Chapter 6: SUMMARY AND EVALUATION

This study presents a conceptual framework that can serve as an aid in making investment decisions. Our intention is to provide a viable alternative to unstructured *ad hoc* approaches, and to approaches that are restrictive, either in their sophisticated but untractable complexity or in their irrealistic oversimplifications. The framework reveals problems that are often overlooked, often ignored, and seldomly solved. These problems are pin-pointed and, where possibly, solved.

We considered a one-period time frame and focussed on the process of portfolio selection: given an opportunity set of securities, an investor faces the problem of selecting a portfolio out of the multiplicity of portfolios that can be composed.

This chapter summarizes and evaluates our findings. We here confine ourselves to a general level; for more detailed summaries, we refer to the closing sections of each of the previous chapters.

Preamble

We started our study by indicating general stages in the investment decision process and by uncovering the accompanying central problems. We distinguished between three stages:

- security analysis, leading to an adequate representation of investment alternatives;
- preference analysis, leading to an adequate representation of the investor's preferences;
- portfolio analysis and portfolio choice, resulting from an adequate confrontation of investor preferences and security characteristics.

Generally, it is assumed that securities are adequately characterized by the joint distribution of their (future) returns and that the investor can explicitize his preferences with respect to the uni-dimensional portfolio return. This places a heavy information burden on the investor, most clearly illustrated in the expected utility framework. The central problems are the specification and tractable representation of the joint return distribution, the determination of the investor's utility function, as well as their confrontation in order to derive a decision rule. For this reason, simplifying assumptions are adopted in the form of preference assumptions (restricting the class of admissible utility functions) and distribution assumptions (reducing the number of relevant characteristics of the joint return distribution). We briefly reviewed the way in which these 'distribution' and 'preference' issues

are handled in the literature, with special attention for the mean-variance framework and its limitations.

Having sketched the central problems attached to the investment decision and the conventional representation of investment alternatives, we returned to the nature of the investment decision. Portfolio selection models are of a (conditional-) normative nature, implying that the validity of the underlying simplifying assumptions is crucial to their adequate applicability. This introduces the problem of obtaining a sufficient degree of tractability while keeping sufficient grasp of reality. Although some simplifying assumptions cannot be avoided, we stressed that a sensible decision framework can only be obtained when both the desires and preferences of the investor and the characteristics of the investment opportunities are adequately incorporated.

The latter characteristics or attributes identify various dimensions in which securities are likely to differ in the economic environment. The investor's decision context in turn reflects the investment objectives he wishes to attain, the restrictions he thereby faces, and his tastes and preferences, which may be multifarious and complex. We stressed that there exists a clear interrelationship between the decision context and the economic environment. In particular, an investor's perspective on the multitude of aspects characterizing investment opportunities is subjective since it depends on his decision context. In addition, we argued that an investor's perception is limited, in the sense that the investor will not possess perfect insight in these aspects.

Recognizing the interdependence between the investor's characteristics and the securities' attributes implies the need for a detailed and investor-specific security analysis. The outcome of the latter process is a representation of securities according to their exposures to relevant attributes, as perceived by the investor. The multi-attribute representation of securities, in turn, forms the input of the portfolio composition stage. On the basis of his preferences towards the assessed security attributes, the investor strives to compose a portfolio that exhibits a desirable constellation of attribute exposures. The contribution of our study, then, is the sketch of a general approach to portfolio selection that avoids restrictive assumptions on the preferences of the investor and on the representation of investment alternatives. Instead, by pursuing a close correspondence with decision making in practice, the framework signifies a valuable aid in shaping and performing the portfolio selection process in a coherent way.

A multi-attribute representation of investment alternatives

In our view, investment opportunities should be expressed in terms of a limited number of attributes. The degree in which a suchlike representation is adequate not only depends on the securities' intrinsic characteristics, but also on the relevance that the investor attributes to them. As this is contingent on the investor's decision context, no general set of relevant attributes can be specified. Although the choice of attributes depends on the particular investor under consideration, we proposed a categorization in terms of direct return related attributes and indirect return related attributes.

The characterization of securities in terms of direct return related attributes rests on the description of securities in terms of their joint probability distribution. An obvious first attribute candidate is a distribution's locus, measured e.g. by its expected return.

