Real Estate Investments in Rio de Janeiro: Risk Management and Real Options

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Abstract

Real estate investments are characterized by high capital outflows, low liquidity and short *payback* together with economic uncertainties related to demand, price/m^2 and sales speed that increase the risk perceived by investors. It is often the case when the property developer and the land owner sign an agreement where the former obtain the exclusive property rights to construct on the land for a certain period of time against an initial payment. This contract introduces in the real estate investment project the option to wait or abandon development depending on the information gathered from the market during the expiration period. We analyze a real estate investment in the city of Rio de Janeiro where the previous Real Options are identified and valued, allowing a better management of the decision process and an effective risk management for the company. We estimate the ceiling price for the exclusive property rights for several assumptions on the exchange contract of land for real estate. Exclusive property rights decrease 30 % with an increase of 10 % in the land cost. The adoption of the Real Option Strategy shows a reduction of 50 % in the Value-at-Risk with respect to the traditional valuation (that does not considers the real options embedded).

Key Words: Real Options, Real Estate, Property Rights, Value at Risk.
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1. Introduction

Real estate investments are very sensible to the economic situation of the country. The high interest policy used to control inflation during most of the 90's and until today in Brazil makes difficult the access to the mortgage market, increases the default of payments and raises the risk of the project.

Investments in this sector present tight working capital, low liquidity, capital-intensive outflows (mainly construction costs), slow *payback* and short to medium construction times. There are also several uncertainties involved such as the demand, the price/m^2 of the building, the sales speed and the price of contracts for the exclusiveness of the land use or the exchange of apartments for paying the cost of the land.

Also, the regulatory/legislation together with the local government risks (authorizations, licenses, etc.) are quite frequent in the country increasing the perceived risk. It is necessary a high knowledge of a constantly changing legal regulation about rent, taxes, licenses, etc. that increases the administrative costs and the volatility of the project. Examples of buildings confiscated even after the corresponding license has been issued are common, given even more importance to the risk management of the firm and to instruments like *hedge* or *insurances*.

Real estate investments in Rio de Janeiro are concentrating on the West Side of the city due to the lack of area to build and to the increasingly high land prices on the south side. Property developer's margins were also around 50 % in the 70's and went down to the current rate of approximately 20 %. These geographical migrations to less profitable areas and the reduction of the margins are making of market, investments and risk analyses essential for a competent administration / management that fulfills the needs of the business and investors.

The first phase in the economic valuation of a real estate investment is the estimation of the expected cash flows. It corresponds to the traditional valuation methodology that uses the NPV, considers the decisions as static ("now or never") and does not take into account the managerial flexibilities under market uncertainties inherent to the project. On the contrary, the introduction of the real option methodology allows us to value these flexibilities and take the optimal sequential decisions that maximize the value of the firm[1].

Several articles apply real options to real estate: Titman (1985) uses option theory to estimate price of several empty lots in urban areas and concludes that the potentiality of the lot is worthier than its immediate use in a construction in the presence of uncertainties, delaying, therefore, the investment; Capozza and Sick (1988) show that land owners have the option to convert agricultural land into urban, and the optimal conversion rule depends on the distance to urban areas; Williams (1991) determines the optimal timing for development and abandonment of the property as well as the optimal density in the presence of uncertainties about cost/m^2 and price/m^2.

[1] A more detailed description can be found in Trigeorgis (1996) and Nalin e Kulatilaka (1999).

In practice, the analyst already introduces the option concept intuitively in the evaluation of the project. Strategies that take into account waiting, expansion or abandonment options for example are common in every day life and not guided by the discounting cash flows but by subjective considerations or the expertise of the analyst. It is important to establish a business culture in order to quantify these options objectively, identifying the uncertainties and most relevant options and implementing strategies to manage them appropriately.

