Urban Planning and Option Values

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Abstract

Starting from the late 1990’s, innovative regulation mechanisms and laws were introduced in the Veneto Region with the aim of encouraging real estate investments and urban development. Urban development involves the social, economic and physical transformation of cities and requests high capital outlays and relevant financial resources that, due to stringent budget constraints, forces Public Administration to public private partnerships. In this respect, when introducing public-private partnership in urban planning many questions arises on the benefit sharing and relative valuation procedures between private operators and Public Administrations. The crisis of the real estate market jointly with the global financial crisis that erupted in 2007, made investors and developers more cautious on the evaluation of private benefits generated by negotiation in urban planning and it highlighted the limits of evaluation procedure so far adopted by Public Administrations and the need for innovative valuation approaches. Present evaluation procedures implicitly assume that developers invest immediately and start properties construction confident on favorable market absorption and increasing real estate market prices. This assumptions is no more realistic. In time of financial crisis when the future is uncertain and investments are more illiquid, private investors changed their investment strategy: they might rather defer investments and negotiation with Public Administration in order to gain higher payoffs in the future. In this changing scenario, investment timing flexibility plays a key role on developer’s investment strategies as it gives the entrepreneur the option
to strategically decide the optimal investment timing and significantly contributes to profit maximization and hedging of risk. It is widely recognized that the NPV rule and traditional Discounted Cash Flow (DCF) analysis fail because they cannot properly capture managerial flexibility to adapt and revise later decisions in response to unexpected market events. DCF approaches presume investor’s passive commitment to a “certain static operating strategy”, but as new information arrives and uncertainty about future cash flows is gradually resolved, management may have valuable flexibility to alter its initial operating strategy in order to capitalize on favorable future opportunities. Aim of the paper is to provide a theoretical model to determine the value of flexibility to defer in integrated urban development and public private partnership. The land owner has the possibility to decide whether and when it is optimal to invest and is holding a real option analogous to a financial call option. If optimally exercised, this option value may increase the investment payoff and alter the investment timing.

**Keywords:** negotiation in urban planning, property investments, value of flexibility, option to defer

## 1 Introduction

In the context of negotiation-based urban planning, the Regional Authorities of the Veneto region have approved a series of regulations aimed at introducing and promoting the development of innovative legislative tools. Regional Law 23/1999, providing for the implementation of Integrated urban and environmental requalification programs, and Regional Law 11/2004, which defines in detail Local Area plans and outlines the issue of construction loans and compensation, are particularly worthy of mention.

These regulations have resulted in the setting up of establishments and procedures that have raised a series of relevant valuation issues, ranging from the assessment of public benefit to interest thresholds for private investors; they have however failed to provide indications as to the valuation methods to be applied. Accordingly, several regional capitals (namely Treviso, Padua and Verona) have adopted guidelines and documents aimed at guaranteeing the transparency and consistency of valuation procedures, for the purpose of ensuring equal treatment for all, and maximizing public benefit whilst safeguarding the economic stability of real estate developments.