The risk attached to the return is directly related to the distribution's shape. When blending individual securities into a portfolio, the interrelatedness of security returns becomes relevant for determining the portfolio's return distribution. On the securities level, this poses an **information problem** in that the interactions between the returns must be assessed. On the portfolio level, this gives rise to a **combination problem**: the information about return interactions must be processed and aggregated in order to obtain information about a portfolio's distribution. On the preference level, finally, this induces a **criteria problem** since an investor's preferences for the probabilistic information on the portfolio must be assessed. Since the risk dimension is truly problematic in its complexity, we devoted special attention to this aspect.

In order to cope with the risk problem, we focussed on the process generating security returns. Chapter two critically discussed several forms in which these return generating processes manifest themselves, both from a theoretical and an empirical perspective. For our purpose, we have special interest in a multi-factor framework, where it is assumed that security returns are generated from multiple sources. In chapter three, we elaborated in more detail on theoretical aspects of multi-factor models. By conditioning security returns on multiple factors, multi-factor models provide a linkage between the joint distributions of the factors and the security returns. This linkage is concretisized by the securities' sensitivity coefficients for (unexpected) changes in the factors. We unraveled the principle of conditioning (as the reverse of generating) and highlighted the models' ability to reduce the complexity of probability assessments (information problem) and of their aggregation to the portfolio level (combination problem). Multi-factor models imply a risk concept that is both conditional and multi-dimensional. In this context, the role of sensitivity coefficients as risk measures is analyzed.

We raised the analysis to a more concrete level by considering the conditioning of returns on appealing economic variables. Each of these variables or factors represents a dimension of the economic environment in which the security returns are generated. From the perspective of the present value framework, we further illustrated how factor models can be derived. This not only enhances the security analysis, but also enlarges the economic transparancy of the investment decision by translating the risk concept in economic-intuitive terms. An important part of the security analysis process is the estimation of multi-factor models for security returns. In chapter four, we show how empirical meaning can be given to the proposed conceptual framework. This is illustrated a.o. by a number of empirical analyses over the period 1970:1 through 1994:5. We devoted special attention to estimating interest rate sensitivities of common stock returns, evaluating the empirical estimates with our theoretical results presented in chapter three.

Next, we incorporated additional factors into the model. We linked the returns on a general market index and several sub-indices to unexpected changes in (dollar and non-dollar related) exchange rates, oil prices, commodity prices and risk premia. The estimation results for two sub-periods give an impression of the way in which stock returns on the Amsterdam stock exchange are related to these variables. Of course, the specific set of relevant factors depends on the decision context of the investor.

The category of direct return related attributes, culminating in a multi-factor representation of securities, can be complemented with a set of indirect return related attributes. The incorporation of additional attributes in the decision process (again) depends on the particular investor. For any of several reasons, he may indicate there exist various other attributes with which he can discriminate between the attractiveness of investment alternatives. We presented various other attributes that are considered relevant in investment practice. Some of these attributes may actually serve as proxies for (components of) expected return and risk. Their inclusion may thus compensate some inevitable inadequacies of direct return related attributes.

We stress that the selection of attributes is to the discretion of the particular investor, nonwithstanding our own opinion regarding their relevance. Financial theory can help an investor by indicating factors that have proved to be relevant in explaining security returns, or by suggesting other attributes. Financial theory can also advice on finding proxy variables for less tangible attributes or factors, as well as guide the empirical process of estimating factor models. Although we clearly recognize the role of financial theory and the insights it can offer, we warned against thoughtless applications of these insights. We argued at length that pricing models do not provide an absolute standard for judging the relevance of attributes. In his attribute appraisals, an

a close correspondence with decision making in practice. It is **consistent** with decision-theoretic principles and with financial-theoretic insights; in our study, we provided theoretical underpinnings to various aspects of the approach. It represents a **unified** and **coherent** framework in the sense that it covers all of the stages of the investment decision process in a balanced way.

In the stage of security analysis, the limitations to the investor's **perceptions** were explicitly recognized. We assumed neither perfect insight in the real world nor the availability of perfect information about joint return distributions. Instead, all partial and circumstantial information can readily be incorporated into the decision process. What we do assume is that the investor can demarcate a set of attributes which from his point of view adequately characterizes the securities in the opportunity set. A marked advantage of the framework in this context is that it induces a learning process, thus enabling the investor to shift the boundaries of his insights.

