Portfolio construction and diversification

Performance persistence of funds and the advantages of good diversification

The task of selecting investment funds has become a particularly complex one. This document deals with selecting funds and optimizing risk in the construction of diversified portfolios.

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Performance persistence of funds and the advantages of good diversification

Over the course of the final decade of the last century, financial markets experienced significant consecutive rises. Since the peak of the year 2000 and further to the bursting of the internet bubble, the alternating up and down trend, has clearly revealed the ability of some portfolio managers to regularly overperform the share indexes. In a difficult financial context only the best funds can invest in assets which have proved to be very resistant to decline, as they are well diversified and chosen on good fundamentals. This ability to generate alpha is occasionally found in all funds, but much less in those that succeed in perpetuating their performance over several years.

Faced with a multiplicity of funds, the portfolio builder finds himself in a difficult situation due to a lack of transparency within the composition of these financial instruments. He must therefore use statistical methods in order to analyse the behaviour of the funds and make a gamble on the future in good conditions. But how can a portfolio builder choose between the tens of thousands of investment funds and alternative management instruments available on the market ? And which of these will enable him to overperform the financial markets? How can he build a portfolio which is sufficiently diversified so as to achieve a minimum value-at-risk in the class of selected assets. In other words, how can he assemble the best assets so as to create synergy in performance ?

Selection of funds

The difficulty with selecting funds lies in the lack of information relating to their composition and their strategy. The published obligatory documents define a wide field of investment and do not provide an accurate view of the strategy followed. It is therefore necessary to rely on precise, tailored and well-defined criteria if one wishes to have a fair chance of seeing past performances reproduced in the future.

Performance measures

1. Annualized profit (including potential dividends)
2. Beta : volatility of an asset or portfolio in relation to its benchmark. If this number is greater than 1, the asset or portfolio amplifies market movements, if it is lower than 1, it reduces market movements and offers less risk than the market.
3. Sharpe Ratio : measure of the return of an asset in relation to its volatility
4. Treynor Ratio : measures return in relation to the volatility of an asset
5. Jensen Alpha : measures performance excess (or deficit) in relation to the market.

6. Sortino Ratio : modification of the Sharpe Ratio which considers only an asset's downward price changes.
7. Value-at-risk : maximum percentage of decline over a period of time and for a given confidence threshold. It is based on historical price trends and is modelled on volatility. Value-at-risks are, in general, calculated with two possible levels of confidence – 95% and 99%. This value-at-risk is based on the Normal law and then corrected by the Cornish-Fisher approximation to adjust asymmetry, the Kurtosis excess and the extreme values recorded on all assets. The corrected value-at-risk is thus closer to the historic reality.

Choosing a benchmark

These methods are widely used by the financial community as a whole but in some cases they can prove inappropriate and can lead to the wrong conclusions being made as regards the selection of funds, particularly if the benchmark has been poorly chosen.

If funds selected on the basis of their alpha publish an inappropriate benchmark then performances may be overvalued. Let us take the example of a fund partially invested in small capitalizations but having as a benchmark the principal index of a marketplace (SP500, EuroStoxx, FTSE, DAX, CAC40, etc). It is highly probable that it will overperform the principal index in a period of euphoria. Nevertheless, this is not due to the manager's skill in selecting the best, publicly traded securities that make up the benchmark index but to a higher risk taken on the small capitalizations. Examples such as these are multiple, particularly when it is a multi-strategy fund.

It is therefore necessary to verify, with the help of correlation, whether or not the benchmark appears adequate and possibly to substitute it for another benchmark which could be calculated on the basis of several indexes, but which must reflect, as best as possible, the strategy followed by the fund.

