



Broadband investments as Growth Options under competition threat

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The basic idea...

- The valuation of ICT investments is a challenging task because it is characterized by high level uncertainty, and rapidly changing business conditions.
- Investment appraisal techniques such as net present value (NPV) have been widely criticized because of their inability to model uncertainty, and take into account flexibility inherent in most of the ICT investment decisions.
- Real Options (ROs) presents an alternative method taking into account the managerial flexibility of responding to a change or new situation in business conditions.
- We model ICT business activities as ROs to control uncertainties and optimally configure investment.
- After the liberalization of the telecommunications markets, the ICT business activities do not belong exclusively to only one firm.
- We adopt financial option theory and enhance it with competition modeling theory to guide decision-making regarding the management and evaluation of ICT investments.



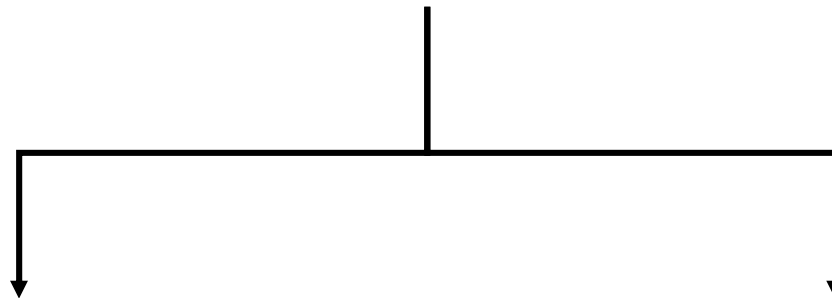
Presentation content

- Financial and Real Options in ICT investments
- Competition modeling and Real Options in ICT investments
- Egnatia Odos S.A. (case study)
- Conclusion and further work



Financial and Real Options

- An option is the right but not the obligation to take an action (at a cost X , the exercise price) for a predetermined period of time (the maturity of the option)



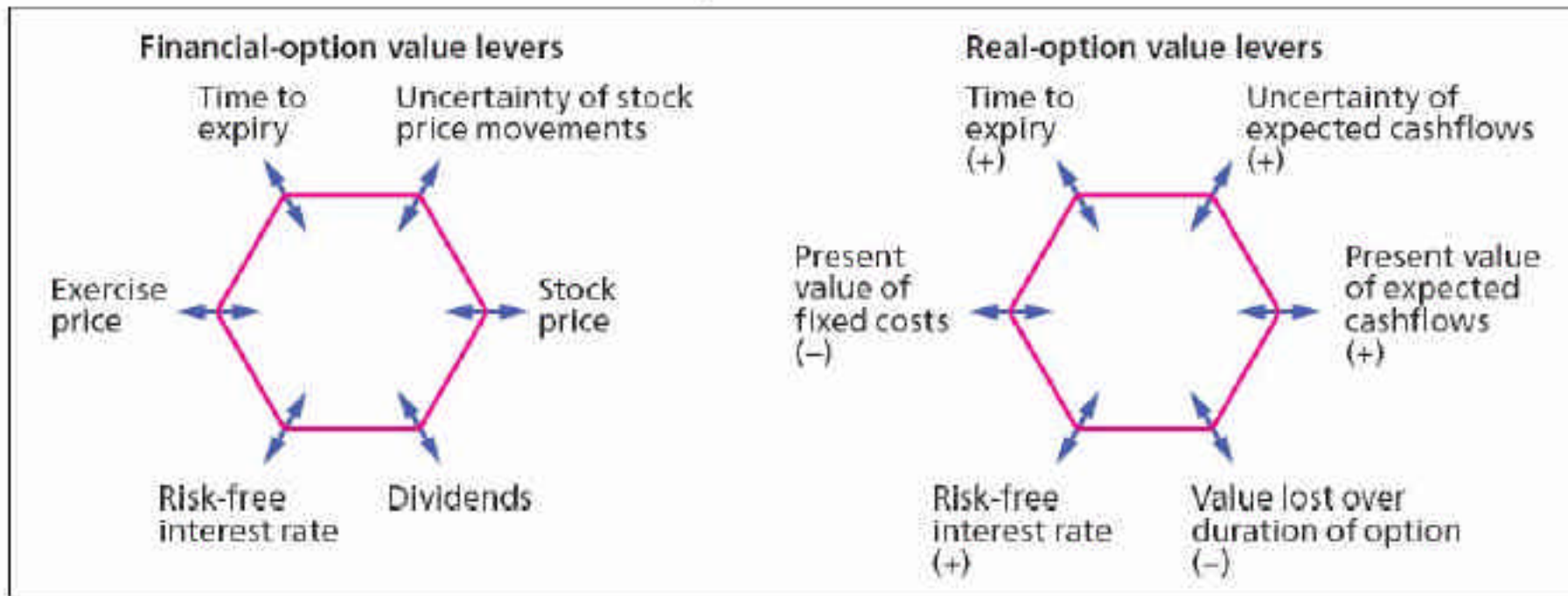
Financial options are options on financial assets (e.g. an option to buy 100 shares of Nokia at 90€ per share on January 2007).

Real Options is the extension of the options concept to real assets (e.g. an ICT investment can be viewed as an option to exchange the cost X of the specific investment for the revenue V resulting from this investment).