However, the local real estate crash, first perceived in 2007 concomitant to the severe global economic crisis, has highlighted the limitations of valuation procedures applied previously by the Public Administration. These procedures failed to perceive the change in attitude of real estate investors who, due to unfavourable market conditions, particularly in terms of time and absorption volumes of construction developments, tended increasingly towards static, determi-
nistic and “instantaneous” projects (construction and sale within the shortest possible time frame based on a univocal project). They sought increased flexibility both in terms of a possible extension in start up of the development, and, in terms of community benefit, in being given the possibility to choose between a series of alternative scenarios with regard to quantity, intended use and superior standard works to propose to the Public Administration. Investment decisions made by applying a conventional discounted cash flow analysis approach, and applying in particular the Net Present Value (NPV) rule, fail to focus explicitly on the strategic impact of an investment project. Indeed, calculation of NPV yields a measure of the value and cost effectiveness at the actual time of valuation, implying that the investment, unless made immediately, may potentially be lost forever; it fails however to give due consideration to the opportunity cost of investment, and foregoes the possibility of collecting new information on the evolution of uncertain decisional variables. Discounted cash flow analysis assumes “a substantial inflexibility of the decision process in the context of a sequence of cash flows or of decisions established at the time of valuation” [1]. However, the high degree of irreversibility of real estate developments resulting from the significant involvement of sunk costs, and the possibility of postponing investment, delaying the undertaking of a project featuring uncertain payoffs until uncertainties are partially resolved, are all aspects which are frequently not captured by traditional capital budgeting techniques. In the climate of a global economic crisis strangling the real estate sector, in which variation of major context variables – such as the type of buyer and potential demand, reference legislation, market structure and competitor dynamics – are frequently sudden and intense, investment costs are high and largely irreversible, and associated capital assets have an extremely long life cycle, thus rendering the use of conventional, consolidated evaluation models potentially inadequate. It is crucial therefore that valuation paradigms capable of underlining the strategic dimension of real estate development projects are adopted. If, on the one hand, a traditional approach generally entails identification of one or more expected cash flows, assuming a “passive” management of specific operational strategies, for example embarking on the project immediately, selling at a specified time, and so on, on the contrary, the real options theory constitutes a valid tool for use in creating value and valuing investments in a world dominated by risk and uncertainty [5, 15, 16, 18, 25, 26]. The real options approach however focuses explicitly on the flexibility of a project and its associated effects, thus constituting a valid support in assessing the risks and uncertainties that frequently characterize real estate investments. For the owner of a plot who, by virtue of his ownership has a right, but by no means obligation, to invest in the development project, changes in the value of a real estate development may, in the long run, assume the characteristics of payoff
of a call option \([7, 17, 21, 32, 33, 34, 35, 37, 38, 39]\). In the light of these considerations, this paper aims to undertake a review of a series of valuations carried out by public bodies in the Veneto region, and subsequently highlight the intrinsic limitations of the same and propose a model capable, at least in part, of overcoming these limitations. This valuation model for real estate investments internalizes both total risk compared to alternative competitor projects and the opportunity cost of delaying investment.

The model will be applied to alternative scenarios which, although referred to in simplified and synthetic terms, represent the salient points of the three options frequently facing an investor: (a) to undertake development in line with the current intended use of the area; (b) to sign a bilateral agreement that meets the generally onerous demands of the Public Administration; (c) to undertake lengthy negotiations with the aim of obtaining more favourable conditions for the proponent.

### 2 The Value of Flexibility

The owner of a plot situated in a residential zoning area has the right, but not the obligation, to invest in a development project designed to meet current or future urban planning provisions, and is allowed to decide the optimal investment timing \([9, 12]\). A private investor is under no obligation to start the project at any given time, but is free to delay investment until any uncertainties – for example related to profits yielded by the sale of the real estate units developed – are resolved. Thus, he may decide to postpone development and acquire new information on the evolution of uncertain variables that could affect profitability of the investment (e.g. intended use, market prices, construction costs, rates of return, etc.).

The value of the investment opportunity is substantially identical to the value of a call option. This flexibility generates a value strongly related to identification of the optimal investment timing. If the call option is effectively exercised, it may result in an increased payoff for the investment.

The theoretical reference to the value of flexibility is a specification \([10, 11]\) of the investment model proposed by Myers [31], Kester [19] and McDonald and Siegel [27] when applied to a real estate development project following the introduction of the simplified hypotheses illustrated below:

1) Once completed, the investment project generates an annual cash flow equal to:

\[ \Pi_t = \pi_t - X \]  \hfill (1)

---

1 For a review of the theory and applications of real options in real estate development in Italy see [4].
where X indicates the dimension of the project (in m$^3$) and $\pi_t$ the unitary cash flow generated at time t, expressed in Euros/m$^3$.

2) The evolution of $\pi_t$ over time is described by a geometric Brownian motion characterized by an instantaneous expected return $\alpha \geq 0$ and instantaneous volatility $\sigma > 0$:

$$d\pi_t = \alpha \pi_t dt + \sigma \pi_t dz_t \quad \pi_0 = \pi$$

where in (2) $dz_t$ represents the increase of a standard Wiener process whereby $E(dz_t) = 0$ and $E(dz_t^2) = dt$.

3) The undertaking of a project implies a sunk investment cost I, inclusive of the costs of construction, marketing of the assets, and any public works. Given the high degree of specificity of the investment, for the sake of simplicity this cost is deemed irreversible. Based on the findings of the Contingent Claim Analysis [24], by hypothesising neutrality towards risk, the growth rate $\alpha$ and consequently the dynamics of annual cash flows can be replaced with its certainty equivalent or “risk-neutral” equivalent $r - \delta$ [8, 20, 30]:

$$d\pi_t = (r - \delta)\pi_t dt + \sigma \pi_t dz_t \quad \pi_0 = \pi$$

where $r$ is the risk-free discount rate, and $\delta$ the cost of carry, being the difference between the expected rate of return of the project $\alpha$ and the expected market rate of return in securities of the same riskiness as the investment$^4$.