Performance persistence

Overperforming its benchmark over a period is certainly interesting, but totally insufficient to interest investors. Indeed, achieving a positive alpha during a given period is only of interest if the probability of this reoccuring is raised, if not the investor risks recording a performance akin to the benchmark. Investing in a fund can only be justified over the long term if the alpha is regularly observed. ETFs now allow investment on share indexes with the guarantee of performance equal to that of the index and with management costs 2 or 3 times lower. It is therefore important to be able to measure if the performances are regular and due to the expertise of the manager or, on the contrary, if they are occasional, thus risking regressing, at term, to those of the benchmark, at best.

Measure of performance regularity

A good and simple indicator for measuring performance is to look at the number of weeks of positive alpha in relation to the defined period of time. This indicator reveals the ability of the fund manager to overperform his benchmark in a probable fashion. However, the question remains as to whether this is due to chance, which remains a possibility even over a period of 3 years, or if on the contrary, it can be considered that, given the results, this is statistically improbable.

By using the Hurst exponent applied to profits and alphas we can respond to this question and show whether or not positive or negative performances are unpredictable. If this exponent is greater than 0.5, the trend is considered persistent, if it is less than 0.5, the trend is considered as anti-persistent. However, this indicator does not reveal the direction of the performances and its significance can therefore be double-edged : either the manager is persistent in his good performances or he is persistent in his poor performances. Of course, an appropriate selection must be made, it is therefore essential to use this statistical indicator in conjunction with another indicator such as the D-Stat test which is the absolute value of the sum of alphas or positive profits divided by the absolute value of the sum of alphas (and/ or positive profits). The D-Stat test can differentiate between good performance and poor performance. These indicators cannot draw definite conclusions for the future however, studies carried out between 1997 and 2002 validated their effectiveness in revealing regular overperfomances of certain funds in relation to their benchmark (Da Souza and Gokcan 2004).

Portfolio construction

The objective of constructing a portfolio is to obtain a global position for which the criteria described above for measuring performance and performance persistence are better than those of each of the chosen funds. If this is the case, the portfolio builder will achieve profitability superior to the benchmarks, volatility significantly below that of the markets, performance regularity and, consequently he will minimise these risks on the market.

Asset allocation

Each investor must choose his own asset allocation strategy according to his constraints, his fundamental convictions and his aversion to risk. Once this strategy has been established, he selects several groups of assets which correspond to his allocation strategy. Preselection must be carried out on the basis of the criterias of profitability, risk and performance persistence, described above. The question that must be considered is how to choose assets in such a way that the constructed portfolio improves the performance criterias defined above.

Synergizing fund selection

Some selection criterias such as profit, beta and alpha are additive. The resulting portfolios will therefore have a profit, beta and alpha equal to the average of these three indicators. Other effectiveness criteria (Sharpe Ratio) or risk criteria (volatility, value-at-risk) are not additive, their resulting value cannot therefore be evaluated by the weighted average of each of these indicators but will be mathematically dependant upon other factors.

Profitability criteria

A selection of funds based only on the criteria of profit, beta and alpha is therefore incomplete and will have no synergizing effect at a portfolio level. These criteria are therefore insufficient for constructing a portfolio and can even lead to an illusory forecast and diversification if the selection is carried out exclusively on this basis.

Risk criteria

The outcome of the risks of each of the assets is, on the other hand, extremely complex to evaluate as it depends at the same time on the range of price varations of each of these assets (volatility) and the manner in which these price variations are produced in each, in relation to the others. In other words, on the degree of internal covariance of the portfolio. Let us take the example of a portfolio composed of 16 funds. All things remaining otherwise equal and with identical volatility, the resulting volatility of the portfolio can vary from 1 to 4 depending on whether the correlations are close to 0 or are close to 1. Reality teaches us (see table 1) that the financial markets are inevitably correlated. On the one hand, the globalization of the economy has the tendency to propagate periods of recession or euphoria to all countries. On the other hand, indexed management and internationalization of investments contributes massively to increasing the correlation of financial assets. However, not all funds are in the same boat and they can be invested in different classes of uncorrelated assets. One of the key elements of portfolio construction is to know how to track down managers with performances which are top quality, persistent and furthermore are less correlated to the markets than most funds.