Analogies Between Financial and Real Options

The six levers of financial and real options





Real Options concept

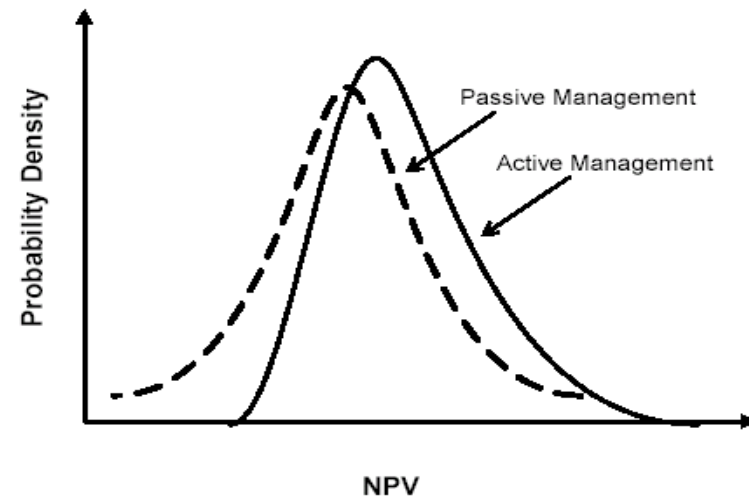
- The logic of Real Options recognizes that firms may be able to defer an investment decision into the future until the uncertainty has been resolved,
...instead of making an immediate and perhaps irreversible investment that may flounder if conditions prove unfavorable.
- Real Options thinking (flexibility: wait and learn about the changing business conditions) decreases the possibility of experiencing losses while increase the possibility of gaining.
- **Identifying Real Options**
 - Uncertainty - Is there uncertainty – will more be known over time?
 - Flexibility - Is it possible to wait and respond to the new information?

Active Management (ROs)

wait and proceed if business conditions are favorable

Passive Management (NPV)

take one decision (invest, yes/no), then the project evolves on a fixed plan





Waiting to invest

Pros

- Waiting allows you to learn / gain information about

Market (e.g. customer demand and prices)

Competition (e.g. a competitor's behavior in the market).

Firm (e.g. the ability of the investing firm to successfully realize an investment opportunity)

Cons

- Waiting can lead to loss of revenues during waiting period
- Waiting can lead to loss of competitive advantage
 - First mover advantage,
 - Competitors will make a preemptive move and the investing firm might lose part or all of the investment opportunity

Need to trade-off "costs of waiting" against "value of waiting"

No obvious solution, Needs case-by-case analysis



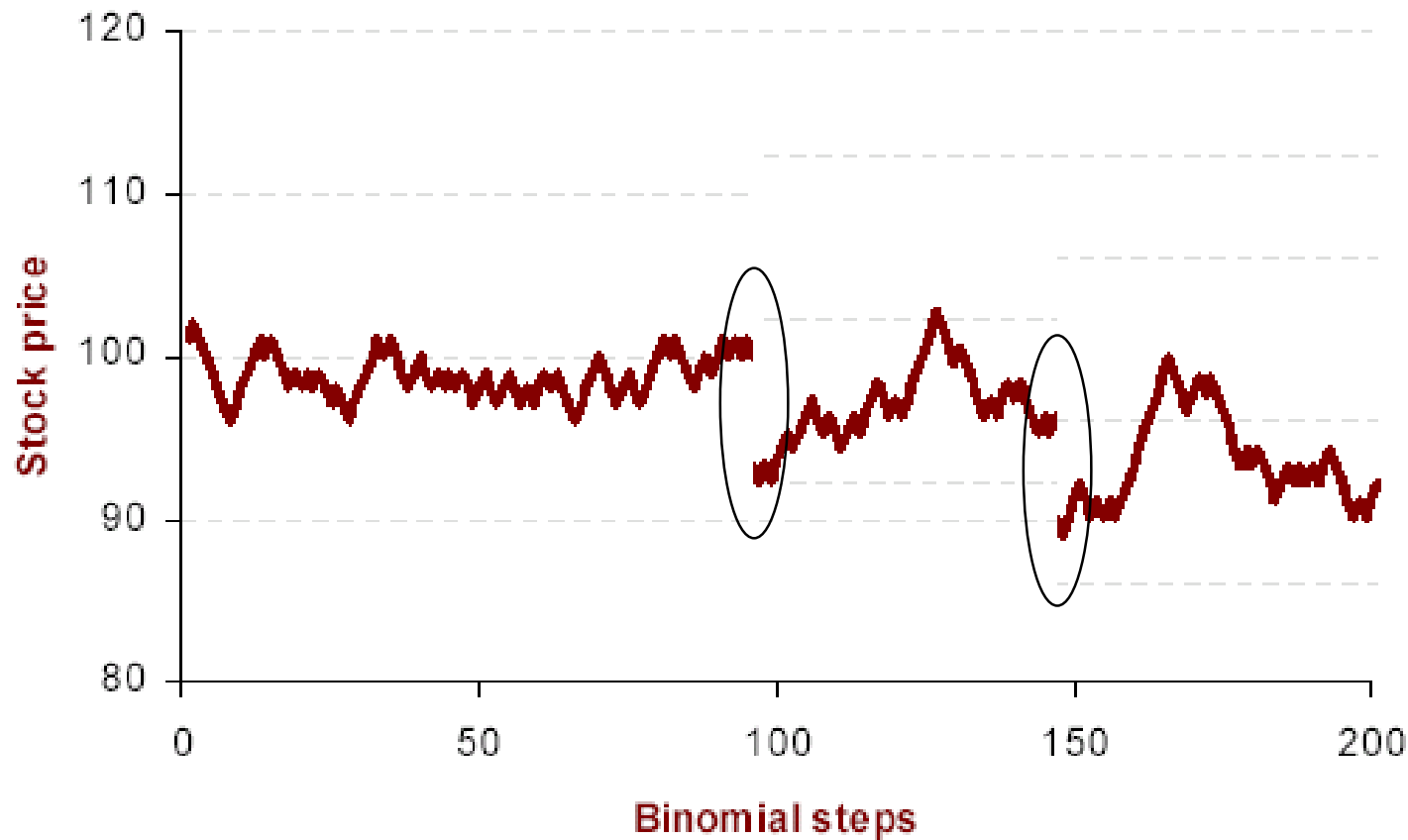
Competition modeling and Real Options 1/2

