EDHEC RISK AND ASSET MANAGEMENT RESEARCH CENTRE
Edhec -1090 route des crêtes - 06560 Valbonne - Tel. +33 (0)4 92 96 89 50 - Fax. +33 (0)4 92 96 93 22
Email: research@edhec-risk.com – Web: www.edhec-risk.com

Indexing Hedge Fund Indexes

December, 2003

Noël Amenc
Professor of Finance at EDHEC

Lionel Martellini
Professor of Finance at EDHEC

Mathieu Vaissié
Research Engineer at the EDHEC Risk and Asset Management Research Center

Noël Amenc, PhD, is a Professor of Finance at Edhec, where he heads the EDHEC Risk and Asset Management Research Center, and Director of Research and Development, Misys Asset Management Systems. His expertise is in the relationship between modern portfolio theory and performance evaluation of actively managed funds. Email: noel.amenc@edhec.edu.

Lionel Martellini, PhD, is a Professor of Finance at Edhec and the scientific director of the EDHEC Risk and Asset Management Research Center. He conducts active research in alternative investment strategies, quantitative asset management and derivatives valuation, and has served as a consultant for various international institutions on these topics. Email: lionel.martellini@edhec.edu.

Mathieu Vaissié is a Research Engineer at EDHEC Risk and Asset Management Research Center and a PhD candidate in Finance at University Paris 9 Dauphine. He specializes in multi-factor models and their use for benchmarking hedge fund returns. Email: mathieu.vaissie@edhec-risk.com.

PREAMBLE

Hedge funds currently represent nearly 700 billion dollars in managed assets. Institutional investors' increasing interest in hedge funds and the massive inflow of capital that has followed has brought an end to the relatively confidential nature of alternative investment strategies, which can no longer reasonably be considered to be a marginal activity within the asset management industry.

There are however a number of obstacles to the industrialization of the alternative investment industry. Its adoption by institutional investors will only come about if a serious effort is made in terms of transparency and rationalization of the investment management process and, above all, performance evaluation. Due to the scarcity of information, the logic of representativeness through market capitalization is difficult to apply to the alternative universe. As a result, finding a benchmark that is representative of a particular management universe is not a trivial problem. The different indexes available on the market are constructed from different data sets, according to diverse selection criteria and methods of construction, and they evolve at differing paces. As a result of this heterogeneity, investors cannot rely on competing hedge fund indexes to obtain a "true and fair" view of hedge fund performance. Investors are therefore at a loss when selecting benchmarks.

As a response to the needs of investors, the Edhec Risk and Asset Management Research Center proposes an original solution by constructing an "index of indexes", which performance is posted on a dedicated web site (www.edhec-risk.com). The aim of the methodology used to construct this "index of indexes" is to construct a benchmark with degrees of representativity and stability that are significantly higher than those of the indexes available on the market. This methodology was first introduced in Amenc, Martellini (2002a). The statistical process leading to the construction of the "index of indexes" (i.e., the Edhec Alternative Indexes) gives them interesting portfolio properties. These indexes improve the soundness of the strategic allocation process and they can be replicated more easily. Hence, the Edhec Alternative Indexes are ideal candidates to help investors to allocate a significant part of their portfolio to the alternative class.

I. THE HETEROGENEITY AND BIASES OF ALTERNATIVE INDEXES

The full flexibility enjoyed by hedge fund managers in terms of products used and strategies implemented leads, as we might expect, to a high degree of diversity in terms of management styles. Just as in the traditional world, this diversity can also be found at the level of the index providers (henceforth referred to as competing indexes, cf. table 1 underneath). It also appears that different competing indexes are constructed from different data sets, according to diverse selection criteria and methods of construction and that they evolve at differing paces.

Such diversity poses serious problems to investors. To see why, we first consider the different biases that are characteristic of hedge funds and their impact on the performances of the different competing indexes available on the market.

Table 1: List of Hedge Fund Index Providers as of December 2003

Index Provider	Launch Date	Calculation Method	Web Site
Hennessee Group (***Hennessee***)	1987*	AM*	hennesseegroup.com
LJH Global Investments (***LJH***)	1992	AM*	ljh.com
Van Hedge Fund Advisors International, Inc. (***Van Hedge***)	1994**	AM*	vanhedge.com
Hedge Fund Research, Inc. (***HFR***)	1994	AM*	hedgefundresearch.com
CISDM / MAR (***CISDM***)	1994	Median	marhedge.com
HedgeFundNews.com / Bernheim Index (***Bernheim***)	1995	Not communicated	hedgefundnews.com/
Evaluation Associates Capital Markets, Inc. (***EACM***)	1996	AM*	eacmalternative.com
Hedgefund.net / Tuna Indexes (***HF Net***)	1998	AM*	hedgefund.net
HFIntelligence / Invest-, Europe-, Asia-Hedge, Absolute Return (***HFIntelligence***)	2002 / 2001 / 2001 / 2003	Median	hedgefundintelligence.com
CSFB/Tremont Index LLC (***CSFB***)	November 1999	WM**	hedgeindex.com
Investorforce / Altvest (***Altvest***)	2000	AM*	investorforce.com
Zurich Hedge Fund (***Zurich***) ****	2001	AM*	www1.zindex.com
Standard & Poor's (***S&P***)	2002	AM*	spglobal.com
ABN AMRO / Eurekahedge (***Eurekahedge***)	May 2002	AM*	eurekahedge.com
MSCI Hedge Fund Indexes (***MSCI***)	July 2002	AM* & WM** for the global indexes	msci.com
Blue Chip Hedge Fund Index *(**Blue X**)*	October 2002	Between 2% and 8% for a HF and maxi 20% for funds from the same organisation	bluex.org
Feri Alternative Assets GmbH (***Feri***)	December 2001	AM* & WM** for the composite index	feri-alta.de
Edhec Alternative Indexes (**Edhec**)	March 2003	Principal Component Analysis	Edhec-risk.com
MondoHedgeIndex (***MondoHedge***)	March 2003	AM* & WM**	mondohedgeindex.com
Talenthedge	October 2003	AM*	talenthedge.com
Barclay Group / Global HedgeSource Hedge Fund Indexes *(**Barclay**)*	September 2003	AM*	barclaygrp.com/indexes/ghs/

** Arithmetic Mean, i.e. the indexes are equally weighted*

*** Weighted Mean, according to the net values of the funds, i.e. the indexes are value weighted*

Source: Vaissié (2003)

The Biases of Hedge Fund Indexes

Hedge fund indexes are built from databases of individual fund returns, and therefore inherit their shortcomings in terms of scope and quality of data, which vary a lot among various data vendors. In what follows, we review the biases hedge fund indexes are known to suffer from.

