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REAL EXOTIC OPTIONS IN EÇA DE QUEIRÓS' *THE ILLUSTRIOUS HOUSE OF RAMIRES* (*) ([1])

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I — Introduction

In the heat and silence of a Sunday in June, Gonçalo Mendes Ramires might well have contemplated in his Tower the real exotic options in his forthcoming efforts. Ramires holds several real options through-out his life which are embedded in managing his estates, writing a historical novel, planning his career, romance and running his political campaign. A real option value analysis compliments the conventional approaches to literary criticism.

Ramires, a timid ([2]), kind, and almost ruined nobleman, is rewriting the history of his ancestors, who maintained castle and walled lands between the Douro and Minho rivers, as early as near the end of the previous millennium. «At every important step in the History of Portugal, there was always a Mendes Ramires outstanding for his heroism, his loyalty, his noble actions», often ferocious, courageous and persistent, in contrast to Gonçalo. The Ramires family went on, always with a male and legitimate descendant to carry on the line. Gonçalo is around 30, without an heir, intimated by almost everyone, and never persistent in writing the family history, in rescuing the family estate, in pursuing his marriage prospects (one strategy for both the survival of the family and the estate) or in his alternative political prospects. *Procrastinare lusitanum est.*

Gonçalo spends four years studying law at the University of Coimbra, during which his father dies, and thus he inherits the Tower estate. The current tenant for the Tower estate, often drunk and dishevelled, pays a rent of 800 mil-reis. A nearby farmer offers 950: «the nobleman, in accordance with ancient custom,

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(*) This paper was written by invitation of the Executive Director.

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([1]) Thanks to Manuel José da Rocha Armada for introducing me to Eça de Queirós, and to Maria do Céu Ribeiro Cortez, João Correia Duque and José António de Azevedo Pereira for introducing me to Portuguese real life options. An earlier version of this article was first presented at the Universidade do Minho, Escola de Economia e Gestão, on June 4th, 1994.

([2]) Often «overcome by that humiliating fear, that slight creeping of the flesh, that always, in the face of any risk, any threat, irresistibly drove him to withdraw, to retreat, to run away».

shook the farmer's hand». Is this a firm contract? (3) Another farmer subsequently offers (even) 1150 (and will sink good money into the estate), unless a deal had already been made. [Only] «a handshake and a glass of wine... to sum it up, I have no firm agreement.» When accepting the new higher offer «...was that a deal?... Shake hands! Now we know where we are! That's giving our word.» (Consistency is not one of Gonçalo's stronger traits.) Another alternative for *managing the estate,* (proposed in negotiation with tenants) is «cultivating the ground himself... with modern methods, with phosphates and machines». But ultimately, outside income/capital is required to support the nobleman and his debts and aspirations (4).

Writing some short articles at Coimbra, he is inspired to write his family history, in the interest of promoting the consciousness of heroism in the disheartened Portugal, perhaps becoming the Iberian Walter Scott. His uncle Duarte had published by 1850 in Guimarães a poem in blank verse on the history of the family. Using this, Gonçalo «would not have the tiresome task of scrutinising chronicles and boring old manuscripts... anyway, who nowadays knew of this poem... the temptation was too strong». After copying out two pages effortlessly, Gonçalo's «over-flowing vein of inspiration dried up». The struggle with effort and boredom appears again and again, which hinders his literary inspirations.

Lacking an heir, he contemplates marriage. The apparent *marriage* prospect is the beautiful Dona Ana («butcher's daughter... a beautiful woman with gold lorgnettes... beautiful black eyes with their deep, liquid radiance»), initially married to the rich sixty year old Sanches Lucena. Although she has a «slow, thick, cooing voice, which made Gonçalo shudder», after her husband's death, she is left at age 28 with «no children... and 200 contos... perhaps more!» But there are disadvantages: in addition to her voice «had she put up with old Sanches for so many years in strict fidelity?... Is she a good girl?»