- The firm has to weight the value of waiting to enter into a new market against the possible erosion of revenue value V of competitor's actions, which it cannot influence.
- The firm has to determine what information has available about competition.
- **In practice, the firm might have a rough idea about the investment revenue V , intensity of competition and its impact without having full information about when and how competitors act.**



Competition modeling and Real Options 2/2

- The underlying asset (investment revenue V) under random competitive arrivals can be modeled as a mixed diffusion-jump process



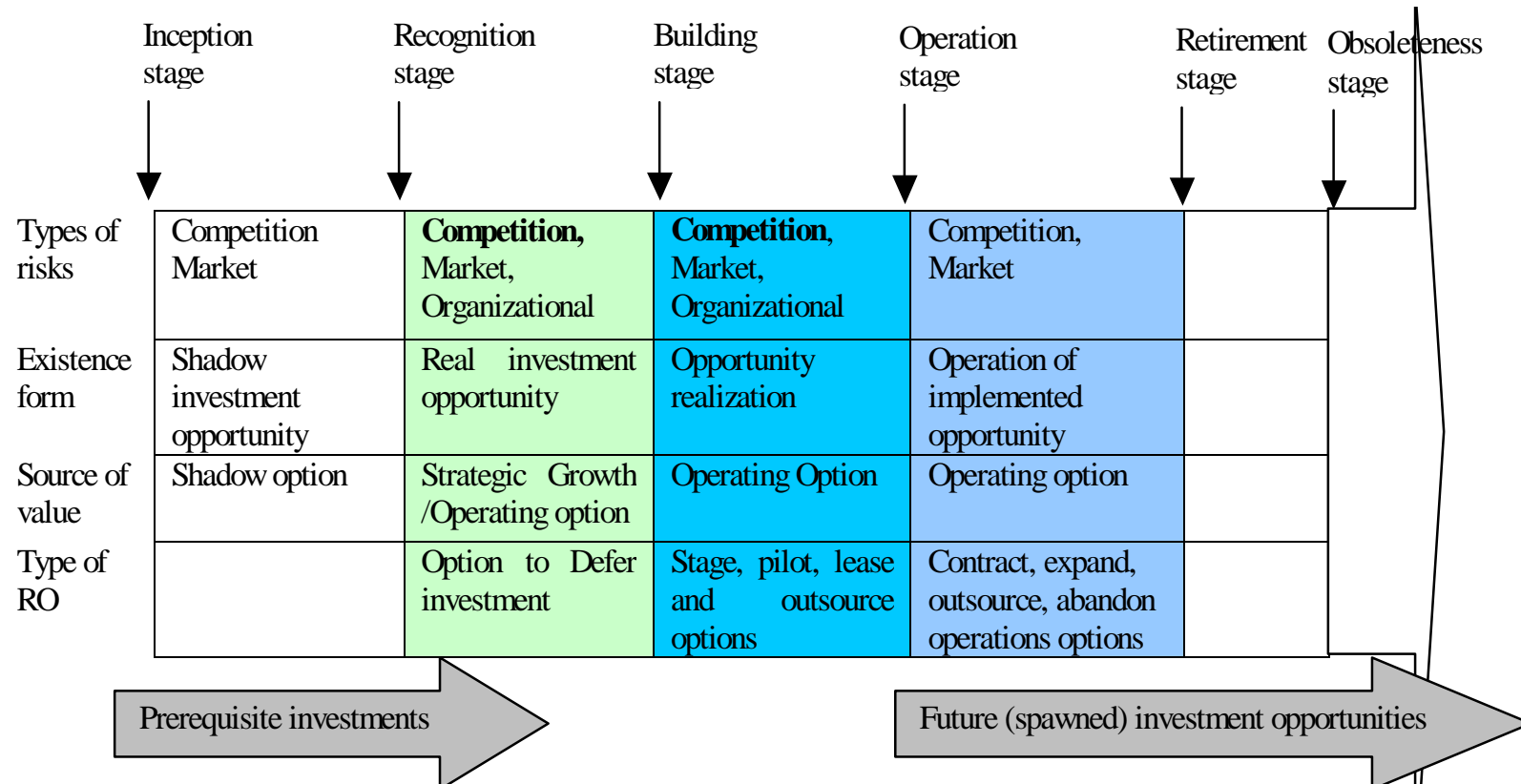


The Greek telecom market as an example

- After liberalization of the Greek market in 2001, an increasing number of new players has entered the market and started competing with the incumbent OTE in the value-added services (e.g ADSL).
- For any new value added service, there is a market “pie” concerning its business activity that is usually growing over time.
- Although, none of them pose a significant threat to OTE, some parts, of the whole “pie” may be subtracted by the competitors as they are entering into the market.
- The OTE’s management has to determine whether it should exercise the option and implement the investment opportunity early or whether it should follow “**wait-and-see**” (**WaS**) strategy despite a competitive damage caused by the early competitors’ entry into the market.



