Fixed-Income Attribution : Proposal of a new methodology

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FIXED- INCOME ATTRIBUTION : PROPOSAL FOR A NEW METHODOLOGY

I. Introduction and Summary

a. Introduction

Performance attribution reporting has been a major step for the asset management industry. Many different methodologies have been defined for the performance attribution of equities portfolios [for example Brinson Hood Beebower (1986), Brinson Singer Beebower (1991) and Singer-Karnosky (1995)], however no consensus has been reached for the analysis of fixed-income portfolios. Of course, a lot of progress has been made: M. Khoury, V. Nabil., R. Veilleux (2003) resumed the different factors explaining the performance of a fixed-income portfolio. Noteworthy contributors also include Campisi (2000), Van Breukelen (2000), Ramaswany (2001) and McLaren (2002). Nevertheless, even if these articles contributed to the general knowledge of the subject, none of them has become a standard.

In the French-speaking countries a global initiative comprising a large number of asset managers, consultants and software vendors, the G.R.A.P.[1], have studied the subject in-depth. This initiative constitutes a first step towards a consensus of the most important elements to look at in fixed income performance analysis. They provide the industry with a set of two methodologies; these two methodologies are presented within documents referenced in the Bibliography. The first is called the "Successive Portfolios" methodology and the second one "Successive Spreads", both of which are summarized below and constitute the fundamental basis of our work. However, we noticed that even if they are disparate, each methodology contains positive and negative aspects. Therefore we have tried to take the best of each methodology to build the unique "Combined Methodology" which enlarges the scope of capabilities of these two methodologies and merges them.

b. The Main Characteristics of Fixed Income Attribution

It is commonly understood that the classic Brinson and alii models are not adapted to the performance analysis of fixed-income portfolios.

Firstly, the investment process of fixed-income management is very different from the equities investment process. The effects highlighted for equities attribution are not adapted to the analysis of fixed income performance. Thus, the most important decision taken by the fixed income Portfolio Manager is that of duration when the most important decision for an equity portfolio is the allocation[2] . Therefore it is necessary to use the contributed modified duration instead of the simple amount of money as an exposure factor.

In addition, the performance of a bond is explained through at least two main components: the interest rate movement and the current yield. These two factors could themselves be split into the government yield component and the credit yield component. As far as equities are concerned, performance is mainly due to the dividends and the price movements. It is important to notice now that as opposed to equities, the determinants of the different securities present in a fixed income portfolio, such as Yield To Maturity, Modified Duration etc., evolve over the time.

Furthermore, with a fixed income portfolio, we are confronted with a wide range of products, including numerous types of bonds, treasury bills, commercial paper and other securities, including those with an optional incentive. Obviously, these products are not always quoted and it would be difficult to find a unique price for each of them.

The last important particularity of this area concerns the performance spread between the portfolio and its benchmark, which is weaker than for an equity portfolio. Thus, the performance analysis of a fixed income portfolio requires a much higher degree of precision.

c. Summary of the two main GRAP methodologies

The GRAP defined two methodologies, the Successive Portfolio Methodology (SPM), also known as the Exposure Decomposition Approach and the Successive Spread Methodology (SSM), or Front Office-oriented approach[3].

The SPM methodology is based upon the construction of « fictitious » intermediary portfolios from the benchmark to the real portfolio. It is necessary to use an intermediary portfolio for each process decision step. This methodology requires the calculation of a new quantity of instruments necessary for the modification of a retained parameter. For instance, to analyze the duration effect, a fictitious duration portfolio is designed with the same instruments as within the benchmark, but with a lower or greater quantity in order to obtain the duration target. Of course, in order to keep the same net asset value, the use of a fictitious cash position is necessary to obtain the same amount of invested money.
This iterative process can be repeated as many times as necessary from the benchmark to the real portfolio. The next step requires calculating the spread of performance between each of the portfolios in order to measure an attribution effect corresponding to a management step.

