Interrelated Investments within the Context of a Real Options Framework: Discussion and Application of a Generic Valuation Model to a Case on Mergers and Acquisitions

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This Version:

September 2002

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Abstract:

Financial theory, both traditional and the most recent, consider investments, almost exclusively, as single assets, whose value depends only on their intrinsic characteristics. However, not rarely, these assets are interrelated with the existent assets of the firm that evaluates and (eventually) implements them which, in turn, means that the value of these assets is also contingent on the established interrelationships. So, it is important to consider these effects (usually denominated synergies) in the valuation process.

These same effects also exist in projects of parallel and sequential development, independently of the interdependence relationships. Since the traditional valuation methods (like the NPV), as it is well known and documented, present several limitations and the Real Options (RO) models are, in principle, more suitable to value, in particular, these types of investment opportunities, in this paper we discuss and apply an appropriate RO model (the Generic Valuation Model developed by Childs, Ott and Triantis (1998)) in the evaluation of Portuguese firm Semapa, after Cimpor's acquisition and try to determine the shareholders' wealth increment, given the Acquisition Public Offer terms and the assumed interrelationships.

From the results obtained, it seems that we can conclude that the value of Semapa, after the acquisition, as well as the shareholders' wealth increment, are considerably superior to those obtained by the traditional valuation methods. This seems to mean that the RO model used would allow the managers of Semapa to perceive the real value of the investment opportunity, which is very important for the success of the operation, since it would condition the offer price.

Keywords: Interrelated Investments (Synergies), Real Options, Mergers and Acquisitions.

1. Introduction

Capital budgeting in an uncertainty world was, during some decades, an almost paralysed field of finance. To the awakening of this field two articles were decisive: the one of Black and Scholes (1973) and, in 1977, the one of Myers. Real options (RO) models become, very quickly, a strong theoretical body, more adapted to the evaluation of investment than the traditional methods (like the NPV).

However, when managers do capital budgeting, they cannot ignore the company's reality in which the investments shall interfere. In fact these investments will probably shape not only the installed assets but also the investment opportunities. Thus, like Kasanen and Trigeorgis (1993) say, the good managers don't treat projects as black boxes, without any operational RO, strategic value, and " ...synergies between parallel projects undertaken simultaneously..." (p. 209). This last aspect is so much more important as larger are the interrelationships among the projects. So, considering the importance of this aspect and, according to Myers (1987), Aggarwal (1993), Stulz (1999), Latimore (2000), and others, the inability of the traditional methods to capture it, in this article we do a critical appreciation of the RO models that evaluate interrelated projects. We conclude that the generic valuation model of projects, developed by Childs, Ott and Triantis (1998), is the most suitable to the evaluation of interrelated projects, since it incorporates, in an only parameter (the multiplicative factor), the synergy effect, is a close form solution, it assumes that project's cash flows follow a normal distribution and the option to abandon, temporary or not, less profitable projects. This model considers that synergies, translated by the multiplicative factor, affect, directly, the projects' cash flows, following the cash flows' stochastic process, which, in our opinion is the right thing to assume (the authors assume that projects' cash flows follow a normal distribution).

Recognizing the importance of the synergies in Mergers and Acquisitions (M&A), we use the generic valuation model and the traditional methods in the determination of Semapa's value, after the acquisition of Cimpor. This allows us to compare the results and to conclude that the traditional methods undervalue investment opportunities, because the combined value of the companies, for the same level of

[+] All results are available from the authors. Please, contact the authors for additional information or comments.
The authors are grateful to João Pedro Nunes and Sydney Howell for comments and suggestions related to this paper.

interrelationships, is superior when we use the Childs's, et al. (1998) model. Once the success of a hostile takeover depends on the financial compensation, by the utilization of this model, Semapa's managers would verify that the value of the combined firms would be larger than the one obtained by the traditional methods, which would allow them to increase the financial compensation, increasing the probabilities of success of the M&A and shareholders' wealth.

2. Review of RO Valuation Models of Interrelated Projects

In the field of RO, it does not exist, properly, any current or developed theory that directly allows the valuation of interrelated projects. However, there are some papers, few, that approach the interrelationships.

The development of an organization depends, widely, on the investment decisions, i.e., on the portfolio of investment options. Some options are simple and do not imply or enable future investments, others are complex and, when exercised, request or enable future investments or growth options. In these circumstances, the value of the option derives not only from its intrinsic value, but also from the value of the incorporated options, which means that they must be analysed as interrelated projects. An investment opportunity usually is and/or incorporates growth options. These growth options, which can or cannot correspond to autonomous projects, could be interdependent and/or interrelated and they should be valued as growth options or compound options. We underline that the object of this investigation is not the interrelationship between RO, just as they were studied by Trigeorgis (1993a) and Kulatilaka (1993, 1995a, b), but among real assets. Now, it is important to distinguish interrelated from interdependent investment opportunities.

We say that projects are interdependent when a dependence relationship exists, that is to say, we can only implement the future project if we previously implement another project, on which the second one depends. These projects are of sequential development. When we speak about interrelated projects we mean the synergy effect (positive or negative), that is to say, the whole is different from the sum of the parts.

Summarizing, in interrelated projects[1], interdependent or not, the synergy effect exists and it can be of parallel or sequential development. In the ambit of RO, we can approach this thematic by the models that indirectly incorporate the interrelationships, i.e., by growth or compound options' models, and by the models that incorporate them directly. Concerning these last models, we have those that consider the interrelationships as a deterministic value and those that consider them as a stochastic value.

2.1 RO Models that consider Interrelationships as a Deterministic Value

Concerning the models that directly incorporate the interrelationships, Kasanen and Trigeorgis (1993) conceive a valuation model, appropriated with the company's value maximization that combines RO theory with strategic management, consolidated by proper control mechanisms. This model is designated by Expanded NPV and incorporates the value of the operational options and the interactive effects (interrelationships and interdependences). The authors apply the model in two hypothetical projects to demonstrate the value of these effects, assuming a deterministic world. However, and in spite of referring that in a stochastic world the value of these effects can be captured through dynamic programming models, they do not make it nor exemplify it. Still in 1993, Kasanen approaches the interrelationships among projects, elaborating a matrix in which the impact of an operational or strategic project implemented today in the growth options is revealed. The managers' objective is to combine the operational and strategic investments in a way that the shareholders' wealth can be maximised. However, they assume a deterministic matrix, which could not be verified.

Smith and Triantis (1995) proclaim that many M&A create valuable options that traditional methods do not capture. These options result, for example, from the combination of firms' growth opportunities, from a certain competitive position obtained, from the alteration of the right moment to exercise the options, among others. All these options add value to the acquiring firm if synergies are observed. In a first example, the authors analyse the impact of the acquisition of a company in the release of a product, through the Black-Scholes' model, in which the value of the underlying asset is the present value of the

+ All results are available form the authors. Please, contact the authors for additional information or comments.

[1] This concept should be interpreted in a financial context and non technician or operational.

cash flows and the exercise price is the present value of the investment, both after the acquisition of the firm and the occurrence of the synergy (a well-known value in the moment zero and deterministic). The result quantifies the value of the project of releasing a new product, for the resulting company of the acquisition and must be added to the NPV of the acquisition[2]. In a second example, the authors demonstrate, using the model developed by Cox, Ross and Rubinstein (1979), that, unlike the argued by the traditional financial theory, the diversification adds value when there is an excess of installed capacity and the productive system is flexible.

