the basis of the percentage of brownfield areas in j kilometres from area centre (with j varying from 0.5 to 5 km).

		New house				Existing house				Old house			
		1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
0.5 km	Average	3600.11	3981.39	5551.04	3251.98	2811.32	3173.56	4208.29	2859.21	2493.85	2593.68	3433.45	2222.32
	St.Dev.	1042.17	1252.36	1789.28	935.47	813.02	1017.59	1382.74	844.19	674.40	774.22	1036.45	580.23
1 km	Average	3604.21	3985.39	5553.04	3257.98	2812.32	3174.56	4207.29	2889.21	2495.85	2596.68	3430.45	2221.32
	St.Dev.	1047.17	1258.36	1800.78	937.47	815.05	1019.59	1377.74	846.99	672.40	776.22	1032.45	578.40
2 km	Average	3609.12	4360.49	3615.17	3457.85	3065.61	3469.60	2795.06	2769.18	2289.81	2894.20	2706.01	2251.69
	St.Dev.	1063.46	1359.20	1064.45	1010.44	949.68	1096.73	840.22	780.62	572.44	840.39	783.51	639.67
3 km	Average	3376.72	4331.93	3625.47	3830.64	2677.62	3697.47	2895.29	2966.45	1941.45	3039.29	2847.10	2363.57
	St.Dev.	970.32	1368.38	1019.94	1192.11	777.55	1226.26	863.36	857.29	459.03	902.35	818.55	670.91
4 km	Average	3022.66	3246.60	4566.90	4327.17	2267.30	2849.15	3615.09	3561.85	1920.78	2652.75	3037.31	2605.47
	St.Dev.	795.74	944.88	1464.76	1365.92	593.95	869.59	1190.75	1099.87	452.50	734.85	906.70	766.43
5 km	Average	2839.72	3464.56	3793.34	5113.96	2201.49	2897.11	3037.41	4129.31	1894.12	2392.23	2696.52	3193.16
	St.Dev.	720.39	1009.85	1115.56	1749.00	566.98	865.67	973.91	1329.99	460.25	624.24	765.95	989.52

Source: Camera di Commercio di Milano, Monza-Brianza e Lodi e FIMAA Milano Monza & Brianza data processed by the authors

3.3 Results

A preliminary analysis of price and rents for areas classified on the basis of different incidence of brownfield areas allow identifying some differences among the city (Table 3).
Independently with respect to the distance considered (from 0.5 to 5 kilometres), the simple analysis of price per square meter does not allow to identify the linkage between brownfield areas and real estate market dynamics for new, existing and old houses. The lack of evidence may be explained on the basis of the differences among real estate units available in different areas of the city (on the basis of size, type and quality at least) that does not allow to compare their value and the expected income produced.
The lack of a clear evidence of the linkage between prices and brownfield areas nearby could be explained by considering the characteristics of the areas that are more characterized by abandoned and dismissed buildings (table 4).
Results obtained showed as expected that the higher is the number of brownfield areas in the district the lower is the price for houses and the impact of concentration of abandoned and derelict areas in nearby the center of district (0.5 km from the center) the higher is the impact. When the analysis considers also areas more distant from the center (from 1 to 5 km) the impact is still negative and statistical significant but on the economic point of view the impact is less relevant. Independently with respect to the distance considered for constructing the brownfield proxy, the choice of including the variable in the model increases its statistical fitness measured by the $R^{2.}$
The analysis of the size of the abandoned area with respect to the size of constructed areas in the district allow to assign different weights on the basis of the relative size of the brownfield area with respect to all built areas in the district (Table 5).
Empirical evidence show that for each one percentage of dismissed or abandoned areas with respect to the constructed and developed areas nearby the center of the district (distance from 0.5 to 2 km) the impact on the price is more than three times the impact of the distance from the central business district. The analysis that considers the relative size of brownfield areas with respect to bigger reference areas (from 3km ongoing) does not provide statistical significant results and the lack of evidence can be justified because independently with respect to the number and the size of each brownfield area the higher is the area of the city considered the lower will be the relative size of dismissed or abandoned area and so the empirical analysis does not allow to identify strong and significant results. Models that consider brownfield size with respect to the built area in not more that 3 km from the district center perform better with respect to the model that is not evaluating the impact of derelict and abandoned areas and are characterized by an higher R^2 with respect to the baseline model.