A fund's participation in a database is voluntary, which poses a real problem in terms of the reliability of the data published ("**self reporting bias**"). A fund can in fact decide, for one reason or another, to register in one or more databases. Since the funds that have refused to report to one or other of the databases are, by definition, unobservable, it is not possible to evaluate the impact of this bias. In addition, since some refuse to display their performance because of poor results and others because they have already reached their critical size, it is even difficult to know whether this bias has a positive or negative impact on the performances announced. The lack of transparency also poses a problem in terms of the reliability of data and exposes investors, in particular, to a risk of a change in the manager's management style (this is known as "**style drift**", cf. Lhabitant - 2001). Hedge fund managers are under no obligation to publish the details of their positions, so it is very unlikely that they will hesitate to seize an investment opportunity, even if this means modifying their management style temporarily (without going as far as declaring it). It is once again difficult, or indeed impossible, to put a figure on the impact of this bias, due to the prevailing lack of transparency.

The voluntary nature of the act presupposes that only some of the funds will decide to register. Since hedge funds do not have the right to advertise, the fact that they are recorded in a database is important in terms of

communication, which is why they may decide to register even if they do not intend to give out information on a regular basis. This makes it possible to smooth the results, a practice that is largely facilitated by the complexity and low level of liquidity of the products handled by the hedge funds (i.e. a "**stale prices**" or "**managed prices**" problem). Asness, Krail and Liew (2000), for instance, revealed an increase in the volatility of convertible arbitrage returns of 41.5% when one switches from monthly data to quarterly data. In the same vein, Okunev and White (2002) evidenced that the volatility of fixed income strategies could be under evaluated by up to 100%.

Depending on the date at which the database began, the quality of past information will vary (notably for funds that ceased their activity before the database began). This affects the performance of the index to a greater or lesser degree, depending on the number of funds that stop communicating their results each year (referred to as the attrition rate) and the average performance differential observed between those funds and the remaining funds. This is known as a "**survivorship bias**." Since the HFR and MAR databases began in 1994, it is likely that they will dispose of more accurate information than the CSFB database (which only begins in 2000) over the period 1994/2000, and that they will not be affected in the same way by survivorship bias. Fung and Hsieh (2000) valued the average impact of this bias at 3.0%, compared to 2.6% for Park, Brown and Goetzmann (1999). As a comparison, it should be noted that Malkiel (1995) estimated this bias to be 0.5% for mutual funds. The various databases are again affected in different ways by this bias. For example, the TASS database has a higher survivorship bias than the HFR database because it has a higher attrition rate, which in turn is due to different selection criteria for adding and removing funds.

The funds have selection criteria that can be very diverse, and the data provided will not be representative of the same management universe. This is referred to as "**selection bias**." For instance, HFR excludes managed futures from its databases while TASS and MAR take them into account. Most funds are present in one but not the other: of the 1,162 HFR funds and the 1,627 TASS funds, only 465 are common to both databases. 59% of the funds that are still in activity and 68% of the funds that no longer report to HFR are not part of the TASS database (cf. Liang - 2001). On top of this, indexes are rarely representative of their own database, as can be seen in table 2.

Table 2: Number of funds in the databases as of December 2003

Index Providers	Database	No. of Funds in the Database	No. of Funds in the Indexes
Van Hedge	Proprietary Database	+5,400	1,300
Feri	Proprietary Database + Other Available Databases (Van Hedge, TASS, HF Net)	+5,000	41
Hennessee	Proprietary Database	+3,500	+690
S&P	Proprietary Database + Other Available Databases	3,500	40
CSFB	TASS Database and Tremont Database	3,300	431
HFIntelligence	Proprietary Database	3,202	2,652
Altvest	Proprietary Database	+2,600	All the funds
Barclay	Global HedgeSource	2,450	All the funds
HF Net	Proprietary Database	+2,300	All the funds
HFR	Proprietary Database	+2,300	+1,400
CISDM	Proprietary Database	2,300	+1,600
MSCI	Proprietary Database	1,800	+1,500
Bernheim	U.S. Offshore Funds Directory	+900	18
Zurich	ZCM + Other Available Databases	900	60
LJH	Proprietary Database	+800	All the funds
Edhec	Main hedge fund indexes available on the market	n.a.	n.a.
MondoHedge	Proprietary Database	720	48
Blue X	Proprietary Database	350 - 400	30-40
Eurekahedge	Proprietary Database	365*	110
EACM	Proprietary Database	100	100
Talenthedge	Proprietary Database	Not communicated	5 to 20 per index

Source: Vaissié (2003)

Of the 465 funds in common between the HFR and TASS databases, only 154 (or 33.1%) have been included in both databases at the same time. However, when a fund is added to a database, all or part of its historical data is recorded *ex-post* in the database. Since the databases are the sole means of communication for most funds, it is reasonable to believe that the funds will only decide to publish their results when they are at their highest levels, in order to attract as many investors as possible. It is therefore probable that the average performances displayed by the funds during their incubation period will be better than those of funds that have belonged to the database under consideration for a longer period. In this case we talk about "**instant history bias" or "Backfill bias"**. Fung and Hsieh (2001) valued the impact of this bias at 1.4 % per year. A recent study by Posthuma and Van der Sluis (2003), however, evidenced that the actual average survivorship bias in the TASS data base is sensibly higher (i.e. 4.35%). In this respect, it is worth noting that the instant history bias may be as high as 6.34% for Long Short Equity funds. If the funds are not recorded at the same date in two different databases, it is probable that the two databases will not be exposed to instant history bias in the same way. This risk is heightened by the fact that only 47% of the performances recorded are strictly identical.

Since the various indexes have different compositions, they will not be affected in the same way by the different biases to which we have referred. This could, in relevant cases, distort the analysis of their performance. The frequency with which an index is modified will also play an important role in the performances of the different indexes. The HFR indexes are equally-weighted and rebalanced on a monthly basis. As a result, they follow a contrarian strategy. The CSFB indexes, for their part, are value weighted and rebalanced quarterly and therefore follow a momentum type strategy. As Fung and Hsieh have shown, these differences alone explain a performance differential of 7.4% between the two databases in 1999! Here we can speak of a "**rebalancing scheme bias**."

