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The Break-Even Analysis applied to urban renewal: a model to evaluate the share of social housing financially sustainable for private investors

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Highlights

1. An evaluation model to support Public Adminsitration decisions in planning urban strategies that aim to involve private investors has been developed.

2. The model has been implemented using the Break-Even Analysis and borrowing marginal economic theory.

3. The model can ben used to define the maximum amount of subsidized housing and the administered selling price to be applied in urban redevelopment investments.

Abstract. In this work an evaluation model to support Public Administration decisions in planning urban strategies that aim to involve private investors has been developed. Considering the unfavorable economic climate, any territorial transformation can be realized only if the public needs meet the financial feasibility of the initiative. For this reason the model allows to define i) the maximum amount of subsidized housing to be realized by the private investor; ii) the administered selling price to be applied. The model has been developed translating in the field of urban planning the Break-Even Analysis, a tool borrowed from the marginal economic theory. It is applied to a real case study concerning the urban renewal of an unused area located in a city in southern Italy. The outputs obtained confirm the potentialities and the user-friendly configuration of the model.

Keywords: public-private partnership, break-even analysis, social housing, urban redevelopment, financial feasibility.

1 Introduction

The 2015 European Commission's Alert Mechanism Report highlights the variety of people that can be considered as potential targets for social housing policies. They are no more constrained to socially disadvantaged families, and they actually need to consider elderly people, young couples, divorcees, singles, occasional workers, etc. (European Commission, 2015). The complexity of this phenomenon is due to the prolonged unfavorable economic climate and the worsening of social conditions (Anundsen & Jansen, 2013). These factors are responsible for an increasing number of people which - while being above the poverty line - are not able to gain access to housing free market (Housing Europe Report, 2015). Carter (2011) investigates the importance of total household income on housing tenure choice, highlighting, through econometric models, the difficulties associated with the existence of a single income within the household for this kind of choices.

If we consider the EU 15 data (referring to the 15 Member States of the European Union as of December 31, 2003), a decrease of owners no outstanding mortgage and an increase of tenants are perceivable, considering both rent market price and reduced price (EU-SILC, 2013). Within this scenario, the number of people in need of housing support is constantly growing. Some studies have shown the importance of efficient national policies to enable higher supply of housing: the responsiveness of housing supply depends not only on national geographical and urban characteristics but also on policies, such as land use and planning regulations (Caldera & Johansson, 2013; Bardhan et al., 2015). Kwong Lui and Suen (2011) show that, in highly urbanized contexts, the definition of the proper allocation of public housing units is essential, in order to not adversely affect the mobility and therefore the lifestyles of households (Liu & Wong, 2015).

Furthermore, in many European contexts social housing is associated to a marked exclusion. The social housing built between the 1950s and 1970s is concentrated in urban areas where economic and social infrastructures are scarce

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or non-existent. Several authors have dealt with the social segregation of people that live in stigmatized neighborhoods (Power & Tunstall, 1997; Shaw & Robinson, 1998; Lupton, 2004). Living in a predominantly deprived area can itself be a source of disadvantage, arising from factors such as stigma, poor services, social networks which are disconnected from jobs and other opportunities, and the development of inward-looking, negative and even deviant social norms as responses to the concentrations of poverty (Pawson & Kintrea, 2002; Wan & Su, 2016). All over the world, there has been a growing interest for affordable housing projects, and studies concerning the assessment of their social impacts are widespread (Mohit et al., 2010; Kowaltowski & Granja, 2011; Gilbert, 2014; Li et al., 2014; Marais & Cloete, 2014).

Considering the specific Italian context, the number of applicants for social housing has increased from 600,000 in 2008 to currently about 650,000, whereas the social housing production – related to an unchanged total expenditure for social housing – has suffered a slowdown since 2009 (European Central Bank Data, 2016). Indeed, Italy is the only State Member that has not registered an improvement in the social housing sector, due to the high number of units characterized by lack of basic amenities, further worsened by overcrowding issue.

In recent years, in Italy, aiming to improve housing offers' methods and typologies for urban requalification, there has been a development of several tools focused on involving, through different types of partnerships, private abilities and resources. This growing interest is also related to phenomena of discrimination in the Italian rental housing market against persons whose names are distinctive of different ethnic groups and gender (Baldini & Federici, 2011). The definition of public-private partnership considers any type of cooperation in which public and private skills and resources can be merged for financing (Ng et al., 2012), realizing and managing territorial initiatives, taking account of respective responsibilities and purposes, sharing the risks of the procedure (Grimsey & Lewis, 2002; Bing et al., 2005; Clifton & Duffield, 2006; UTFP, 2009). Local authorities are more and more using complex forms of public-private partnerships for the development of urban and regional areas (Sagalyn, 2007; Bourguignon, 2013). Among these typologies, there are Complex Integrated Plan (L. No. 109/92), Urban Transformation Companies (L. No. 127/97; explanatory circular, Ministry of Public Works, No. 622/2000) and negotiated agreements (L. No. 241/90; L. No. 449/97; L. No. 662/96; L.D. No. 267/2000). Recently, following the article 26 of L. 164/2014, an important directive has been issued, that aims to enhance unused public assets considering also social housing opportunities. According to the first subparagraph of the article 26, aiming to promote initiatives for enhancing unused public buildings to support economic and social development, a negotiated agreement between Public Administration and private investor is possible to consider - with regard to recovery actions of unused public buildings – as town planning amendment. In this way, the administrative procedure related to changes of functions for public buildings that need to be enhanced and at the same time to reduce operational time and risk, is possible to streamline. In particular, the aforementioned comma states that priority should be given to the recovery of public buildings intended, as a whole or partially, to develop new public housing units.