We study in this paper options usually found in the real estate market of Rio de Janeiro, such as waiting option, information gathering option after the first launch, expansion and abandonment options. We do not consider the optimal density option since the legislation of Rio de Janeiro limits the maximum height of the building and impose other restrictions like the minimum distance to the neighbor building, minimum distance to the beach to avoid shadow, etc. that, together with the high price/m^2 and scale economies, make developers construct at the maximum density allowed.

The paper is organized as follows: Section 2 presents the investment analysis process in real estate with the sequential decisions and relevant options involved; Section 3 present a case study taking place in the West Side of Rio de Janeiro; Section 4 summarizes results; and Section 5 gives an overview and conclusions.

2. Investment Analysis in Real Estate

Before the first launch, the property developer already takes into account information from market research about the potential market, the target consumer, the geographical location, number of inhabitants, revenue per-capita, current price level, free lots, situation of the existing buildings, etc. in order to choose the most appropriate type of building and density.

The launch of a residential construction, for example, is not planned as a single phase but as a series of sequential decisions to diversify risk. This first launch reveals important managerial information related to futures expansions or developments of the local potential market. If the initial launch is successful, the following construction phases will be appreciated and the revenues increased as well as the attractiveness of the potential market. In the opposite case, the developer can wait for a better moment before continuing with the next construction phase and will, in the meantime, revaluate his/her prospects about the investment or the region in question. In this way, the first development provides a valuable option to obtain market information and generating waiting, expansion or abandon options in the following phases of the project. Another important aspect is that the launch of the real estate investment in stages requires a lower initial capital outflow and may finance subsequent construction phases.

The presence of uncertainties and flexibilities is inherent to real option valuation, which allows the investor to analyze and manage strategic decisions optimally. The relevant options considered in this study are:

- Information option, as the success/failure of the first construction stage that influences the performance and expectations of the next development phases,
- Waiting option, of the next phase of the construction if the market does not positively receive the previous launch,
- Expansion option, when the market turns to be favorable for new developments,
- Abandon option, due to excessive construction and contractual (exclusive rights) costs.

Figure 1 presents a static decision process that does not consider sequential decisions nor information, waiting or expansion options and, therefore, implements simultaneously all stages of the project.

Figure 1. Static Decision-Making Process.

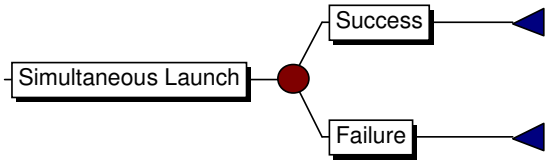
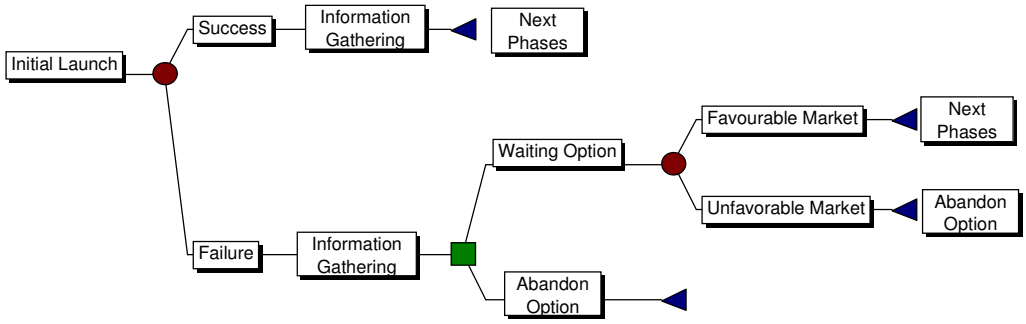


Figure 2 presents the dynamic decision process of the same investment including the real options available to the developer. The first phase provides valuable information for the next stages. The value of this information is the cost of the first phase itself. Usually, the total cost of a simultaneous development (static) is lower than a sequential one and so we have to verify if the cost savings compensates for the information obtained.