2.2 RO Models that consider Interrelationships as a Stochastic Value

Childs and Triantis (1999) use a numeric solution to determine the value and the right investment strategy in R&D programs. The authors admit the possibility of a firm to develop, simultaneously and/or sequentially, several projects (although, in the empirical valuation they consider only two), where we verify the learning effect, the revision of the investment rhythms, the capital restrictions and the competition and interrelationships among projects. Unlike the model of Berk et al. (1998) and Schwartz and Moon (2000), the uncertainty is eliminated by the accomplishment of investments, being therefore an endogenous variable, and interrelationships are verified among the programs of R&D.

Joaquin and Khanna (2000) approach the interrelationships' subject under another perspective. They try to find the effects of the cannibalisation (negative synergies) among projects. They demonstrate, unlike the previous authors, that, when firms diversify, the cannibalisation effect is verified, which reduces the firm's value. The authors assume that the cannibalisation happens when the projects' cash flows follow opposite signs, that is to say, the level of cannibalisation is inversely related with the correlation among the projects' cash flows. This is the main limitation of this study because cannibalisation could happen with positive correlations.

Raynor (2000) argues that the financing plan defines the ability of a firm to capture the resulting synergies of the integration of two activities. The author uses the Black-Scholes' model to value these synergies. Theoretically the application of the Black-Scholes' model to synergies is discussible because it implies that those synergies follow a lognormal distribution.

Everything that was exposed allows us to conclude that the interrelated projects valuation models are not very developed yet, having several limitations.

Recognizing the importance of considering interrelationships among projects, Childs, Ott and Triantis (1998) develop a generic valuation model of projects that is adaptive to interrelated projects. The main advantages of this model are the fact of incorporating, in an only parameter (the multiplicative factor), the synergy effect, of having a close form solution and of assuming a normal distribution for the cash flows of the project and the option to abandon, temporary or not, the less profitable projects. This model considers that synergies, translated by the multiplicative factor, affect, directly, the projects' cash flows, following the cash flows' stochastic process, which, in our opinion is the right thing to assume (the authors assume that projects' cash flows follow a normal distribution).

3. Generic Valuation Model of Interrelated Projects

According to Childs, Ott and Triantis (1998), the total value of two projects (project *a* and project *b*), if implemented in parallel, is represented by:

(1) $$V^P = \gamma_a x_a + \gamma_b x_b$$

in that, γ_i is the multiplicative factor[3] that translates the interrelationships ($\gamma_i \geq 0$, i = *a, b*) and x_i (i = *a*, *b*) is the projects' NPV if implemented separately (represents the difference between the value of the project, X_i, and the investment, K_i).

To obtain a close form solution to this problem, the authors consider that the projects' value, x_a and x_b, follows a normal distribution, meaning that projects' NPV could be negative. Brennan (1979), in fact,

[2] The obtained result is not more than we would obtain by the use of Expanded NPV.

[3] If $\gamma a < 1$, project *b* cannibalises the cash flows of the project *a*, i.e., project *b* partially substitutes project *a*. On the other hand, if $\gamma_a > 1$, project *b* complements *a* and its cash flows will be increased by the parallel development. When $\gamma_a = \gamma_b = 1$, the projects are independent.

reiterates this aspect when he affirms that the normal distribution is more adapted to the valuation of an option whose underlying asset are the project's cash flows.

The following parameters completely characterize the bivariate normal density function, g (x_a, x_b), under the equivalent martingale measure for the strategy of parallel development. The expressions g (x) and g (x | y) translate, respectively, the univariate normal density and conditional density function.

$$E[x_i] = \mu_i, \qquad i = a, b$$
$$E[(x_i - \mu_i)^2] = \sigma_i^2, \qquad i = a, b$$
$$E[(x_a - \mu_a) \times (x_b - \mu_b)] = \rho \times \sigma_a \times \sigma_b, \qquad i = a, b$$

where $\mu_i, \sigma_i \in \mathbb{R}^+$ and $\rho \in [-1, 1]$.

The assumptions made for x_a and x_b, allow them to define the value of parallel development, V^P, at t_0, as,

(2)
$$V^P = e^{-rt_1}(G(x_a, x_b) + G(x_b, x_a) + H(x_a, x_b, \gamma_a - 1, \gamma_b) + H(x_b, x_a, \gamma_b - 1, \gamma_a)) - C_a - C_b$$

where t_1 is the moment of time when the projects are implemented or the option to parallel development is exercised. The conditional expectation term, G (x_i, x_j), is defined as,

(2.1)
$$G(x_i, x_j) = \mu_i N_2(h_{ji}, -h_i; \alpha_j) + \sigma_i \left[n(h_i) N(\kappa(h_i, h_{ji}, -\alpha_j)) + \alpha_j n(h_{ji}) N(-\kappa(h_{ji}, h_i, -\alpha_j)) \right]$$

and the term H(x_i, x_j, a, b) as,

(2.2)
$$H(x_i, x_j, a, b) \equiv \int_0^{\infty} \int_{-\frac{a}{b}x_i}^{x_i} (ax_i + bx_j) g(x_i, x_j) dx_j dx_i$$
$$= (a\mu_i + b\mu_j) \times (N_2(h_{ji}, -h_i; \alpha_j) - N_2(h_{ji}(0, -\frac{a}{b}), -h_i; \alpha_{ji}(-\frac{a}{b})))$$
$$+ (a\sigma_i + b\rho\sigma_b) \times (n(h_i)(N(\kappa(h_i, h_{ji}, -\alpha_j)) - N(\kappa(h_i, h_{ji}(0, -\frac{a}{b}), -\alpha_{ji}(-\frac{a}{b})))$$
$$+ \alpha_j n(h_{ji}) N(-\kappa(h_{ji}, h_i, -\alpha_j))$$
$$- \alpha_{ji}(-\frac{a}{b}) N(h_{ji}(0, -\frac{a}{b})) \times N(-\kappa(h_{ji}(0, -\frac{a}{b}), h_i, -\alpha_{ji}(-\frac{a}{b}))))$$
$$+ (b\sigma_j\sqrt{1-\rho^2}) \times (n(h_{ji})\sqrt{1-\alpha_j^2} N(-\kappa(h_{ji}, h_i, -\alpha_j))$$
$$- n(h_{ji}(0, -\frac{a}{b}))\sqrt{1-\alpha_{ji}^2(-\frac{a}{b})} N(-\kappa(h_{ji}, h_i, -\alpha_j)))$$

The terms between parentheses are defined as:

$$h_i(x) = \frac{x - \mu_i}{\sigma_i} \qquad h_{ij}(x, y) = \frac{x - \mu_i + y\mu_j}{\sqrt{\nu_T(y)}} \qquad h_i = h_i(0) \qquad h_{ij} = h_{ij}(0,1)$$

$$\alpha_{ij}(x) = -\frac{\rho\sigma_i - x\sigma_j}{\sqrt{\nu_T(x)}} \qquad \kappa(x, u, v) = \frac{u - vx}{\sqrt{1 - v^2}} \qquad \alpha_i = \alpha_{ij}(1) \qquad \nu_T(x) = \sigma_b^2 - 2x\rho\sigma_a\sigma_b + x^2\sigma_a^2$$

and, where:

N (.) – cumulative standard normal univariate distribution function;
N_2 (.) – cumulative standard normal bivariate distribution function;
n (.) – univariate standard normal density function;
C_a e C_b – development costs.

The first conditional expectation term, G (x_a, x_b), represents the value of implementing project *a* and abandoning project *b*; the second conditional expectation term, G (x_b, x_a), represents the value of implementing project *b* and abandoning project *a*; the Hs terms represent the value added by the implementation of both projects, *a* and *b*, simultaneously.

The detailed apprehension of the generic valuation model, its theoretical background and derivations could be done in the original model of Childs, Ott and Triantis (1998). The model presented in the body of their paper allows the evaluation of two projects that are mutually exclusive and the model presented in the appendix, the one exposed above, allows the evaluation of two projects, independently of their interrelationships[4].