Although social housing production and urban renewal constitute both themes of primary importance in the current economic situation (Zhou et al., 2016), hardly ever Public Administrations have appropriate skills to rationally set the best implementing modality. As a consequence, the planned strategies almost always fail or are not duly taken into account by private investors, due to the wrong analysis of financial feasibility or even for the total absence of any kind of evaluation (Gan et al., 2015; Buckley et al., 2016;).

An examination of the international literature has highlighted that, in spite of the interest shown by the main institutional operators (Public Adminsitrations, private investors, banks and insurance companies, etc.), there are very few studies that systematically deal with the topic in question. Not by chance, some authors (Li et al., 2014) highlight the lack of relevant valuation model aimed at promoting the private sector's provision of public rental housing.

In this framework, the present study bridges the gap in current literature and opens up perspectives for future research. The model presented in this paper is a flexible tool, user-friendly, able to bring the reasoning on the main variables that affect the financial feasibility of the investment (costs, revenues, profit, surfaces to realize and sell), implementable by collecting a few information that are easily traceable during the preliminary planning phases of the initiatives and usable in any territorial context.

The model is defined with reference to Italy, where the economic crisis has led the housing emergency to high levels, and, despite new plans for the protection of the weaker members of society and the requalification of the existing housing patrimony (New Housing Plan 2014), there are 2.5 million individuals independently unable to satisfy their housing needs (Censis, 2012).

2 Aim

With regard to the depicted scenario, the aim of this research is to develop and check an evaluation model to support Public Administration decisions in planning urban renewal initiatives involving private investors. The model allows to define the maximum amount of subsidized housing – as a percentage of the total housing gross floor surface that has been planned – to be realized by the private investor and the respective administered selling price, able to ensure the

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financial feasibility of the initiative. In this way, it is possible to facilitate the cooperation between collective instances of urban reorganization, social housing implementation and private needs for financial convenience. In fact, the financial balance is a necessary condition for the participation of the private investor within the urban renewal initiative; it needs to be positive or at least to present a break-even result. In other words, revenues generated from the sale in the free market of the authorized building units produced within the territorial transformation, must cover – and exceed if it is possible – costs incurred by the private investor for the realization of the initiative, and at the same time the public one under his responsibility. Otherwise, the private interest could be endangered, with the consequence of – in the contemporary scenario affected by the scarcity of resources – undermining urban renewal and social housing improvement.

Public Administration could use the model for the costs/revenues simulation of the intervention to be realized by the private investor. Evaluating the range of financial convenience of the initiative, it is possible to offer reasonable conditions for the cooperation with investors. Public operator therefore will be able to evaluate possible advantages in terms of cost savings for public works, considering works to be realized by the private investor in the form of "direct" production of social housing and/or other public works. In other words, through the simulation of the balance of the initiative, the public operator will be able to evaluate – from the perspective of the private operator – advantages that could be generated, proportioning in the right way, and avoiding to damage the financial feasibility, the extent and the typology of the investment. This is useful to better specify the requests for the private investor focusing on the project, its complexity and the market appeal generated by the building units.

On the other hand, the private investor will be able to use the model to verify the financial balance, having the opportunity to propose different solutions of the initiative. Among the cost items there will be also costs associated to the realization of public shares that could be defined by the same investor or decided by the Public Administration considering the agreement typology. With this model, the private investor will be able to enlarge the analysis about issues related to initiative, clarifying strengths and weaknesses, and defining risks that could be faced considering the economic scenario and the local market conditions.

The model has been developed translating in the field of urban planning, criteria and tools borrowed from the marginal economic theory. The tool used as main reference for this study is the Break-Even Analysis (BEA). BEA is a decision support tool used for business planning to validate short-medium term choices.

In this paper, BEA is applied with an "instantaneous approach", without considering time effects. This means that costs/revenues of the procedure can be considered synchronously, with regard to the moment of the evaluation. Consequently, following this hypothesis, when BEA needs to be implemented with some financial items, influenced by time variable, they need to be evaluated as lump amounts. This is the case of interest rates on the capital borrowed from the credit institute to the private investor, as well as of the normal profit of the investor. Actually, any productive activity, and particularly focusing on processes of urban transformation, can be developed in a variable amount of time that is influenced by technical, administrative and market procedures related to the specific case-study. Time factor is a critical variable for investor's decisions, and it must be included within the limited resources.

On the other hand, acting without considering time factor prevents i) uncertainty derived from time distribution assumption of costs, from selling time prevision related to the market reaction for the product, ii) the approximations of the choice of the discount rate. Moreover, this assumption is coherent with the aim of the work, that is the definition of a simple user-friendly tool. In this way the model can be used by inexperienced users, simply providing the amount of different variables involved within the process for a short-medium period.

The research is structured as follows. In section 3 most important international examples of BEA applications are presented, considering conditions of use of this tool within investment planning field. The basis of this evaluation technique are introduced using equations and assumptions. In section 4 the evaluation model is presented. In section 5 BEA is implemented to a real case concerning the urban renewal of an area in disuse, located in a Municipality of Naples' Province (Italy). In section 6 the conclusions of the work are drawn.