Figure 2. Dynamic Decision-Making Process.



If the investment is not well accepted by the market, we have a waiting option for the next stages. This option will turn out profitable if its value exceeds the payment for the exclusive property rights of the land, while always having the abandon option.

In this paper we show that the expected NPV of the dynamic strategy is higher than the static NPV due to the value added by the real options embedded, and generates a lower risk exposure as measured by Value-at-Risk (VaR).

3. Case Study

We analyze a typical real estate investment on the West Side of Rio de Janeiro[2], where the property developer evaluates an initial residential building and needs to determine the optimal timing to launch the next phases of the construction by accounting for the market information obtained after the initial phase (first construction).

There are four events in the process: purchase of the land (in cash or using a exchange contract), launch of the investment for sale before construction, start of construction, and end of construction. The occupancy license is usually obtained one month after the conclusion of the construction.

Following the sector guidelines, the developer analyzes several static indicators in order to determine the success or failure of the initial phase. If all indicators satisfy the conditions, it will be considered a success. The financial ratios are presented in Table 1.

Table 1. Static Indicators for Success or Failure.

Land Value / GSV (General Sales Value)	≤ 35 %
Construction Cost / GSV	≤ 50 %
Net Income / GSV	≥ 20 %
Net Income / Land Value	≥ 80 %
Net Income / Total Expenses	≥ 15 %
Habitable Area / Equivalent Area	≥ 60 %

We briefly explain them:

Land Value: The land can be bought by cash, loan, exchange contract on other free lots, exchange contract on apartments of the construction or other buildings, and by exchange contract on the GSV. To the base value, which is the taxable price of the land, we have to add some expenses inherent the lot such as taxes (dealing, and property taxes), commission expenses, demolition and infrastructure expenses, etc.;

Equivalent Area: It is the construction area that multiplied by the cost/m^2 gives the total cost of construction;

[2] The analysis can be applied to any other district.

Habitable Area: Area for sale, which corresponds to the squared meters that the developer is selling;

GSV: It is the present value of the revenue flows as the Habitable Area sold multiplied by the sale price/m^2, calculated from the cash flows according to the *sales speed* and the *amortization table*. The *sales speed* determines how fast the building will be sold and how the revenue flows are appropriated. There are three sales speeds: one on the launch of the project, one between the launch and the end of construction, and the last one after the occupancy license. Usually, sensitivity analyses are done with these variables. The *amortization table* considers that the customers will buy the apartments with loans of different characteristics. In general, there are different amortization conditions depending on when the apartment is bought (launch, construction, or after occupancy license). All amortization tables use the *price* method.

Construction Cost: It is the present value of the total cost of construction, i.e., the equivalent area multiplied by the construction cost/m^2 considering the time to build. In addition, there is an administration fee for the construction company plus some other expenses related to the architecture plan project.

Total Expenses: They are the construction costs plus the rest of the expenses (commissions, taxes, marketing campaigns, legal expenses, etc.).

Net Income: It is the GSV – Total Expenses, income taxes already deducted.

The NPV of the investment is the sum of the GSV flows less Expenses of every period discounted by the developer's cost of capital (WACC), assumed here to be 15 %.

The sale speeds are modeled with triangular distributions. The limits of the launch distribution are [0; 30; 100] %, for the time between the launch and the start of construction the limits become [0; (100 – $speed_1$)/2; (100 – $speed_1$)] %, and for the sales after the occupancy license [0, (100 – $speed_1$ – $speed_2$); (100 – $speed_1$ – $speed_2$)] %. Thus, following the sector guidelines, we have three sale speeds for each iteration ($speed_1$, $speed_2$, $speed_3$), which sum 100 % on average.

The second phase of the property development uses the same sale speeds iterated in the previous phase. Nevertheless, if the first stage is a success (all indices in Table 1 are satisfied) we assume an increase of the sale price/m^2 and cost/m^2 used in the previous phase because the subsequent constructions are usually more luxurious and with more expensive materials. In this case the second phase starts immediately.