Life cycle of an investment opportunity and ROs

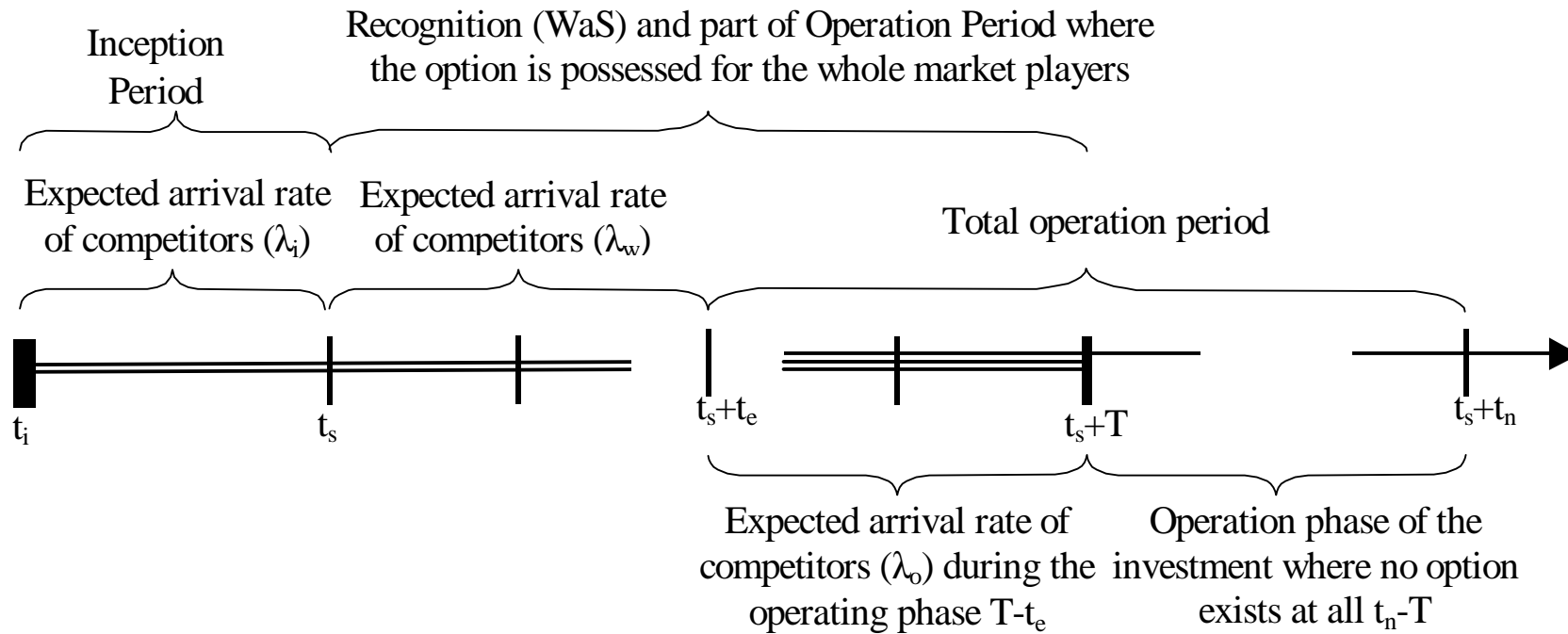


Types of risks and real options arising at different stages in the investment lifecycle



Competition modeling

We define T as the maximum time to enter the market



Inception, waiting (recognition) and operation periods competition modeling for a single RO



Objectives and assumptions of our analysis

Objectives

- To model competition threat and estimate its impact to the value of an ICT investment that can be treated as RO to invest, in the near future, if the business conditions become favorable
- To estimate the influence of correlation between investment revenue V and competition parameters (λ_w, σ_w)
- To find the optimum implementation time for the entry into the market (implement investment)

Assumptions

- We assume that business opportunity concerns a new product or service provision into the market



Competition conditions and investment strategies

We define three terms for modeling the competition conditions:

- *Elimination Threat of Competitors (ETC) during inception,*
 - *Preemption Threat from Competitors (PTC) during waiting,*
 - *Preemption Capability of Firm (PCF) after implementation of investment (operation).*
- No any PCF – ($I_{cwT} - I_{cwe} = I_{co}$). It is more preferable to wait up to time T, since V will be the same independently of the option exercise strategy.
 - Full PCF – ($I_{cwT} - I_{cwe} = I_{co} = 0$) for $t_e < T$. It is more preferable for the Firm to exercise its options at $t = t_e$. There are two effects negatively correlated between each other: i) the uncertainty control assured by both the ROs analysis and the managerial flexibility to deploy investment in a longer deferral period, and ii) the PTC that may fully eliminate the option value for the IO.
 - Partial PCF - It is still a matter of compensation between managerial flexibility and Competition Threat as before.



Optimum time to implement investment

- **Decision Rule:** *Make the investment (exercise the option) at time t_e , $0 < t_e < T$, where T is the maximum deferral time, for which the option OV_{ct_e} is positive and takes on its maximum value.*

$$OV_{ct_e} = \max_{(t=0 \dots T)} OV_{ct}$$

- Assuming that the competitor's arrival follows a Poisson distribution with an expected arrival rate λ_w and an expected competitive erosion c_w the overall option value (n_w, n_o no of competitors' arrivals during the inception, waiting and operation phase) is given by:

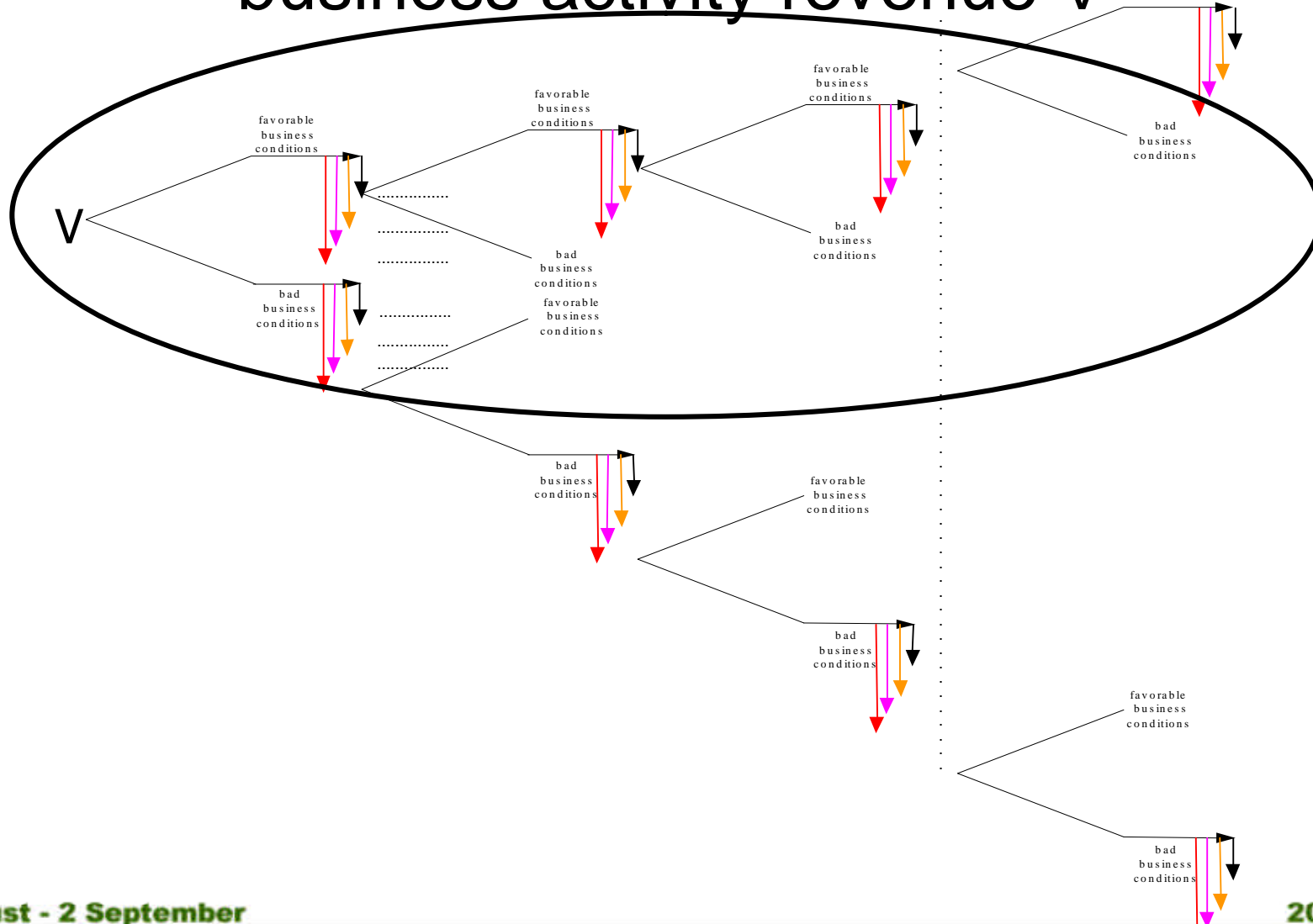
$$\begin{aligned} OV_{cte} &= \max(V_f - X, 0) = \\ &= \max\left[V(1 - c_i)^{n_i} (1 - c_w)^{n_w} (1 - c_o)^{n_o} - X, 0\right] \end{aligned}$$