The market value at time t of an asset having a hypothetical marketing plan with a duration of T years$^5$ and marketing start up at time t, in view of the fact that (3) describes the cash flow dynamics in a neutral-risk world [10, 13] will be:

$$V(\pi_t) = E\left[ \int_t^T e^{-r(s-t)} \pi_s X ds \right] = \frac{\pi_t X}{\delta} (1 - e^{-\delta T})$$

---

$^2$ Equation (2) readily demonstrates how $\alpha$ represents the mean growth rate in cash flows related to the project.

$^3$ Replacement of a stochastic cash flow with a lower certain cash flow represents its certainty equivalent.

$^4$ If markets are complete, we could hypothesize the existence of an asset the value of which corresponds to the present value of the project traded on the economic market, and yielding dividends equal to $\delta$. In other words, $\delta$ is the annual opportunity cost of taking out a financial standing in that specific project, rather than invest in a risk equivalent project that is, however, ready to be traded [12, 14].

$^5$ In the case of a project relating to the construction of saleable assets, T coincides with the time of sale of the last real estate unit built (short or mean-term hypothesis).
where $E(\cdot)$ indicates the expectation operator calculated taking into account a risk-neutral probability [8, 20].

Recalling (3), the value of the asset at time $t=0$ is therefore:

$$V(\pi) = \frac{\pi X}{\delta} (1 - e^{-\delta T}). \quad (5)$$

If the current intended use of the plot is not changed over time, or rather, in the purely theoretical case of an urban planning program of unlimited duration, the investment may be assimilated to a perpetual American option, where exercising of the option would not be subject to temporal limitations, as the project could be undertaken at any time. In this case, the solution of the problem as to whether or not to invest consists in determining the optimal investment timing, subject to loss of value $\delta$ and irreversible investment costs $I$\(^6\). Based on the above assumptions, the option value is:

$$F(V(\pi_t)) = \max[(V(\pi_t) - I)e^{-\delta t}, 0]. \quad (6)$$

As the payoff deriving from the investment at each time $t$ is $V(\pi_t) - I$, the solution of the problem consists in determining the time $T^*$ best suited to investment (sustaining costs $I$), in a project with a value of $V(\pi_t)$. As the project value evolves stochastically, time $T^*$ is impossible to define, although the investment rule can be translated into identification of the critical or threshold value $V^*$, thus confirming advisability of investing in the project when $V \geq V^*$. Vice versa, when $V < V^*$, it is optimal to wait and delay investment until the value either exceeds or corresponds to threshold value $V^*$.

The differential equation that solves this problem

$$\frac{1}{2} \sigma^2 (V(\pi_t))^2 F_{\pi\pi} + (r - \delta)(V(\pi_t))F_\pi - rF^2 - F_t = 0 \quad (7)$$

is subject to the following boundary conditions:

- $F(V^*) = V^* - I$
- $F_\pi(V^*) = 1$
- $\lim_{V_t \to 0} F(V_t) = 0$. \(^\ast\)

By solving the differential equation (7), the following is obtained:

\(^6\) Investment costs represent the exercise price of the option.
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\[
F(V(\pi_1)) = \begin{cases} 
AV(\pi_1)^{\beta_1} & \forall V(\pi_1) < V^* \\
V(\pi_1) - I & \forall V(\pi_1) \geq V^* 
\end{cases}
\]

(8)

where \( A > 0 \) is a constant to be determined and \( \beta_1 > 1 \) is the positive root of the following quadratic equation:

\[
\Psi(\beta) = \frac{1}{2} \sigma^2 \beta (\beta - 1) + (r - \delta) \beta - r = 0.
\]

By replacing (8) in the equations defining boundary conditions, the following is obtained:

\[
V^* = \frac{\beta_1}{\beta_1 - 1} I \quad \text{where} \quad \frac{\beta_1}{\beta_1 - 1} > 1
\]

and

\[
A(V^*) = \frac{1}{\beta_1} (V^*)^{1/\beta_1} > 0.
\]

In view of the irreversibility of the investment, the threshold value indicating a favourable condition for investment is higher than the cost of the project I.