Given procrastination in writing, *politics* was the other immediate career alternative. His father was the Civil Governor of Oliveira «always busy and caught up in political intrigue and debts, spending only Sunday mornings in the Tower». Gonçalo has a feud with a local philandering politician (André Cavaleiro), who jilted his sister (5). In soliciting votes, he calls in his many past kindnesses throughout the community. Then he becomes reconciled with Cavaleiro, in order to promote his election, and in the process compromises his sister.

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(3) Contract remedies have been modeled on the theory of options, see Mahoney (1995), who uses a discrete version of the conventional Black-Scholes model, which has a fixed exercise price. Perhaps more appropriate would be an American exchange option pricing model with a stochastic exercise price, see Paxson (1997).

(4) «Poverty — the meagre income from two estates, plenty for a simple man, but poverty for him, with his education, his tastes, his duties as a nobleman, his sociable temperament.»

(5) Educated by a Miss Rhodes, whose father was a Professor of Greek Literature in Manchester. Eça de Queirós was a consul in Newcastle and Bristol, and lived in Richmond for some years.

There are several real option actions in Ramires' life, ranging from DEFER, EXPAND, CONTRACT, ABANDON, and ENLARGE CHOICES. Exhibit I outlines the range of these actions in Ramires' real options. It would spoil the story to describe the eventual actions and exercise of life options. Instead the next section proposes a simple real option model for Ramires' career developments, including the estate, writing, politics and romance, and suggests some fictitious numbers to illustrate the option values and sensitivity. The third section proposes a simple exotic model as a characterisation of some of his marriage options, given the physical decline of the nobleman over time [6], and the apparent eligible women between the Douro and Minho at the time. The last section concludes and comments on the transition from fiction to reality for identifying and valuing life's options.

II — Career development options

Since DEFER is a primary and natural instinct of Ramires, we will concentrate on analysing the real option values around this (in-)action. The real option value, where both the investment cost (in terms of education and effort) and the present value of the completed undertaking (career) are risky, is summarised in the following methodology.

Consider the case of Ramires' career development options, where the education and effort cost (X) follows a stochastic process, that is a geometric Brownian motion with drift μ_X and volatility σ_X :

$$\frac{dX}{X} = \mu_X\, dt + \sigma_X\, dz_X \qquad (1)$$

and the value of the career P follows a similar process:

$$\frac{dP}{P} = (\mu_P - \beta)dt + \sigma_P\, dz_P \qquad (2)$$

where β is the sentimental «income» from the current prestige, and ρ is the correlation between $d\,z_X$ and $d\,z_P$. The education and effort are considered to be a perpetual option to build a career with an infinite horizon. (Limiting both the effort and the career value to the life of a mortal is only a complicating factor.) The education and effort to develop a career continue until Ramires makes an irreversible choice, such as marry and remain an unemployed nobleman, or finish his novel, or become a politician, or pursue other business

[6] «What an infernal nuisance. Thirty years old and already going bald!»

interests. Suppose the annual costs (drift rates) of X and P can be represented as υ_X and υ_P, ($\upsilon_X = \mu_X - \lambda_X \sigma_X$), ($\upsilon_p = \mu_p - \beta - \lambda_p \sigma_p$), that is the expected future cash flows under risk-adjusted probabilities are discounted at the adjusted risk-free rate (time preference), and the risk adjustment is based on the risk multiplied by Ramires' risk aversion coefficients for X and P volatility, λ_X and λ_P.

The value of the career development option $V(P,X)$ is:

$$\frac{1}{2}\sigma_X^2 X^2 V_{XX} + \sigma_{XP} XPV_{XP} + \frac{1}{2}\sigma_P^2 P^2 V_{PP} + \upsilon_X XV_X + \upsilon_P PV_P - iV + \beta P = 0 \qquad (3)$$

where i is the riskfree rate and β is the current «prestige income», such as the pleasure of the Tower and self-satisfaction of kindness and charity to the community.