4. Acquisition Public Offer (APO)

"Cimpor - Cimentos de Portugal, SGPS, SA", ahead just referred as Cimpor, is the Portuguese market leader of cements, with a market share of about 60%. "Semapa – Sociedade de Investimentos e Gestão SGPS, SA", ahead just referred as Semapa, possesses the remaining 40% of the Portuguese market share of cements. On June 15, 2000, Semapa, by a special purpose vehicle, "Secilpar, S. L.", threw an APO to the totality of the representative Cimpor's shares (134.400 thousands). The offered compensation was exclusively in money and, after revision, of €23,5 for share. The issue of shares and bonds will finance this investment. This action was made with the support of "Holderbank Financiere Glaris, SA", one of world cements market leaders.

When we do the operationalisation of the Childs's et al. (1998) model we ignore the existence of partners and instrumental firms.

5. Model Operationalisation and Results

The valuation of Semapa, after the acquisition, will be done through the traditional discounted cash flow valuation method, with and without interrelationships, and by Childs' et al. (1998) generic valuation model, using the interrelationships observed by the use of the traditional method. After this, the results will be confronted to analyse the fairness of the offered price, the maximum value that Semapa could offer, Semapa's value after the acquisition, its shareholders' wealth increase and the interrelationships' value.

5.1 Discounted Cash Flow Valuation Method for Cimpor

Cimpor's internationalisation strategy, through acquisitions, endowed it of an installed productive capacity of 18 million tons/year, being pointed out, for the year 2004, the obtaining of a capacity among the 25-30 million tons/year. However, because we do not have all the information needed to do the evaluation of these acquisitions, we assume that these projects have a NPV = 0. Considering the weight of each country in Cimpor's business portfolio, the evolution of the construction market and cement consumptions, the price's evolution and the installed and used capacities in the several countries, a sustained growth of the sales is foreseen (the source of these data is Banco Comercial Português and Finantia's reports). Parallelly to the sustained growth of the sales, it is pointed out, for the year 2003, a stabilization of exploration cash flows margin at 44,5% (Table I). The increase of this margin is justified by a growing rotation of the assets in all markets, with economies of scale and a better operational efficiency. The investments in operational assets and working capital are forecasted assuming the ending of Cimpor's acquisition program in the year 2000.

Table I – Operational Cash Flow of Cimpor

	1999	2000	2001	2002	2003	2004
Sales (thousands euros)	981.268	1.258.436	1.369.044	1.443.843	1.509.399	1.559.619
Growth Rate	5,5%	28,2%	8,8%	5,5%	4,5%	3,3%
Operational Cash Flow (OCF)	378.964	530.160	590.548	634.209	671.368	694.459
Growth Rate	13,2%	39,9%	11,4%	7,4%	5,9%	3,4%
Operational Cash Flow Margin	38,6%	42,1%	43,1%	43,9%	44,5%	44,5%

Some of the parameters needed to find Cimpor's value were extracted or deducted from Cimpor's Accounting Report and Bank Finantia's research.

Assuming that Cimpor's acquisition program ended in the year 2000, table II expresses the investments in operational assets and working capital.

[4] We believe that the intuition behind equation 2 is implicit in the equation 1 of this paper and figure 6 of the original paper (Childs et al. (1998), p. 327).

TableII – Cimpor's Investiments

(thousands euro)

	2000	2001	2002	2003	2004
Investments	700.154	194.439	175.078	165.866	121.029
Intangible Assets	402.960	0	0	0	0
Tangible Assets	297.194	194.439	175.078	165.866	121.029
Investments in Working Capital	17.678	24.814	28.411	27.923	26.060
Var. Working Assets	135.781	54.346	45.621	41.547	34.422
Var. Working Liabilities.*	118.103	29.532	17.210	13.624	8.362
Total Assets	2.929.413	2.993.576	3.025.645	3.041.558	3.003.973

* Only the short term operational liabilities

Font: Cimpor's Accounting Report and Bank Finantia's research.

In what concerns the capital structure, to make possible the use of the weighted average cost of capital (WACC), we assume that 45% of the firm is financed by debt and the remaining 55% by equity. We assume this capital structure as optimal, since it corresponds to the capital structure of similar firms. For the determination of WACC (Table III[5]) we had in consideration Cimpor's Accounting Reports and the estimates of Bloomberg[6] (for firm's beta).

Table III – Cimpor's Weighted Average Cost of Capital

TB 10	5,5 %
Rm	10 %
β	1
K_e (CAPM)	10%
K_d	5,5 %
WACC	7,1%

TB 10: YTM of Treasury Bonds 10 years; R_m: market return; β: CAPM's beta; K_e: cost of equity (defined by CAPM); K_d: cost of debt.

These data and that presented in the Appendix I allow us to do the financial planning of Cimpor and to find its fundamental value, in June 2000. The discounted cash flow valuation method points out a fundamental price of €27,8 for share (Table IV). The terminal value was determined by the perpetuities method with a constant growth rate (g) of 1%.

Table IV - Discounted Cash Flow Valuation Method for Cimpor

(thousands euro)

	2000	2001	2002	2003	2004
Net Income	182.110	195.959	219.381	239.806	253.261
Amortizations + Provisions	187.206	193.680	198.183	201.486	203.354
Interests (after Tax)	45.677	46.677	47.177	47.425	46.839
Working Capital	17.678	24.814	28.411	27.923	26.060
Investments	700.154	194.439	175.078	165.866	121.029
Free Cash Flows (FCF)	**-302.840**	**217.063**	**261.252**	**294.929**	**356.365**
Terminal Value (TV)					**5.940.151**
PV FCF and TV (WACC = 7,1%)	-292.685	195.952	220.292	232.291	4.632.244
Others Assets	65.596				
Enterprise Value (EV)	**5.053.690**				
Debt's Value *	1.318.236				
Equity's Value	**3.735.455**				
Fundamental shares price (€)	**27,8**				

* 45% of Cimpor's Total Assets Value in year 2000

Some of the parameters needed to find Cimpor's value were extracted or deducted from Cimpor's Accounting Report, Bank Finantia's research and Bloomberg.

[5] Damodaran (2000b) says that the used period, the risk free asset, the periodicity of the quotations, etc condition the market risk premium. So, we presuppose that 4,5% is a fair market risk premium for the Portuguese market. The calculation of this parameter will still be more complex if we have in consideration the number of markets in that Cimpor works.

[6] Knowing the credibility of Bloomberg and that Cimpor's sensibility to the Portuguese market is not reflected in the historical series (given the changes that has been coming to operate in its structure, mainly after the beginning M&A program) we decided to use Bloomberg's beta estimate of the firms. We underline the fact that Bloomberg adjust the betas values (Adjusted Beta = Beta of regression*(0,66) + 1*(0,33)). This adjustment pulls the regression betas for values close to one. Damodaran (2000c) said that this adjustment is justified because with the growth of firms, they consolidate their businesses, which pushes their betas to one.

Making a sensibility analysis to WACC and to perpetuity growth rate we find an interval of values for Cimpor's shares fundamental price that varies between €24 and €32,6, being the most probable value €27,8. However, this price seems to high, given the prices target defined by the main international investment banks and Cimpor´s shares spot price (~ € 18 per share).

Alternatively, and considering that the terminal value is an exploration cash flow multiple (being this multiple the mean or medium of this ratio in comparable firms – Table V), the fundamental price of the shares varies between €24,7 and €24,9, approaching the price target defined by the main international investment banks, turning this analysis more consistent with the market. For this reason, the reference price for Cimpor's shares that we will use, through the paper, is €24,7. Thus, without considering synergies, the reviewed price offered in the APO (€23,5) is at discount of 5%.