The actual time limit for urban planning programs does not generally exceed 10 years; thus, when exercising the option to invest in and carry out urban planning activities, the developer will be limited by time constraints and an expiration date, in the same way as the maturation of an American or European call option on financial securities.

Therefore, if the urban planning program is liable to change should the construction potential not be exploited within the time frame of program validity, the matter of whether or not to invest is solved by determining the option value, in the case of a European option, or the option value and optimal exercise time for an American option.

From (4) onwards the value of the investment opportunity for a private investor can be calculated at generic time \( t < \tau \), where \( \tau \) represents the exercise time of the option, and therefore the period of postponement of project start up. Based on the abovementioned assumptions, if the landowner is in a position to make the investment at any given time throughout the duration of the program (i.e. to exercise the option at any time prior to expiration), this opportunity assumes all the characteristics of an American call option with an expiration date in \( \tau \) years,

\[ \tau \]

\( \tau \) may, for example, be restricted by an upper limit represented by the expiration date of the urban planning program.
defined on an asset, the project, denoted by a value loss rate $\delta$ and a strike price $I$. In other words, at the current time $t < \tau$ is:

$$F(V(\pi_\tau), t) = E\left\{ e^{-(t-\tau)} \max\left( V(\pi_\tau) - I , 0\right) \right\}$$  \hspace{1cm} (9)

where $\tau$ represents the time of exercise of the option and $V_\tau$ the value of the asset at time $\tau$.

Under no arbitrage conditions, by imposing the new boundary conditions associated with exercising of the American call option, the solution of the differential equation (7) to the second-order partial derivatives represents the “extended” net present value of the investment $F(V(\pi_\tau), t)$, i.e. the value of the investment inclusive of the value of flexibility:

$$\frac{1}{2} \sigma^2 (V(\pi_\tau))^2 F_\pi + (r - \delta)(V(\pi_\tau))F_\pi - rF - F_\tau = 0.$$  

There is no closed-form solution to determine the value of an American call, although numerous literature references provide numerical approximations, the most widely acknowledged of which published by Barone Adesi and Whaley [2]. The sub-optimality of exercising an American call option prior to expiration and in the presence of a lack of dividends can be demonstrated. In this case, the value of the American call coincides with the value of the corresponding European call. However, in the presence of dividends or loss of value, it may be an optimal choice to exercise the American call before the expiration date. Consequently, the value of the American call will be higher than the value of the corresponding European call [28].

In the present case, and for the purpose of the study, the value of flexibility associated with the decision on the optimal investment timing, and the possibility of delaying the investment in view of the right, but not obligation, conferred by ownership, to invest in the project, is suitably represented by the value of a European call subject to the terminal condition:

$$F(\pi_\tau, \tau) = \max[V(\pi_\tau) - I , 0]$$

and to the boundary conditions:

$F(0, t) = 0$

and

$$\lim_{\pi \to \infty} F(V(\pi_\tau), t) / V(\pi_\tau) = 1.$$  

The yearly timing thus achieved appears to be particularly appropriate for this type of real estate valuation, as financiers routinely plan their funding operations on an annual basis.
The solution to (7), subject to the abovementioned conditions, was determined by Black and Scholes [3], and calculated at time $t=0$ is:

$$F(V(\pi), t = 0) = e^{-rt} \Phi(d_1) V(\pi) - e^{-rt} \Phi(d_2) I$$

(10)

where:

$$d_1(\pi) = \frac{\ln(V(\pi)/I) + (r - \delta + \sigma^2 / 2) \tau}{\sigma \sqrt{\tau}}, \quad d_2(\pi) = d_1(\pi) - \sigma \sqrt{\tau}, \quad V(\pi) = \pi X$$

and

$\Phi(\ )$ is the distribution function of normal standard distribution.