- The final investment revenue that will be available to the IO is given by

$$V_f = V - I_{ci} - I_{c_w t_e} - I_{co}$$

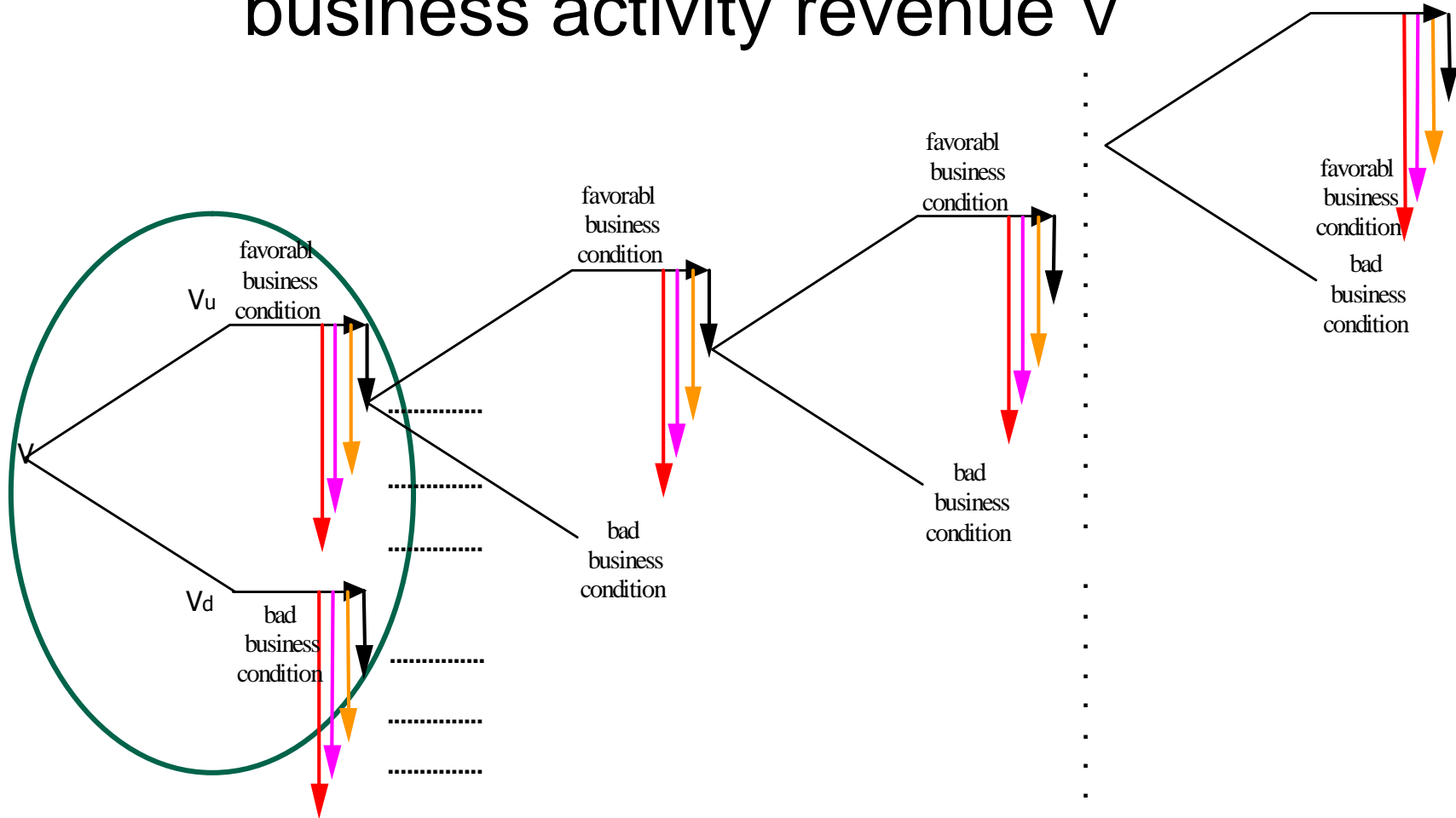


Mixed diffusion and jump processes for business activity revenue V



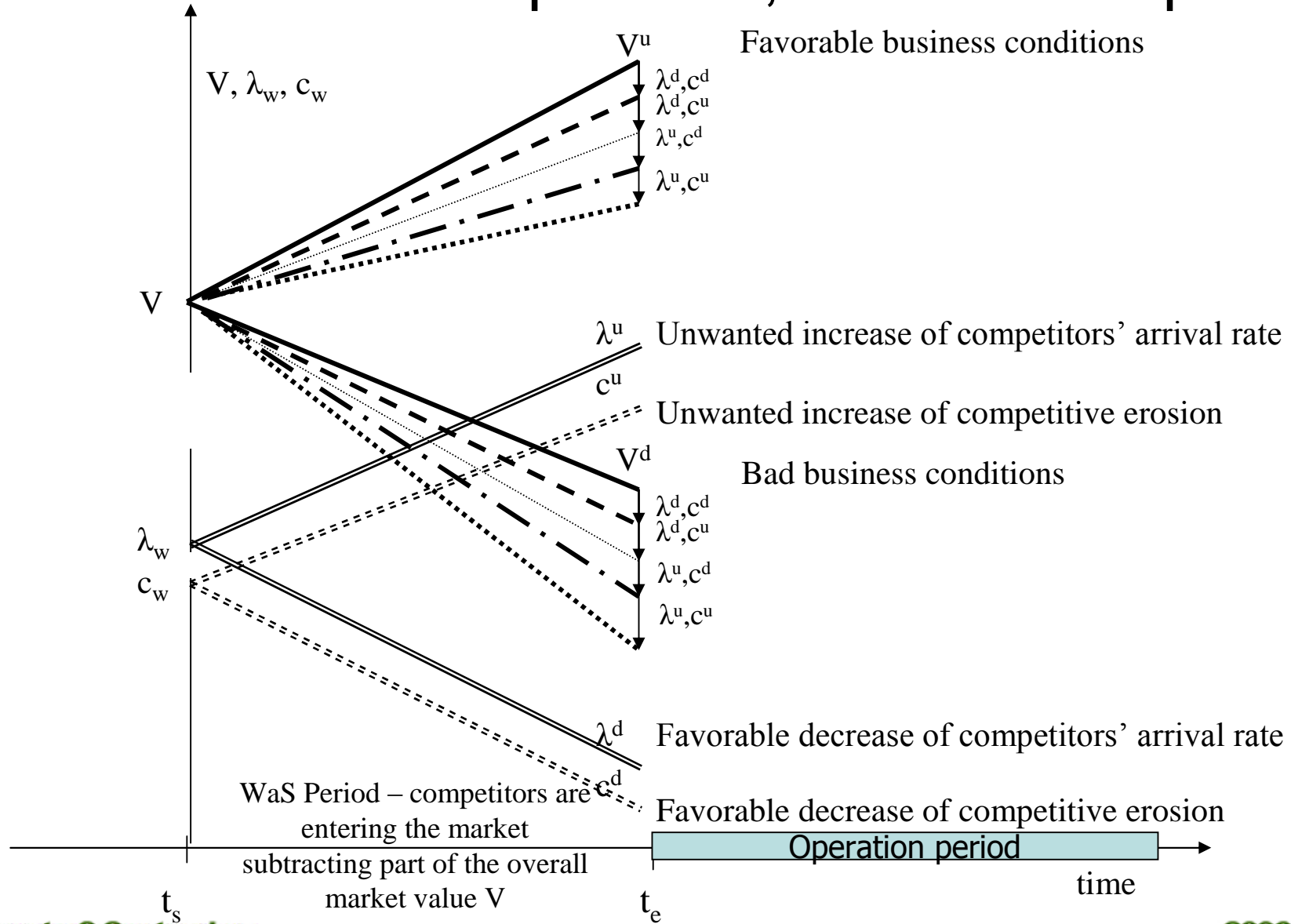


Mixed diffusion and jump processes for business activity revenue V





Joint diffusion process, one time step





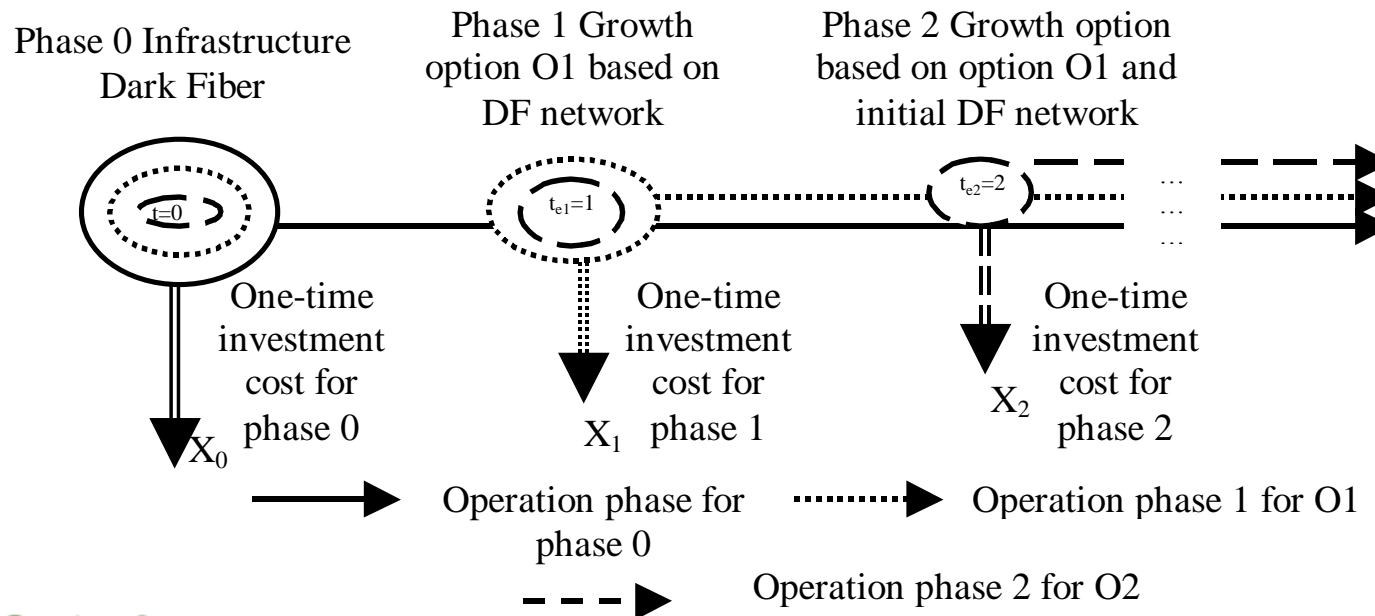
Correlation between revenue and competition parameters

- **λ , c are positively correlated with V**
 - Network externality effects, achievement of critical mass of customers demand.
- **λ , c are negatively correlated with V**
 - The competitors do not have the adequate ICT infrastructure value to fully utilize their own investment's opportunity benefits.
 - In addition cost asymmetry between Firm and other competitors.
 - Information asymmetry between market players.
- **Correlation between λ and c**
 - positively correlated since the higher the competitive erosion is the higher the competitors' incentive to invest will be too.