Table V – Relative Valuation of Cimpor

	EV/ECF*	TV (10^3 €)	Price (€)
Holderbank	7,8	5.416.780	24,9
Lafarge	6,9	4.791.767	21,5
Blue Circle	8,5	5.902.902	27,6
Mean	**7,7**	**5.370.483**	**24,7**
Median	**7,8**	**5.416.780**	**24,9**

* Year 2000 estimate

The multiple values were obtained from Bank Finantia's research.

5.2 Discounted Cash Flow Valuation Method for Semapa

Semapa's valuation is considerably less complex, once it began its internationalisation strategy in the end of the year 1999, acquiring the "Société des Ciments des Gabes", in Tunisia, which represents just about 10% of the Semapa's revenues, and since the international growth opportunities are scarce (this is one of the reasons of APO). So, Semapa is, almost totally, exposed to the Portuguese market, a market in a phase of maturity and stability, which allows us to make more accrued estimative. Also for Semapa it is foreseen a sustained growth of the revenues and it is pointed, for 2002, a stabilization of the exploration cash flow margin in 37,9% (Table VI). In the sequence of the referred about the difficulties of an internationalisation program that adds value, we assume an investment plan that just foresees investments in operational assets (substitution and modernization). The investment in working capital is a constant rate of the sales (we do not preview an alteration of working capital management).

Table VI – Operational Cash Flow of Semapa

	1999	2000	2001	2002	2003	2004
Sales (thousands euros)	395.453	465.038	489.285	518.758	550.006	583.137
Growth Rate	5,5%	17,6%	5,2%	6,0%	6,0%	6,0%
Operational Cash Flow (OCF)	160.522	175.765	185.550	196.426	208.452	221.009
Growth Rate	13,2%	9,5%	5,6%	5,9%	6,1%	6,0%
Operational Cash Flow Margin	40,6%	37,8%	37,9%	37,9%	37,9%	37,9%

Some of the parameters needed to find Semapa's value were extracted or deducted from Semapa's Accounting Report and Bank Finantia's research.

Since the implementation of an internationalisation strategy is complex, we assume that the investment plan only considers the substitution and modernization of operational assets. Table VII expresses the investments plan. The investments in working capital are a constant rate of the sales, being not verified an alteration of the working capital management.

Table VII – Semapa's Investiments

(thousands euro)

	2000	2001	2002	2003	2004
Investments	321.192	58.371	58.420	58.500	58.500
Intangible Assets	150.901	0	0	0	0
Tangible Assets	170.291	58.371	58.420	58.500	58.500
Investments in Working Capital	3.721	132	1.568	2.200	2.333
Var. Working Assets	26.582	4.651	7.408	8.250	8.747
Var. Working Liabilities.*	22.861	4.519	5.840	6.050	6.415
Total Assets	880.767	879.615	881.635	884.562	887.986

* Only the short term operational liabilities

Font: Semapa's Accounting Report and Bank Finantia's research.

In what concerns the capital structure, we assume that 30% of the firm is financed by debt and that the remaining 70% by equity, which, in fact, approaches the actual structure and, as we can see on Semapa's Accounting Reports, also to the optimal. For the determination of WACC (Table VIII[7]) we had in consideration Semapa's Accounting Reports (for the yield to maturity of the most recent bond issue) and the estimates of Bloomberg[8] (for firm's beta).

Table VIII – Semapa's Weighted Average Cost of Capital

TB 10	5,5 %
Rm	10 %
β	0,9
K_e (CAPM)	9,6%
K_d	5,5 %
WACC	7,7%

TB 10: YTM of Treasury Bonds 10 years; R_m: market return; β: CAPM's beta; K_e: cost of equity (defined by CAPM); K_d: cost of debt.

These data and that presented in Appendix II allow us to complete the financial planning of Semapa and to determine its fundamental value, in June 2000. The discounted cash flow valuation method points out a fundamental price of €22,1 for share (Table IX). The terminal value was determined by the perpetuities method with a constant growth rate (g) of 0,5%. Making a sensibility analysis to WACC and to perpetuity growth rate we find an interval of values Semapa's share fundamental price varies between €19,4 and €25,4, being the most probable value €22,1.

Table IX – Discounted Cash Flow Valuation Method for Semapa

(thousands euro)

	2000	2001	2002	2003	2004
Net Income	29.376	33.184	38.357	43.620	49.066
Amortizations + Provisions	64.718	65.670	64.846	64.823	64.823
Interests (after Tax)	8.720	8.708	8.728	8.757	8.791
Working Capital	3.721	132	1.568	2.200	2.333
Investments	321.192	58.371	58.420	58.500	58.500
Free Cash Flows (FCF)	**-222.099**	**49.059**	**51.943**	**56.500**	**61.848**
Terminal Value (TV)					**866.296**
PV FCF and TV (WACC = 7,7%)	-214.037	43.909	43.176	43.616	665.424
Others Assets	205.845				
Enterprise Value (EV)	**787.932**				
Debt's Value *	264.230				
Equity's Value	**523.702**				
Fundamental shares price (€)	**22,1**				

* 30% of Semapa's Total Assets Value in year 2000

Some of the parameters needed to find Semapa's value were extracted or deducted from Semapa's Accounting Report, Bank Finantia's research and Bloomberg.

5.3 Semapa Valuation, after the Acquisition of Cimpor, using the Generic Valuation Model

Given the intrinsic value of the firms involved in APO, it remains us to find Semapa's value after the acquisition of Cimpor, with the parallel development of the activities. The valuation will be processed by the application of Childs' et al. (1998) model. However, we will first use the traditional methods, with and without the verification of interrelationships, which allow us to make the confrontation of the results.

To be coherent with the previously valuations we assume that these analyses are referred to June 2000 and that the investment is of €23,5/share.

[7] See footnote 5.
[8] See footnote 6.

5.3.1 Without Interrelationships – Traditional Methods

The determination of Semapa's value after the acquisition of Cimpor, without the existence of interrelationships, demands the following assumptions:

- Cimpor is integrated in Semapa without any intervention, operational, administrative or financial, i.e., there is only a change in Cimpor's ownership;
- Semapa will maintain its capital structure unaffected, issuing shares to finance the investment;
- Debt's tax shields are ignored;
- The shares are issued at its fundamental price and we ignore the emission costs.

Table X – Semapa's value after Cimpor acquisition, without interrelationships

	Price Share	N.º of Shares	Total
Investment	23,5	134.400.000	3.158.400.000
Cimpor's Value	24,7	134.400.000	3.319.680.000
Value of the Acquisition			161.280.000
Equity Issued			2.210.880.000
N.º of shares issued (€22,1)			99.911.344
Var. Semapa's share price			1,3
New fundamental share price			23,4

Equity Issued: 70% of Investment; Var. Semapa's share price: Value of the Acquisition/ (no. of issued shares + no. of existent shares[9])

Table X expresses the combined value of the companies, in these circumstances. The new Semapa's shares fundamental value is not more than the sum to fundamental value of Semapa's shares, before the acquisition, of Cimpor's intrinsic value.

In this context, we have a small increase in shareholders' wealth, but we are also supposing an extreme situation - the interrelationships are not verified.

5.3.2 With Interrelationships – Traditional Methods

The determination of Semapa's value, after the acquisition, is quite complex, once, on the one hand, the operation was not concretised, disabling an accrued determination of possible interrelationships and, on the other hand, the acquisition would generate a monopoly, for the Portuguese market, which would allow Semapa to control cement's sale price. For these reasons, and without considering the consequences of the creation of a monopoly, Semapa's value, after the acquisition of Cimpor, and shareholders' wealth creation will be based in the previous assumptions and another suppositions relative to the originated interrelationships (see Appendix III).