The Performance Heterogeneity of Hedge Fund Indexes

Significant performance differences for the same style are commonly observed between the different competing indexes. This phenomenon is particularly noticeable in periods of crisis (between August 1998 and October 1998, cf. table 3 below). The heterogeneity of the information supplied by the different index providers is actually spectacular. More than 20% separates the performances of the Zurich and EACM Long/Short Equity indexes in February 2000. An analysis of the mean and median correlations between the performances of the different competing indexes confirms the lack of homogeneity. The mean correlation between competing indexes for the same type of strategy (Equity Market Neutral: 0.43, Long/Short Equity: 0.46) can be lower than 0.5. The increasing number of index providers and construction methods poses the problem of the heterogeneity of the data. It appears clearly that the competing hedge fund indexes do not today provide representativity and stability conditions that would allow investors a homogenous and relevant overview of alternative funds.

Table 3: Maximum Return Differences by Investment Style (from January 1998 through July 2003)

Investment Styles		Max differences (with dates and indexes)
Convertible Arbitrage	7.55%	(Dec 01: EACM (-6.93%) / Hennessee (0.62%))
CTA Global	5.09%	(Feb 99: CSFB (-0.54%) / HF Net (4.55%))
Distressed Securities	6.99%	(Feb 00: EACM (1.23%) / Zürich (8.22%))
Emerging Markets	19.45%	(Aug 98: MAR (-26.65%) / Altvest (-7.20%))
Equity Market Neutral	5.00%	(Dec 99: Hennessee (0.20%) / Van hedge (5.20%))
Event Driven	5.06%	(Aug 98: CSFB (-11.77%) / Altvest (-6.71%))
Fixed Income Arbitrage	10.48%	(Oct 98: HF Net (-10.28%) / Van Hedge (0.20%))
FoHF	8.01%	(Dec 99: MAR (2.41%) / Altvest (10.42%))
Global Macro	14.17%	(Oct 98: CSFB (-11.55%) / Altvest (2.62%))
Long/Short Equity	22.04%	(Feb 00: EACM (-1.56%) / Zürich (20.48%))
Merger Arbitrage	2.71%	(Sept 01: EACM (-4.32%) / HF Net (-1.61%))
Relative Value	10.47%	(Sept 98: EACM (-6.08%) / Van Hedge (4.40%))
Short Selling	21.13%	(Feb 00: Van Hedge (-24.30%) / EACM (-3.17%))

Source: Edhec Risk and Asset Management Research Centre

With the help of a simple heterogeneity indicator, we can attempt to evaluate the degree of heterogeneity of the different strategies. This indicator is denoted HI and is calculated as follows: HI = 1 – Average Correlation. Therefore, a perfectly heterogeneous situation for the indexes is translated by HI=1.

Such an analysis reveals for example that the Equity Market Neutral and Long/Short Equity strategies are particularly heterogeneous. They exhibit respectively, for the test presented above, degrees of heterogeneity of 57.24% and 54.25%. Conversely, the Emerging Markets and Merger Arbitrage strategies respectively present degrees of heterogeneity of only 7.16% and 8.07%. These results confirm those obtained through a correlation analysis (table 4).

Table 4: Heterogeneity Index by Investment Style (from January 1998 through December 2000)

Investment Styles	HI
Convertible Arbitrage	18.17%
Distressed Securities	13.55%
Emerging Markets	7.16%
Equity Market Neutral	57.24%
Event Driven	7.67%
Fixed Income Arbitrage	45.92%
FoHF	12.43%
Global Macro	44.02%
Long/Short Equity	54.25%
Merger Arbitrage	8.07%
Relative Value	32.48%
Short Selling	11.89%

Source: Amenc, Martellini (2002a)

To document the heterogeneity of the different indexes, one may also highlight their contrasted exposures to a various risk factors (see table 5). For example, HFR fixed-income arbitrage index is significantly more exposed to liquidity risk as proxied by changes in trading volume on the NYSE (correlation coefficient = –0.18) than the corresponding HF Net index (correlation coefficient = –0.01). In the same way, the correlation coefficient of the performances of the Van Hedge index with the returns of the S&P500 is 0.53, compared to 0.00 for the CSFB index! Finally, the exposure of the Van Hedge index to volatility risk is relatively high (–0.47), while that of the HFR index is significantly lower (0.14). It again appears clearly that different competing indexes are very heterogeneous. Taking the differentiated exposures to various risk factors into account, it would not be the same to take one or other of the competing indexes as a benchmark. So which one should be chosen?

Table 5: Sensitivity to Broad-based Risk Factors – The Case of Fixed Income Arbitrage

Fixed Income Arbitrage	Market Risk	Volatility Risk	Interest Rate Risk	Slope of the Yield Curve	Currency Risk	Commodity Risk	Credit Risk	Liquidity Risk
CSFB	0.00	0.12	0.15	0.23	0.42	0.05	-0.38	-0.10
HFR	-0.16	0.14	0.25	0.19	0.57	0.07	-0.24	-0.18
Van Hedge	0.53	-0.47	0.09	0.02	-0.13	0.14	-0.16	-0.05
Hennessee	0.37	-0.37	0.06	O.19	0.26	0.12	-0.22	-0.12
HF Net	-0.10	0.20	0.22	0.20	0.42	0.03	-0.37	-0.01

Source: Amenc, Martellini (2002a) *From January 1998 through December 2000*

The data used to characterise the different sources of risk is as follows:

The market risk is measured by the evolution of the S&P 500 Price Index
The volatility risk is measured by the relative price variations of the VXO contract (formerly VIX), the underlying of which is the implicit volatility of the S&P 100
The interest rate risk is measured by the variations of the rate of return of the 3-month Treasury bill
The slope of the yield curve is obtained by calculating the difference between the rate of return of a bond with a 10-year maturity and that of a 3-month Treasury bill
The currency risk is measured by the evolution of the exchange rate of the US dollar compared to a basket of foreign currencies
The commodity risk is measured by the relative price variations of a barrel of crude oil
The credit risk is measured by the relative variations of the differential between the returns on bonds rated Baa and Aaa by Moody's
The liquidity risk is measured by the evolution of the volume of securities exchanged on the NYSE

The Different Uses of Hedge Fund Indexes

The hedge fund industry has developed in two stages over the past fifty years. Firstly, there was an incubation stage, during which only some high net worth individuals in search of absolute returns invested in hedge funds. With the burst of the internet bubble, institutional investors have been looking

for investments that are capable of improving the diversification of their portfolio. They have therefore turned to hedge funds. This shift of interest from alphas (i.e. a rationale of absolute returns) to betas (i.e. a rationale of risk diversification) marks the beginning of the period of "industrialization" of alternative investment management. The massive arrival of institutional investors together with the expansion of the profiles of final investors, have in fact led to a profound contemplation on investment practices in the alternative universe, with a particular focus on risk control. In particular, while a certain number of hedge fund strategies are non-directional, they are subject to exposure to a number of other risk factors (e.g. credit-, liquidity- and volatility risk). Consequently, using the return on the risk-free asset as a benchmark to evaluate hedge fund performance is certainly inappropriate (see Amenc, Martellini and Vaissié -2003). Numerous hedge fund indexes have thus emerged (see Vaissié – 2003).