If the first stage is a failure, the project still has a value equivalent to the deferment of the subsequent phases until market conditions turn favorable again. The waiting option expires in 5 years, an acceptable period in the local sector, which is equivalent to an American option where the property developer may implement the rest of the stages at any time.

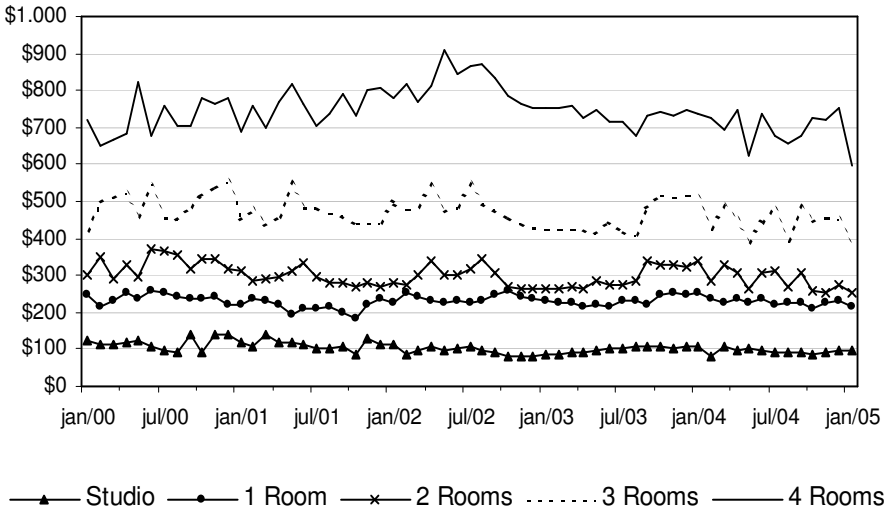
We assume that the sale price/m^2 (P) follows a Geometric Brownian Motion, presented in the equivalent martingale measure form in Equation 1, where dz is the Wiener increment, r is the risk free interest rate, δ is the convenience yield (like lost dividends), and σ the volatility; all these parameters annualized:

$$\frac{dP}{P} = (r - d)\,dt + s\,dz \tag{1}$$

The underlying asset of the real option is the GSV of the investment, which is a proportional function of the sale price/m^2. Due to this proportionality, GSV also follows a Geometric Brownian Motion of same volatility as sale price/m^2.

Figure 3 shows the average monthly sale prices (real prices as January 2005) in BRL for residential homes in the West Side of Rio de Janeiro between Jan 2000 – 2005, as published by SECOVI-RJ[3].

Figure 3. Sale Prices in BRLx10^3.



The volatility is estimated by OLS from the returns of the previous data and it is shown in Table 2. We take the average volatility of 13.42 % p.a. for the base case.

Table 2. Estimation of Volatility.

District	Studio	1 Room	2 Rooms	3 Rooms	4 Rooms	Average
West Side	17,80%	11,47%	14,63%	13,02%	10,16%	13.42

The cost of carrying the waiting option (δ) is equivalent to the flows lost by the owner of the underlying assets, i.e., the rental yield of build property. This rate is usually between 4 and 12 % p.a., and we shall choose a value of 10 % p.a. for the West Side area. The risk-free rate (r) is the

[3] Syndicate of Buying, Selling, Renting, and Administration of Residential and Commercial Buildings Enterprises of Rio de Janeiro.

basic interest of the Brazilian economy (Selic) estimated at an average of 15 % p.a., for the next 5 years. The exchange contract on the land specifies a cost of 30 % of the GSV, and for the exclusive property rights of the free lot for a period of 5 years the owner demands BRL1.5 millions. The construction costs may differ from phase to phase (depending on quality, luxury, materials, etc.) and it is considered as the exercise price of the option.