We begin by supposing that the acquisition will not have implications in the level of productive capacity used, because both companies are close to the maximum level. Simultaneously, we assume that there is no alteration of investment plans and of working capital management, staying at the level considers in the point 5.1 and 5.2. At the level of the cost of sales we assume that there is some optimisation margin and, therefore, we point out for a stabilization of the values (in percentage terms of the revenues). It is regarding the structure of Cimpor's holding that we suppose more significant alterations. From acquisition results a duplication of structures, at the administrative level. So, we assume the extinction of Cimpor's holding, which implies the dismissal of approximately 100 employees and a saving of € 6.734.000. We only assume the selection of key elements from crucial areas to the integration and development of the companies, such as the departments of Human Resources, of Industrial Development, of Market Research and of Informatics. From these alterations, and assuming an efficient operational structure, we consider a stabilization of personnel expenses in 10% of the sales.

It is at the financial level that Cimpor's acquisition will have larger repercussions. First, the incorporation will decrease substantially Semapa's dependence of the Portuguese market, contributing to operational cash flow stabilization and, consequently, to the decrease of the financial risk and increase of debt capacity. In this sense, according to Stulz (2001), this operation can be faced as a decision of risk management. Second, once the capital structure will change, increasing the proportion of debt (Semapa's optimal capital structure, after the acquisition, resembles Cimpor's capital structure) and the tax shield,

[9] Semapa's Equity is composed by 23.666.489 shares.

will be a decrease in the WACC and an increase of firm's value. Considering these data, for the calculation of WACC, we presuppose that:

- after the acquisition, the Semapa's capital structure moves automatically to the optimal point;
- debt's cost stays unaffected;
- equity's cost is determined by the CAPM. For the effect, and in agreement with Damodaran (2000a), we consider that Semapa's beta, after the acquisition, is the weighted average by the equity values, of the unleveraged betas of the firms, adjusted by Semapa's degree of leverage, after the acquisition (Table XI).

The assumed marginal tax rate is 37% and the amortization of the goodwill generated by the acquisition is not tax deductible because Portuguese's fiscal system does not allow it.

Table XI – Semapa's Weighted Average Cost of Capital, after the acquisition[10]

β_U Cimpor	0,66
β_U Semapa (before acquisition)	0,72
β_U Semapa (after acquisition)	0,67
β_L Semapa (after acquisition)	1
K_e (CAPM)	10,1%
K_d	5,5 %
WACC	7,1%

Finally, we consider that Semapa's terminal value in 2004 is an exploration cash flow multiple (7,7, which is the mean of the values of this ratio for similar companies - Table V). In these conditions, after the acquisition and with an investment of €23,5/share, Semapa's shareholders wealth will increase €5,7/share (see Table XII and Table XIII).

Table XII – Shareholders' wealth increase, after acquisition

(euro)

	Share Price	N.º shares	Total
Investment	23,5	134.400.000	3.158.400.000
Total Assets (after acquisition)			5.357.402.850
Equity (after acquisition)			2.946.571.568
Equity (before acquisition)			616.536.900
Equity Issued			2.330.034.668
N.º shares issued (€22,1)			105.296.034
Increases of Equity's Value			3.065.315.593
Equity Invested			2.330.034.668
Interrelationships' Value			**735.280.926**
Interrelationships' value by share			**5,7**
New fundamental share price			**27,8**

Total Assets Value (after acquisition) = Semapa's assets accounting value + Semapa's investments + Cimpor's equity accounting value + goodwill; Equity (after acquisition) = 55% of Total Assets Value; Increases of Equity's Value = Semapa's Equity Market Value, after acquisition – Semapa's Equity Market Value, before acquisition.

Maintaining the assumptions unaffected, the increment of Semapa's shareholders wealth will be null when the offered price goes to €28,96/share. Curiously, Cimpor's CA expresses in its report that the success of the present APO would mean a price for share superior to € 26. However, if this was the offer price, Cimpor's shareholders would absorb the totality of the resulting interrelationship's value, what would be an unfair value division because Semapa is an indispensable part in the creation of the synergies.

[10] The established relationship among the leveraged (β_L) and the unleveraged (β_U) beta, according to Modigliani and Miller, (Fernández, 2001, p. 10) is:

$$\beta_L = \beta_U + (D/E)*(\beta_U - \beta_d)*(1 - T)$$

where T is the marginal tax rate and β_d reflects the systematic risk of debt (we assume to be zero).

Table XIII – Discounted Cash Flow Valuation Method for Semapa, after acquisition

(thousands euro)

	2000	2001	2002	2003	2004
Net Income	189.936	208.159	238.712	266.255	270.172
Amortizations + Provisions	251.924	259.350	263.029	266.309	268.177
Interests (after Tax)	83.535	80.493	80.999	81.279	80.772
Working Capital	21.399	24.946	29.979	30.123	28.393
Investments	1.021.346	252.810	233.498	224.366	179.529
Free Cash Flows	**-517.350**	**270.246**	**319.263**	**359.354**	**411.200**
Terminal Value					**6.982.239**
PV FCF and TV (WACC = 7,1%)	-499.942	243.874	269.046	282.794	5.433.327
Others Assets	271.441				
Enterprise Value	**6.000.540**				
Debt's Value *	2.410.831				
Equity's Value	**3.589.708**				
Fundamental shares price (€)	**27,8**				

* 45% of Semapa's Total Assets Value in year 2000, after the acquisition

Table XIV evidences the impact of cash flows' multiplier alteration (exposed previously) in the Semapa's shares price, after acquisition. As it is verified, to an increase of the multiplier, that reflects interrelationships' intensity, corresponds an increase of Semapa's shareholders wealth, after acquisition.

Table XIV – Impact of Cash Flows' Multiplier in Semapa's shares price, after acquisition

(thousands euro)

V(Semapa, after aquisition)	5.999.849	6.508.479	7.039.224	7.569.969	8.133.886	8.664.631	9.195.376	9.759.292	10.290.037	10.820.782
V(Semapa)	787.932	787.932	787.932	787.932	787.932	787.932	787.932	787.932	787.932	787.932
V (Cimpor)	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595	4.634.595
V (Semapa) + V (Cimpor)	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527	5.422.527
Interrelationships' Value	**577.322**	**1.085.952**	**1.616.697**	**2.147.442**	**2.711.359**	**3.242.104**	**3.772.849**	**4.336.765**	**4.867.510**	**5.398.255**
Multiplier	**1,11**	**1,20**	**1,30**	**1,40**	**1,50**	**1,60**	**1,70**	**1,80**	**1,90**	**2,00**
Semapa's Price, after acquisition (€)	**27,8**	**31,8**	**35,9**	**40,0**	**44,4**	**48,5**	**52,6**	**57,0**	**61,1**	**65,2**

The value of the firms, before the acquisition, is constant whatever the Childs' et al. model cash flows multiplier; The cash flows multiplier is a given number and affects both firms' cash flows; V (Semapa, after acquisition) = Multiplier * [V(Semapa)+V(Cimpor)]; Semapa's Price, after acquisition = V (Semapa, after acquisition) / No. shares.

In the original situation, the multiplier approaches the value 1,1. In this context, and assuming that Cimpor is acquired by its fundamental price (€ 24,7), the value of the interrelationships for share is €4,3 (Table XV). However, once again, we underline that NPV is not the best method to evaluate interrelated projects.