3 Outlines of the BEA

In the international literature, BEA has been studied and applied since more than 50 years, and specifically in the Anglo-Saxon territory there is a broad range of scientific applications (Dean, 1939; Ingraham, 1951; Raun, 1951; Dearden, 1962; Goggans, 1965; Colantoni et al., 1969; Adar et al., 1977; Harris, 1978; Hassan et al., 1978; Klipper, 1978; Chan, 1985; Conine, 1986; Schweitzer et al., 1991; Conine, 1987; Welsch, 1994; Kee, 2001).

In the Italian context, BEA has been mainly applied in the business sector and in several engineering fields, in order to rapidly check the financial convenience of an investment or to correct – following changes in market conditions – some factors of the ongoing ones (Guatri, 1992; Pratali, 1996; Luciano & Ravazzi, 1997; Fusa, 1998; Mella, 1998). Recently, BEA has been applied for checking the financial feasibility of urban renewal initiatives (Morano, 2007), and for calculating the main variables within renewal action of industrial areas in disuse (Morano & Tajani, 2013).

Among the issues in which BEA can be applied, the most important are:

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- the identification of functions and/or assets and/or services among the already/to be produced ones that can be used to maximize the convenience of the initiative (Adrian, 1993);
- the sizing of the amount of product to be realized and sold, knowing the organizational structure of the enterprise that will realize the investment and the market reaction for the product (Kortge, 1984; Gantt, 1994);
- the definition of the selling price for the building products to be realized and pricing policy analysis to evaluate the effects on sales (Pollock, 1995);
- the influence of the financial structure of project costs on the feasibility of the initiative (Powers, 1987; Pilcher, 1992);
- the comparison between technical-financial alternatives, in order to choose the best one to be implemented (Fellows et al., 1990);
- the evaluation of the consequences caused by variations in products demand, related to exogenous factors, and how they could influence the financial balance of the initiative and the "safety margin" for the enterprise (Starr & Tapiero, 1975; Shashua & Goldschmidt, 1986; Thuesen & Fabrycky, 1994; Hawes et al., 1995);
- the analysis of the results' stability and the effects on the operators' convenience in investing their resources, influenced by modifications of the relevant variables of the investment (Zhao et al, 2008).

Further applications of BEA were carried out in the energy field (De Kok et al., 2008; Szklo et al., 2008; Ekren et al., 2009; El Alimi et al., 2014; Nykamp et al., 2014), in the agricultural sector (Berry, 1972; Dillon, 1993; Dasgupta & Tidwell, 2003; Sathiadhas et al., 2009), in logistics (Kim & Van Wee, 2011), in the business management (Gritta, 1979; Lesure, 1983; Meyer & Sherraden, 1985; Levy & Brooks, 1986; Paek, 2000; Broyles et al., 2003), for the valuation of programs' fiscal viability (Carney et al., 1989; Saywell et al., 1995; Murdock et al., 2010), for environmental issues (Saveland, 1987; Caulfield & Teeter, 1988; Fox, 1988; Siegel & Johnson, 1991; Yamamoto & Takeuchi, 2012);

In the evaluation of an investment, BEA considers only the monetary aspects of the interventions in the *short term*, because it provides the order of magnitude of the variables examined over a period of a short duration. Therefore, it operates by limiting the aspects of the monitored investment, and the analysis is focused (Pelfrey, 1990; : on the *total* costs (*Ct*), which are disjointed in the components of the *fixed* costs (*Cf*), that are cost items defined without considering the amount of the product to be realized (e.g. acquisition of land, its environmental remediation and restoration, the urbanization and the infrastructure for mobility, the recovery of existing buildings, the establishment of spaces and equipment of collective interest) and *variable* costs (*Cv*), that are cost items defined considering the amount of the product to be realized and sold within the initiative (e.g. energy costs, cost of raw materials directly used in the production, costs for the distribution and sale of the products, workers' salaries based on flexible contracts); on *total* revenues (*Rt*); on the quantity (*q*) of the goods or services that are expected to be produce and sell; on the financial feasibility of the initiative, computed in terms of *total* profit (*Pt*).

These are elements linked together in the mathematical relationship that expresses the total profit of the initiative:

$$Pt = Rt - Ct = Rt - (Cf + Cv) \tag{1}$$

According to microeconomic laws (Ndaliman & Bala, 2007), the aforementioned parameters can vary depending on the amount of product (*q*) through a non-linear relation, coherently with the law of diminishing returns. For this reason, it is possible to introduce some assumptions to simplify BEA application: 1) costs and revenues are produced instantaneously, which means that the time dimension is not considered in the evaluation. In practice, it is as if the operator asserts expenses and realizes the value of the products and services at the same time; 2) the total production costs have a linear trend. The variable costs should be calculated as the product of the unit variable costs (*Cvu*) and the amount to be realized ($Cv = Cvu \cdot q$); 3) the total revenues have equally a linear trend, so that they must be defined by the product of their unit price and the quantity to produce and sell ($Rt = pu \cdot q$).

Substituting into Eq. (1), the algebraic expressions of the variable costs and total revenues arising from the working hypothesis:

$$Pt = pu \cdot q - Cvu \cdot q - Cf. \tag{2}$$

By determining the quantity (*q*) to be produced and sold and imposing the zero-total profit condition ($Pt = 0$), that – by definition – should be verified corresponding to the break-even point, it is possible to obtain:

$$Cf + (pu - Cvu) \cdot q = 0. \tag{3}$$

By solving Eq. (3), it is possible to define q^*:

$$q^* = \frac{Cf}{pu - Cvu}. \tag{4}$$

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This relation links the main financial variables of the investment and allows to calculate through a direct and rapid method the break-even quantity *q**, knowing fixed costs (*Cf*), selling price per unit (*pu*), variable production cost per unit (*Cvu*) of the initiative.