3 Valuation Scenarios

As a general rule, in the field of so-called negotiation-based urban planning, a private investor will propose to undertake a project that requires a variation to currently implemented urban planning regulations, in order to obtain a change in the intended use of the area and in construction volumes, for the specific purpose of increasing land revenues and raising profitability of the development project [22]. In view of the economic gain thus achieved, the private investor is expected to reinvest part of the surplus in carrying out works for community benefit, such as superior standard primary and secondary urbanization works [6, 23, 29, 36]. Although on one hand the public administrative authorities should acknowledge that the items of community benefit provided for by contract are deemed adequate to compensate for the privileges granted to the private investor, on the other, the private investor should also deem the agreement advantageous with regard to other options that may be available. In a climate of deep crisis pervading the real estate market at the current time, the strategic dimension of an investment project and the change in attitude of real estate agents is fundamental. Indeed, agents will take on board the consequent reduced volumes and longer absorption times manifested by construction projects, and tend increasingly to revisit static scenarios to put forward to the public administrative authorities, with the aim of achieving increased flexibility in terms of a potential postponement of project start up and of comparison with valid alternatives with regard to quantities, intended use and superior standard urbanization works.

When weighing up the benefits of undersigning an agreement with the Public Administration, the landowner is generally faced with three distinct options: (a) to develop the project in line with the current intended use of the area without providing the Public Administration with any form of compensation capable of generating a significant community benefit; (b) to acknowledge the bilateral agreement and meet the generally onerous demands of the Public Administration, ensuring project start up within a specific time frame; (c) to undertake lengthy negotiations with the aim of obtaining more favourable conditions for the proponent, and thus defer undersigning of an agreement.
In the first instance, the issue of whether or not to invest is solved by determining the optimal investment timing and exploiting the value of flexibility by exercising the option to invest in order to maximize the project value. In line with this hypothesis, the value of the investment coincides with the extended net present value of the project, i.e. the sum of the net present value and value of flexibility (i.e. the option value). Thus, as Alternative 1 provides for the right of the landowner to decide whether or not to undertake the requalification project and delay investment, resulting in a decision to delay the investment reflecting the characteristics of a call option (European, American, perpetual), the solution to the issue of whether or not to invest is represented by the solution to equation (7). If the investment opportunity is analogous to a European call, then from (10) the extended net present value of the project can be determined as:

$$F_1(V_1(\pi), t = 0) = e^{-\delta t} \Phi(d_1) V_1(\pi) - e^{-\tau t} \Phi(d_2) I_1$$

where $V_1$ is the current project value in scenario 1, calculated according to equation (4), and $I_1$ represents the costs of investment.

In the second case (Alternative 2), with no provision for a deferment option ($\tau=0$), the conditions of the consensual agreement require the landowner to start the project on a specific date (immediately), failing which the agreement is nullified and the investment opportunity related to the new intended urban use of the area is forfeited. In this case, the extended net present value of the agreement coincides with the net present value of cash flows generated by the project as, on deciding to invest in line with the conditions of the agreement, the proponent forgoes the option to defer and thus annuls its value:

$$F_2 = \text{NPV}_2 = (\pi_2 e^{-\delta t}) X - I_2$$

where $\pi_2$ is the net unitary cash flow generated by the project, $X_2$ is the dimension of the project and $I_2$ the investment costs inclusive of extra works to the standard required by the Public Administration.

In the third case (Alternative 3), the landowner is entitled to undertake lengthy negotiations and defer undersigning of the agreement, and consequently start up of the project. In this instance, the value of investment is similar to a European call with an expiration date $\tau$ and can be determined from equation (10) as follows:

$$F_3(V_3(\pi), t = 0) = e^{-\delta t} \Phi(d_1) V_3(\pi) - e^{-\tau t} \Phi(d_2) I_3$$

where $V_3$ is the net present value of Alternative 3, calculated according to (4), and $I_3$ the investment costs. If the probability of obtaining more favourable conditions by delaying signing of the agreement is represented by $p$, $F_3^*$ represents a good approximation of the value of the investment (extended net present value):
\[ F_3^+(V_3(\pi), t = 0) = p \quad F_3(V_3(\pi), t = 0). \]  

(14)

4 Case Study: Numerical Simulations

The case study presented below is described for the purpose of illustrating results obtained by the theoretical model and relates to a series of joint public-private development ventures regulated by the clauses of regional law n. 11/2004 passed by the Veneto region. In particular, it represents a stylized fact study of an urban requalification and real estate development project carried out in the province of Padua, in which several simplifications and quantitative changes have been introduced to safeguard confidentiality.