Table 4. Panel regression analysis of price of housing by distance from the CBD and number of brownfield areas in the district

The table presents results of a random effect panel regression of housing prices with respect to distance to CBD ($DistCBD_i$) and percentage of brownfield areas ($\%NBrownfield_{it}^{\alpha km}$) in the district. The analysis is performed by considering brownfield areas at different distances from the center of the district (from 0.5 to 5 km).

As control variables for the housing prices, the model considers the quality of the house (high, medium and low), the vintage of the house (old, existing, and new), the distance from the nearest airport, the distance from the nearest high speed train station, the distance from the nearest university the number of public green areas, the number of schools, the square meters for commercial activities in the district, the number of metro lines that serve the district, the percentage of population of the city that lives in the area, and the percentage of foreigners among the population of the district. The analysis is performed on the time horizon 1993-2016 using half year data for each of the 66 districts of Milan.

	4	(5a)	(5b)	(5c)	(5d)	(5e)	(5f)
$DistCBD_i$	-794.05**	-826.72**	-836.02**	-709.75**	-690.55**	-657.48**	-869.98**
$\%NBrownfield_{it}^{0.5km}$		-296.28**					
$\%NBrownfield_{it}^{1km}$			-41.74*				
$\%NBrownfield_{it}^{2km}$				-16.61*			
$\%NBrownfield_{it}^{3km}$					-9.73*		
$\%NBrownfield_{it}^{4km}$						-13.29*	
$\%NBrownfield_{it}^{5km}$							-15.55*
α_{it}	4781.43**	5360.53**	5018.04**	4244.35**	4123.04**	3411.61**	7990.12**
N° control Variables	15	15	15	15	15	15	15
Observations	28434	28434	28434	28434	28434	28434	28434
City districts	66	66	66	66	66	66	66
R^2 Overall	58.19%	0.5873%	58.97%	58.92%	58.92%	58.54%	58.52%

Source: Camera di Commercio di Milano, Monza-Brianza e Lodi e FIMAA Milano Monza & Brianza data processed by the authors

Table 5. Panel regression analysis of price of housing by distance from the CBD and size of brownfield areas in the district

The table presents results of a random effect panel regression of housing prices with respect to distance to CBD ($DistCBD_i$) and relative sized of brownfield areas ($\%SizeBrownfield_{it}^{\alpha km}$) in the district. The analysis is performed by considering brownfield areas at different distances from the center of the district (from 0.5 to 5 km).

As control variables for the housing prices, the model considers the quality of the house (high, medium and low), the vintage of the house (old, existing, and new), the distance from the nearest airport, the distance from the nearest high speed train station, the distance from the nearest university the number of public green areas, the number of schools, the square meters for commercial activities in the district, the number of metro lines that serve the district, the percentage of population of the city that lives in the area, and the percentage of foreigners among the population of the district. The analysis is performed on the time horizon 1993-2016 using half year data for each of the 66 districts of Milan.