For simplification, let $z = P/X$ and $W(z) = V(P,X)/X$, the relative value of the career option to the education and effort costs, W'' indicates the second order derivative, W' indicates the first order derivative and:

$$\omega^2 = \sigma_X^2 - 2\rho\,\sigma_X\,\sigma_P + \sigma_P^2 \qquad (4)$$

Then equation **(3)** is simplified as:

$$\frac{1}{2}\omega^2 z^2 W'' + (\upsilon_P - \upsilon_X) zW' + (\upsilon_X - i)W + \beta_z = 0 \qquad (5)$$

In solving this differential equation, assume there is a ratio (z^*) of career payoff to costs at which it is optimal to decide upon a career (or actually run for election, or finish a novel) and that there are certain other boundary conditions.

One solution of equation 5 is (see Quigg, 1993):

$$V(P,X) = X(Az^j + k) \qquad (6)$$

where:

$$j = \omega^{-2}(.5\omega^2 + \upsilon_X - \upsilon_P + [\omega^2(.25\omega^2 - \upsilon_P - \upsilon_X + 2i) + (\upsilon_X - \upsilon_P)^2]^{.5})$$

$$A = (z^* - 1 - k)(z^*)^{-j}$$

$$z^* = j(1 + k)/(j - 1)$$

$$k = \beta z/(i - \upsilon_x)$$

As an illustration, we put in fictitious numbers (for after all, this is fiction) (7). Let's focus on Ramires' total real wealth [prestige and payoff], including the value

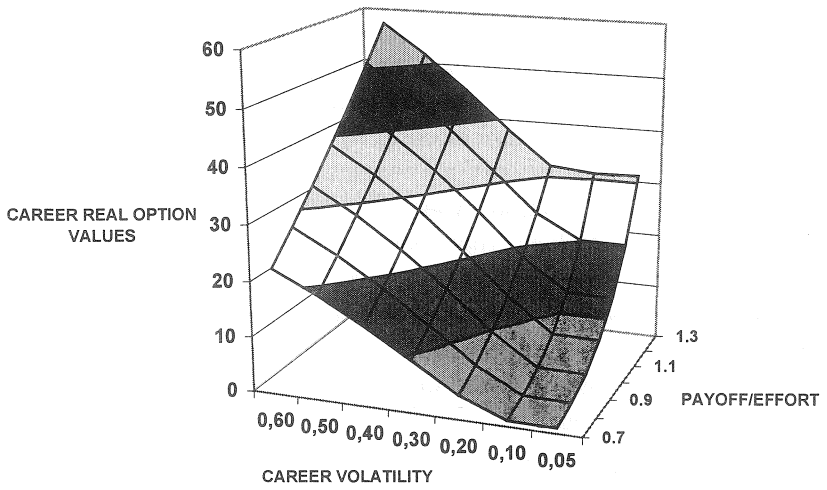
(7) Parameters for real life options might be based on personal interviews regarding risk aversion, hard data on salary levels and volatility over time periods given certain qualifications and costs of education. Dothan and Williams (1981) modeled education as an option, and Malos and Campion (1995) modeled careers as simple options.

of the estate, the capitalised value of future income from any career, capital (and prestige and pleasure) contribution from any future wife, and a monetized equivalence for any prestige from writing or politics: call this total real wealth «career prestige and payoff». Then suppose the present value of Dona Ana Lucena's two hundred contos (times the likelihood of marriage to her), the present value of the survival of the estate, and personal prestige and career is currently worth 90. Suppose that all education, effort and other costs (such as bearing the delay in an author's prestige recognition) are 100. Thus the initial ratio of payoff/effort is 90%, which in financial options would be termed «out-of-the-money», that is an option which should not currently be exercised. It is assumed initially that the educational and effort costs increase by 5% per annum, as do the prestige and payoff values, the current estate and other career current net benefits yield 3%, the volatility of both effort costs and payoff values is 10%, the risk aversion coefficient is .1 for X and P, and the correlation is .5.

