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A Real Option Analysis of the "Flats for Land" System - an Idiosyncratic Equity Financing Mechanism on Real Estate Investments

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A typical real estate development project encounters an entrée capital expense for land purchase that is not immediately recovered until the allocated capital for the land acquisition is replaced with new capital that converts the land to a rentable building space. This article presents an idiosyncratic equity financing scheme that eliminates the sunk cost for a land purchase over a real estate development, within a real options framework. The study provides a model solution, numerical results of the option value, and the optimal investment threshold of a real estate development that is initiated through the "flats for land" scheme.

Keywords

Real options, Real estate assets, Housing finance

1. Introduction

Real estate assets are less liquid than other asset classes and irreversible investments (Rocha et al., 2007). The standard net present value (NPV) analysis is a one-off investment decision approach. It is a static analysis which is used to determine the future profitability of an investment opportunity (Trigeorgis, 1993). An investor who deals with irreversible investments or risky assets is not optimal to make direct decisions. An initial waiting period should be allowed to assess the investment opportunities and obtain the updated knowledge and information (Quigg, 1993). This waiting time has a value (Dixit and Pindyck, 1994). The real options approach examines the value of flexibility in an investment opportunity (Myers, 1977; Brennan and Schwartz, 1985). In a real option framework, the decision maker has the option to abandon, expand or delay an investment. In this context, the optimal time to invest is when the value of the project reaches a critical threshold that is higher than the cost of an investment and the delay option (McDonald and Siegel, 1986).

The real option theory considers developable land as a call option and the development process as an exercise of that option. The price of the underlying asset is the gross value of the developed project, and the strike price is its construction cost (Titman, 1985). In the extant literature, a number of studies simulate real estate development as a construction exercise option with the investor (developer) already being the landowner. However, the land acquisition process contains an entrée capital expense, which a typical investor needs to undertake, to have the right to the option to initiate a real estate development. Given that the level of capital used in a real estate development interacts with the density of the property per unit of land and the generated revenue, the capital outflow for land acquisition that is practically embodied in a typical development needs to be assessed. The land acquisition process contains an intensity premium that is not immediately recovered. For the special case of vacant land, there is no revenue until the allocated capital (for land acquisition) is replaced with new capital that converts the land to a rentable building space.

To this end, this study provides the theoretical framework and numerical results of the option value and the optimal investment threshold of a real estate development that is initiated through a "flats for land" (FFL hereinafter) scheme. The FFL scheme was conceived by developers (in Greece - over the early post-WWII years), as an effective mechanism that eliminates the sunk cost for the land acquisition process and reduces the foundational capital required to initiate a real estate development (Petris et al., 2020). It is an economic agreement between an investor (developer) and landowner. The landowner contributes a tract of land to a developer, free of charge in exchange for a pre-agreed portion of the completed real estate unit(s) given by the developer, who self-finances the entire development of the project.

The FFL scheme emerged (in Greece) over a period of time that was characterized by an underdeveloped banking system, shortage of housing loans, remarkably low level(s) of social housing and limited state intervention in housing finance. Indeed, the FFL scheme is an equity sharing model that was initially adopted by capital-constrained developers, and provides access to housing at a relatively low capital cost and nationwide facilitated housing production at an aggregate level. The FFL system is an idiosyncratic equity financing mechanism, given that the developer does not need to finance the purchase of the land over a real estate development.

Arguably, the FFL mechanism provides easy access to urban land, especially to capital constrained developer(s). Given that there is no entrée capital expense (for the land acquisition process), under the FFL scheme, the developer can instead allocate the (equivalent) foundational capital to develop the housing "product". At the same time, the FFL scheme is suitable for households (i.e., landowners) who consider property to be a superior store of value compared to money[1].

On this point, it is noted that equity sharing models for property development have also been developed in other countries, such as the public land development (PBL) system in the Netherlands, "Sozialwohnung" (social housing) and "Baugruppen" (group build) systems in Germany, "l'habitat participatif" (participatory housing) scheme in France, community land trusts (CLTs) in the United States (US) and home-purchase shared ownership schemes in the United Kingdom (UK; housing association). In contrast to the FFL scheme, these equity sharing models either involve government intervention and state expenditures (i.e. ("Sozialwohnung" and the PBL system), impose a series of restrictions on home purchasers (i.e. CLTs), or do not have the capacity to advance the development of the housing product at an aggregate level (nationwide) (i.e. "Baugruppen", "l'habitat participatif", and other co-housing schemes).

Indeed, the main contribution in this paper is an assessment of the investment opportunity of real estate development that is initiated via the FFL system. The study provides an analytical solution and numerical results for the FFL mechanism and a baseline scenario case model, by also accounting for the capital outflow during the vacant land acquisition process, in a compound development option.