Table XV – Interrelationships' Value for Share (NPV)

(euro)

	Share Price	N.º shares	Total
Investment	24,7	134.400.000	3.319.680.000
Total Assets (after acquisition)			5.518.682.850
Equity (after acquisition)			3.035.275.568
Equity (before acquisition)			616.536.900
Equity Issued			2.418.738.668
N.º shares issued (€22,1)			109.304.635
Increases of Equity's Value			2.992.348.403
Equity Invested			2.418.738.668
Interrelationships' Value			**573.609.736**
Interrelationships' value by share			**4,3**
New fundamental share price			**26,4**

Total Assets Value (after acquisition) = Semapa's assets accounting value + Semapa's investments + Cimpor's equity accounting value + goodwill; Equity (after acquisition) = 55% of Total Assets Value; Increases of Equity's Value = Semapa's Equity Market Value, after acquisition – Semapa's Equity Market Value, before acquisition.

5.3.3 - With Interrelationships – Adopted Model

To define Semapa's true value, after the acquisition of Cimpor, we need, previously, to define the parameters that will allow us to use the model, translated by the expression (2), some of them were already identified. We underline the fact that we are valuing the parallel development of two projects, in this case two companies, Semapa and Cimpor, that are already in function and one of them, Cimpor, for assumption, will be acquired. Thus,

- X_a and X_b will be, respectively, the value of Semapa and of Cimpor (fundamental value of the firms and not of the equity, at t_0). These parameters correspond to the martingale measure of the present value of firms' free cash flows, determined by the traditional methods (NPV). The model assumes that these parameters follow a normal distribution (so a random walk).
  X_a = 787.932 thousand euro
  X_b = 4.634.595 thousand euro
- To the parameters K_a and K_b corresponds the value zero, for the following reason: this model allows us to quantify the value of two interrelated projects when developed in parallel (in the case Semapa's value, after the acquisition and assimilation of Cimpor's assets and activities). However, it ignores the impact of the financing form in the capital structure of the firm that implements it (Semapa). In this case, as the impact is tremendous and what we intend to determine is the value of Semapa's equity, after the acquisition (that allows us to determine Semapa's shares fundamental price and its shareholders wealth increase), the impact of the accomplished investment is incorporated by the deduction of debt to projects' value and by the division of the result for the number of existent shares.
- x_a and x_b will be, respectively, the NPV of Semapa and of Cimpor, what is to say, X_a and X_b because $K_a = K_b = 0$, and they follow a normal distribution.
- To the parameters C_a and C_b we also attribute the value zero. Eventually, the development costs of Cimpor, C_b, (the costs of the operation, of the valuation, of the attorneys, among others), are not zero but, faced to the involved values in the acquisition and to the insufficient information, we decide to ignore them.
- The parameters σ_a and σ_b represent the standard deviation of the prices (and not of the returns) of Semapa and Cimpor, respectively, and are obtained by the analysis of firm's daily quotations since the 27-07-1995 up to 31-05-2000. It is in the determination of these parameters that the singularity of this model resides. Since we intend to obtain the standard deviation of the firm's value, we begin by the determination of annual standard deviation of the prices, multiplying it for the number of existent shares, to find the companies' value standard deviation (Table XVI).
- $\rho_{a,b}$ represents the correlation coefficient among the daily quotations of Semapa and of Cimpor (Table XVI).
- r and t_1 correspond, respectively, to the rate of OT 10 = 5,5% and zero. The value of t_1 is zero because all valuations are referred to June 2000 and since we assume that after this period the probabilities of APO's success is null. Thus, we consider this investment opportunity as an European option, what converges to the model's assumptions.
- γ_a and γ_b, are the cash flows' multipliers of Semapa and Cimpor, respectively, to which we attribute the value of 1,11 (the value found in the initial valuation, evidenced in the Table XIV).

Table XVI - Resume of Model's Parameters

(euro)

	Semapa	Cimpor
Cash Flows Value (X_i)	787.932.065	4.634.594.862
Investment (K_i)	0	0
NPV (x_i)	787.932.065	4.634.594.862
Initial Investment (C_i)	0	0
Standard Deviation (σ_i)	2.141.907.237	8.169.083.951
Correlation Coefficient (ρ)	0,84	
Multiplicative Factor (γ_i)	**1,11**	**1,11**

Applying the defined parameters in the model, at equation (2), we obtain the following result (Table XVII), which, in our opinion, is a better estimation of Semapa's value, after the acquisition.

As we can see, Semapa's shares fundamental value, after the acquisition, and consequently its shareholders' wealth, increases to values superior to those captured by NPV. According to this model and assuming that Cimpor is acquired by its fundamental price (€24,7), the interrelationships' value for share is €7,8 (Table XVIII), corresponding to an increase of 82% face to the value obtained by NPV (€4,3).

Table XVII – Results of Empirical Investigation

	(euro)
Semapa's value, after the acquisition [eq. (2)]	6.459.793.926
Debt's value	2.410.831.283
Equity's value	4.048.962.643
Shares' Fundamental Value	31,4
Shareholders' wealth increases	9,27

Debt´s value = 45% of Semapa's value, after the acquisition; Equity's value = 55% of Semapa's value, after the acquisition; Shares' Fundamental Value = Equity's value / No. shares; Shareholders' wealth increases = Shares' Fundamental Value, after acquisition – Shares' Fundamental Value, before acquisition.

Table XVIII – Interrelationships' Value for Share (RO)

	(euro)
Semapa's value, after the acquisition	6.459.793.926
Debt's value	2.481.912.838
Equity's value	3.977.881.088
Shares' Fundamental Value	29,9
Shareholders' wealth increases	7,8

Debt´s value = 45% of Semapa's value, after the acquisition; Equity's value = 55% of Semapa's value, after the acquisition; Shares' Fundamental Value = Equity's value / No. shares; Shareholders' wealth increases = Shares' Fundamental Value, after acquisition – Shares' Fundamental Value, before acquisition.

6. Conclusions

The interrelationships among investments, installed or not, are an important feature of themselfs, that condition and determine their value, for the entity that evaluates and implements them. However, the traditional methods, like NPV, as verified by several academics and managers, are extremely fallible and limited, namely in the assimilation of interrelationships among parallel development investment. So, at a theoretical level, the use of RO models is justifiable. In this context, the Childs' et al. (1998) generic valuation model is particularly useful because it incorporates, in an only parameter (the multiplicative factor), the synergy effect, is a close form solution and assumes a normal distribution for the cash flows of the project and the option to abandon, temporary or not, the less profitable projects. This model considers that synergies, translated by the multiplicative factor, affect, directly, the projects' cash flows, following the cash flows' stochastic process, which, in our opinion is the right thing to assume.

By the operationalisation of this model and by the confrontation of its results with those given by traditional methods, we can conclude that this last ones undervalue the interrelated investments, once the firm's combined value, for the same level of interrelationships, is superior when we use Childs' et al. (1998) model. In addition, like the success of a hostile takeover depends on the offered price, which in its turn depends on the used valuation's model(s), given the results of the applied model, Semapa would verify that the value of the combined firms would be larger than the obtained by the traditional methods, which would allow it to increase the offered price, increasing the probabilities of APO's success and shareholders' wealth. With this model, the increment of Semapa's shareholders wealth will be null when the offered price goes to €32,4, while, with NPV, it resulted in an offered price of €28,96. Moreover, it is curious and worth pointing out that, although seemingly Semapa does not use RO models, because the offered price was so reduced, after the Cimpor's fourth phase of privatisation (accomplished in July of 2001), Semapa has demanded an APO of the totality of Cimpor's shares to the privatisation winner company, for a price close of the value above which, according to Childs' et al. (1998) model, the wealth increment for its shareholders, if the acquisition is summed up, would be null.

In appendix IV, a sensibility analysis is performed over Semapa's price, after the acquisition of Cimpor, in relation to the correlation coefficient, cash flow multipliers and volatility of both firms and the results

are the expected ones, according to real options theory. Semapa's price, after the acquisition, increases with the increase of both firms' volatility and cash flow multipliers. When correlation coefficient assumes the extreme values Semapa's price decrease because sequential development is preferable.