The «career» real option $V(P,X)$ has a positive value of 4.295 ($\omega^2 = .010$, $A = .076$, $z^* = 1.229$, $k = .000$, $j = 5.372$), indicating that Ramires would value but not currently exercise his career options. This shows the value of the real option approach to literary criticism, since the present value of the educational and effort costs is above the current career prospects. In conventional terms, Ramires would give up pursuing any career; but from an option's prospective, he would not decide upon action until the ratio of payoff/effort exceeds 123%.

FIGURE 1

Ramires' career option values



This represents the real career option values at various payoff/effort ratios and career payoff volatilities, when the expected annual cost of education and effort is 5%, the risk of effort is 10%, the expected annual benefits of the payoff net of educational costs is 3%, the risk aversion to effort and to career payoffs is 10%, the time preference rate is 5% and the correlation of efforts and career payoffs is 0,5.

FIGURE 2

Ramires' career option values

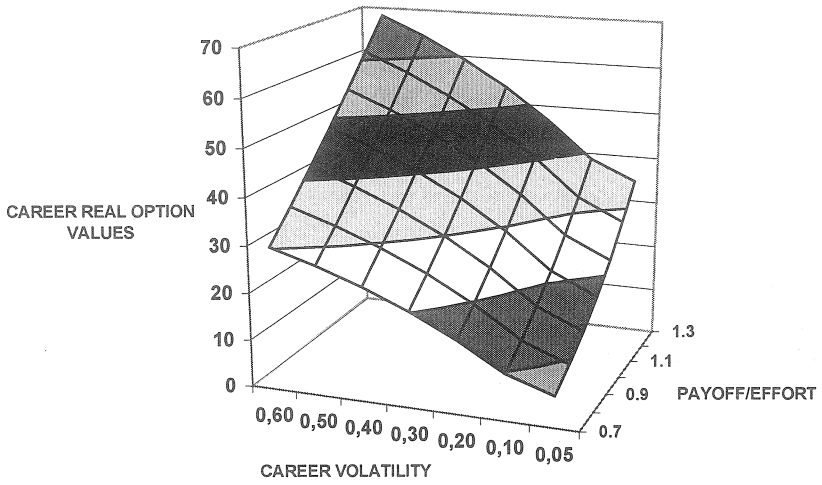


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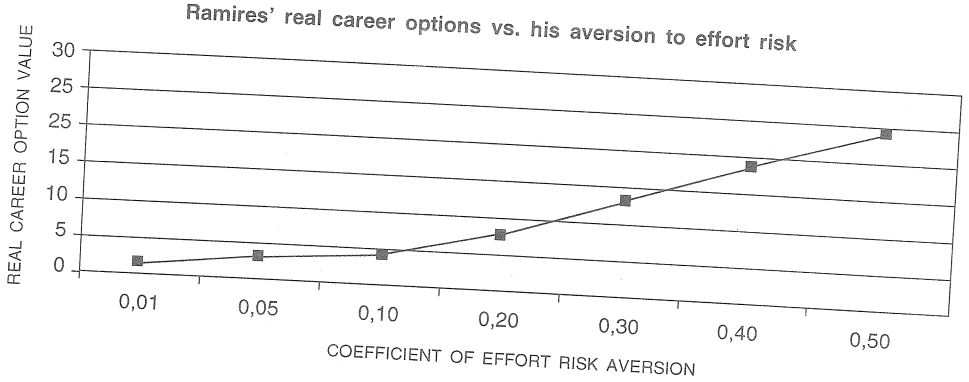
Figure 1 shows the option value for various ratios of «Payoff/Effort», that is relative career benefit/cost combined with different levels of the assumed risks of the career, at a correlation of .5. Note that Ramires' real career option values for all benefit/cost levels increase with the volatility of the career. Note that the career option value increases from close to nil to around 20, as career volatility increases from 5% to 60% when the «benefit/cost» ratio is only 70%. For the same increase in career volatility when the «benefit/cost» ratio is 130%, the career real option value doubles. That shows perhaps why Ramires contemplates a variety of potential careers at his current age, since his risk-adjusted efforts in any one direction appear to exceed his prospects.