Within the fixed costs items it is also important to include the "normal" profit of the private investor. This profit is the expected compensation for the generic investor – in a specific area and for a specific typology of initiative – considering his activities of production's coordination and assumption of the risk investment. This means that *q** defines the minimum amount for the financial convenience, ensuring also the normal profit to the private investor. Amounts to be produced or sold that are bigger than the amount of *q**, will produce an extra-profit.

In order to check the feasibility of the initiative, the quantity *q** needs to respect all technical, normative and market restrictions. In fact, there will be a convenience for the private investor only if the break-even point is lower than the maximum threshold estimated. If it is possible to gather in the balance items of the initiative - in the form of measures of the fixed/variable cost and revenues - the financial "translations" of the restrictions, project choices, negotiated agreements for the solutions to be realized, and also considering the amount of public works to be realized by the private investor, the break-even analysis will be able to define the amount of *q** as building products to be realized and sold. This amount will ensure the balance between the several conveniences for the whole set of operators involved within the initiative.

4 The model

With reference to urban renewal projects to be realized through the participation of the private investors, the proposed model has been developed to support territorial transformations for which Public Administration – taking into account also the financial convenience of the private – decides to maximize the percentage of subsidized housing to be realized by the private investor, that will sell the units respecting administered selling prices. In fact, the analysis of the reference literature has highlighted that few studies have addressed the fundamental issue of the assessment of the financial viability of affordable housing projects to be implemented in public-private partnerships. In particular, Li et al. (2014; 2016) propose stochastic procedures for assessing the investment value of public rental housing projects through the integration of the Net Present Value method through the Real Option Pricing Model. A recent paper (Tajani & Morano, 2015) deals with the issue of the determination of the share of social housing financially feasible for private developers. However, the practical use of the models developed in those papers involves advanced statistical skills, which the end users - Public Administrations and private investors - hardly have. In this framework, the following model is aimed at ensuring transparency and easy repeatibility of operations for all the actors involved.

The share of social housing to be realized by the private investor reduces his total incomes. The selling price per unit of subsidized housing (p_{sh}) needs to be lower than the selling price per unit of housing for the free market (p_m). In Italy, criteria for the definition of administered prices are established by law, considering the selling prices related to the costs of construction of the housing units, and using a direct proportionality defined at regional level (L. No. 457/1978). However, it is not always verified that social housing prices are lower than housing prices in the free market: considering areas affected by depressed property market, the application of this principle could generate administrated selling prices that are incompatible with the local scenario. For this reason, the proposed model considers a multiplying coefficient (*w*), lower than 1, that compares administered prices with the free market, considering prices which normally are defined within the area of study, following the relation:

$$p_{sh} = w \cdot p_m \qquad 0 \le w < 1 \qquad (5)$$

At this point, starting from Eq. (2) it is possible to disaggregate the price per unit (*pu*) and variable cost per unit (*Cvu*), considering the different functions that contribute to define the project. Taking into account the Eq. (5) it is possible to write:

$$Pt = \left(\frac{p_m \cdot q_m + w \cdot p_m \cdot q_{sh} + p_c \cdot q_c}{q}\right) \cdot q - \left(\frac{Cvu_m \cdot q_m + Cvu_{sh} \cdot q_{sh} + Cvu_c \cdot q_c}{q}\right) \cdot q - Cf \qquad (6)$$

The meanings of the elements of Eqs. (5) and (6) are summarized in Table 1.

Recalling that the normal profit of the private investor has been also considered among the fixed costs (*Cf*), through Eq. (6) it is possible to calculate the extra-profit, i.e. the profit share that exceeds the normal profit.

Considering also that the aim of the model is to define the amount of subsidized housing (q_{sh}) and the percentage (*w*) of deduction for the selling price per unit of housing in the free market able to nullify the total profit (*Pt*), Eq. (6) must be equal to zero:

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$$p_m \cdot (q_m + w \cdot q_{sh}) + p_c \cdot q_c - Cvu_m \cdot q_m - Cvu_{sh} \cdot q_{sh} - Cvu_c \cdot q_c - Cf = 0 \qquad (7)$$

Specifying with q_r (= q_m + q_{sh}) the total gross floor area to be allocated to the housing units, it is possible to write:

$$p_m \cdot [q_r - (1-w) \cdot q_{sh}] + p_c \cdot q_c - Cvu_m \cdot (q_r - q_{sh}) - Cvu_{sh} \cdot q_{sh} - Cvu_c \cdot q_c - Cf = 0 \qquad (8)$$

From Eq. (8), isolating the amount of subsidized housing (q_{sh}) that zeros the total profit:

$$q_{sh} = \frac{Cf + (Cvu_c - p_c) \cdot q_c + (Cvu_m - p_m) \cdot q_r}{[Cvu_m - Cvu_{sh} - (1-w) \cdot p_m]} \qquad (9)$$

Knowing dimensional data of the initiative, considering the distribution – defined through demand analysis - between the total gross floor area and the non residential functions, gathering registered fixed costs from the market, cost items that contribute to define variable cost per unit and selling prices for the different functions of the project's elements, Eq. (9) has two variables, i.e. q_{sh} and w.