We employ the Barone-Adesi and Whaley (1987) approximation to estimate the value of the waiting option (American type), which is detailed in Appendix A. A strategic plan is presented to the property developer estimating the curve of critical GSV*, i.e., which GSV value (net of taxes, exchange contract costs and operational costs) triggers the development of the next phase. The American option is exercised by investing the total cost of construction and its value distribution obtained from the simulation of the sale price/m^2.

The waiting option adds value only if it exceeds the exclusive property rights cost, otherwise the abandon option should be exercised.

We present in Table 3 the parameters used in the study.

Table 3. Parameters Employed.

Equivalent Area	20.736 m^2
Habitable Area	16.173 m^2
Cost/m^2	BRL800, 00
Sale price/m^2	BRL2.500, 00
Construction Cost (in present value)	BRL14 millions
Exclusive property rights cost	BRL1.5 millions
Exchange contract of land for real estate (as a % of VGV)	30 %
Operational costs	15 % of VGV
Periods	
- Launch	8 months
- Launch – End of Construction	6 months
- After occupancy license	24 months
Amortization Tables	
- Lunch	90 months
- Launch – End of Construction	75 months
- After occupancy license	60 months
Sales speed	
- Lunch (a)	Triang [0, 30, 100] %
- Launch – End of Construction (b)	Triang [0, (1-a)/2, (1-a)] %
- After occupancy license	Triang [0, (1-a-b), (1-a-b)] %
Price/Cost increase (in case of success)	
- Sale price/m^2	+10 %

- Cost/m^2	+10 %
Expiration time of the waiting option	5 years
Volatility of returns on sale price/m^2	13.42 % p.a.
Rental yield	10 % p.a.
Risk free interest rate	15 % p.a.
Weighted average cost of capital (WACC)	15 % p.a.

4. Results

The value of the project considering simultaneous investments (static) is BRL4.4 millions, but if we consider sequential decisions (dynamic) with the information, waiting and abandon options embedded in the project the value increases to BRL7.3 millions, a difference of BRL2.9 millions.

The Value-at-Risk (VaR) of both strategies is presented in Figure 4, where we can notice the reduction of risk exposure comparing both strategies. The VaR from the static strategy is –BRL3.46 millions at 5 % confident interval, while for the dynamic one is just –BRL1.71 millions, a reduction of more than 50 %. We also can see how the dynamic strategy increases the right tail of the NPV distribution due to the option characteristics. The 95 % percentile reaches BRL9.86 millions for the static strategy, going up to BRL15.17 millions for the dynamic one.