Table 1 below shows North American growth stock and yield stock which make up the S&P 500 index. This data was collected over several periods between 1991 and 2002. A relatively stable strong correlation is maintained from 1991 to 2002.

Table 1

Correlation in relation to the S&P 500 (January 91 – December 02)	91-92	91-94	95-99	00-02
Growth stock	93%	91%	92%	92%
Yield stock	75%	80%	77%	72%

While a position's risk can be evaluated by the intensity of its volatility, the value-at-risk is more appropriate since, in practice, financial assets do not have a perfectly Gaussian price distribution and it is advisable to take into account their asymmetry (Skewness) and their « peakedness » (Kurtosis). Choosing assets for a portfolio so as to obtain the lowest possible value-at-risk amongst a preselect ion is not an easy feat as neither the volatility, nor the Skewness, nor the Kurtosis add up. However, it is a determining element of choice, since the possible reduction of value-at-risk in relation to that of other preselect ion funds is significant. While volatilities can increase or decrease by a substantial amount, studies show that correlations vary from one period to the next, but over several trimesters a certain stability is observed and this occurs regardless of the class of asset used. This gives us an important lever which can help to reduce the portfolio's value-at-risk. This reduction will lead to a higher Sharpe ratio and a much lower probable maximum loss. All this from an identical volatility and profitability.

But this raises the question of how, amongst a preselect ion of several tens or even several hundreds of assets, to individualize the group of assets which present the most interesting synergy in order to minimize risk. There is a very high number of possible portfolios in such a selection and it is impossible to study them all. The construction algorithm within the Portfolio software enables this research to be carried out and enables the study of performances within the portfolio over several time periods, thus validating performance persistence.

Effectiveness criteria

An asset is described as effective if its Sharpe ratio is positive, meaning if the investor receives a return greater than the risk-free rate for a given volatility threshold. The Sharpe ratio depends on three criteria of which only two add up to the level of the portfolio, the third, the resulting volatility, being a function at the same time of the volatilities of each of the funds and the correlations of their market values. According to the choices, with equal profitability, the portfolio can turn out to be more or less effective in terms of Sharpe ratio.

Portfolio diversification

Table 2 below highlights the correlations between the main share indexes in Europe, the USA and Japan.

Table 2

2003-2006	CAC 40	DAX	FTSE 100	NIKKEI 225	SP 500
CAC 40	—				
DAX	88%	—			
FTSE 100	85%	76%	—		
NIKKEI 225	27%	24%	24%	—	
SP 500	49%	57%	44%	8%	—

This table speaks for itself. The French, German and English stock markets offer only a little room for diversification as far as big capitalizations are concerned. Indeed, the correlation coefficients vary from 76% to 88%, which means an investor investing equal amounts on these three European indexes through an ETF will only reduce his risk very slightly. Every shockwave and period of euphoria will occur at the same time and in the same way. The portfolio's volatility and value-at-risk will be connected to those of each of the indexes.

It is not the same for an investor investing on the DAX, the NIKKEI and the SP500 who will see his value-at-risk considerably reduced by a correlation ranging between 8% and 24%. The internal correlation of such a portfolio is established at 30%, it is therefore far from being completely diversified, but constitutes an improvement in relation to the preceding portfolio. Profit or alpha performances remain equal to the share index average, but the volatilities and value-at-risk (and therefore the Sharpe ratio) are considerably improved through a much more diversified construction. Table 3 shows that while correlations can vary, over a term of several years a certain stability is observed. This allows, to a certain extent, planning of the future and gives a precise idea

of the outcome of good diversification in the construction of the portfolio. There are numerous advantages for the investor, such as a maximum capital loss less significant than on the indexes, a shorter under water period and a maximum risk divided by two or three etc.

