Developing and implementing a stochastic decision-support model within an organizational context: The experience.

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Abstract

Enterprise risk management is defined as the strategy that aligns the firm’s business with the risk factors of its environment in the pursuit of strategic objectives. Mathematical models will always be part of enterprise risk management. By means of a case study, we discuss why it is necessary to align a model with the organization in order to achieve the desired results. The structure of a model’s input must fit with the structure of data collection in the firm, and the output must be consistent with the decision structure. Otherwise, data collection will not be properly taken care of and the results of a model will not find their way to where decisions are made.

Since July 1999, Gjensidige NOR Asset Management has used a stochastic programming-based decision-support model for their internal macro hedge fund. The methodology was originally developed as part of a doctoral thesis, and five years passed from the cooperation first started with the university until the model came on-line. This time was needed to develop the ideas, and the necessary tools and procedures.

In Parts 1 and 2 of this series of papers we have discussed the model itself and the relationship between the model and the organization. In this part we discuss the experience of running the model since 1999, including its track record.
Experiences

There has been real money behind the model since July 1999. Since then, the TAA-team, which was established January 1st 1998, has grown from three to seven people. Up until today, the model has had two goals: To achieve excess return and to integrate new employees into the investment philosophy of the team. The results indicate success on both goals.

Up until the second quarter of 2001, much emphasis was put on the latter goal, i.e. the building of the TAA-team. This has been possible since the fund has been run as a separate portfolio within a larger portfolio, and the risk taken in the fund has not dominated the total risk taken. As the experience of the team grows, all emphasis will be put on the goal of generating excess return. The fund will also go public in the near future. In this section we start by discussing our experience with respect to integrating new employees into the investment style / philosophy of the team. Six to seven analysts are involved in the decision making. We discuss the decision making process, including how consensus expectations are calibrated. These observations are put into the picture of organizational learning, before we present the track record of the fund.

Training and integrating employees

There exist many different investment styles or philosophies within equity, bond, TAA and other kinds of asset management. On the one extreme you have funds that are 100% dependent on one or a few star portfolio managers. On the other extreme there are funds that can be run almost
without any investment/market competence, for instance by making use of mechanical trading rules based on empirical prices. Clearly, funds that completely rely on one or a few star portfolio managers and their personal investment styles are vulnerable.

Asset managers compete for skilled labor and will most likely have a certain turnover. It is therefore essential to be able to replace human competence smoothly, i.e. to be efficient in the process of educating and integrating new employees. Our experience in building up the TAA-team is that the modeling framework has been very valuable in this respect. New employees are introduced to an established structured process and will hopefully learn from the investment process and in particular from the processes of generating market expectations. After observing from the sideline for a period, a new employee is allocated a responsibility and is forced to quantify market expectations. Hopefully, and at least if the team has employed the right people, this creates motivation to develop a structured information collection and analyses process. Indeed, this is our experience.

Different analysts will have different approaches in analyzing the markets. One extreme is the pure technician who base expectations on historical price movements and does not care about economic fundamentals. Another extreme does not consider technical analysis at all, and base expectations purely on fundamental analysis. In principle, the modeling framework we are describing does not exclude any analytical style. However, as a macro hedge fund we are based on fundamental analysis. The group has developed a common platform that all the analysts apply, but within this platform, there are many different approaches to analyzing the markets with differences in the emphasis on different factors. The group does not want to exclude any analysis style and we believe that a variety of styles is desirable. The fund has investments with different
time horizons. The investments with long time horizons are very much based on fundamental analysis, while the investments with a shorter horizon often have a stronger tilt to technical analysis.

The decision making process

Consensus decision-making is in general a difficult task. The decision-making is not only about reaching a conclusion, but also a process where responsibilities have to be delegated and followed up in a dynamic world. To ensure high quality decisions, it is important that consensus decision making does not dilute responsibilities and remove possibilities for taking actions based individual knowledge in special situations.

For consensus decision making in portfolio management, an asset management group must agree both on market expectations and the portfolio composition. As regards market expectations, the first step is to agree on what are the important factors that will influence the portfolio composition. Should for instance asymmetry or fat tales in the return distributions be considered and should a possible stock market crash be taken into account? Having agreed on what to agree on, consensus expectations should be established. Given consensus expectations, the next step is to agree on the portfolio composition.

For the problems we are discussing in this paper, the portfolio construction itself is a high dimensional and continuous optimization problem. Finding the potential profit positions and potential hedges can be hard, and deciding the magnitude of each position is even harder. In
general, the group consensus process is made more complicated by differences among team members in both experience and their personal risk attitude. Due to these difficulties it is very common that investment funds are not based on consensus decision-making. Instead, the funds are often split into several sub-funds, which are run by individual fund managers.