Even when benefit/cost ratio is 130%, it may not be worthwhile immediately to take up a career or marry Dona Ana, since the option value (nearly 60) is worth more than the intrinsic value (of immediately exercising the option = 30) at high levels of career volatility.

Figure 2 shows the career option values as a function of benefit/cost and career volatility at complete negative correlation between education/effort and career benefit. Note that the real option value surface shifts upward, so the option value is worth nearly 70 at the high volatility and high benefit/cost extreme. As career real option values are increased, the sense of not exercising options and going for high volatility career alternatives is emphasised.

FIGURE 3



This represents the real career option values at a payoff/effort ratio of 90%, effort and career payoff volatilities of 10%, when the expected annual cost of education and effort is 5%, the expected annual benefits of the payoff net of educational cost is 3%, the risk aversion to career payoffs is 10% and to effort is as indicated, the time preference rate is 5%, and correlation of efforts and career payoffs is .5.

How much effort should Ramires expend on his career, whether this is further electoral campaigning, finishing a novel, or courting with zeal? That partly depends on his coefficient of effort risk aversion. Figure 3 shows that the career option values increase as Ramires' aversion to effort risks increases. Since Gonçalo is inclined to defer exercising his valuable options by extended writing, electoral soliciting or wooing efforts, one might infer that his «implied effort risk aversion coefficient» is high. Since real option values decrease as his risk aversion coefficient to career uncertainty increases as shown in figure 4, one might further infer that the implied risk aversion to effort exceeds that of career risks.

FIGURE 4

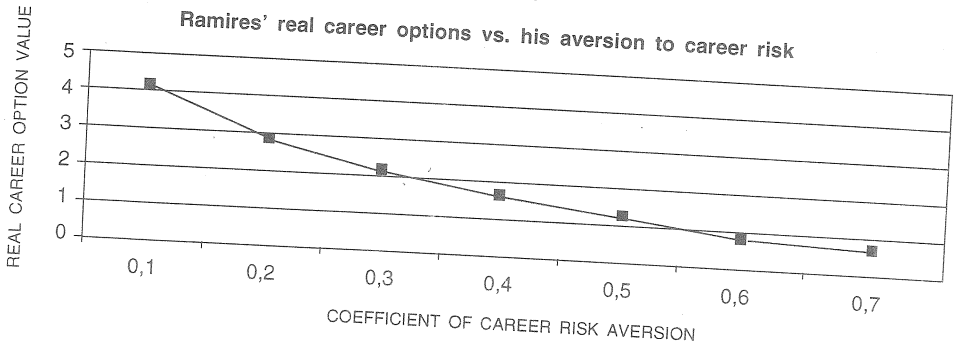


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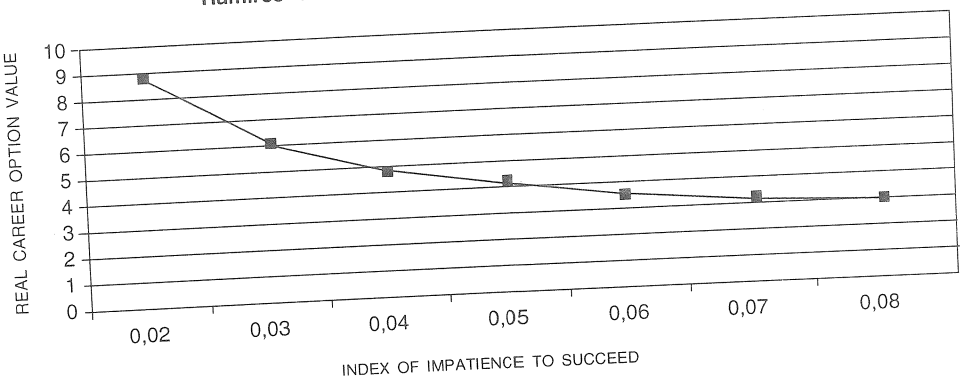
FIGURE 5