The methodology and assumptions adopted in this article are generally based on studies in the literature that have assessed real estate development within a real options framework.

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[1] The perception that property is a superior store of value relative to money is attributed to the hyperinflation and monetary instability of the Greek economy during the early post WWII years. The latter remains, to date, a permanent mark on the collective memory of households.

First, Williams (1991) provides essential background information on the option value of a real estate development which suggests that the option value of real estate projects depends on the stochastic evolution of the operating revenues and construction cost of the developed property. Secondly, Capozza and Li (1994) show that the value of real estate development depends on capital intensity that is not fixed. They claim that the amount of capital used in a real estate development interacts with both the density of the development (per unit of land) and generated revenue, while the land acquisition process contains an intensity premium that is not immediately recovered and provides no revenue until the allocated capital (for land acquisition) is replaced with new capital that converts the land to a rentable building space.

A number of studies provide the essential background of this article, which include, Clarke and Reed (1988), Capozza and Helsley (1990), Capozza and Sick (1991), Sing and Patel (2001), Somerville (2002), Chiang et al. (2006), and Grovenstein et al. (2011).

This article is organized as follows. Section 2 provides the baseline model and describes the value of developing vacant land. Section 3 describes the structure and pricing framework of the FFL scheme and includes the development option value of a real estate development under the FFL scheme. Section 4 provides the numerical results and sensitivity analysis. The last section presents the concluding remarks and the implications of the study, and suggests directions for future studies.

2. The Model

2.1 Baseline Model

This section provides the baseline model for the option to develop. Now consider the case of a developer who is purchasing a vacant piece of land to develop into a real estate project at its highest and best use. The developer has the perpetual option to acquire the vacant land by initiating a capital outflow k_1 and maximizing the value of the investment by replacing capital k_1, allocated during the land acquisition process, with new capital k_2 that is used to convert land to a rentable building space $q(k_2)$, hence generating an income stream $y\, q(k_2)$. Thus, the value of the development project can be determined in a simple form, as a function of the density $q(k_2)$, the rental price y per density and the expected rate of rent return δ (%), as follows:

$$V = y\frac{q(k_2)}{\delta} \tag{1}$$

The value of the real estate development that is denoted by V follows a stochastic Brownian motion:

$$dV = aVdt + \sigma Vdz \tag{2}$$

where a is the mean growth rate, σ is the instantaneous volatility of the growth rate and dz is the increment of a Wiener process.

As in Williams (1991), certain assumptions are necessary to value the investment. First, the developer can either delay the project or has the investment opportunity to initiate the project; that is, to purchase a vacant land and develop a building at a density q, which satisfies the condition $0 < q \leq q^*$, where $q^*$is the maximum density permitted by regulation. Secondly, the cash flows are not taxed ($\tau = 0$), there is no depreciation - no bankruptcy costs and zero maintenance cost for both the land and building property. It is also assumed that the vacant land provides no revenue $y\, q(k_1) = 0$ and that the capital outflow k_1 for the land acquisition creates a fixed cost f.

Now, considering a conversion cost $c\, q(k_2)$ and a cost elasticity of scale γ, the total cost I of the developed building space becomes:

$$I = f + c\, q^\gamma(k_2) \tag{3}$$

The option value of the real estate development $F(V)$ must satisfy the Bellman equation:

$$rF(V)dt = \mathcal{E}[dF(V)] \tag{4}$$

Equation (4) shows that the expected value of the investment decision at any point in time is equal to the sum of the immediate reward and expected value of the remaining decision. Recall that the option value of the investment evolves in response to the stochastic evolution of the value of the real estate development. Therefore, the investment opportunity yields zero cash inflow up to the time that the building development is undertaken at a density q. Note that a riskless (r) portfolio is also considered, to preclude arbitrage opportunities.

By using Ito's lemma, $\mathcal{E}(dz) = 0$ and expanding $dF(V)$:

$$\mathcal{E}[dF(V)] = \mathcal{E}\left[\frac{\partial F(V)}{\partial V}dV + \frac{\partial F(V)}{\partial t}dt + \frac{1}{2}\frac{\partial^2 F(V)}{\partial V^2}(dV)^2\right]$$

and the Bellman[2] equation becomes:

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[2] By substituting Equation (2) for dV and given that: $dt^2 = 0$, $dtdz = 0$ and $dz^2 = dt$, the Bellman equation can be written as: $\mathcal{E}[dF(V)] = \frac{\partial F(V)}{\partial V}(aV\,dt) + \frac{\partial F(V)}{\partial t}dt + \frac{1}{2}\frac{\partial^2 F(V)}{\partial V^2}\sigma^2 V^2\, dt\ (4a)$.From Equations (4) and (4a) and dividing by dt: $\frac{\partial F(V)}{\partial V}aV + \frac{1}{2}\frac{\partial^2 F(V)}{\partial V^2}\sigma^2 V^2 - rF(V) = 0\ (4b)$.By setting $F' = \frac{\partial F(V)}{\partial V}, F'' = \frac{\partial^2 F(V)}{\partial V^2}$, Equation (4b) is found to be:$\frac{1}{2}\sigma^2 V^2 F(V)'' + aVF(V)' - rF(V) = 0$ (5)

$$\frac{1}{2}\sigma^2 V^2 F(V)'' + aVF(V)' - rF(V) = 0 \tag{5}$$

The total return on the developed property consists of two components - the rate of the capital gain α and the rental rate δ. Hence, considering no arbitrage opportunities (the riskless rate $r \equiv a + \delta$), and $\alpha \equiv r - \delta$, where $\delta > 0$ and $r > a$, Equation (5) can be written as:

$$\frac{1}{2}\sigma^2 V^2 F(V)'' + (r - \delta)VF(V)' - rF(V) = 0 \tag{6}$$

The solution of $F(V)$ must satisfy the following boundary conditions:

$$F(0) = 0 \tag{7}$$

$$F(V^*) = V^* - I \tag{8}$$

$$F'(V^*) = 1 \tag{9}$$

Condition (7) suggests that if the value of the project is zero ($V \rightarrow 0$), the option value $F(V)$ of the investment opportunity will be also zero. Condition (8) shows the value matching conditions, that is upon the investment, the developer receives a payoff $[y\frac{q(k_2)}{\delta}] - [f + c\, q^{\gamma}(k_2)]$. Simply put, the project value V^* is set to equal the investment cost I plus the opportunity cost $F(V^*)$. Finally, Equation (9) shows the smooth pasting condition.

Now, the general solution of the quadratic equation or Equation (6) can be written as:

$$F(V) = A_1 V^{\beta_1} + A_2 V^{\beta_2} \tag{10}$$

To satisfy the boundary condition of Equation (7), $A_2 = 0$, and hence the solution takes the form:

$$F(V) = A_1 V^{\beta_1} \tag{11}$$

Solving[3] for the remaining boundary conditions, i.e., Equations (8) and (9), the critical value V^* and the constant A_1 are found to be:

$$V^* = \beta_1 I/(\beta_1 - 1) \tag{12}$$

$$A_1 = (V^* - I)/(V^*)^{\beta_1} \tag{13}$$

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[3] From Equations (8) and (11) $\rightarrow A_1 V^{*\beta_1} = V^* - I$ and $V^{*\beta_1} = \frac{V^* - I}{A_1}$ (11a). From Equations (9) and (11) $\rightarrow$ $F'^{(V^*)} = 1 \rightarrow)(A_1 V^{*\beta_1})' = 1 \rightarrow A_1 \beta_1 V^{*\beta_1 - 1} = 1 \rightarrow A_1 \beta_1 \frac{V^{*\beta_1}}{V^*} = 1 \rightarrow A_1 \beta_1 \left(\frac{V^* - I}{A_1\, V^*}\right) = 1 \rightarrow \beta_1 V^* - \beta_1 I = V^* \rightarrow V^*(\beta_1 - 1) = \beta_1 I \rightarrow V^* = \beta_1 I/(\beta_1 - 1)$ (12) From Equations (11a) and (12) ,the constantA_1yields to be:A_1=$(V^* - I)/\ (V^*)^{\beta_1}$ (13)

and

$$\beta_1 = \frac{1}{2} - \frac{r-\delta}{\sigma^2} + \sqrt{\left(\frac{r-\delta}{\delta^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} > 1 \tag{14}$$

Thus, the investment opportunity $F(V)$ of the real estate development is given by:

$$F(V) = \begin{cases} A_1 V^{\beta_1}, & for\ V \leq V^* \quad (15a) \\ [y\frac{q(k_2)}{\delta}] - [f + c\, q^{\gamma}(k_2)], & for\ V > V^* \quad (15b) \end{cases}$$

3. "Flats for Land" Mechanism

3.1 Structure and Pricing Framework of "Flats for Land" Agreement

This section provides the essential background information of the structure and the pricing framework of the FFL agreement. The FFL scheme involves the contribution of two separate entities. They are a capital contribution member (of the land) and an operating member (with internal funds) who self-finances the real estate development. According to the agreement, the landowner disposes the land to a developer free of cost and the developer, in exchange, (self)-finances the construction of the real estate development.