Style indexes that are representative of different hedge fund strategies

The first difficulty investors - and above all institutional investors - are faced with, is the lack of transparency of hedge funds, as well as the complexity of the strategies followed. The analysis of their risk and its corollary, the evaluation of their performance, can thus be regarded as more of an art than a science. Numerous articles on this subject have shown the limits of traditional performance measures when evaluating the performance of hedge funds (see for example Lo - 2001, Spurgin - 2001 or Brooks and Kat - 2002). The only pragmatic response currently available to investors is the use of style indexes that are representative of different hedge fund strategies. Investors can thus evaluate the performance of their investment by comparing it to that of representative indexes. Likewise, they can evaluate the risk profile of their investment, or conduct performance attribution, with the aid of style analysis (see Sharpe - 1992) by using hedge fund indexes as "pseudo" risk-factors (see Lhabitant - 2001).

"Investable" Indexes that allow investors an access to hedge fund strategies

Alternative investments offer remarkable opportunities in terms of portfolio diversification. For this reason, a growing number of institutional investors now include hedge funds in their target allocation. In spite of this, while recent research shows that an optimal allocation to hedge funds is in the order of 20-30% (see Singer et al. - 2002 or Amin and Kat – 2003a), they represented merely 1.7% (respectively, 6.7%) of a typical European (respectively, American & Japanese) institutional portfolio in 2002 and should represent around 3.4% in 2003, according to the “Fifth Joint Global Survey on alternative Investment by Pension Funds, Endowments and Foundations” issued by Goldman Sachs and Frank Russell. Consequently, the hedge fund industry has significant growth opportunities. In order to develop the latter however, it is indispensable to facilitate access to hedge funds by a maximum number of investors. However, the majority of investors do not have the know-how, the resources or the network of personal contacts that are necessary to invest directly in the best funds. Some of them therefore prefer to stay away from alternative investments. As a solution to this problem, hedge fund "indexes" that are aimed at being used as a basis for various "investable" products, have recently been launched (see table 6).

The objective of these "indexes" differs from that of maximizing the representativity dimension by covering the largest possible number of funds. Instead, the priority is to choose a limited number of funds that are open to new investors and that guarantee a minimum investment capacity. We can therefore speak of FoHF rather than of indexes that are representative of a given investment universe. The index provider is responsible for fund selection and the development of structured products or derivative instruments that deliver the performance of the FoHF with a small tracking error. Indexes provided by S&P, HFR, CSFB or MSCI are among the best known examples. S&P and their partner Plusfunds, for instance, have signed distribution agreements for investment vehicles that replicate the S&P hedge fund index, or one of its 9 sub-indexes, with numerous providers of funds of funds such as Bawag, Deutsche Bank, XL Capital and UOB. Certificates linked to the S&P index have been issued by UBS Warburg and the launch of capital-guaranteed products as well as derivatives (options and swaps) on funds of funds that track the S&P index have been announced by BNP Paribas. It can therefore be seen that the principal objective of these "indexes" is to allow a broad range of investors, access to alternative investment strategies at low cost. They do not intend to be used as a reference for "the market" but to provide liquidity where it is crucially lacking. These "indexes", or more precisely these FoHF, thus offer an ideal characteristic for use in the asset allocation process.

Table 6 : Major investable hedge fund indexes

Indexes	Available Since	Constituents (No. of hedge funds)	Pricing & Liquidity	Rebalance Frequency	Index Weighting
S&P HFI	May 2002	40	Daily	Annual	Equally Weighted
HFRX	March 2003	50	Monthly	Quarterly	Asset-Weighted
MSCI HII	July 2003	64	Weekly	Quarterly	Asset-Weighted
CSFB/Tremont IHFI	August 2003	60	Monthly	Semi-Annually	Asset-Weighted

Source: StandardandPoors.com, HFR.com, MSCI.com and HedgeIndex.com

The "industrialization" of alternative investments implies both improved control of the risks inherent in hedge fund strategies and uncomplicated access to FoHF. In this respect, the different types of hedge fund strategies play an important role. It is interesting to note, however, that while most indexes were initially constructed by data bases' providers to be representative of a particular investment style, the great majority of recently launched indexes are offered by alternative investment "boutiques" (CSFB/Tremont, HFR, Feri Alternative Assets, Benchmark, Talenthedge, etc.) or renowned financial institutions (S&P, MSCI, Dow Jones, etc.) to be investable. On the other hand, while some index providers such as HF Net, EACM, Hennessee or Altvest stick to their historic business model, some others like MSCI, CSFB/Tremont, HFR or Van Hedge have adopted a diversified strategy and now offer both representative and investable indexes. This trend is perfectly illustrated by MSCI's recent shift in strategy. While they chose in the first place to differentiate from their rival S&P by focusing on indexes' representativity as opposed to indexes' investability, they now launch an investable index in partnership with Lyxor.

II. HOW TO DEAL WITH THE HETEROGENEITY OF HEDGE FUND INDEXES?
The Edhec Approach

Just as in the traditional world, none of the competing indexes are either collectively exhaustive or mutually exclusive. The lack of regulation and its corollary, a lack of transparency, accentuate the problem dramatically in the hedge fund universe. It is therefore necessary to construct style indexes that allow for a response to the needs of practitioners in terms of transparency and reliability. However, the logic of representativity through market capitalization is difficult to apply to the alternative universe. As a result, finding a benchmark that is representative of a particular management universe is not a trivial problem.

Principal Component Analysis

Given that it is impossible to come up with an objective judgment on what is the best existing index, a natural idea consists of using some combination of competing indexes to reach a better understanding of what the common information about a given investment style would be. One straightforward method for obtaining a composite index based on various competing indexes would involve computing an equally-weighted portfolio of all competing indexes. This would obviously provide investors with a convenient one-dimensional summary of the contrasted information contained in competing indexes. In particular, because competing hedge fund indexes are based on different sets of hedge funds, the resulting portfolio of indexes would be more exhaustive than any of the competing indexes it is extracted from. We can push the logic one step further and use factor analysis techniques to extract the best possible one-dimensional summary of a set of competing indexes, and design what can be called "pure style" indexes. This method is thus a natural generalization of the idea of taking a portfolio of competing indexes. The refinement involves relaxing the assumption of an equally-weighted portfolio.