Ramires' real career options vs. his time preference

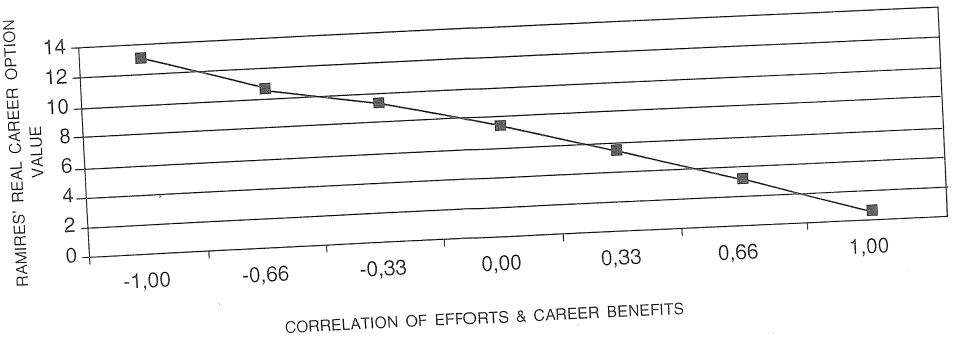


This represents the real career option values at a payoff/effort ratio of 90%, effort and career payoff volatilities of 10%, when the expected annual cost of education and effort is 5%, the expected annual benefits of the payoff net of educational cost is 3%, the risk aversion to effort is 10%, the time preference rate (index of impatience to sucess) is as indicated, and the correlation of efforts and career payoffs is .5.

Figure 5 shows that Ramires' career option values decrease as his time preference rate increases; that is, if he is an impatient young man, with a high opportunity cost, his career options will be worth little. Figure 6 shows that his career option values are proportional to the correlation of the cost of effort and career benefits, with the highest option values occurring with negative correlation.

FIGURE 6

Ramires' real carreer option vs. correlation effort & benefits



This represents the real career option values at a payoff/effort ratio of 90%, effort and career payoff volatilities of 10%, when the expected annual cost of education and effort is 5%, the expected annual benefits of the payoff net of educational cost is 3%, the risk aversion to effort and to career payoffs is 10%, the time preference rate is 5%, and the correlation of efforts and career payoffs is as indicated.

III — Ramires' exotic marriage options

Finally, consider some of Ramires' real exotic options such as real barrier options regarding marriage (and other ways of saving his estate, before running out of funds). A down & out (D&OC) barrier call option is extinguished if the value of the underlying «asset» sinks to a pre-determined level. Thus a personally leveraged estate such as the Tower may cease to be a real option on property development, if the landowner is forced to liquidate because of insufficient funds for repaying educational debts or on-going expenses. A down & in (D&IC) barrier call option becomes an option only if the current prestige and marriage payoff value declines to a certain level.

A D&I call option, which has a knockout barrier K, on an asset with a yield of α and with an ultimate termination date (T) of the earlier of K being hit or T is worth (see Paxson, 1997):

$$Call\,(D,I) = Pe^{-\alpha T}\,(K/P)^{2\lambda}\,N(y) - Xe^{-iT}\,(K/P)^{2\lambda-2}\,N(y-\sigma\sqrt{T}) \qquad (7)$$

where:

$$\lambda = (i-\alpha+\sigma^2/2)/\sigma^2$$

$$y = \frac{1n\,(K^2/PX)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T}$$

$N(\ )$ is the standard normal cumulative distribution function.

A D&O call is equal to a vanilla call (8) less a D&I call.