In the case examined, the investor is faced with three distinct scenarios. The first (Alternative 1) entails the possibility of developing the plot according to the intended urban use and in line with the building capacities established by currently enforced urban planning standards. This represents the most linear and secure solution from an administrative point of view, allowing the developer to choose between starting construction works immediately or, alternatively, to defer the investment over a number of years not exceeding the duration of the urban planning programs \((\tau=1,2,\ldots,10)\). However, this solution might not reflect the developer’s need to maximize profits, as the buildability index does not fully reflect the potential of the plot, permitting the development of only 9,000 cubic metres.

He may therefore prefer to undertake negotiations with the Public Administration to examine the possibility of applying one of the consensual tools provided by regional law in order to agree on a new intended use which fits better with the development plan prepared by the private investor. The second scenario (Alternative 2) involves an initial agreement which largely coincides with the requirements of the Public Administration, aimed at increasing the permitted building cubage \((21,000 \text{ m}^3)\), in exchange for the development, at expense of the private investor, of extra standard urbanization works at an additional estimated cost of 650,000 Euros. As frequently occurs, the public requirements, in terms of extra standard works and contributions tend, for a series of reasons, to be initially demanding. Firstly, there is a tendency to attempt to compensate for budgetary limitations generated by the stability pact by applying Local Area Plans to carry out public works that would otherwise be incompatible with the triennial municipal budget. This may result in the private investor being asked to meet demands reflecting the need for new community infrastructures, which may at times be incompatible, in view of the consequent economic burden, with the margins approved for urban requalification of the area. Furthermore, in our experience, during the initial stages of negotiation, the public administrative authorities frequently overestimate the private economic benefits that may result from a change in intended use of the plot (and consequently the quota relating to community benefits that can reasonably be achieved). This is particularly evident
in the current negative climate of the real estate market due, amongst other things, to a widespread optical distortion that wrongly induces stakeholders to view the high profits and land revenues registered in the past, and associated with considerably higher real estate prices and a higher demand compared to the current situation, as being reproducible in the future.

Accordingly, the second case described, with the advantage of minimising the negotiation stage \((\tau=0)\), as it meets in full the requirements of the Public Administration, presents a negative balance between increased construction capacity and a higher demand for community benefit works, which may limit the potential for increased land revenues generated as a result of the change in intended use of the area.

The third case (Alternative 3) entails the possibility of the developer undertaking lengthy negotiations with the municipal authorities, with the aim of tipping the balance between the opposed interests in favour of the interest of the private subject. This option involves a longer negotiation stage \((\tau=1,2)\), but may yield the possibility of increased building capacities \((24,000 \text{ m}^3)\) to compensate for the increased cost of undertaking extra standard public works. In this way, a fairer distribution of the surplus between public and private stakeholders would be achieved.

Technical data and economic parameters for the three scenarios are listed in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
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<tbody>
<tr>
<td>(X \text{ (m}^3) )</td>
<td>9,000</td>
<td>21,000</td>
<td>24,000</td>
</tr>
<tr>
<td>(I_p \text{ (Euro)} )</td>
<td>0</td>
<td>650,000</td>
<td>650,000</td>
</tr>
<tr>
<td>(R_0 \text{ (Euro/m}^3) )</td>
<td>600</td>
<td>600</td>
<td>600</td>
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<tr>
<td>(I_0 \text{ (Euro/m}^3) )</td>
<td>310</td>
<td>310</td>
<td>310</td>
</tr>
<tr>
<td>(\pi_0 \text{ (Euro/m}^3) )</td>
<td>290</td>
<td>290</td>
<td>290</td>
</tr>
<tr>
<td>(T \text{ (years)} )</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>(\tau \text{ (years)} )</td>
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<td>0</td>
<td>1,2</td>
</tr>
<tr>
<td>(r \text{ (%)} )</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 1: Technical and economic data relating to the three alternative scenarios**

As can be observed, in all scenarios examined, the time frame required for completion of the entire transformation process, including undertaking of public and private works, is approximately three years. Estimated sales profits are 600 Euro/m\(^3\), and related production costs 310 Euro/m\(^3\).