We suggest using factor analysis techniques to generate a set of alternative indexes that can be thought of as the best possible one-dimensional summaries of information conveyed by competing indexes for a

given style, in the sense of the largest fraction of the variance explained. Here, we are looking for the portfolio weights that make the combination of competing indexes capture the largest possible fraction of the information contained in the data from the various competing indexes. Technically speaking, this amounts to using the first component of a Principal Component Analysis (see the Appendix for more details on this method, which is henceforth referred to as PCA) of competing indexes as a candidate for a pure style index. Note that the first component typically captures a large proportion of cross-sectional variations because competing styles tend to be at least somewhat positively correlated.

The PCA of a time-series involves studying the correlation matrix of successive shocks. Its purpose is to explain the behavior of observed variables using a smaller set of unobserved implied variables. From a mathematical standpoint, it involves transforming a set of K correlated variables into a set of orthogonal variables, or implicit factors, which reproduces the original information present in the correlation structure. Each implicit factor is defined as a linear combination of original variables.

The Edhec Alternative Indexes are able to capture a very large fraction of the information. The average percentage of variance explained by the Edhec Alternative Indexes is 79.12% (and the median percentage of variance is 81.12%) across all sub-universes. The percentage of variance explained by the Edhec Alternative Indexes is, of course, all the more significant that the correlation between the competing indexes is high. For example, emerging market style indexes have a percentage of variance explained that is greater than 90% from a population of 7 competing indexes. The mean correlation was almost 0.93 for emerging market indexes. In the same vein, the Edhec Event Driven and Merger Arbitrage Indexes capture more than 80% of the information originally available in a set of 8 and 4 competing indexes, respectively. The Edhec Fund of Funds Index also enjoys very low information loss as more than 91% of the information is captured by the one-dimensional summary. On the other hand, the percentage of information loss is higher in the case of equity market neutral (41.09% = 100% - 58.91% information loss) and fixed-income arbitrage (35% = 100% - 65% information loss). This is because these strategies were the ones for which the heterogeneity of information provided by competing index providers was the most extreme (see N. Amenc and L. Martellini, 2002a, for further explanation).

Edhec Alternative Indexes generated as the first component in a factor analysis have an appealing built-in element of optimality, since there is no other linear combination of competing indexes that implies a lower information loss.

Edhec Alternative Indexes and their Constituents

In order to establish the list of Edhec Alternative Indexes we first eliminated alternative strategies for which fewer than 4 competitors were available. For statistical purposes it is essential to have at least 4 competing indexes for it to make sense to construct an index of indexes. We then eliminated strategies with a narrow focus (e.g., sectors - health care) to concentrate on popular strategies. As a result of that selection, we were left with a list of 13 investment styles with 5 to 9 index providers for each style (see table below).

The second step involves selecting the indexes to be included in the Edhec Alternative Index for each strategy. The Edhec Alternative Indexes are required to enjoy completely transparent construction methodology and management principles. As a result, the selected indexes must be publicly available and have transparent style classification (i.e., well defined sub-universes) and construction methodologies, so that one can easily check the performances of the Edhec Alternative Indexes. Finally, the indexes must be based on a broad database (to ensure a minimum degree of representativity) and post their performances on time (see next section for more details).

We have identified the 10 index providers listed in the table 7 and included those that fulfilled the aforementioned requirements in the composition of the Edhec Alternative Index. Xs indicate that the index is included in the Edhec Alternative Index. It should be noted that these compositions are those established as of January 2004 and are subject to revision by the Edhec Alternative Index advisory board.

It should be noted that the list of Edhec Alternative Indexes was also established to enable different levels of analysis. For example, broad style indexes such as the Edhec Relative Value Index or the Edhec Event Driven Index are perfect for analysis at a global level. On the other hand, the Edhec Convertible Arbitrage/Equity Market Neutral/Fixed Income Arbitrage Indexes or the Edhec Distressed Securities/Merger Arbitrage Indexes are ideal for more detailed analysis of those two broad categories.

Table 7: List of Edhec Alternative Indexes and their Constituents as of December 2003

Edhec Indexes	HFR	CSFB	EACM	Altvest	Hennessee	Van Hedge	CISDM	HF Net	Barclay	S&P
Convertible Arbitrage	X	X	X		X			X	X	
CTA Global		X					X	X	X	X
Distressed Securities	X	X	X	X	X	X		X	X	
Emerging Markets	X	X		X	X	X	X	X	X	
Equity Market Neutral	X	X			X	X	X	X	X	
Event Driven	X	X	X	X	X		X	X	X	X
Fixed Income Arbitrage	X	X			X	X		X	X	
Funds of Funds	X			X		X	X	X	X	
Global Macro	X	X		X	X	X	X	X	X	
Long / Short Equity	X	X		X				X	X	
Merger Arbitrage	X	X	X	X	X			X	X	
Relative Value	X		X	X	X	X		X		X
Short Selling	X	X	X		X	X	X	X	X	

Source: Edhec Risk and Asset Management Research Centre

The composition of different Edhec Alternative Indexes is calculated every three months based on the historical performance data (three years) of the selected competing indexes. Each month these successive weightings are applied to the performance history of the indexes concerned. The return on these indexes can be downloaded free of charge from EDHEC Risk and Asset Management Research Center's website: www.edhec-risk.com.

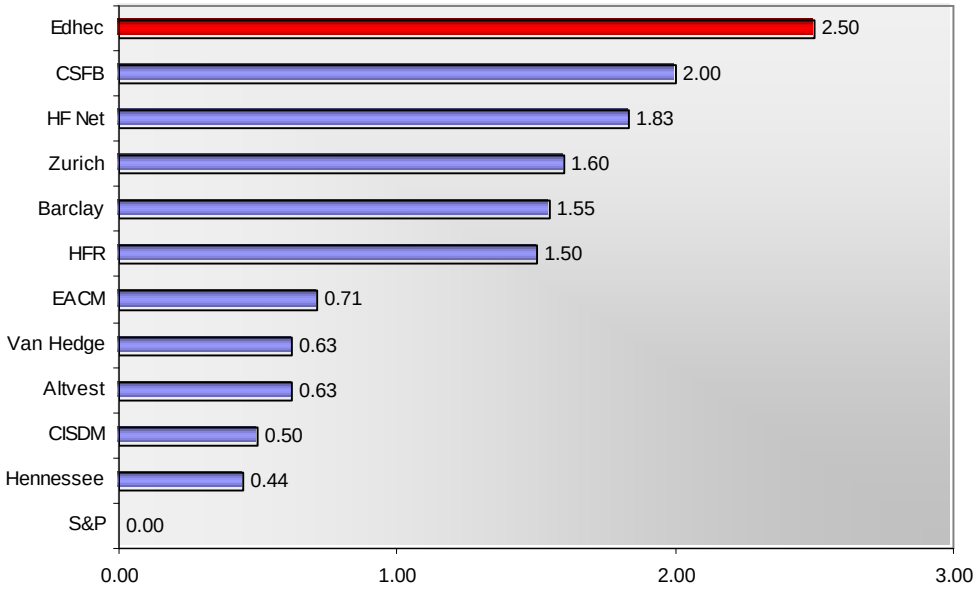
III. THE PROPERTIES OF THE EDHEC ALTERNATIVE INDEXES

We have tested the qualities of the Edhec Alternative Indexes. We first assess the degree of representativity and purity of the Edhec Alternative Indexes to show the extent to which they are able to capture the substance of the alternative investment strategies. We then assess the impact of short-term market or economic trends on their composition.