Table 3

Correlations	2002-2003	2004-2005	2006-2007
CAC 40/DAX	85%	93%	93%
CAC 40/FTSE	83%	83%	91%
DAX/NIKKEI	18%	34%	32%
DAX/DJIA	67%	41%	54%

Measure of diversification

The criteria for the diversification measure are derived from the degree of internal correlation of the portfolio which is calculated by adding the correlations of each of the assets taken two by two. This gives an internal correlation percentage of between -100% (in the case of an immunized portfolio) and + 100% (in the case of a portfolio with zero diversification), a good diversification ranges between -10% and 0%. In order to achieve this it is necessary to call on several categories of funds invested in diverse underlyings, to call on alternative management funds, or to carry out a particularly extensive investigation, if limiting oneself to the category of equity funds. An intra-portfolio correlation of 0% is considered equivalent to a risk elimination of 50%, a correlation of minus 100% is equivalent to a risk elimination of 100% and a correlation of 100% is equivalent to a risk elimination of 0%. By using the correlation statistics presented above, we can see that with an average correlation of 83% over the three European indexes – CAC40, DAX and FTSE we are close to an absence of diversification. It is therefore essential during the construction of a portfolio to accurately quantify this element which serves as a good indicator of the degree of diversification. It is all the more important in situations where the fund manager is faced with regular or unexpected cash outflows which can heavily penalize his performances if they occur during a difficult period.

Diversification, besides the indisputable advantage that it presents in terms of reducing risk, also enables the achievement of much greater regularity in the performances of a portfolio and, if the assets have been well selected, the achievement of a persistent Sharpe ratio that is much better than the benchmark. Diverse portfolio management construction simulations carried out, with the help of the Portfolio software, on funds invested on several continents have highlighted these advantages.

Internal correlation stability within a portfolio

Only the temporal stability of correlations allows us to draw conclusions for the future.

Portfolios constructed with the help of the Portfolio software, as well as the correlation statistics from the main share indexes (table 3), allow us to demonstrate that, while correlation variations exist in the short-term, one observes for all portfolios a certain stability over the long-term (one year or more) with variations whose range does not challenge the degree of diversification, particularly if the portfolio is made up of a good

number of lines. It is, however, essential to follow the development of this element throughout the entire life of the portfolio so as to conduct arbitrage of the funds which behave unexpectedly and are capable of affecting the degree of diversification of the portfolio.

Diversification and number of lines in a portfolio

The addition of lines in a portfolio only has a positive effect on its diversification if the funds which are added have a weak correlation with all the other elements. Moreover, even with zero correlation, the extra benefit of the addition of funds on the degree of diversification, tends mathematically to decrease as fast as the number of lines increases ; and the difficulty of finding funds becomes greater since they must have a minimum correlation with all the portfolio's assets and must also satisfy the performance persistence criteria. It is better therefore to be satisfied with a limited number of lines.

Internationalization of portfolios is quickly becoming an essential element in the effectiveness and quality of diversification and this is complicating the task of the manager. On the one hand the manager has a better knowledge of the country in which he resides (the best alphas are achieved by local managers), on the other hand foreign currencies make him run additional risks.

The portfolio manager must therefore rely on sound and thorough databases containing historical price trends and case histories relating to a very large number of funds.

Variations in a portfolio's internal correlation

Statistically, the correlation between assets tends to vary upwards in periods of stock-market turbulence and also in periods of euphoria. It recovers its historic level in periods of normality. However, the long term trend observed over the last three decades shows a definite upward trend in the correlation of indexes.

Conclusion

Choosing funds is a difficult exercise which necessitates resorting to comprehensive databases, built from several years of case histories relating to several countries, so as to take full advantage of the effect of persistence in performance and the effect of diversification. Only after studying the behaviour of a portfolio over several periods is it possible to deduce a good probability of performance continuity. Arbitrage, which must be less frequent, should be carried out periodically in instances where certain funds are deviating from the forecasted trend with regard to their performances or their degrees of correlation. The volume of financial data and calculations required by these analyses is immense. The use of software such as Portfolio, published by JM Software, is an extremely useful tool in the realisation of such analyses.