	4	(5a)	(5b)	(5c)	(5d)	(5e)	(5f)
$DistCBD_i$	-794.05**	-830.12**	-799.82**	-804.24**	-721.23**	-734.123**	-892.35**
$\%SizeBrownfield_{it}^{0.5km}$		-3024.09*					
$\%SizeBrownfield_{it}^{1km}$			-2960.06*				
$\%SizeBrownfield_{it}^{2km}$				-3885.76*			
$\%SizeBrownfield_{it}^{3km}$					-16156.00		
$\%SizeBrownfield_{it}^{4km}$						-27199.47	
$\%SizeBrownfield_{it}^{5km}$							-253024.01
α_{it}	4781.43**	4893.60**	4833.24**	4859.08**	4317.98**	4265.31**	8331.10**
N° Control Variables	15	15	15	15	15	15	15
Observations	28434	28434	28434	28434	28434	28434	28434
City districts	66	66	66	66	66	66	66
R^2 Overall	58.19%	0.5873%	58.64%	59.01%	58.05%	57.91%	57.76%

Source: Camera di Commercio di Milano, Monza-Brianza e Lodi e FIMAA Milano Monza & Brianza data processed by the authors

4. Conclusion

Real estate price and rents are significantly affected by location features and the existence of derelict and abandoned areas affect significantly the demand. The negative effect on prices in the housing sector is clear due to the effect of brownfield areas on the quality and the type of services that could be available for citizens living in the area. The negative effect is stronger when the analysis is focused on the neighbourhood of the dismissed and abandoned areas and the higher losses are normally related to brownfield areas that have a significant size with respect to the amount of square meters built in the city district.

Empirical evidence provided demonstrate that there could a direct loss for housing owners due to the existence of brownfield areas and any type of public intervention for requalifying an area has a direct effect on the citizens' wealth. Urban planning policies cannot be defined without considering the cost of delaying intervention on a brownfield area and the cost for the residents will be higher the higher is the size of the area considered.

Derelict lands or properties are mainly concentrated in the downtown and they could represent profitable investment opportunities for developers due to the high value of the location and the lack of greenfield areas with comparable features in the city (Greenberg and Schneider, 1995). Requalifying investments normally try to develop new retail and residential areas instead of the abandoned building and after the intervention the frequency and the value of the transaction in the real estate market increases due to the better average quality of buildings in the area (Heberle e Wernstedt, 2006). Main developed economies defined a plan for transforming derelict lands or properties into new real estate assets requested by the market and avoiding that the increase of the population increase the land consumption and reduced the amount of space used for common services and green areas (i.a. Dixon e Adams, 2008).

A more detailed analysis of the issue has to consider the brownfield area's features that matters the most for the housing market in order to identify the type of derelict or abandoned areas that potentially are riskier for the citizens. Moreover the effects cannot be evaluated properly if the market condition for the housing sector in the city area are not considered because the effect of a brownfield area will be totally different on the basis of the liquidity of the market and the number of buyers / renters potentially interested to invest in the area.

References

Accordino J. and Johnson G.T. (2000), "Addressing the Vacant and Abandoned Property Problem", *Journal of Urban Affairs,* vol. 22, n. 3, pp. 301–315.

Amekudzi A.A., Attoh-Okine N.O. and Laha S. (1997), "Brownfields redevelopment issues at the federal, state, and local levels", *Journal of Environmental Systems*, vol. 25, n. 2, pp. 97-121.

Baxter V. and Lauria M. (2000), "Residential mortgage foreclosure and neighborhood change", *Housing Policy Debate*, vol. 11, n. 3, pp. 675-699.

BenDor T.K., Metcalf S.S. and Paich M. (2011), "The Dynamics of Brownfield Redevelopment", *Sustainability*, n. 3, pp. 914-936.

Burchell R., Shad N., Listokin D., Phillips H., Downs A., Seskin S., Davis J., Moore T., Helton D. and Gale M. (1998) The Costs of Sprawl Revisited, TRCP Report 39, Washington, DC, National Academy Press.

De Sousa C.A. (2003), "Turning brownfields into green space in the City of Toronto", *Landscape and Urban Planning*, vol. 62, n. 4, pp. 181–198.