The value of the real estate development is given by:

$$V = \underbrace{sV}_{\text{developer}} + \underbrace{(1-s)V}_{land\ owner} \tag{16}$$

where V is the value of the real estate development and $0 < s < 1$ is the percentage of the share that each party appropriates from the completed project. Recall that the total cost of the real estate development I is given by the sum of the land cost f and the conversion cost for the project development $c\, q^{\gamma}(k)$. Also, note that under the FFL scheme, the landowner carries no conversion cost ($c\, q^{\gamma}(k_2) = 0$) which is fully undertaken by the developer and the developer carries no land cost ($f = 0$) which is fully undertaken by the land owner. To this end, given that under the FFL scheme, the landowner provides the land free of cost to receive back a share of the project $(1-s)V$, it follows that the landowner grants the developer with a value that is equal to $\underbrace{s\, f_{(Land\ Cost)}}_{\text{landowner}}$. In the same way, since the developer self-finances the entire construction project to receive back a share of the whole project $s\,V$, it follows that the developer grants the landowner a value that is equal to $\underbrace{(1-\mathrm{s})c\, q^{\gamma}(k)_{(Conversion\ cost)}}_{\text{developer}}$.

Now, to preclude arbitrage opportunities (under the FFL scheme), the exchanged value of the landowner shall equal that of the developer. Therefore, the following condition shall be met:

$$\underbrace{s\, f_{(Land\ Cost)}}_{\text{landowner}} = \underbrace{(1-\mathrm{s})c\, q^{\gamma}(k)_{(Conversion\ cost)}}_{\text{developer}} \tag{17}$$

Now, by solving for s, the theoretical share s of the FFL agreement that the developer appropriates is given by:

$$s = c\, q^{\gamma}(k)/(f + c\, q^{\gamma}(k)) \tag{18}$$

Note that qualitative characteristics (i.e. property - hedonic attributes, design - aesthetic aspects, construction quality, etc.) are not considered in the pricing framework. Indeed, these may be essential elements to be considered, especially by the landowner, and may also affect the project ownership share, for each member. However, considering qualitative characteristics in the development option value is beyond the scope of this study but certainly entitled to further investigation in future research work.

3.2 Development Option Value of the "Flats for Land" Agreement

This section analyses the investment opportunity of a developer on a real estate development under the FFL scheme. Hence, consider the case of a developer who holds the perpetual option to conduct an FFL agreement with a landowner; to initiate a real estate development at its highest and best use. The developer has the option from $t \rightarrow \infty$ to maximize the value of the investment by allocating capital k to convert the vacant land of the landowner to a building $q(k)$ and generate an inflow $y\, q(k)$.

For the developer, the value of the real estate project under the FFL scheme is a function of the share of property density $s\, q(k)$ that the developer appropriates upon completion, rental price y per density and expected rate of rent return δ (%). Hence, the value of the developer, which is given by Equations (1) and (18), now becomes:

$$s\, V = y \frac{c\, q^{\gamma}(k)}{[f + c\, q^{\gamma}(k)]} \frac{q(k)}{\delta} \tag{19}$$

From Equations (12) – (14), and by setting $f = 0$[4] in Equation (3), the corresponding value of the investment opportunity and optimal investment rule for the developer is:

$$sV^{*} = \frac{c\, q^{\gamma}(k)}{[f + c\, q^{\gamma}(k)]} \beta_1\, c\, q^{\gamma}(k)/(\beta_1 - 1) \tag{20}$$

[4] Under the FFL scheme, the land cost is fully undertaken by the landowner; hence for the developer $f = 0$.

$$A_1 = [(s\,V^* - c\,q^\gamma(k)]/(s\,V^*)^{\beta_1} \tag{21}$$

$$\text{and } \beta_1 = \frac{1}{2} - \frac{r-\delta}{\sigma^2} + \sqrt{\left(\frac{r-\delta}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} > 1 \tag{22}$$

From Equations (15a) - (15b), and again by setting $f = 0$, the investment opportunity of the developer $F(V)$ under the FFL scheme becomes:

$$F(V) = \begin{cases} A_1 \dfrac{c\,q^\gamma(k)}{[f + c\,q^\gamma(k)]} V^{\beta_1}, & for\ V \le V^* \quad (23a) \\ y \dfrac{c\,q^\gamma(k)}{[f + c\,q^\gamma(k)]} \dfrac{q(k)}{\delta} - [c\,q^\gamma(k_2)], & for\ V > V^* \quad (23b) \end{cases}$$

4 Numerical Results and Sensitivity Analysis

This section provides the numerical simulations and investigates the sensitivity of the investment opportunity and critical point of the real estate development on the model parameters for both the baseline case model and FFL scheme. The base case parameter values and variations considered in the model are mostly based on previous studies (i.e., Williams, 1991; Dixit and Pindyck, 1994). Therefore, the density of the development q is set to 1.5, cost of vacant land per density unit f equal to 10, cost of development per density unit c equal to 10, cost of scale γ equal to 1.0, annual risk free rate r equal to 5%, annual rental rate δ equal to 3%, and standard deviation σ of the investment equal to 30%. Table 1 summarizes the base case parameter values which are used in the numerical analysis.