Table 1 - Parameters of the model

Cf	fixed costs of the transformation [€]
Rt	total revenues of the transformation [€]
Pt	total profit (extra-profit) of the private investor [€]
q	total gross floor surface (GFS) of the project [m^2]
q_m	GFS of housing sold in the free market [m^2]
q_{sh}	GFS of subsidized housing [m^2]
q_r	total residential GFS [m^2]
q_c	GFS for not residential functions (e.g. commercial) [m^2]
p_m	selling price per unit for housing in the free market [€/m^2]
p_{sh}	selling price per unit for subsidized housing [€/m^2]
p_c	selling price per unit for non residential functions [€/m^2]
w	coefficient for the definition of the selling price per unit for subsidized housing
Cvu_m	variable cost per unit for housing in the free market [€/m^2]
Cvu_{sh}	variable cost per unit for subsidized housing [€/m^2]
Cvu_c	variable cost per unit for non residential functions [€/m^2]

It should be noted that the variable cost per unit for the realization of housing in the free market (Cvu_m) is higher than the respective variable cost per unit for the realization of subsidized housing (Cvu_{sh}). Each of these items involves i) local planning fees and construction cost taxes per unit, ii) the normal profit per unit of the private investor, iii) technical and general expenses per unit, iv) financial charges per unit and v) the construction cost per unit. In particular, the normal profit per unit of the private investor is determined as a percentage of the selling price per unit of housing in the free market - in the case of Cvu_m - or of the selling price per unit of subsidized housing - in the case of Cvu_{sh}. Therefore, the cost Cvu_{sh}, as it varies - through the respective rate of normal profit that includes - according to the administered selling price per unit defined for subsidized housing, also depends on the percentage of deduction (w) for the selling price per unit of housing in the free market. Furthermore, in those market contexts characterized by a demand for higher housing quality and, consequently, by higher selling prices, the construction cost per unit of subsidized housing is generally lower than the construction cost per unit of housing in the free market: Ram & Needham (2016) highlight the "market strategy" of private developers that build simple and decent affordable housing units which meet minimum standards of construction with five basic amenities (toilets, electricity, drainage, roads and water supply), reducing the costs for the interior finishes.

If it is possible to prefigure several alternatives for the public and private actors involved within the urban renewal investment, Eq. (9) allows to define combinations of q_{sh} and w able to ensure the financial convenience of the initiative.

It is important to underpin how the empirical evidence shows that if w assumes values close to 1 – meaning the possibility to define social housing prices close to the ones of the free market – the amount of subsidized housing to be realized by the private investor increases; vice versa, if w assumes values close to 0 – meaning that the administrated

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price is really low, and the private can only gives the housing units for free to the Public Administration - the amount of subsidized housing to be realized by the private investor decrease considering the restriction of financial convenience.

5 Application of the model

The illustrated model has been applied to an urban renewal investment of an area located in a municipality of Naples' Province (Italy). The intervention area is owned by the Public Administration, well served by infrastructures, extended for 11,580 m^2, located in an expansion area characterized by five levels buildings with commercial functions in the ground floors and residential units for the others.

The area is free from buildings and is usually used for the weekly municipality market or to host events of collective interest (expositions, exhibitions, etc.).

The strong demand for affordable social housing expressed by local people induced the Public Administration to arrange a transformation project for the area. It consists of the realization of nine buildings with five levels above ground and one basement level to be realized by a private investor. In particular, a part of the housing accommodations should be sold in free market regime, another part with fixed price values, whereas ground floor commercial units and appurtenant basement parking should be sold on the free market.

The initiative expects the private developer to commit himself to buy the building foundation layer, following a specific agreement defined with the Public Administration. Moreover, he commit himself to realize public green spaces onto the area free from the building and to pay local planning fees (L. No. 10/77 and Presidential Decree No. 380/2011) and construction cost taxes (art. 16, Presidential Decree No. 380/2011), related to the residential accommodations and to the commercial premises to be realized and sold in free market regime.

In this setting, the Public Administration needs to fix the total residential gross floor surface (GFS) to be realized as subsidized housing and its administered selling price, in order to guarantee financial convenience for the private investor, individuating the unavoidable condition for a real feasibility of the investment.

The implementation of the model needs the development of typical BEA phases (Adar et al., 1977), that are:

1) the analysis of initiative's dimensional and urban data,
2) the investor's financial balance construction,
3) the re-organization of the financial balance in "fixed" and "variable" elements.

These operations will be explained in the following paragraphs.

5.1 Dimensional and urban data and definition of the financial balance of the private investor

Main dimensional and urban data of the investment are summarize in Table 2.

Table 2 - Dimensional and urban data of the evaluated investment

land area	11,580 m^2
building foundation layer	3,730 m^2
residential volume	25,980 m^3
residential GFS	8,500 m^2
commercial volume	7,200 m^3
commercial GFS	1,600 m^2
total volume above ground	33,180 m^3
total GFS	10,100 m^2
appurtenant parking	3,320 m^2
public green area	7,850 m^2

It is easy to verify that the total GFS, equal to 10,100 m^2, is allocated in 84.16 % of residential use (8,500 m^2) and in 15.84% of commercial use (1,600 m^2); the 32.21% of land area is characterized by buildings to be realized (equal to 3,730 m^2), whereas the public green area covers the 67.79% (equal to 7,850 m^2).

The scheme of the financial balance of the initiative for the private investor is shown in Table 3.

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The *land purchase* items considers only taxes that the private investor supports to purchase areas defined for the private part of the initiative (equal to 3,730 m^2). Following the case study analysis, the market value is equal to 182,248 €.