The above data were used to implement the theoretical model described in previous chapters assuming the following values for the more significant parameters: \(\sigma=10\%, \ 20\%, \ 30\%, \ 40\%; \ \delta=1\%, \ 2\%, \ 3\%, \ 4\% \ e \ p=70\%, \ 80\%, \ 90\%\). The results of the simulations carried out are reported in Table 2.
Analysis of Table 2 highlights how, in line with the real options theory, as the uncertainty, or rather \( \sigma \), increases *ceteris paribus*, for scenarios 1 and 3 the value of flexibility yielded by delaying investment and gathering new information on the evolution of the uncertain decision variables increases. Naturally, following negotiations and agreement with the Public Administration (scenario 2), a decision to invest is not sensitive for \( \sigma \), as the decision rule is based on a static criterion such as NPV. In all three cases, under identical conditions, as \( \delta \) increases, both net present value and extended net present value of the investment decrease. In other words, as the opportunity cost of delaying investment and the cost of carry rise, the future payoff of the investment falls as the rate \( \delta \) exceeds the growth rate of profits (expected returns)\( \alpha \). The expected current value of the asset is actually inversely proportional to the opportunity cost of the invested capital, corresponding to the difference between the rate of return and the risk adjusted rate of return of the investment.

When applying identical values for \( \sigma \) and \( \delta \) to scenarios 1 and 3, as the exercise time of the option increases, the option value to delay likewise increases, consequently raising the extended net present value of the investment. Over time, the possibility to delay investment for the purpose of acquiring new information is of increasing value, due to the fact the new information may permit the investor to take advantage of additional opportunities, and avoid or minimise his losses by “exploiting” the uncertainties to create value. Moreover, for the third scenario, as the probability \( p \) decreases, the extended net present value of the project also falls in view of the lower probability of a successful outcome to negotiations. Vice versa, *ceteris paribus*, as \( \tau \) increases, the extended net present value increases concomitantly. Over time, particularly in periods of economic crisis and structural lack of economic resources, the Public Administration may be increasingly interested in ensuring the timely completion of extra standard works for community benefit, and thus in compensating for this by granting a higher building capacity to the private investor.

<table>
<thead>
<tr>
<th>( \tau )</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sigma =10% )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \delta =1% )</td>
<td>2.507.660</td>
<td>2.561.144</td>
<td>2.700.615</td>
</tr>
<tr>
<td>( \delta =2% )</td>
<td>2.341.930</td>
<td>2.341.930</td>
<td>2.341.930</td>
</tr>
<tr>
<td>( \delta =3% )</td>
<td>2.119.331</td>
<td>2.119.331</td>
<td>2.119.331</td>
</tr>
<tr>
<td>( \delta =4% )</td>
<td>1.920.974</td>
<td>1.920.974</td>
<td>1.920.974</td>
</tr>
<tr>
<td>( \delta =5% )</td>
<td>1.709.535</td>
<td>1.709.535</td>
<td>1.709.535</td>
</tr>
<tr>
<td>( \delta =10% )</td>
<td>2.341.930</td>
<td>2.341.930</td>
<td>2.341.930</td>
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**Table 2:** Extended net present value and net present value of the three project options with varying \( \sigma \), \( \delta \) and \( \tau \).

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A comparison of the three scenarios highlights the benefits for the landowner of undersigning an agreement with the Public Administration to obtain a more profitable use of the land, although on the condition that extra standard community works will be provided as compensation. The optimal investment strategy, i.e. one that allows the investor to maximize the value of his investment, in which the probability of obtaining a more profitable intended use is extremely high (higher than or equal to 80%) does not imply an immediate undersigning of the agreement, but rather of procrastinating prior to commencing negotiations. On hypothesising p=90%, irrespective of the value of losses δ, an optimal strategy would imply a two-year wait before undertaking negotiations. Vice versa, if probability is lower than 80%, an optimal strategy would be to undersign an agreement with the Public Administration and to invest immediately. Lastly, where p=80%, if value losses δ are high, e.g. δ=4%, the agreement should be undersigned immediately. The positive outcome on value deriving from the partial resolution of uncertainty over time, is counterbalanced, and partly annulled by the cost of carry.

