11 Currency risk management

11.1 Introduction: risk planning over time

We have seen in Chapter 10 methodologies whereby to represent uncertainty and manipulate uncertainty-affected propositions. One particular class of uncertainty is the likelihood of the loss (or gain) of an asset or of return on it, which in a generic way can be one definition of "risk". In general terms, insurance of property and financial assets is the most common way whereby this risk can be limited, and possible losses recouped. However, in most cases, such insurance will have a cost whereby the risk can be protected over a time span; the notion of "premium" corresponds to the payment of the cost of this insurance over a specified time interval.

One basic approach to risk management is to analyse the factors and the probabilities involved. The mortgage loan credit granting system introduced in Chapter 1.4 exemplifies this approach. After that, meaning after the risk has been taken, the remaining approach is to allocate available resources in view of minimizing the likelihood for loss. This corresponds to the role assumed by insurance companies, credit rating agencies, but also commercial enterprises committed to deliver a good/service at a fixed price in the future. To exemplify this last risk allocation approach, we will in this Chapter 11 present a knowledge-based technique addressing this last type of risk management. Of course, this methodology could be extended to the other two main classes of such activity.

Specifically, this Chapter deals with the issue of how to combine, in a knowledge-based way, the currency exposure of an investor or of a company, in view of a portfolio of $N$ assets and liabilities in two currencies. The largest risk are a devaluation, and currency rate fluctuations. This technique consists in several steps:

1. a single period model, which does not take into account the time profile of the exposure to the two currencies
2. a multi-period model, extending 1.
3. a risk management procedure, or allocation procedure, for the $N$ assets and liabilities, which will refine 2., and thus update 1.

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In Steps i. and ii. the exposure for each asset or liability \( i = 1, \ldots, N \) is the sum of commercial, financial and currency futures transactions, represented by their flows of payments over time.

### 11.2 Single period model

The assumed quantities are (Fig. 1):

- **x**: stochastic variable for a devaluation happening, equal to 0 or 1
- **P(x)**: probability for a devaluation of the reference currency \([0]\) versus currency \([1]\)
- **d**: size of the devaluation, as a fraction of the unit of reference currency \([0]\)
- **E(D)**: expected size of \(d\)
- **V(D)**: variance of \(d\)
- **I(0), I(1)**: market interest rates in currencies \([0], [1]\)
- **F**: futures premium in currency \([0]\), as a fraction of the normal exchange rate of \([1]\) vs \([0]\)
- **p_t**: currency rate for \([1]\) in currency \([0]\) at time \(t\)

For the assets and liabilities \( i = 1, \ldots, N \) (Fig. 2):

- **R_i**: total net profit (or expense) from exposure \(i\), expressed in currency \([0]\)