The Representativity and Purity Dimensions

To test the representativity qualities of the main hedge fund indexes[1], we proceeded in the following way: we constituted, for each of the 12 most important strategies in terms of assets under management, an equal weighted portfolio from a database of 7,422 funds (2,317 of which are not recorded in any database)[2]. These portfolios therefore contain an average of more than 600 funds for each of the strategies and are, as such, considered to be relatively representative of their investment management universe. We then calculated these portfolios' correlation coefficients with the hedge fund indexes between January 1998 and December 2000. The higher the correlation coefficient, the more representative the indexes are. For each of the strategies, we ranked the indexes in ascending order of their correlation coefficients and attributed a number from 1 to 3 corresponding to the group in which they were situated (1 corresponding to the top third and 3 to the bottom third). We then attributed 3 points to the indexes that were ranked in the first third, 1 point to those in the second third and 0 points to the indexes in the last third. Figure 1 below gives the average number of points obtained by each of the index providers for all of the strategies that they cover. We observe that the indexes do not all provide the same representativity qualities.

Figure 1 : Average ranking of the index providers according to their



Source: Vaissié (2003)

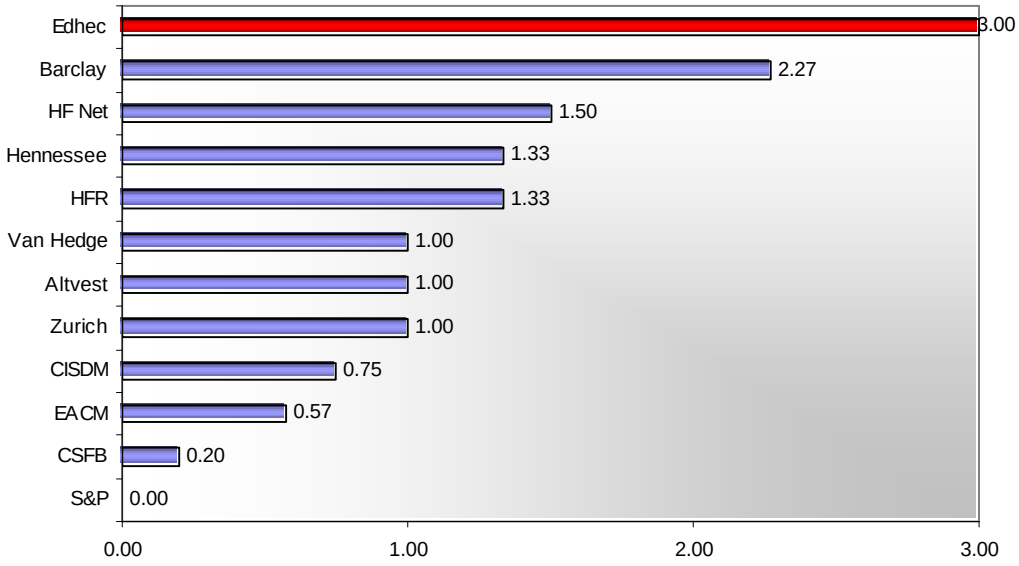
The PCA approach ensures that the Edhec Alternative Indexes capture the largest possible fraction of the information contained in the data from the various competing indexes. The first consequence, as can be seen in Figure 1, is a maximization of the representativity dimension. The second, significant, consequence is that the Edhec Alternative Indexes are, by construction, systematically less biased than the indexes they contain. Since the competing indexes are affected differently by biases, searching for the linear combination of competing indexes that implies a maximization of the variance explained, leads to a minimization of the bias. This characteristic is of great interest from a performance evaluation perspective.

[1] Only the indices for which the returns over the period 1998-2000 were available to the public were considered. The providers that only publish regional and/or global indices were also set aside.

[2] Special thanks are due to François Serge Lhabitant for providing us with the representative portfolio data.

Even though the information provided by the different indexes is not exactly the same, a large part of the information is nonetheless common between them. The pure index is the one that best reflects this common information because it is not affected by the different biases. It is therefore possible to test the purity of the different indexes by following the procedure proposed by Amenc and Martellini (2002a). This involves an initial extraction of the common information from the different indexes with the help of the Kalman Filter method. We thereby obtain a time series that represents a perfectly pure index. One then simply calculates the correlation coefficients of the different indexes with this pure index. The higher the coefficient, the purer the index. For each of the strategies, we ranked the indexes in ascending order of their correlation coefficients and attributed a number from 1 to 3 that corresponded to the group in which they were situated (1 corresponding to the top third and 3 to the bottom third). We then attributed 3 points to the indexes that were ranked in the first third, 1 point to those in the second third and 0 points to the indexes in the last third (see figure 2).

Figure 2: Average ranking of the index providers according to their degree of purity



Source: Vaissié (2003)

The Stability of the Edhec Alternative Indexes

We then assess the impact of short-term market or economic trends on the composition of Edhec Alternative Indexes. The first test consists of calculating the average weighting evolution caused by the quarterly index rebalancing. For example, if the Edhec Style Index is composed of 40% of Index 1 and 60% of Index 2 in Q1 and 50% Index 1 and 50% of Index 2 in Q2, we consider a weighting evolution of ½ * Abs (40% - 50%) + ½ * Abs (60% - 50%), i.e. 10%. We then calculated the average weighting evolution over the period January 2001 through December 2002. This test shows that the index composition is very stable over time (see table 8 below for detailed results), which confirms that the construction methodology enables Edhec Alternative Indexes to capture the substance of the investment strategy and not statistical artifacts.

Table 8: Stability of the Composition of the Edhec Alternative Indexes

Edhec Style Indexes	Average weighting change
Convertible Arbitrage	0.24%
Emerging Markets	0.07%
Equity Market Neutral	1.18%
Event Driven	0.17%
Fixed Income Arbitrage	2.03%
Global Macro	0.61%
Long/Short	0.57%
Merger Arbitrage	0.05%
Relative Value	0.34%
Short Selling	0.07%
Distressed Securities	0.27%
Funds of Funds	0.08%

From January 2001 through December 2002

Source: Edhec Risk and Asset Management Research Centre

The high level of stability of Edhec Alternative Indexes is of great interest for asset management firms who invest (or are willing to invest) in hedge funds. The practical advantages are numerous. First (but not least) is the fact that the Edhec Alternative Indexes are easier to replicate.