The case study above is cited merely for the purpose of illustrating the potential of the valuation model described in section 3, and the authors suggest that a comparative statics analysis should be carried out. However, it should be underlined that the approach described here represents a robust method for use in valuating investments under uncertainty which, in part, internalizes within the choice of a stochastic process to describe cash flow trend, the definition of alternative valuation scenarios arising from outcomes on the real estate market. As \( \alpha=r-\delta \), it is clear how \( \delta=\alpha-r \) represents the risk premium of the investment, which is closely linked to expectations in the evolution of fundamentals. The simulation parameters applied here reflect the average trend in market prices and variability calculated over a sufficiently long time horizon to encompass more than one market cycle, thus guaranteeing a suitable “telescopic” capacity of the model towards potential future market trends. In particular, use of simulations in carrying out comparative statics analysis enhances the identification of variables demonstrating a higher sensitivity to the slightest variations of \( \alpha \) and \( \sigma \); this may prove crucial when the reference time horizon of the option values generated is significantly long. Although beyond the main scope of this paper, a more detailed estimation of \( \alpha \) and \( \sigma \) obtained by analysing three-monthly real estate prices for assets comparable to those examined here, and estimation by means of contingent claim analysis of the risk-adjusted rate of return on the investment might yield findings of greater quantitative interest relating to application of the theoretical model to an actual case study, rather than a stylized facts study as illustrated here.

5 Concluding Remarks

The unfavourable economic conditions of the Italian real estate market have, at least in part, led to a change in the developers’ perception of investment valuation.
From the start of the crisis, the blind trust placed in the ability of the market to absorb any type of new construction at increasingly higher prices, resulted in the time-related variable of project start up being overlooked. In other words, investors were convinced that an early start up of the project would result in higher profits.

Today however there is a growing awareness that the possibility of introducing some degree of flexibility to the timing and carrying out of the development, even in dilatory terms, may allow the investor to seize more profitable opportunities. Accordingly, the aim of this paper was to demonstrate how, under changeable market conditions, consideration of the strategic dimension of an investment is of fundamental importance.

The paper describes a dynamic investment analysis tool capable of clarifying the strategic dimension of urban requalification programs and internalizing the opportunity cost of postponing investment until part of the uncertainties characterizing the variables is resolved.

The use of conventional capital budgeting techniques, which have proven to be the only valuation tool applied to date by the public administrative authorities of the Veneto region, has resulted in an underestimation, at times quite significant, of the investment value. The possibility to postpone the decision process and carry out the project only when faced with a positive net present value, allows the developer to limit eventual losses deriving from unfavourable market conditions.

The case study examined here, relating to urban planning works in the Veneto region, has demonstrated how a deterministic view of a single context is no longer capable of reflecting the actual orientation of real estate agents. Indeed, the latter are called upon to choose between a series of investment scenarios featuring different dimensions, obligations and, particularly, timings.

In particular, analysis of the case study highlights the contribution made by the value of flexibility together with the choice of the optimal investment timing, in defining the present value of the asset. In line with the real options theory, the results obtained from the simulations reveal how value increases in line with the higher uncertainty of cash flows, and decreases in line with higher cost of carry, representing the opportunity cost of ownership of the development project subject to valuation. The opportunity cost of deferring the investment is seen as a key decision variable for the investor who is faced with a decision between three alternative investment scenarios. In some cases, a significant loss of value may impact on the optimal investment strategy and speed up implementation. There is a clear-cut trade-off for the real estate agent between the value of delaying the decision to invest to allow new information to be obtained on the evolution of uncertain variables, and the fact that this deferment is associated with a cost. In the case examined, if the developer is able to ensure an optimal exercising of his option to invest, and to exploit the surplus deriving from flexibility, it will prove significantly advantageous for the private investor to undersign one of the consensual agreements established by regional law, and thus obtain a new intended
use which is more appropriate for the development project to be carried out. Indeed, even taking into account the value of flexibility, the current intended use generates a sequence of expected cash flows with a lower present value than that provided for in the agreement signed with the Public Administration. The decision between signing the agreement immediately, or delaying the latter and embarking on a lengthy negotiation process, is largely dependent on the uncertainty of the market, the opportunity cost of deferment, on the probability that the Public Administration may soon grant a more advantageous intended use. It should lastly be underlined that the risk-neutral valuation approach proposed here solves the crucial issue of the choice of discount rate (widely discussed in the application of conventional methods of capital budgeting), as it promotes the possibility of estimating both the present value and the extended net present value of the asset irrespective of calculation of the expected returns on the project and the risk premium requested by the investor in order to carry out the work. Accordingly, the valuation model can be implemented simply by knowing the risk-free rate of return on the market. It is clear therefore that a real options approach is particularly useful in yielding a robust estimation of the total risk of investment by means of a dynamic hedging strategy that underpins the choice of portfolio on the economic market.

References


Urban planning and option values


http://dx.doi.org/10.1007/bf00173124

Received: September 23, 2014; Published: November 10, 2014