Given this, Childs' et al. (1998) model seems to be accrued to evaluate interrelated projects, however we underline the fact that the answers provide by any real options model must be analysed with some careful and this one is not an exception. In fact, this model has several limitations. For instance, it does not consider, for example, the several real options incorporated in the assets and the interactions between them, as Trigeorgis (1993a) and Kulatilaka (1995a, b) do. The model should be modelled as an american option and not as an european one and incorporate the defer option (however, in this case, the uncertainty should be defined as an exogenous parameter and not as an endogenous one). We also propose the combination with the defer option of the competition effect, as Majd and Pindyck (1987) realize. Another limitation of this model, which we verified in the empirical investigation, is that it does not consider the impact of the investment in the firm's capital structure. But, as Trigeorgis (1993b) states, the financing plan is and has in itself several options, being important to consider them. Finally, we underline the importance of the standard deviation's determination method because it is a key factor and the authors do not mention how we should determine it.

Appendix I: Previsional Income Statement of Cimpor

(thousands euros)

Previsional Income Statement					
	2000	**2001**	**2002**	**2003**	**2004**
Sales	1,258,436	1,369,044	1,443,843	1,509,399	1,559,619
Cost of Sales	277,153	296,264	308,114	318,921	329,245
Change in Inventories	0	0	0	0	0
Gross Income	**981,283**	**1,072,780**	**1,135,729**	**1,190,478**	**1,230,374**
External Services and Supplies	328,069	350,692	364,719	377,511	389,732
Personnel Expenses	128,456	137,314	142,806	147,815	152,600
Other Operating Income (Net)	5,402	5,774	6,005	6,216	6,417
Exploration Cash Flow	**530,160**	**590,548**	**634,209**	**671,368**	**694,459**
Amortizations	178,880	184,622	188,630	191,500	193,036
Provisions	8,326	9,058	9,553	9,986	10,318
Operating Earnings	**342,954**	**396,868**	**436,026**	**469,882**	**491,105**
Financial Earnings	**-33,916**	**-64,091**	**-64,885**	**-65,279**	**-64,348**
Earnings before Taxes	**309,038**	**332,777**	**371,141**	**404,603**	**426,757**
Earnings Tax Rate	37%	37%	37%	37%	37%
Tax	114,344	123,127	137,322	149,703	157,900
Minority Interest	12,584	13,690	14,438	15,094	15,596
Net Income	**182,110**	**195,959**	**219,381**	**239,806**	**253,261**
Amortisation + Provisions	187,206	193,680	198,183	201,486	203,354
Working Capital Investment	17,678	24,814	28,411	27,923	26,060
Investments	700,154	194,439	175,078	165,866	121,029
Operational Cash Flow	**-313,160**	**220,014**	**270,897**	**303,349**	**361,646**

Operational Assumptions					
	2000	**2001**	**2002**	**2003**	**2004**
Sales (growth rate)	28.2%	8.8%	5.5%	4.5%	3.3%
Cost of Sales (% of Sales)	22.0%	21.6%	21.3%	21.1%	21.1%
Change in Inventories	0%	0%	0%	0%	0%
Gross Income	**78.0%**	**78.4%**	**78.7%**	**78.9%**	**78.9%**
External Services and Supplies	26.1%	25.6%	25.3%	25.0%	25.0%
Personnel Expenses	10.2%	10.0%	9.9%	9.8%	9.8%
Other Operating Income (Net)	0.4%	0.4%	0.4%	0.4%	0.4%
Exploration Cash Flow	**42.1%**	**43.1%**	**43.9%**	**44.5%**	**44.5%**
Amortizations	7.6%	7.8%	8.0%	8.2%	8.5%
Provisions	0.7%	0.7%	0.7%	0.7%	0.7%
Operating Earnings	**27.3%**	**29.0%**	**30.2%**	**31.1%**	**31.5%**
Financial Earnings	**-2.7%**	**-4.7%**	**-4.5%**	**-4.3%**	**-4.1%**
Minority Interest	1.0%	1.0%	1.0%	1.0%	1.0%
Net Income	**14.5%**	**14.3%**	**15.2%**	**15.9%**	**16.2%**

Appendix II: Previsional Income Statement of Semapa

(thousands euros)

Previsional Income Statement					
	2000	**2001**	**2002**	**2003**	**2004**
Sales	465,038	489,285	518,758	550,006	583,137
Cost of Sales	133,096	139,750	148,365	157,302	166,777
Change in Inventories	0	0	0	0	0
Gross Income	**331,942**	**349,535**	**370,393**	**392,705**	**416,360**
External Services and Supplies	95,606	100,386	106,496	112,751	119,543
Personnel Expenses	57,560	60,438	64,117	68,201	72,309
Other Operating Income (Net)	-3,011	-3,161	-3,354	-3,300	-3,499
Exploration Cash Flow	**175,765**	**185,550**	**196,426**	**208,452**	**221,009**
Amortizations	63,296	64,174	63,808	63,823	63,823
Provisions	1,422	1,496	1,038	1,000	1,000
Operating Earnings	**111,047**	**119,880**	**131,580**	**143,629**	**156,186**
Financial Earnings	**-14,033**	**-14,014**	**-14,047**	**-14,095**	**-14,152**
Earnings before Taxes	**97,014**	**105,866**	**117,533**	**129,534**	**142,034**
Earnings Tax Rate	40%	40%	40%	40%	40%
Tax	38,806	42,347	47,013	51,814	56,814
Minority Interest	28,832	30,336	32,163	34,100	36,154
Net Income	**29,376**	**33,184**	**38,357**	**43,620**	**49,066**
Amortizations + Provisions	64,718	65,670	64,846	64,823	64,823
Working Capital Investment	17,678	24,814	28,411	27,923	26,060
Investments	700,154	194,439	175,078	165,866	121,029
Operational Cash Flow	**-588,382**	**-70,771**	**-43,464**	**-29,500**	**18,920**

Operational Assumptions					
	2000	**2001**	**2002**	**2003**	**2004**
Sales (growth rate)	17.6%	5.2%	6.0%	6.0%	6.0%
Cost of Sales (% of Sales)	28.6%	28.6%	28.6%	28.6%	28.6%
Change in Inventories	0%	0%	0%	0%	0%
Gross Income	**71.4%**	**71.4%**	**71.4%**	**71.4%**	**71.4%**
External Services and Supplies	20.6%	20.5%	20.5%	20.5%	20.5%
Personnel Expenses	12.4%	12.4%	12.4%	12.4%	12.4%
Other Operating Income (Net)	0.6%	0.6%	0.6%	0.6%	0.6%
Exploration Cash Flow	**37.8%**	**37.9%**	**37.9%**	**37.9%**	**37.9%**
Amortizations	13.6%	13.1%	12.3%	11.6%	10.9%
Provisions	0.3%	0.3%	0.2%	0.2%	0.2%
Operating Earnings	**23.9%**	**24.5%**	**25.4%**	**26.1%**	**26.8%**
Financial Earnings	**-3.0%**	**-2.9%**	**-2.7%**	**-2.6%**	**-2.4%**
Minority Interest	6.2%	6.2%	6.2%	6.2%	6.2%
Net Income	**6.3%**	**6.8%**	**7.4%**	**7.9%**	**8.4%**

