Network-Switching Version 1.0 | Fairmat

1 Introduction

The Network Switching plug-in is a powerful modeling extension which enables Fairmat to:

- model investment projects which embedded real options containing switching options: if demand or prices change, management can change the output mix of the facility (product flexibility). Alternatively, the same outputs can be produced using different types of inputs (process flexibility). This option is also available to the management when the same business can be operated in several ways, so that the management can choose the best course of action in response to changed circumstances.

2 Quick introduction to the network switching models

The Real Options approach to investment under uncertainty can capture the flexibility of managers to adapt and revise later decisions in response to unexpected market developments and reactions from competitors. This managerial operating flexibility can be regarded as being similar to a financial option. An option on an asset confers the right, but not the obligation, to buy (call option) or sell (put option) the asset at a fixed price (the exercise price) at any time on (European option) or before (American option) a given date (maturity).

Capital budgeting projects often involve embedded Real Options (managerial and / or operational flexibilities). For example, a company that decides to build a new factory immediately will forego the opportunity to delay construction to wait for additional information about the market for its products. This is the option to postpone and it is equivalent to an American call option on the present value of the profits from operating the factory (the asset) with a strike price equals to the cost of building the factory. With a financial option, market volatility or uncertainty as to the future price of its underlying asset (normally a share) will increase the value of the option itself. The same is true for Real Options, which are options on real assets. In the case of the factory investment, the more uncertain the level of profits, the more valuable will be the option to postpone construction and wait for additional information which will reduce

this uncertainty. An investment project that can be postponed is more valuable that an otherwise identical project that can not. This extra value is the value of the flexibility.

Kulatilaka and Trigeorgis (([1],[2])) proposed the general real option pricing model based on the idea of switching among different operating modes and implemented using some discrete-time approximation (either binomial lattices or, in general, Markov chains) of the continuous-time dynamics of the state variable. In their approach, given an investment with many embedded options, at any time a decision is to be made, there is an option to switch from the current *mode* to a different one. The switching cost of the decision is the *strike price* of the option. For further details and examples see [3]).

3 How to use the plug-in

Figure 1 shows how the Fairmat User interface is changed by the plug-in:

- in the option map toolbar, three new buttons appear: network, network node and network transition. The Network button allows you to create a network which is a container of nodes or operating modes. Network nodes represent the operating modes which are the available operating modes, and the network transitions represent the switching cost from going from one operating mode to another.

- in the left panel, a new button called 'Endogenous Variables' appears. Endogenous variables are state variables whose value can be modified by an endogenous decision. This is in contrast to the exogenous variables such as the stochastic processes whose dynamic is independent from the decisions.

In practice, Fairmat Network-switching models allows users to evaluate projects in which a decision maker can choose between different operating modes basically defined by a payoff rate and by an change of state due to the the change of the endogenous variable. The decision maker optimizes the value of the project by choosing rationally the best within the available operating modes. The plug-ins calculates the optimal operating-mode transition policies, the expected value of the project and the probability of being in a given operating mode as a function of time.

4 Examples

- See a Fairmat model for the valuation of a natural resource. The model replicate the example #4 of [3] and can be downloaded in the following page: `http://www.fairmat.com/resources`.

- See a video that shows how to use of the network-switching to model a virtual power plan: `http://www.fairmat.com/software/videos/vpp.htm`.
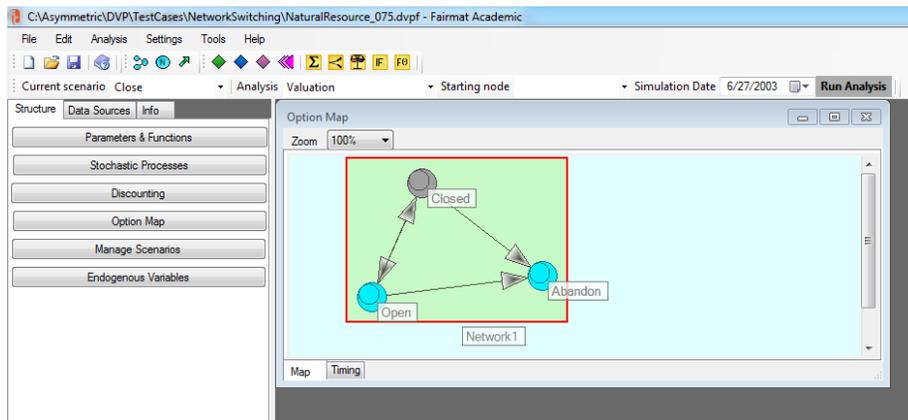
Figure 1: New elements introduced by the Network switching plug-in

References

[1] N Kulatilaka. Valuing the flexibility of flexible manufacturing systems. *IEEE Transactions in Engineering Management*, 35:250–257, 1998.

[2] N. Kulatilaka and Trigeorgis L. The general flexibility to switch: Real options revisited. *International Journal of Finance*, 6:778, 1994.

[3] Gamba A. Real options valuation: A monte carlo approach. Available at SSRN: http://ssrn.com/abstract=302613, 2003.