Why is Ramires' marriage a D&IC, or D&OC option? Firstly, the marriage might be considered a call on Dona Ana's contos, her improvements for the Tower (a woman's touch) and her possibility of producing an hier. Alternatively, a marriage option in Portugal to such a rich and suitable woman may be extinguished (at the time) considering the temptations offered by visiting «cousins» (as in *Cousin Bazilio*) and the unknown qualities of women (as in *The Maias*). Indeed Ramires' own sister «blossomed» in Cavaleiro's amorous warmth, and Ramires was naturally concerned about Dona Ana's virtue. That would be modelled as a D&O call option. Also given Ramires' propensity to inaction and procrastination, perhaps the value of Ramires' «total wealth», including the Tower, career and prestige, would have sink to a low level (D&IC) before Gonçalo has sufficient incentives to put forth the required efforts to succeed in marriage, career or development of the Tower (9).

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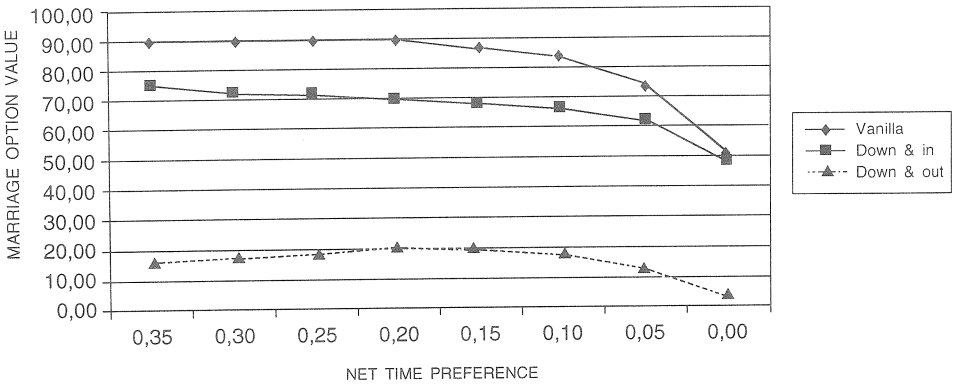
(8) A vanilla call option is valued according to the Black-Scholes formula, with $K=P$ in equation 7.

(9) Without giving away the story, and thus reducing your incentive to read this masterpiece, this is not an incorrect representation of the case.

FIGURE 7

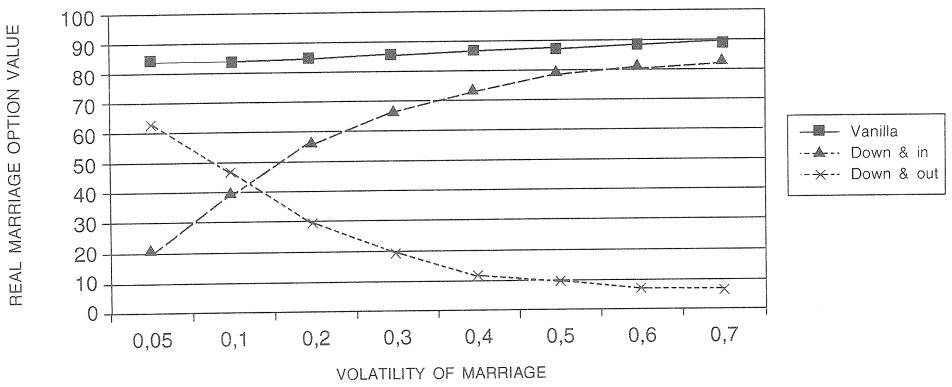
Ramires' real marriage barrier options



This shows Ramires' marriage option values, when the current expected net payoff is 90, the effort required is 100, the time to expiration is 30 years, the net time preference is as indicated and the volatility of the marriage payoff is 30%. The Down & In option value assumes that the marriage choice becomes an option only if the ratio of the marriage payoff to effort falls to 85. The Down & Out Marriage option value assumes that the marriage choice ceases to be an option if the ratio of the marriage payoff to effort falls to 85.

FIGURE 8

Ramires' real marriage barrier options



This shows Ramires' marriage option values, when the current expected net payoff is 90, the effort required is 100, the time to expiration is 30 years, the riskless rate is 10%, and the volatility of the marriage payoff is as indicated. The Down & In Marriage option value assumes that the real marriage choice becomes an option only if the ratio of the marriage payoff to effort falls to 85. The Down & Out Marriage option value assumes that the real marriage choice ceases to be an option if the ratio of the marriage payoff to effort falls to 85.