Table 1 Base-Case Parameter Values

Description of variables	Parameter notation	Parameter value
Density of development	q	1.5
Cost of vacant land per density unit	f	10
Cost of development per density unit	c	10
Cost of scale	γ	1.0
Risk-free rate (annually)	r	5%
Rental rate (annually)	δ	3%
Standard deviation of the investment (annually)	σ	30%

Figure 1 plots the investment opportunity and critical point of the development of the real estate project for the baseline model case where the developer purchases the vacant land to convert to a rentable building space and the case where the developer initiates an FFL scheme to initiate the real estate project.

First, it is observed that the FFL scheme provides a lower investment trigger point relative to the baseline model case. Note that for the baseline scenario, the sunk cost for the land acquisition process, given that the vacant land provides no revenue, increases the investment expenditure, and tends to depress immediate investment. Hence, it is observed that for the baseline scenario, the value of the investment opportunity is higher relative to the FFL scheme. The dependence of the development trigger point as a function of the land cost, for both the baseline case and FFL scheme, is plotted in Figure 2. As expected, a higher cost of land increases the necessary foundational capital to initiate the real estate development for the baseline model case and raises the development trigger point. On the other hand, an increase in the cost of land (holding everything else constant) for the FFL scheme does not raise the critical point of the investment but only reduces the share of the developer s over the total project value V. In effect, for the developer who is conducting an FFL scheme, an increase in the land value does not increase his/her investment expenditure but only limits his/her final payoff. In this case, the developer initiates the development above the critical point, as long as the land value is such that allows the developer to appropriate a percentage share s, hence a project value sV that exceeds the conversion cost (red line). Indeed, the eradication of the entrée capital expense for the developer (for the land acquisition process) provided by the FFL scheme stimulates the project development earlier. Hence, the option to wait is not as valuable, as the cost of project is shared between the two parties (landowner and developer).

Arguably, a development project is not practically a perpetual option for the developer. Hence, the above numerical outcomes (and the model) may differ in places with limited development time and where the development option is no longer a perpetual option. For example, places (land sites) of high demand characterized by competitive pressure, compel an immediate investment decision and may distort the value of delay as an option over a real estate development. This condition may cause the developer to more likely behave as a price taker in the face of the landowner. In which case, the developer becomes more susceptible to accepting a higher land value under the FFL scheme which ultimately limits the final payoff of the developer from the developed project.

In addition, real estate development is a time-consuming process, and does not give the developer any flexibility to react to market fluctuations. To this end, the sensitivity of the value of the investment opportunity to market uncertainty (as expressed by variations of σ) is also assessed.

Figure 1 Value of Investment Opportunity $F(V)$ and Trigger Point of Baseline Model and FFL Scheme Cases

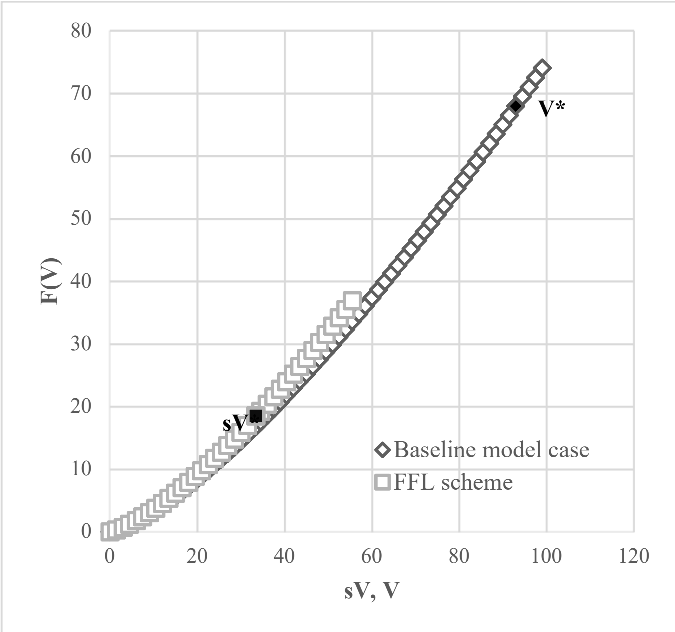


Figure 2 Critical Value of Baseline Model and FFL Scheme Cases as Function of Land Cost f