IV. USE OF EDHEC INDEXES FOR PORTFOLIO MANAGEMENT

The higher degree of representativity and stability of the Edhec Alternative Indexes give them not only superiority in terms of statistical properties but also in terms of portfolio properties.

The Trackability of the Edhec Alternative Indexes

To demonstrate the advantages of the Edhec Alternative Indexes in terms of trackability, we have constructed portfolios made up of single funds that replicate the Edhec Alternative Indexes. We then did the same thing with the HFR and CSFB Indexes. Portfolio replication involves a tracking error minimization problem (see the formula underneath):

$$\min_{w} TE = s\left(R_{PF} - R_{B}\right)$$

Where R_{PF} is the return of the replicating portfolio and R_B the return of the benchmark. W refers to the composition of the replicating portfolio.

The single funds used for this experiment were drawn randomly (without replacement) from the HF Net Database. The replicating portfolios were composed on average of twenty-five funds (which is a good compromise between industry practice – 20 to 40 funds - and academic evidence – 5 to 10 funds) with at least 4 years of historic performances. We excluded the Short Selling strategy since we did not dispose of 20 funds with at least 4 years of existence. As a result, we calculated the "in sample" tracking error for January 1999 through September 2002 for the 7 strategies common to Edhec, HFR and CSFB (the choice of the HFR and CSFB indexes is motivated by the fact that they are often quoted by practitioners).

The results confirm the superiority of Edhec Alternative Indexes, since we obtain a lower "in sample" tracking error in 6 out of 7 strategies (see table 9). The tracking error is systematically lower than 2.5% and in 4 out of 7 cases it is lower than 1.0%. This is all the more interesting that the tracking error obtained with Edhec Alternative Indexes appears to be sound (lower than 2.5% in 5 out of 7 cases). The low difference observed between the "in-sample" and "out-of-sample" tracking errors indicates that the tracking error is stable over time. In some cases the "out-of-sample" tracking error is even lower than the "in-sample" tracking error obtained with the competing indexes.

Table 9: Trackability of Edhec Alternative Indexes

	Edhec		CSFB	HFR
	In sample	*Out of sample*	*In sample*	*In sample*
Convertible Arbitrage	**0.73%**	1.05%	2.23%	0.74%
Emerging Markets	**2.34%**	3.39%	4.61%	3.19%
Event Driven	**0.95%**	1.36%	2.40%	1.03%
Fixed Income Arbitrage	1.11%	1.25%	**0.83%**	2.70%
Global Macro	**0.12%**	2.23%	0.17%	0.13%
Long/Short Equity	**1.90%**	3.25%	4.02%	2.07%
Market Neutral	**0.73%**	0.86%	1.03%	2.28%

From January 1999 through September 2002

Source: Edhec Risk and Asset Management Research Centre

Edhec Alternative Indexes in the Strategic Allocation Process

Since Edhec Alternative Indexes are easy to replicate, we have tested the benefits of including them in the strategic allocation of a typical institutional investor. For that purpose we have tested the stability of the minimum variance portfolio. We consider that this portfolio is made up of stocks (proxied by the S&P 500), bonds (proxied by the Lehman Global Bond Index) and alternative investments (proxied by the Edhec Alternative Indexes, or the competing indexes). We impose the following constraints: an asset class cannot represent more than 60% of the portfolio's holdings and hedge funds must represent between 10% and 30% of the portfolio's holdings. It has been shown in several research papers (see for example Amin and Kat – 2003b) that a significant proportion of a portfolio must be dedicated to the alternative class for it to impact the portfolio's risk/return characteristics. The latter constraint is set in this respect.

The minimum variance portfolio corresponds to the portfolio that offers the lowest variance on the efficient frontier (see Amenc and Martellini – 2002b, for further explanation). The construction of this portfolio involves a variance minimization problem:

$$\min_{x} \text{var}\left(R_{PF}\right) = \sum_{i=1}^{n}\sum_{j=1}^{n} x_i \; x_j \;\; \text{cov}\left(R_i \, , R_j\right)$$

where R_{PF} is the return of the portfolio, R_i the return of the i^{th} asset and x_i the weight of the i^{th} asset.

The test aims to assess the stability of the strategic allocation (i.e., minimum variance portfolio). We used a three-year calibration period (from January 1998 to December 2000) to compute the first minimum variance portfolio. We then rolled over a 6-month calibration period to construct the second minimum variance portfolio, and so on. The last step was to calculate the average portfolio turnover implied by the semi-annual rebalancing. We performed this test with the Edhec Alternative Indexes, as well as with the HFR and CSFB Indexes, for all the strategies common to the three providers.

Once again, the Edhec Alternative Indexes turn out to be more efficient than the competing indexes, since they make the strategic asset allocation more robust, regardless of the investment style (see table 10 for more details). The turnover is systematically lower with the Edhec Alternative Indexes than with the CSFB or HFR Indexes.

Table 10: Average Minimum Variance Portfolio Turnover

	Edhec	CSFB	HFR
Convertible Arbitrage	0%	0%	0%
Emerging Markets	6.10%	7.17%	7.34%
Equity Market Neutral	0%	0%	0%
Event Driven	0%	0%	0%
Fixed Income Arbitrage	0%	0%	0%
Global Macro	0%	3.70%	0%
Long/Short Equity	0%	3.35%	0%
Short Selling	0.80%	1.83%	1.36%

From January 2001 through December 2002

Source: Edhec Risk and Asset Management Research Centre

Conclusion

In this paper, we attempt to emphasize the need for a better understanding of investment style benchmarks by focusing on the alternative investment universe. Our contribution is two-fold. First, we provide detailed evidence of strong heterogeneity in the information conveyed by competing indices. Second, we attempt to provide remedies to the problem and suggest a methodology designed to help build a "pure style index" or "index of the indices" for a given style.

Our results can easily be extended to traditional investment styles such as growth/value, small-cap/large-cap and a series of returns on pure indices can be constructed on the basis of the S&P/BARRA, MSCI, Dow Jones, Wilshire, Russell, etc., equity style indices. In a related work (Amenc, Faff and Martellini (2003)), we show that existing indices also provide a somewhat confusing picture of the return on style factors (growth/value, small/large cap), and we also report disturbing evidence that this heterogeneity poses serious problems, not only for modern portfolio analysis, but also for empirical tests of asset pricing theory. Some of the techniques introduced in this paper could actually be also used to help design better benchmarks in the traditional investment universe.