The *taxes and notary's fees* include the amount that the private have to pay for the indirect taxes linked to the area purchase and for the notary's honorary. This item is fixed to 20,047 €, that is the 11% of the land purchase price.

Table 3 - Scheme of the financial balance of the initiative led by the private investor

COSTS	**unit cost or percentage**		**QUANTITY**	
land purchase	48.86	[€/m^2]	3,730	[m^2]
taxes and notary fees	11	[%]	182,248	[€]
SUB TOTAL A				
URBANIZATION COSTS				
subsidized residential	11.50	[€/m^2]	q_{sh}	[m^2]
free market residential	34.50	[€/m^2]	q_m	[m^2]
commercial	50.20	[€/m^2]	1,600	[m^2]
SUB TOTAL B				
CONSTRUCTION COSTS				
subsidized residential (appurtenant parking included)	900	[€/m^2]	q_{sh}	[m^2]
free market residential (appurtenant parking included)	1,100	[€/m^2]	q_m	[m^2]
commercial	1,000	[€/m^2]	1,600	[m^2]
urban green area	75.00	[€/m^2]	7,850	[m^2]
TOTAL COSTRUCTION COSTS (SUB TOTAL C)				
technical and general expenses *(SUB TOTAL D)*	8	[%]	*SUB TOTAL C*	
TOTAL INVESTMENT COSTS BEFORE FINANCIAL CHARGES AND PROFIT (SUB TOTAL A+B+C)				
FINANCIAL CHARGES	6.50	[%]	*50% * SUB TOTAL A+B+C+D*	
NORMAL PROFIT	20	[%]	TOTAL REVENUES	
TOTAL INVESTMENT COSTS				
REVENUES	**unit price**		**QUANTITY**	
subsidized residential (appurtenant parking included)	f(*w*)	[€/m^2]	q_{sh}	[m^2]
free market residential (appurtenant parking included)	2,300	[€/m^2]	q_m	[m^2]
commercial	2,600	[€/m^2]	1,600	[m^2]
TOTAL REVENUES				

The *local planning fees and construction cost taxes* are calculated applying to the gross floor surfaces the parametric values – in euro per square meter of GFS – reported in municipal tables and periodically updated, depending on the functions and on the type of the investment to be realized. In particular, the specific agreement between the Public Administration and the private developer provides that these items of cost are equal to 11.50 €/m^2 for the subsidized housing, to 34.50 €/m^2 for housing sold in free market regime and to 50.20 €/m^2 for the commercial part sold in free market regime. The three spending items depend on costs of GFS related to each function: so, in the last column of Table 3, the -known- quantity of commercial use is reported, whereas subsidized residential quantity (q_{sh}) and free market residential quantity (q_m) constitute the outputs of the model.

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The amounts for the realization of new buildings and public green area are extimated in *construction costs*. The quantity of construction costs for each intended use, expressed in €/m^2 of GFS, was obtained by a study carried out in some construction enterprises about building typologies usually realized in the territory of study. The empirical survey has highlighted the "market strategy" of local private developers, that guarantee the basic amenities for the subsidized housing units (Muttagi, 1998), but save costs for the realization of the interior finishes. In particular, the parameter related to the unit cost of construction of residential buildings includes the cost of appurtenant parking. Costs used are 900 €/m^2 for the subsidized housing including appurtenant parking, 1,100 €/m^2 for housing in the free market including appurtenant parking, 1,000 €/m^2 for commercial use, 75 €/m^2 for the realization of the green area. Again, in this case, only quantities related to already known surfaces to be realized are reported in Table 3, that is 1,600 m^2 for the commercial use and 7,850 m^2 for the green area.

Technical and general expenses include, in technical expenses, design, construction office and testing charges required from the investment. The total amount has been evaluated considering an incidence equal to 5% on total construction costs, that is consistent with the calculation method generally used in the territory of study. Costs for editing the strategy, payments for technical experts and costs for the commercialization of building units are listed in the general expenses. These have been evaluated considering an incidence of 3% on total construction costs. Consequently, the total amount for technical and general expenditures is 8% of the total construction costs (SUBTOTAL C).

In *financial charges* the cost of the capital borrowed from the credit institute by the private investor is included. This item will change depending on total amount, passive interest rate performed within the market at the moment of the evaluation, financial guarantees offered by the debtor and the period of the loan. The latter in its turn depends on the market reaction. For the case study, due to the "instantaneous approach" implemented, finance charges are calculated considering that the 50% of the needed capital for the initiative is obtained by loan and with an interest rate equal to 6.50% of the total investment costs before considering finance charges and profit (SUBTOTAL A+B+C+D).

The n*ormal profit* defines the remuneration for the private investor for the management of the initiative and the risk related to the initiative. The normal profit has been considered as percentage of the expected revenues of the initiative, considering the profit of the ordinary private investor that acts in the territory where the initiative has been planned. For the case study, a 20% ordinary rate has been estimated.

Revenues of the initiative come from the sale of building products to be realized within the investment. From market analysis, selling prices per unit are equal to 2,300 €/m^2 of GFS for free market housing and 2,600 €/m^2 of GFS for commercial functions. Selling price of the housing units includes also appurtenant parking area. Also in this case, being not yet known the quantities of the GFS of the subsidized housing units and the ones for the free market, as variables of the models, in Table 3 there are q_{sh} and q_m to indicate the equivalent amount. Also the administered price of subsidized housing is not known, because it depends on w that, considering the output obtained with the implementation of the model, will be considered convenient to be applied. For these reasons, in the third to last row of Table 3, instead of this data there is the symbol (*f(w)*), that indicates the function of the multiplying coefficient *w*.