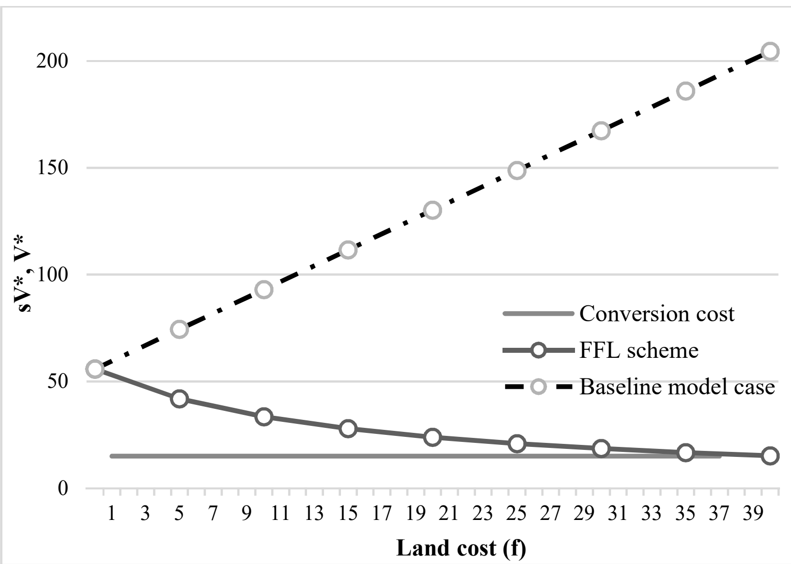


Figure 3 provides graphically the relationship of the investment opportunity $F(V)$ of the real estate development for the FFL scheme against the value of the investment $sV*$ by considering the base-case parameter values and for variations of $\sigma = 0.1, 0.3\ and\ 0.4$. Clearly, the investment opportunity is sensitive to market uncertainty. Greater risk as expressed by an increase in standard deviation σ raises the option value of the investment $F(V)$ as well as the critical point $sV*$ at which it is optimal to invest. In addition, Figure 4 demonstrates the sensitivity of the critical value $sV*$ to changes in market risk, as expressed by σ. Note that the trigger point $sV*$ is raised by a larger standard deviation. Moreover, it is observed that an increase in the risk-free rate ρ, raises the investment threshold. The reason is that a higher risk-free rate increases the opportunity cost of the immediate investment (see Figure 5).

Figure 3 Value of Investment Opportunity $F(V)$ for the FFL Scheme Case ($\sigma = 0.1, 0.3$ and 0.4)

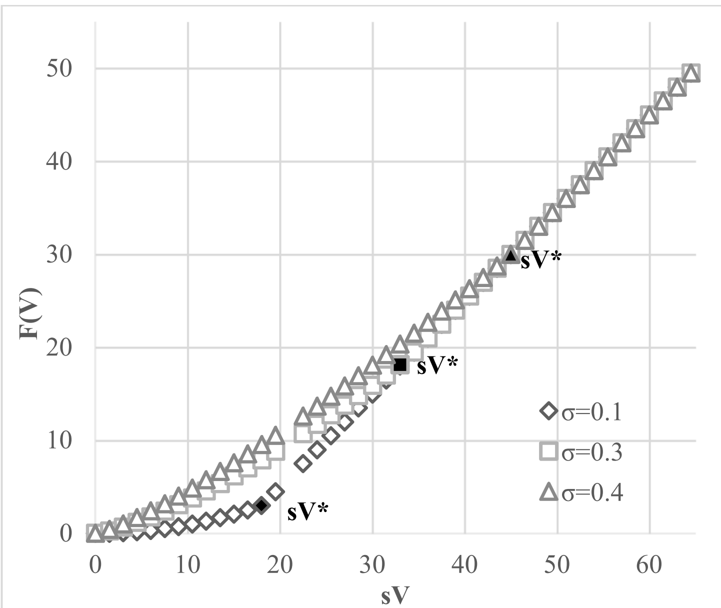


Figure 4 **Critical Value of sV^* as a Function of σ ($\delta = 0.02, \delta = 0.03, \delta = 0.04$) for FFL Scheme Case.**