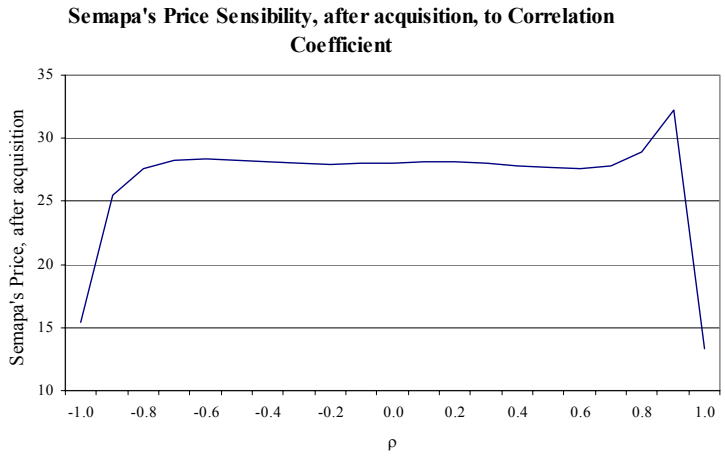
Appendix III: Previsional Income Statement of Semapa, after the acquisition of Cimpor, with interrelationships

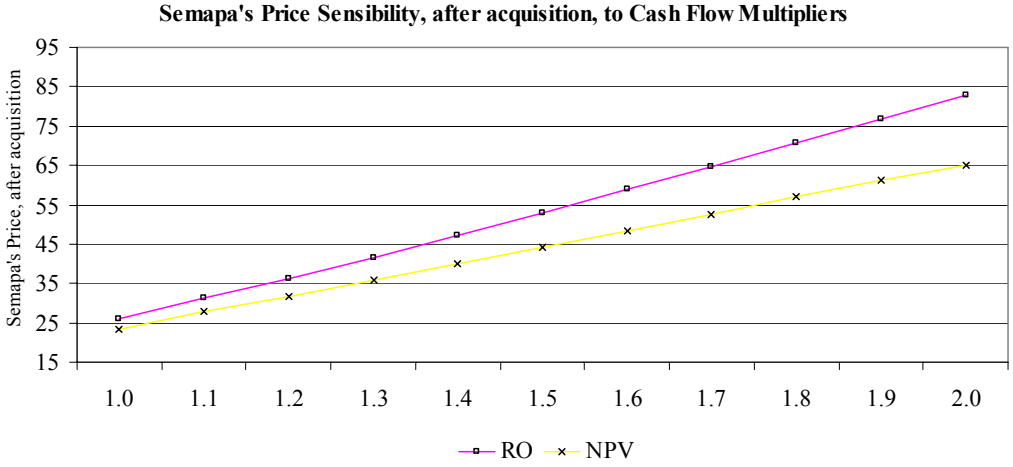
(thousands euros)

Previsional Income Statement					
	2000	**2001**	**2002**	**2003**	**2004**
Sales	1,723,474	1,858,329	1,962,601	2,059,405	2,142,756
Cost of Sales	410,249	436,014	456,479	473,663	492,834
Change in Inventories	0	0	0	0	0
Gross Income	**1,313,225**	**1,422,315**	**1,506,122**	**1,585,742**	**1,649,922**
External Services and Supplies	423,675	451,078	471,215	490,262	535,689
Personnel Expenses	179,282	189,550	196,260	205,941	214,276
Other Operating Income (Net)	2,391	2,613	2,651	2,916	2,918
Exploration Cash Flow	**712,659**	**784,300**	**841,298**	**892,455**	**902,876**
Amortizations	242,176	248,796	252,438	255,323	256,859
Provisions	9,748	10,554	10,591	10,986	11,318
Operating Earnings	**460,735**	**524,950**	**578,269**	**626,146**	**634,699**
Financial Earnings	**-97,500**	**-127,647**	**-128,491**	**-128,957**	**-128,111**
Earnings before Taxes	**363,235**	**397,304**	**449,778**	**497,189**	**506,587**
Earnings Tax Rate	37%	37%	37%	37%	37%
Tax	134,397	147,002	166,418	183,960	187,437
Minority Interest	41,417	44,657	47,163	49,489	51,492
Net Income	**187,421**	**205,644**	**236,197**	**263,740**	**267,658**
Amortizations + Provisions	251,924	259,350	263,029	266,309	268,177
Working Capital Investment	17,678	24,814	28,411	27,923	26,060
Investments	700,154	194,439	175,078	165,866	121,029
Operational Cash Flow	**-243,131**	**295,369**	**352,559**	**392,106**	**440,866**

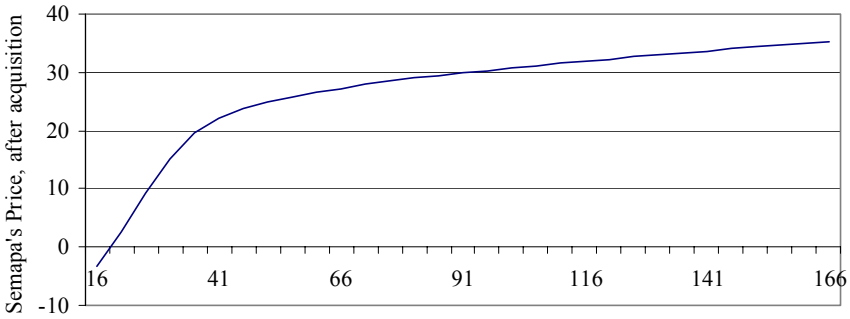
Operational Assumptions					
	2000	**2001**	**2002**	**2003**	**2004**
Sales (growth rate)	5.5%	7.8%	5.6%	4.9%	4.0%
Cost of Sales (% of Sales)	23.8%	23.5%	23.3%	23.0%	23.0%
Change in Inventories	0%	0%	0%	0%	0%
Gross Income	**76.2%**	**76.5%**	**76.7%**	**77.0%**	**77.0%**
External Services and Supplies	24.6%	24.3%	24.0%	23.8%	25.0%
Personnel Expenses	10.4%	10.2%	10.0%	10.0%	10.0%
Other Operating Income (Net)	0.1%	0.1%	0.1%	0.1%	0.1%
Exploration Cash Flow	**41.4%**	**42.2%**	**42.9%**	**43.3%**	**42.1%**
Amortisation	14.1%	13.4%	12.9%	12.4%	12.0%
Provisions	0.6%	0.6%	0.5%	0.5%	0.5%
Operating Earnings	**26.7%**	**28.2%**	**29.5%**	**30.4%**	**29.6%**
Financial Earnings	**-5.7%**	**-6.9%**	**-6.5%**	**-6.3%**	**-6.0%**
Minority Interest	2.4%	2.4%	2.4%	2.4%	2.4%
Net Income	**10.9%**	**11.1%**	**12.0%**	**12.8%**	**12.5%**

Appendix IV: Sensibility Analysis

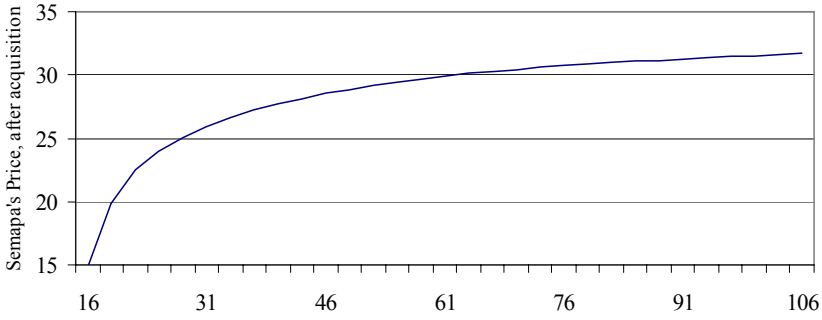




Semapa's Price Sensibility, after acquisition, to Semapa's Volatility



Semapa's Price Sensibility, after acquisition, to Cimpor's Volatility



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