Finally, it must be underpinned how for the case study, where the amount of surface for commercial purpose is already fixed by the Public Administration, in the following phase - in which there is the subdivision between "fixed" and "variable" for the costs and revenues – the cost items related to the commercial purpose are considered as "fixed" ones. This means that for the definition of the amount of subsidized housing the Eq. (10) is needed:

$$q_{sh} = \frac{Cf - p_c \cdot q_c + (Cvu_m - p_m) \cdot q_r}{[Cvu_m - Cvu_{sh} - (1-w) \cdot p_m]} \tag{10}$$

5.2 Reorganization of the financial balance in "fixed" and "variable" items

Considering that the model borrows the BEA operative process, a further step is needed for the procedure: the reorganization of costs/revenues items within the financial balance in "fixed" and "variable" (Lesure, 1983; Dillon, 1993). The result of this step is shown in Table 4.

For the case study, within the fixed items there are land purchase, taxes and notary's fees, costs for the realization of the green area and costs items related to the realization of the commercial share (local planning fees and construction cost taxes, normal profit of the private investor, construction costs).

Among *fixed* costs there are also technical and general expenditures related to the realization of the commercial share and of the green area. Furthermore, there are also finance charges related to the aforementioned items.

Within the *fixed* revenues there are the incomes generated by the sale of the commercial share, equal to 4,160,000 €. They have been evaluated applying to the surfaces with commercial purpose a price per unit defined through a market survey, equal to 2,600 €/m^2.

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Among *variable costs* there are the sums related to the distribution of the total residential GFS in the subsidized share (q_{sh}) and in the share for the free market (q_m), local planning fees and construction cost taxes for the subsidized housing and for the ones on the free market, construction costs, the amount of normal profit of the investor, technical and general expenses and finance charges related to the residential share. It is important to notice that the normal profit of the private investor related to the sale of subsidized residential GFS depends on *w* for the definition of the administered selling price per unit: this means that the realization cost per unit for subsidized housing units depends, in its turn, on the value that will be defined for the coefficient *w*. The variable cost per unit for residential share in the free market is equal to 1,722.23 €/m^2.

Within the *variable* revenues there are the incomes generated by the sale of subsidized housing GFS and GFS of the housing in the free market.

Table 4 - Organization of the private investor's balance items in "fixed" and "variable"

FIXED COSTS	
land purchase	182,248 €
taxes and notary's fees	20,047 €
local planning fees and construction cost taxes for the commercial share	80,320 €
normal profit of the investor (commercial)	832,000 €
commercial construction cost	1,600,000 €
realization of the green area	588,750 €
technical and general expenses (commercial and green area)	175,100 €
financial charges	86,008 €
TOTAL	**3,564,473 €**
VARIABLE UNIT COSTS	
SUBSIDIZED RESIDENTIAL	
local planning fees and construction cost taxes	11.50 €/m^2
normal profit of the investor	*f*(*w*)
technical and general expenses	72.00 €/m^2
financial charges	31.96 €/m^2
construction cost	900 €/m^2
TOTAL	***f(w)***
FREE MARKET RESIDENTIAL	
local planning fees and construction cost taxes	34.50 €/m^2
normal profit of the investor	460 €/m^2
technical and general expenses	88.00 €/m^2
financial charges	39.73 €/m^2
construction cost	1,100 €/m^2
TOTAL	**1,722.23 €/m^2**
UNIT REVENUE	
subsized residential sale	***f(w)***
free market residential sale	**2,300 €/m^2**
commercial sale	**2,600 €/m^2**

5.3 Definition of the acceptable combinations of q_{sh} and w

In Table 5 there is a summary of the values of the parameters that are needed for the application of the Eq. (10) for the case study.

Table 5 - Values of the parameters for the implementation of the case study

Cf	3,564,473 €
q_c	1,600 m^2
p_m	2,300 €/m^2
p_c	2,600 €/m^2
Cvu_m	1,722.23 €/m^2

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In Table 6, considering increases in the value of *w* equal to 0.05, the amount of subsidized housing (q_{sh}) defined through the Eq. (10) and the amount of housing in the free market (q_m) are reported. The latter is calculated through the difference between total residential GFS defined within the investment, equal to 8,500 m^2 , and the amount of subsidized housing related to each *w* value considered. In Fig. 1 a graphic summary of the results is shown.

Considering Table 6 data, it is evident that the aforementioned empiric link characterized by direct proportionality between the coefficient *w* and the amount of subsidized housing q_{sh}, is verified: if the coefficient *w* is equal to 0 - meaning that the private can only give the housing units for free to the Public Administration – the model defines a value of q_{sh} = 3,456 m^2, equal to 40.66% of the total planned residential GFS within the project; for increasing values of *w*, also the amount of subsidized housing to be sold with administrate price raises considering the limit of the financial convenience of the private investor. The value *w* = 0.51 – meaning an administered price per unit slightly higher than the half of the price per unit of the residential share in the free market – represents the maximum threshold for the case study. This is the scenario in which all the planned residential share can be intended for social housing.