 - negatively correlated since the higher the the competitors' incentive to invest the lower the competitive erosion will be (not enough space for the new comers).



A real life case study

- The firm under investigation is Egnatia Odos S.A. (EO).
- First (phase 0), EO decides to enter the market of broadband networks, installing optical dark fibers, along the Motorway, looking afterwards for their commercial exploitation.
- Second (phase 1), EO goes a step ahead and decides to light the optical fibers. This means that the customers are able to buy wavelengths. Hiring wavelengths requires the installation, operation management and maintenance of active equipment.
- Finally (phase 2), the company examines the possibility of entering the market of network services provision, like Fast Internet and Virtual Private Networks.





- The total value of an initial infrastructure project (IP), can be represented as a nested options model and is given by:

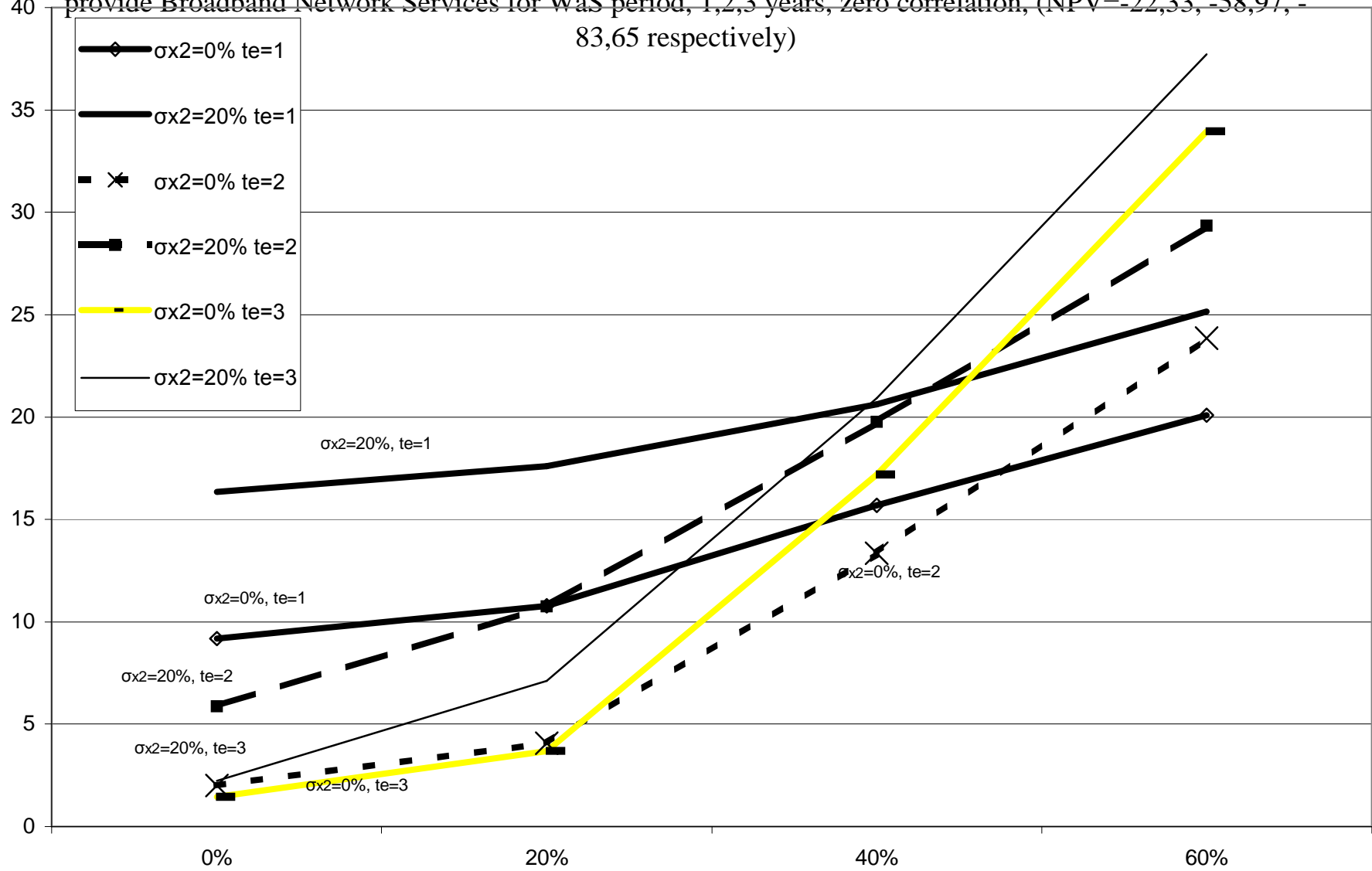
$$ENPV (IP) = NPV_{(phase\ 0-IP)} + Option\ Value[phase\ 1 \\ + Option\ Value_{(phase\ 2)}]$$