In the stage of preference analysis, we avoided making restrictive assumptions with respect to the investor's **preference structure**. We neither required an explicit representation of the investor's preference functional, nor an explicit quantitative specification of his trade-offs among attribute exposures. We do assume that the investor strives to attain various goals. These goals are related to (a number of) the perceived attributes and may be conflicting.

The advantages in the form of weak behavioral assumptions on the side of investor's perceptions and preferences can only be maintained by allowing a likewise degree of flexibility in the stage of portfolio analysis and portfolio selection. The generality of the approach calls for **systematical search procedures** in order to cope with the increased complexity of the decision process. For efficiently confronting feasible portfolios with the investor's tastes and desires, finally, we propose an interactive technique, offering all the flexibility needed.

Without doubt, the integration of multifarious security analysis, non-restrictive preference analysis and flexible portfolio analysis signifies a distinctive advantage of multi-attribute portfolio selection over conventional approaches. This advantage, however, must be credited to the underlying general framework. Its success in real-world applications depends on several circumstances.

Almost silently, we narrowed the set of securities to domestic common stocks. However, the selection of a stock portfolio constitutes only part of a much wider ranging investment decision. The opportunity set of investment alternatives can be enlarged by considering international investment opportunities and, in the light of the asset allocation process, other asset categories. It seems that attributes are ideal vehicles to commensurate various investment categories and that international factor models in turn may adequately cope with

international aspects of return behavior. Further research in this direction is needed.

More explicitly, we adopted a one-period time frame, in sharp contrast with real world dynamics. We briefly touched upon this issue, indicating that the decision context and the economic environment need continuous monitoring and that investment performance should be fed back for a new start of the investment cycle. As portfolio investment is an ongoing process, the portfolio selection decision should be embedded in the process of portfolio management. Apart from the dynamization of the process, the organizational implementation deserves its share of attention. In (professional) investment practice, several of the stages in the investment process are allocated to separate divisions. This requires the coordination of activities and the tuning of information needs throughout the organization.

In the stage of security analysis, the investor indicates a set of relevant attributes. As remarked before, financial theory can help an investor by indicating factors that have proved to be relevant in explaining security returns, or by suggesting other attributes. Financial theory can also advice on finding proxy variables for less tangible attributes or factors, as well as guide the empirical process of estimating factor models. In connection with this last point, the value of the models in a prospective context is important.

We mainly considered linear attributes. One may ask whether this suffices to adequately characterize securities and their returns, especially from the perspective of diversification. Indeed, the inclusion of only one single linear attribute (like expected return) will in principle result in one-security portfolios. Note, however, that multiple attributes –even when they are all linear– in general will induce some degree of diversification. After all, multiple securities will be needed in a portfolio in order to obtain the specific (i.e. desirable) constellation of attribute exposures. In addition, upper bounds on portfolio weights can provide a minimum degree of (naive) diversification. Nevertheless, when an investor still wishes to include non-linear attributes, one can incorporate quadratic or general non-linear routines in the interactive procedure without inflicting the flexibility of the decision process.

On the side of risk exposures, we not only considered sensitivities for all of the (unexpected) factor changes, but also partial sensitivities. The former measures are full domain measures. The latter measures are partial domain measures, since they represent sensitivities for factor changes either above some target value or below some target value. These partial sensitivities cannot only be used for modelling non-linearities in the data, but could also be used as partial domain conditional risk measures. This is an interesting line for future research.

In the context of present value models, we illustrated how factor models can be derived. In this field, there is an obvious challenge for

fundamental analysis to expand the applicability of present value models (dividend discount models) from an expected return oriented context to the more general context of the accompanying risks. In addition, fundamental analysis can provide relevant firm-related attributes.

On a more theoretical side, factor models proved suitable vehicles for simplifying the representation of joint return distributions. In addition to their use as risk models (focussing on the factor sensitivities), they can be of much more general use. We discussed various applications in chapter three and indicated an extension along the lines of probabilistic modelling. It may be fruitful to explore this matter and its application to portfolio analysis in more detail.

Many lines for future research are open yet. Nevertheless, we believe that the sketched methodology in its present form already has a clear potential as a tool to support the investor in evaluating and selecting portfolios that meet his investment goals as close as possible.