References

N. Amenc, R. Faff, and L. Martellini, 2003, Desperately Seeking Pure Style Indexes, *Working Paper*, Edhec/Misys multi-style/multi-class research program.

Amenc, N., and Martellini L., 2002a, The Brave New World of Hedge Fund Indexes, *Working Paper*, Edhec/Misys multi-style/multi-class research program.

Amenc, N., Martellini, L., 2002b, Portfolio Optimization and Hedge Fund Style Allocation Decisions, *Journal of Alternative Investments*, Fall 2002, Vol. 5, N°2, p.7–20

Amenc, N., Martellini, L. and Vaissié M., 2003, Benefits and Risks of Alternative Investment Strategies, *Journal of Asset Management*, Vol.4, N°2, p.96-118.

Amin, G. and Kat, H., 2003a, Hedge Fund Performance 1990 – 2000: Do the Money Machines Really add Value?, *Journal of Financial and Quantitative Analysis*, June 2003, Vol.38, N°2, p.251-274

Amin, G., Kat H., 2003b, Stocks, Bonds and Hedge Funds, *Journal of Portfolio Management*, Summer 2003, Vol.29, N° 4, p.113-120

Asness, C., Krail, R. and Liew J., 2000, Do Hedge Funds Hedge?, *Journal of Portfolio Management*, Fall 2001, Vol.28, N°1, p.6-19.

Brooks, C. and Kat H., 2002, The Statistical Properties of Hedge Fund Returns and Their Implications for Investors, *Journal of Alternative Investments*, Fall 2002, Vol.5, N°2, p.26-44

Brown, S.J., W. Goetzmann, and R. Ibbotson, 1999, Offshore Hedge Funds: Survival & Performance 1989–95, *Journal of Business*, Vol. 72, N°1 (January), p.91–118.

Fung and Hsieh, 2000, Performance Characteristics of Hedge Funds and Commodity Funds: Natural vs. Spurious Biases, *Journal of Financial and Quantitative Analysis*, Vol. 35, N°3 (September), p.291–307.

Malkiel, B. 1995, Returns from Investing in Equity Mutual Funds 1971 to 1991, *Journal of Finance*, Vol. 50, N°2 (June), p.549–572.

Learned, M. and Lhabitant, F.S., 2002, Diversification: How much is enough*?*, *Journal of Alternative Investments*, Winter 2002, Vol.5, Issue 3, p.23-49

Lhabitant, F., 2001, Assessing Market Risk for Hedge Funds and Hedge Funds Portfolios, *Journal of Risk Finance*, Spring 2001, p.1-17

Liang, B., 2001, Hedge Funds: The Living and the Dead, *Journal of Financial and Quantitative Analysis* Vol. 35, p.309-326, September 2000

Lo, A., 2001, Risk Management for Hedge Funds: Introduction and Overview, *Financial Analysts Journal*, Vol. 57, p.16-33

Okunev, J. et White D., 2002, Smooth Returns and Hedge Fund Risk Factors, *Working Paper*

Posthuma, N. and Van der Sluis, P. J., 2003, A Reality Check on Hedge Fund Returns, *Working Paper*

Sharpe, W., 1992, Asset allocation: management style and performance measurement, *Journal of Portfolio Management*, Vol.18, p.7-19.

Singer, B., Staub, R. and Terhaar, K., 2002, The Appropriate Policy Allocation for Alternative Investments, UBS Global Asset Management

Spurgin, R., How to Game your Sharpe Ratio, 2001, *Journal of Alternative Investments*, Winter 2001, Vol. 4, N°3, p.38-46

Vaissié, M., Are Hedge Fund Indexes Created Equal?, *Working Paper*, Edhec Risk and Asset Management Research Centre

APPENDIX: Principal Component Analysis

The PCA of a time-series involves studying the correlation matrix of successive shocks. Its purpose is to explain the behavior of observed variables using a smaller set of unobserved implied variables. From a mathematical standpoint, it involves transforming a set of K correlated variables into a set of orthogonal variables, or implicit factors, which reproduces the original information present in the correlation structure. Each implicit factor is defined as a linear combination of original variables. Define R as the following matrix:

$$R = (R_{tk})_{\substack{1\le t\le T \\ 1\le k\le n}}$$

We have n variables, i.e., monthly returns for n different competing indexes, and T observations of these variables.

$$R_{tk} = \sum_{i=1}^{n} \sqrt{l_i}\, U_{ik}\, V_{ti} \quad (1)$$

where

$(U) = (U_{ik})_{1\le i,k\le n}$ is the matrix of the n eigenvectors of R'R.

$(U^T) = (U_{ki})_{1\le k,i\le n}$ is U transposed.

$(V) = (V_{ti})_{\substack{1\le t\le T \\ 1\le i\le n}}$ is the matrix of the n eigenvectors RR'

Note that these n eigenvectors are orthonormal. ?{i} is the eigenvalue (ordered by degree of magnitude) corresponding to the eigenvector U{i}. Denoting $S_{ik} = \sqrt{l_i}\, U_{ik}$ the principal component sensitivity of the k^{th} variable to the i^{th} factor, and V{ti}=F{ti}, one can equivalently write equation (1)

$$R_{tk} = \sum_{i=1}^{n} s_{ik}\, F_{ti}$$

where the n factors F{i} are a set of orthogonal variables. One may use the method to describe each variable as a linear function of a reduced number of factors. To that end, one needs to select a number of factors I such that the first I factors capture a large fraction of asset return variance, while the remaining part can be regarded as statistical noise

$$R_{tk} = \sum_{i=1}^{I} \sqrt{l_i}\, U_{ik}\, V_{ti} + e_{tk} \quad = \sum_{i=1}^{I} s_{ik}\, F_{ti} + e_{tk} \quad (2)$$

where some structure is imposed by assuming that the residuals e_{tk} are uncorrelated one to another. The percentage of variance explained by the first I factors is given by $\dfrac{\sum_{i=1}^{I} l_i}{\sum_{i=1}^{N} l_i}$.

By taking I=1in equation (2) this method can be used to generate "the best one-dimensional" summary of a set of competing indexes. Furthermore, a simple normalization allows one to obtain an index which can be regarded as a portfolio of competing indexes, so that an actual decomposition in terms of actual funds in the index can easily be obtained as long as information is available in each competing index composition.

$$R_{tk} = \sum_{i=1}^{K} \frac{s_{ik}}{\sum_{k'=1}^{K} s_{ik'}}\, F_{ti}$$