Results 1/2

The effect of the competitors arrival rate λ_{w2} and competitive erosion c_{w2} , uncertainty on growth option value to provide Broadband Network Services for WaS period, 1,2,3 years, zero correlation, (NPV=-22,33, -58,97, -83,65 respectively)

Network Broadband Services Option to Growth under Competition

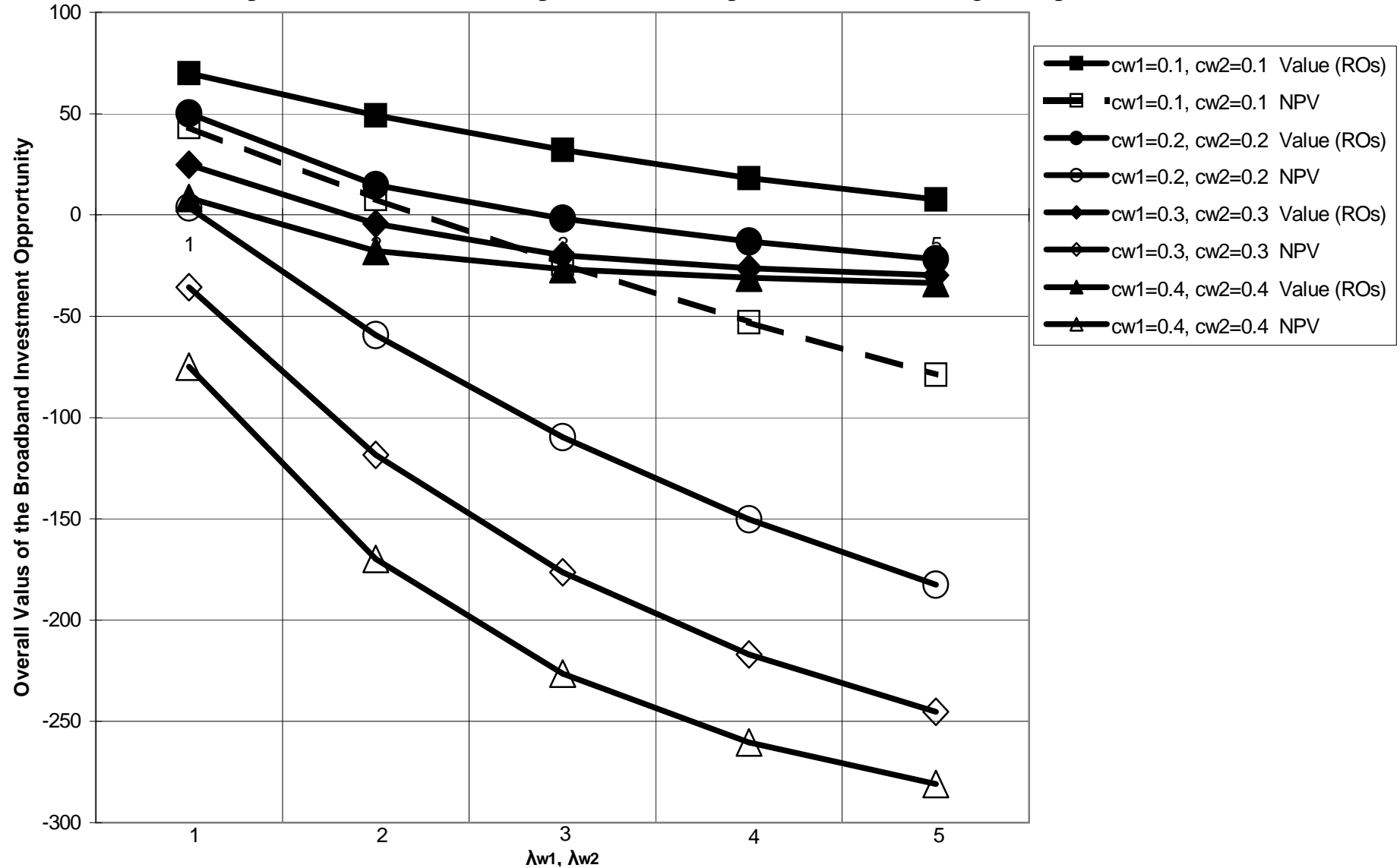


Competitors arrival rate λ_{w2} and competitive erosion c_{w2} uncertainty ($\sigma\lambda_{w2}$, σc_{w2})



Results 2/2

Effect of the expected arrival rate of competitors and competitive erosion during WaS period to the ENPV





Conclusion and Future Research

- The results of our analysis prove that sometimes it is more referable to adopt longer WaS period for an investment opportunity despite competition threat that can subtract part of it.
- Extensions of our work can be the modeling of qualitative factors
- Multiple time steps result to increased granularity and so to increased accuracy in the results. Hence, we capture more efficiently the additional dimension of competition entry.
- To adopt endogenous competition modeling assuming that each one of the competitors in the market experiences a different level of the competition parameters λ_w and c_w (ROs and Game Theory).



Thank You!

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