Figure 4. NPV Distributions

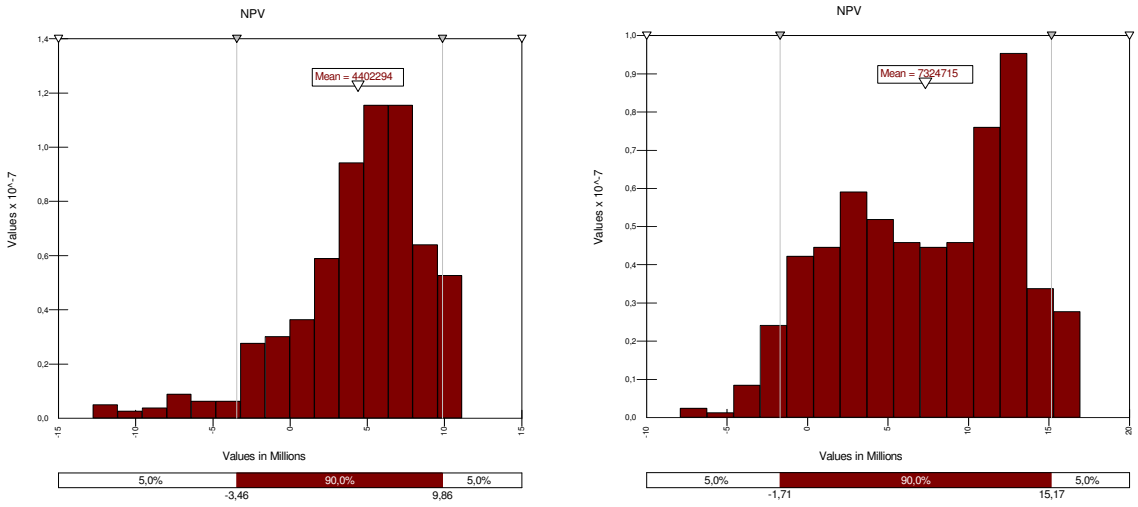


Table 4 shows the ceiling price for the 5 years exclusive property rights in relation to the exchange contract (as a percentage of the GSV). Exclusive property rights decrease 30% with an increase of 10 % in the land cost.

Table 4. Ceiling Price for the Exclusive Rights

	Exchange Contract of Land for Real Estate (as % GSV)		
	20%	30%	40%
Exclusive Property Rights (in BRL millions)	7.88	6.05	3.76

5. Summary and Conclusions

Real estate investments are characterized as being capital intensive, low in liquidity, slow in payback and including several uncertainties about demand, sale price/m^2, sales speed, etc. that increase their risk.

We present a real estate project in the West Side of Rio de Janeiro that merge the traditional discounted cash flow and real options methodologies in order to provide decision strategies that better maximize the value for the property developer.

We identify the relevant options embedded in the project such as information acquisition, waiting and abandonment options, and calculate the value of the investment project for the optimal decision path. The ceiling price for the exclusive property rights on the lot is estimated and the effect of the exchange contract of land for real estate on the value of the development analyzed. Exclusive property rights decrease 30 % with an increase of 10 % in the land cost. The real option analysis reduces the risk exposure (Value-at-Risk) by 50 % with respect to the risk of the static strategy.

In practice, many analysts already include intuitively these options in their investment appraisal. It is important to stimulate and establish a managerial culture in order to quantify these options with objective criteria and perceive the relevant uncertainties, thus, providing an effective management and risk assessment.

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Appendix A: Barone-Adesi & Whaley American Call Option Approximation

Let c the Black-Scholes European call option formula, where N(.) is the cumulative normal distribution function, S_0 the current value of the underlying asset, X the exercise price, r the risk-free interest rate, δ the dividend yield, σ the volatility parameter and T the expiration date.

$$c(S_0,t) = S_0.e^{-\delta.(T-t)}.N(d1) - X.e^{-r.(T-t)}.N(d2)$$

$$d1 = \frac{\ln(S_0/X) + \left(r - \delta + \frac{\sigma^2}{2}\right).(T-t)}{\sigma.\sqrt{T-t}} \qquad d2 = \frac{\ln(S_0/X) + \left(r - \delta - \frac{\sigma^2}{2}\right).(T-t)}{\sigma.\sqrt{T-t}}$$

The American call option value C is given by the following expression:

$$C(S_0,t) = \begin{cases} c(S_0,t) + A_2.\left(\frac{S_0}{S^*}\right)^{g2} & se\ S < S^* \\ S_0 - X & se\ S \geq S^* \end{cases}$$

$$A_2 = \left(\frac{S^*}{g2}\right)\left\{1 - e^{-d(T-t)}N(d1(S^*))\right\} \qquad g2 = \frac{\left[-(b-1) + \sqrt{(b-1)^2 + \frac{4a}{h}}\right]}{2} \qquad a = \frac{2r}{s^2} \qquad b = \frac{2(r-d)}{s^2} \qquad h = 1 - e^{-r.(T-t)}$$

and S* is the solution of:

$$S^* - X = c(S^*,t) + \left\{1 - e^{-d.(T-t)}.N\left[d1(S^*)\right]\right\}\frac{S^*}{g2}$$