Dixon T. (2007), "The Property Development Industry and Sustainable Urban Brownfield Regeneration in England: An Analysis of Case Studies in Thames Gateway and Greater Manchester", *Urban Studies*, vol. 44, n. 12, pp. 2377-2400.
Dixon T. and Adams D. (2008), "Housing Supply and Brownfield Regeneration in a post-Barker World: Is There Enough Brownfield Land in England and Scotland?", *Urban Studies*, vol. 45, n. 1, pp. 115-139.
Edgens J. and Staley S. (1999), "The myth of farmland loss", *Forum for Applied Research and Public Policy*, vol. 14, n. 3, pp. 29-34.
Greenberg M., Lowrie K., Mayer H., Miller K.T. and Solitare L. (2001), "Brownfield redevelopment as a smart growth option in the United States", *Environmentalist*, vol. 21, n. 2, pp 129–143.
Greenberg M. and Schneider D. (1995), "Hazardous waste site cleanup and neighborhood redevelopment: An opportunity to address multiple socially desirable goals", *Policy Studies Journal*, vol. 23, n. 1, pp. 105-112.
Heberle L. and Wernstedt K. (2006), "Understanding brownfields regeneration in the US", *Local Enviroment*, vol. 11, n. 5, pp. 479-497.
Hoover E.M. and Vernon R. (1959), *Anatomy of Metropolis*, Doubleday Anchor, Garden city
Immergluck D. and Smith G. (2005), "Measuring the Effects of Subprime Lending on Neighborhood Foreclosures: Evidence from Chicago.", *Urban Affairs Review*, vol. 40, n. 3, pp.362-389.
Keenan P., Lowe S. and Spencer S. (1999), "Housing Abandonment in Inner Cities-The Politics of Low Demand for Housing", *Housing Studies*, vol. 14, n. 5, pp. 703-716.
Lubell M., Feiock R.C. and Ramirez de la Cruz E.E. (2009), "Local Institutions and the Politics of Urban Growth", *American Journal of Political Science*, vol. 53, n.3, pp. 649-665.
Northridge M.E., Yankura J., Kinney P.L., Santella R.M., Shepard P., Riojas Y., Aggarwal M. and Rosen S. (1974), "Hedonic prices and implicit markets: product differentiation in pure competition", *Journal of Political Economy*, vol. 82, n. 1, pp. 34–55.
Ross C.E. and Mirowsky J. (1999), "Disorder and Decay. The Concept and Measurement of Perceived Neighborhood Disorder", *Urban Affairs Review*, vol. 34, n. 3, pp. 412-432.
Simons R.A. Quercia R.G. and Maric I. (1998), "The Value Impact of New Residential Construction and Neighborhood Disinvestment on Residential Sales Price", *Journal of Real Estate Research*, vol. 15, n. 2, 147-162.
Strickland P. (1999), "Diesel exhaust exposure among adolescents in Harlem: a community-driven study", *American Journal of Public Health*, vol. 89, n. 7, pp. 998-1002.
Turvani M. and Tonin S. (2008), "Brownfields Remediation and Reuse: An Opportunity for Urban Sustainable Development" in Clini C. et al. (eds.), *Sustainable Development and Environmental Management: Experiences and case studies*, Springer, Verlang.
Troy A. and Grove M. (2008), "Property values, parks, and crime: A hedonic analysis in Baltimore, MD", *Landscape and Urban Planning*, vol. 87, n. 3, pp. 233-245.
Van Duijn M. and Rouwendal J. (2012), "Analysis of household location behaviour, local amenities and house prices in a sorting framework", *Journal of Property Research*, vol. 29, n. 4, pp. 280-297.
Wernstedt K., Meyer P.B. and Alberini A. (2006), "Attracting private investment to contaminated properties: The value of public interventions", *Journal of Policy Analysis and Management*, vol. 25, n 2, pp. 247–369.
White M.J., (1986), "Property taxes and urban housing abandonment", *Journal of Urban Economics*, vol. 20, n. 3, pp. 312-330.