We believe that the team consensus process is substantially simplified by using the modeling framework described in part 1 of this series of papers. Its very existence forces the team members to see the full picture, and they will all have to be concerned, not only about their own input, but also that of the others. The portfolio construction itself is done by the TAA-model. Hence, the only consensus decisions are the market expectations. If there are disagreements about the quality of the portfolio, discussions will always have to revert to the data that produced the result. This way the model and the organization are set up to support each other.

There are still challenges in the group consensus market expectation process. In particular, differences in experience and personal risk attitude can create imbalances in the expectation process. By the risk reward trade-off in the objective function of the TAA-model, a common risk attitude function for the group as a whole is established. However, all analysts have a feel for how the portfolio is constructed relative to the expectations. Hence, a risk averse analyst will be careful in presenting expectations that are likely to lead to large positions within “his” asset classes, while less risk averse analysts are more likely to seek such positions. The personal risk aversion levels for the members of the group are functions of both personal attitudes and experience. Due to such differences, the group has put a lot of emphasis on the process of calibrating the expectations. The key is to obtain the right balance between the different model
inputs, taking into account the expectations of each member of the group and the personal
differences within the group.

When calibrating the expectations, much attention is given to the key expectations, which are the
expectations for the return on global cash, bonds, equity and commodities, in addition to the
ranking of the different regions within each asset class. A potential danger in this calibration
process is that the senior group members dominate. However, the group accepts that there are
differences in experience, and seeks to obtain a balance between influence and experience.

**Organizational learning.**

In portfolio management, we believe it is of great importance to document our views and learn
from the mistakes and successes. Many traders use so called trading plotters, where the reasoning
behind a trade and the profit and loss taking levels are documented. With its quantitative
approach, the TAA-team is naturally forced to do this documentation and all material from all
TAA-meetings, including the analyses and the actual expectations, are collected. This is used to
evaluate the performance from month to month and also to make a more comprehensive
evaluation at the end of the year. Our belief is that systematic evaluation sharpens and motivates
the members of the team and that this improves the quality of the investment process.

It may be useful to relate, briefly, the above discussions to organizational learning, see Huber
[1991] for an overview. First, the knowledge acquisition here is mostly through performance
monitoring. The organization keeps track of all its decisions with respect to investments,
including the bases for the decisions, and the financial results. That way, it is possible to
understand, ex post, why a certain decision was made, and hopefully learn, irrespective of whether we are talking about a good or a bad outcome. In particular, this way of keeping records will help avoid hindsight taking the front seat in the learning process. It is a well-known phenomenon that, ex post, all humans seek to explain what happened. Fischhoff [1982] calls this *creeping determinism*. It is hard to accept that an outcome was random, and that something else could have happened as well. In the same spirit, it is important to realize that a good decision can lead to a negative result, simply because of bad luck. Good records will not automatically overcome this problem, but it is a necessary basis for proper learning about random phenomena.

When records are kept this way, also experimental learning is facilitated. By studying the past through the records, the chance is that an organization will learn about aspects of its performance not foreseen when the recording was decided.

The model can also be seen as a computer-based form of organizational memory. This is so since its very structure shows the basis for decision-making in a way that is not fully dependent on human memory. This is what the organization uses to introduce new members into the team.

A related theme to evaluation is the incentive structure. The team as a whole has a performance related bonus and a bonus based on qualitative aspects. In building the incentive structure we must take into account the incentives of the employees, clients, and the owners of the company. The main goal has been to make sure that the incentives of the asset managers are in line with the incentives of the clients and also in line with the longer term goals of the asset management company.
The performance related bonus is the biggest share of the total bonus and is directly linked to the total generated excess return relative to the total risk limits. The qualitative part of the bonus is based on activities that are not directly linked to the performance of the funds. It is up to the leader of the group to allocate the total bonus between the members of the team. This allocation is based on the quality of the input to the consensus group decisions, the performance of the discretionary traders, and also to the contribution to other tasks agreed upon in advance that are not directly linked to the asset management, like sales efforts and model development. This allocation is today done on a judgmental basis. The challenge is to motivate the individuals by giving them credit for good work, but at the same time making sure that the incentive system does not have a negative influence on the group decision process and create internal conflicts. We do recognize the construction of an adequate incentive structure as an interesting area for future research both from a practical and academic viewpoint.

**Track record**

Exhibit 1 shows the performance of the fund since the start up in July 1999. The accumulated excess return from startup to the end of October 2001 is 5.52%. The risk, measured by annualized ex post tracking error (one standard deviation of excess monthly returns) is 1.85%. This gives an average information ratio\(^1\) of approximately 1.27 in each year.

\[\text{Insert Exhibit 1 here}\]
The risk limit for the fund has been 5% in tracking error. The fund has been run for Gjensidige NOR Spareforsikring and Gjensidige NOR Forsikring (the life and non-life insurance company), and the capital base has been 7.5 billion NOK, equivalent to more than 800 million USD, since May 2000.