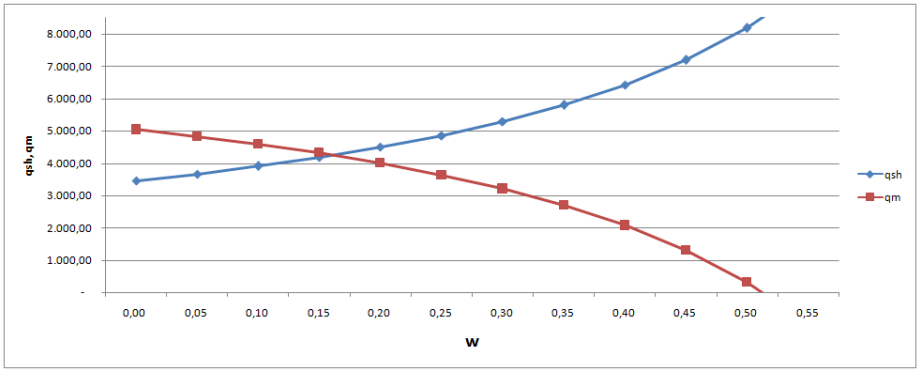
It is important to underpin how the empirical evidence shows that if *w* assumes values close to 1 – meaning the possibility to define social housing prices close to the ones of the free market – the amount of subsidized housing to be realized by the private investor increases; vice versa, if *w* assumes values close to 0 – meaning that the administrated price is really low, and the private can only gives the housing units for free to the Public Administration - the amount of subsidized housing to be realized by the private investor decreases considering the restriction of the financial convenience.

Table 6 - Outputs of the application of the model

w	q_{sh} [m^2]	q_m [m^2]
0.00	3,456	5,044
0.05	3,668	4,832
0.10	3,907	4,593
0.15	4,180	4,320
0.20	4,494	4,006
0.25	4,860	3,640
0.30	5,288	3,212
0.35	5,800	2,700
0.40	6,424	2,076
0.45	7,195	1,305
0.50	8,180	320
0.51	8,500	0.000

In conclusion, it is important to reflect about the potential uses of the model. It can be used by Public Administration to calibrate possible additional requests for the private investor, considering the several financial conveniences that can be generated by the initiative. In particular, Eq. (6) can be used to define the extra-profit of the private investor. Using this equation the Public Administration can define and check several solutions among the combinations between *w*, q_{sh} and additional requests. In this way, it will be possible to choose the best solution for each evaluated case, considering the level of interest that the Public Administration wants to create for the private investors in supporting financially the initiative.

Fig. 1. Graphic summary of the outputs obtained by the application of the model



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In the case study, by instance, the value obtained from the model, considering a decrease of 49% for price per unit of housing in the free market (w=0.51), allows to allocate all the residential GFS for the subsidized housing share. This value could be used from the Public Administration to define an higher administrated price, supporting the request of further public works to be realized by the private investor, immediately convertible into monetary terms or for the realization of service for the community benefits. Actually, through the implementation of Eq. (6), it is possible to verify that if all the residential GFS is sold considering a decrease of 30% for price per unit of housing in the free market (w=0.70), the extra-profit of the private investor to be translated in additional finance charges would be equal to 2,912,083 €.

6 Conclusions

Conclusions drawn from this paper are suggested by qualities and structure of the proposed model itself, as well as by practical advantages emerged from its implementation.

Urban requalification projects are the model's range of application. These kind of projects needs first of all a preview about housing to be sold with controlled price, because of the actual socio-economic conjuncture that allowed an increase of subjects unable to access to the free housing market. Moreover, with urban requalification projects are essential both the private investor's sources involvement and competences, even if he is interested to participate only in investment with verified restriction of financial feasibility.

This research seeks to fill the lack of evaluation models of the financial viability of affordable housing projects to be implemented in public-private partnerships, through the development of a methodology characterized by high transparency and easy to implement. The model is firstly composed of a procedure that borrows main logical features of BEA, to later calibrates combinations of two variables, "price" and "share" of social housing, on total, that guarantee to the private investor the initiative's balance. This calibration is carried out referring to a specific market area and to a design hypothesis with achievable volumes and gross floor surfaces preliminary defined.

The logical and functional relations of the developed model allow to easily and mutually link the technical and financial variables of the initiative, underlining interconnections and critical aspects. This characteristic constitutes the main strength and novelty of the model, that can be quickly implemented by the actors involved: on the one hand, by the private investor, that, through a procedure simply codified in a spreadsheet, can monitor the sensitivity of the initiative to evolutions of the economic scenario and local market conditions; on the other hand, by the Public Administration, that can calibrate possible additional requests to the private developer, taking clearly into account the spectrum of financial conveniences that can be reached by the investment.

The application of the model to a tangible case has highlighted its adaptability to specific territorial conditions because of its simple structure, rationalizing the process of decision making.

The possibility to retrace operations legitimates the management of both private and public actors involved, with positive consequences about transparency and decision effectiveness. Therefore, the model will be particularly useful in cases of bilateral monopoly: in this market form the exchange price is not defined a priori, but only a range of values of the equilibrium price can be determined, depending on different variables, that represent the negotiating skills of the parties involved (Manganelli & Tajani, 2014). This situation is typical of urban redevelopment, in which the final decisions depend on the contractual ability of both Public Administrations and private investors (Manganelli, 2016).

Finally, stability and flexibility elements, whose the introduction in the planning of the investments is allowed by the model, amortize unruliness and hesitations caused not only by property market changes but also by the complex nature of urban requalification initiatives.

Insights and refinements of the model certainly will derive from its application to new case studies, also concerning to different territorial contexts. Further improvements will undoubtedly generate from considering, in the model, the time variable (Xia & Luo, 2014), which will make the results most effective, especially in the case of urban renewal investments of longer duration.

Note: The paper is to be attributed in equal parts to the two authors.

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