Figure 7 shows that all of Ramires' real marriage barrier call option values decline with the decline of his net time preference coefficient. That is consistent

with a vanilla call option, where an increase in the personal time preference increases the call option value. However, in this case, the D&O call option declines to nil, as the time preference rate declines to nil. Such a Real Down and Out Barrier assumes there is a barrier so that if Gonçalo runs out of funds, or perhaps becomes too old and/or feeble to marry, he can no longer sustain the Illustrious House of Ramires, so obviously the time preference function is critical. There is obviously a trade-off between the time value of options during the search for the optimal marriage partner and the decline or improvement (learning through experience) of the possible partners.

Figure 8 shows that the real marriage barrier options are sensitive to the volatility of the marriage prospects. The vanilla option for the next thirty years (after which, at that time, like for Sanches Lucena, it is presumed that producing an heir from the union of Ramires and Dona Ana is unlikely) is not an appropriate model. However, the D&I is possibly an appropriate model, as «time waits for no man», so as Ramires' fortune sinks, marriage options become more important, especially as the volatility of the marriage prospects increases.

IV — Conclusion and further research

The Illustrious House of Ramires is the story of a timid, kind, nobleman, who faces several career options (in modern terminology): develop his estate, write the history of his illustrious family, marry (wealth and an heir), politics and who knows (read the story).

«Do you know... who he reminds me of?... Gonçalo's different qualities, his weaknesses, his kindness, his goodness, his exceptional goodness...His crazes and enthusiasm, which peter out almost immediately... his generosity, his carelessness, his invariable chaos in business matters, his sentiments of honour, certain scruples... A streak of melancholy, in spite of his talkativeness and sociability...do you know who he reminds me of?

Who?

Portugal... so full of endearing charm, that it might be for ever blessed among lands.»

So perhaps these models are also appropriate for the real options of nations as well as individuals. Eventually, applications to other characters and situations in fiction will cover the wide field of real and exotic options, extending far beyond the two simple real options modelled herein.

The illustrations in this essay are easy, because the parameters are fictitious. Parameters for real life options might be based on personal interviews (and games) regarding risk aversion, hard data on salary levels, personal wealth, and prestige values (willingness to pay for popularity and brand image), and the volatility of many of these items over various time periods. The education and

efforts required for exercising these options might cover matching personal success against education and effort, and the exercise costs would include the personal cost and stress of obtaining certain qualifications and other non-parametric indicators of personal success.

One can imagine the vast future research program of identifying real options in life, adapting models where required, and designing new real option models specifically for real life options, along with the efforts at quantifying, if possible, the inputs for such models. Will literature then compliment real option analysis?

EXHIBIT I

Ramires real options

Option to	Estate business	Writing history	Career development	Politics election	Romance marriage
DEFER	Short vs. long lease, handshake is deal, farm improve.	Delay writing, plagiarize (Duarte), delay publish.	Delay job choice, remain nobleman.	Wait for right position, good publicity, test popularity.	«Maybe» marry, wait for further contact.
EXPAND	Improvement, long lease, profit sharing.	Enlarge story (Scott), market Ramires' «brand».	Propose marriage, stand for election, finish novel.	Visit electors, call in «favours», more estate connections.	Enlarge prospects (Porto) (Lisbon).
CONTRACT	Cancel leases, shorter leases.	Stop writing	Retire to Tower	Stand-down, reject André, call «bluff».	Stop meeting Dona Ana.
ABANDON	Sell estate, fallow	Burn manuscript or never finish.	Fire servants	Don't stand	Stop all meetings.
ENLARGE CHOICES.	New products: port, melons, new uses: time sharing, noble holidays.	Write real family history, political journalism.	Lisbon, marriage, África, business history lecturer.	Other elections, support other friends.	Trade-offs: 200 contos vs. voice & virtue.

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