Recall that the fund applies a pure overlay strategy, meaning that only derivatives are used to construct the allocations. This implies that the underlying money that is put into the fund can be invested in any benchmark, like for instance S&P 500 or Norwegian money market. Hence, for measuring the performance of the fund, it does not matter which benchmark is chosen. The derivative activities generate an excess return. The total return for the client will be the return on the benchmark (whatever that is) plus the excess return generated from the derivative strategies.2

The risk profile of the fund has been modest relative to other funds with a similar macro hedge fund style. Since the fund has run the tactical asset allocation for the life and non-life company, (both running a moderated balance risk), we have chosen to run the fund with a large capital base and low risk. It is the relative risk multiplied by the capital base that will be relevant for the results. For example, if the capital base had been defined to be 750 million NOK instead of 7.5 billion, the excess return and the tracking error would have been 55% and 18.5% respectively, instead of 5.5% and 1.85%. To evaluate the result we need to consider the information ratio and the shape of the actual return distribution. Exhibit 2 shows a histogram of the monthly returns since startup. Notice that the histogram is skewed to the right. The five highest monthly returns in

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1 Information ratio is the excess return divided by the standard deviation of the excess return.
2 The model implication is that the shortfalls (outcomes that generates a negative contribution to the objective function value) will be measured relative to zero. For a cash portfolio, where the cash is allocated to the different asset classes, the shortfalls would be measured relative to the return on a specific benchmark chosen by the customer.
absolute value are positive, and there are nine observations with a higher return than 0.5%, whereas only one observation with a lower return than -0.5%. Although the number of observations is low, it appears that the group is able to construct an asset allocation – which is consistent with the goal of optimization – to create a right skewed return distribution.

Insert Exhibit 2 here

Conclusions

This series of papers describes the use of a stochastic programming based decision support model, which is the core of a macro hedge fund run by Gjensidige NOR asset management. The model is a result of a close cooperation between academic resources and the tactical asset allocation group in Gjensidige NOR Asset Management. We address the interaction between the model and the organization, both in the development and use of the model. We describe how the model was developed in line with the needs of the organization and also how the organization developed relative to the structure of the model.

We illustrate how the model has influenced different parts of the investment process of the tactical asset allocation team. In particular, we discuss the experiences in using such methodology as a basis for group consensus decision-making. Although we believe that the methodology is very well suited for this, there are several challenges. Calibration of market expectations from the different group members is a hard task, and is complicated by the fact that different group members will have different experience and different personal risk attitudes.
The methodology has proven successful in integrating new employees into the investment philosophy of the tactical asset allocation group. It has also proven successful in terms of a good track record for the hedge fund.

It is well known from the decision analysis and operations research literature that models are often not used after being developed. A major reason for this is that the model and the organization are not aligned. Only when responsibilities and incentives are correctly set up can a model function well. This paper has shown how a model and an organization can be aligned to the benefit of all parties. For enterprise risk management to succeed, such alignments are crucial.

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References

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Biographies

Stein W. Wallace is professor of quantitative logistics at Molde University College, Norway. He was earlier a professor of business administration at The Norwegian University of Science and Technology. It was in this position he supervised Kjetil Høyland on the thesis leading to the model of this article. Wallace has published about 50 refereed articles in international journals, and co-authored Stochastic Programming (with Peter Kall on Wiley), the world’s first textbook on the subject (as it is understood now). He has been a member of many international organizations, and chaired The Committee on Stochastic Programming 1992-95. Wallace has been a guest professor at The Centre for Advanced Study in Oslo, INPG in Grenoble, France, University of Washington, Seattle, University of Linköping, Sweden and University of Iceland.

Kjetil Høyland is First Vice President in Gjensidige NOR Asset Management, and holds a Ph.D. in Stochastic Programming from the Norwegian University of Science and Technology. The methodologies described in this paper were to a large extent developed in his thesis. He has been with the tactical asset allocation group in Gjensidige NOR Asset Management since the group was established in 1998. He has been responsible for developing the TAA-models described in the paper, and has also been a key analyst and key portfolio manager of the hedge fund.
Erik Ranberg is Senior Vice President in Gjensidige NOR Asset Management and in charge of the asset allocation. He joined Gjensidige in 1990. He holds a master degree in economics from the University in Oslo. Previous positions have been with the Central Bank of Norway and Den Norske Bank working as analyst, portfolio manager and treasurer.
Exhibit 1. Track record.
Exhibit 2. Histogram of monthly excess returns. The lowest monthly return is –0.67%, whereas the highest is 1.46%