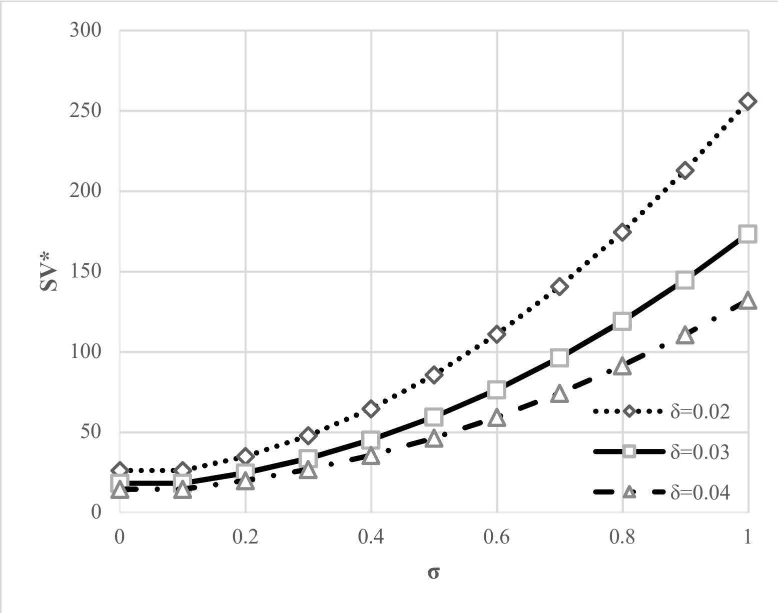
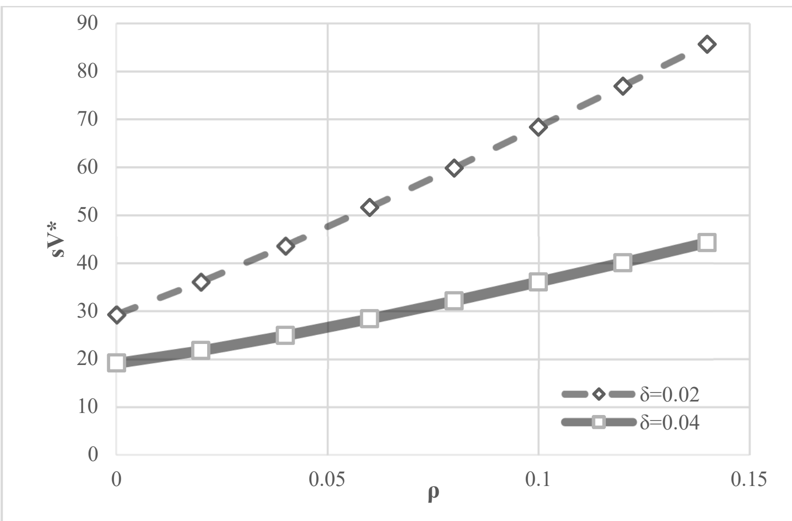


Figure 5 **Critical Value of sV^* as a Function of ρ ($\delta = 0.02, 0.04$) for FFL Scheme Case**



Additionally, Figures 6 and 7 present the relationship between the investment opportunity $F(V)$ and value of the investment $sV*$ under the FFL scheme for variations in the rental rate δ=0.02, 0.03 and 0.04. It is observed that an increase in the rental rate δ causes a decrease in both the investment opportunity $F(V)$ and development trigger point $sV*$. The reason is that a higher rental rate results in a reduced rate of growth in the value of the investment V, hence causing a decrease in the growth expectations of the development option value. Consequently, the cost of delay is higher relative to an immediate investment. This is simply because the waiting time has ultimately less value for the developer who initiates the project development to receive the rental income earlier. Finally, Figure 8 illustrates how the critical point of the real estate investment of the developer under the FFL scheme is dependent on the cost of scale γ. As expected, a decrease in cost per density unity, as expressed by a reduction in factor γ, reduces the investment threshold of the developer sV^*.

Figure 6 Value of Investment Opportunity $F(V)$ for FFL Scheme Case ($\delta = 0.02, 0.03$ and 0.04)

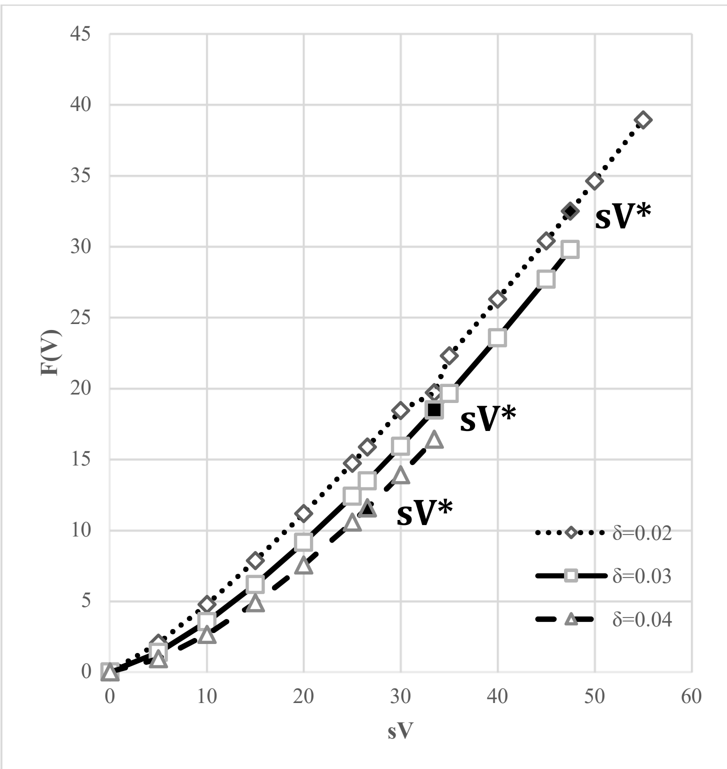


Figure 7 Critical Value of sV^* as Function of δ ($\sigma = 0.1, \sigma = 0.3, \sigma = 0.4$) for FFL Scheme Case

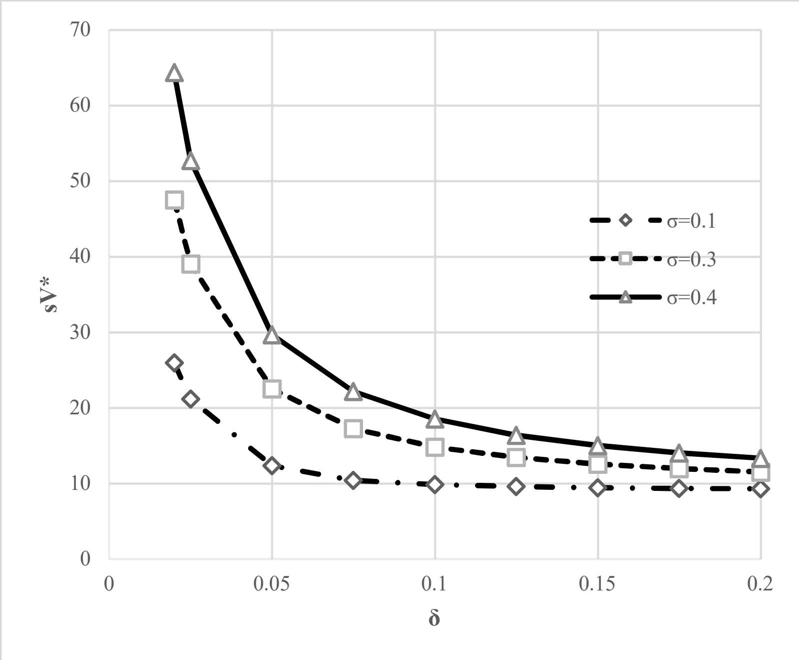
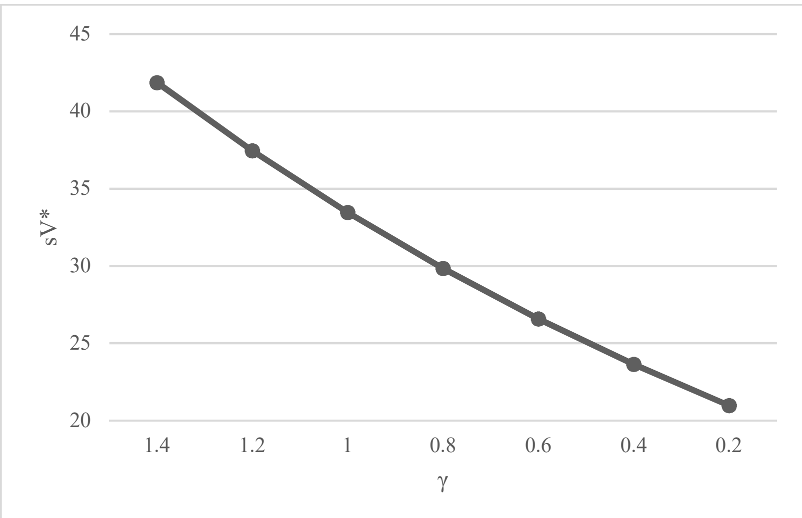


Figure 8 Critical Value for FFL Scheme Case as Function of Cost of Scale γ



5 Conclusion

This article assesses the investment opportunity of a real estate development, and focuses on a “sui generis” equity finance tool; i.e., the FFL system, and land purchase process. In a typical real estate project, the developer needs to attend to the following to generate revenue. First, the developer acquires a vacant land and then maximizes the value of the investment by allocating new capital to convert the vacant land to a building space, hence generating an income stream. On the other hand, the FFL scheme is a mechanism that eliminates the foundational capital necessary for the acquisition of vacant land. A numerical simulation shows that the cost of land has a significant impact on the investment threshold and the option value of a real estate development that encounters an entrée capital expense for the purchase of the vacant land. In the special case of the FFL scheme, the land value does not affect the expenditure of the developer, nor raises the investment threshold, but only limits the share of the developer from the completed project, and hence his/her final payoff. In addition, various sensitivities on the FFL scheme are implemented on the base case parameter values. As with typical real option pricing, market uncertainty increases the opportunity cost of investing and critical value of the development. Similarly, a higher risk-free rate increases the opportunity cost of the investment. It is also shown that higher rental rates discourage the growth expectations of the development option value, while a reduction in the cost of scale lowers the threshold of the real estate investment.

Future research could investigate, within a real options framework, the effect of debt and equity finance on the option value and optimal timing of a real estate investment that is conducted through an FFL scheme.

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