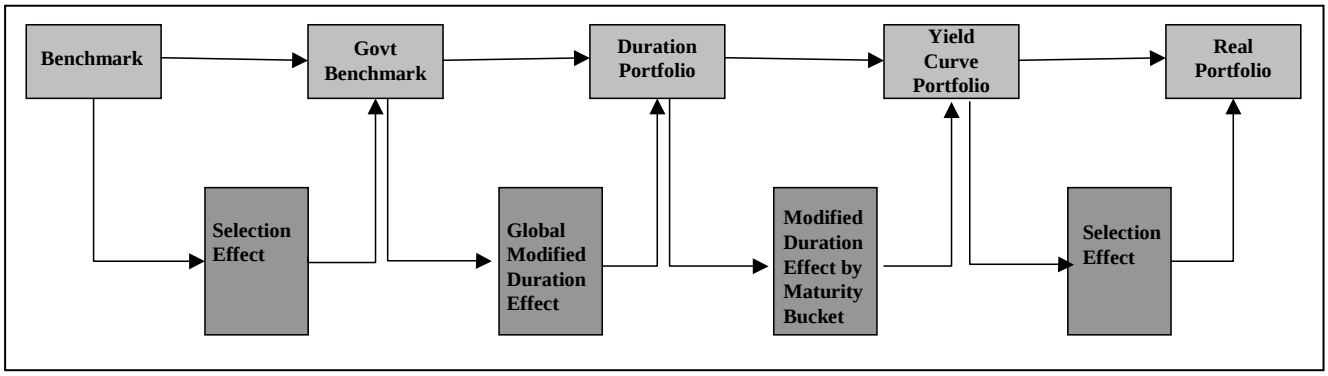

Chart 1: The SPM Methodology

The SSM methodology can be split into two phases. The first phase consists of decomposing the bond prices between its different characteristics (passage of time, evolution of yield curves, variation of spreads). A detailed calculation formula of these elements is given above, in the following section.
This decomposition is applied simultaneously to the constituents of the portfolio and to the constituents of the benchmark. The second phase consists only in regrouping the separated elements according to the axes defined by the management process. The process can be illustrated with the following chart:

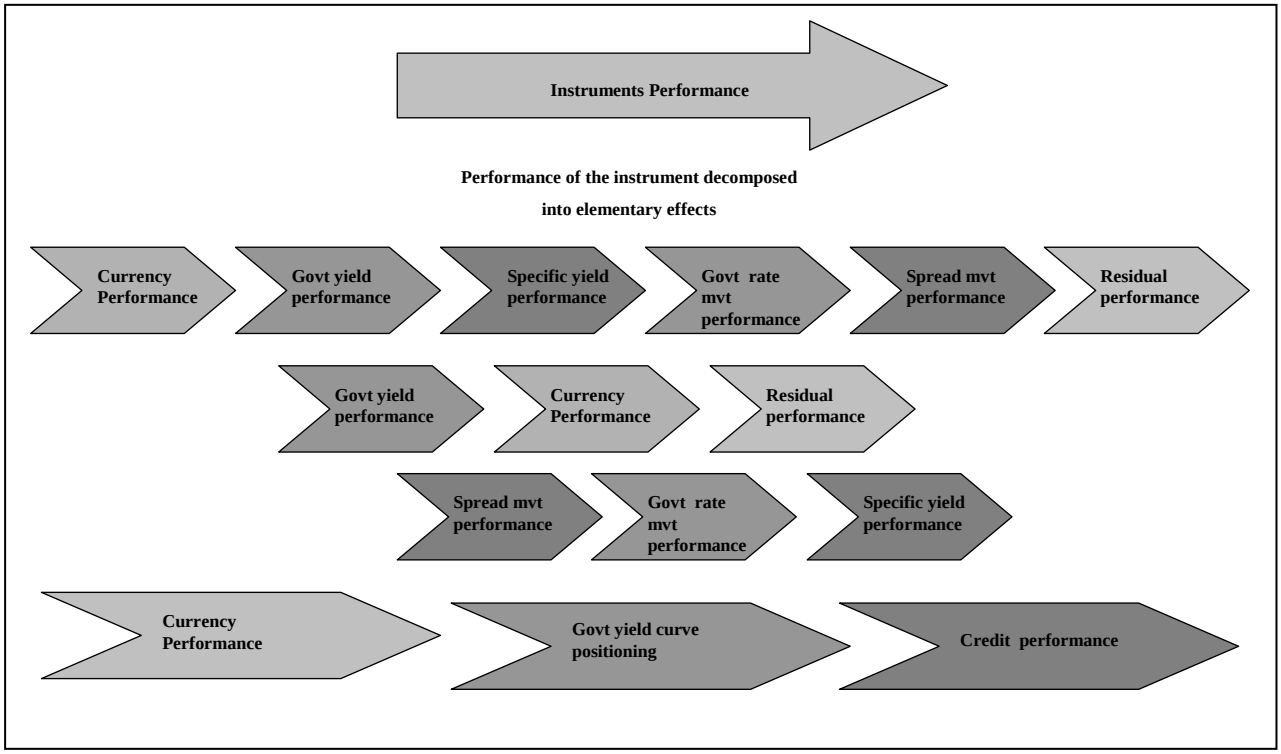

Chart 2: The SPM Methodology

The SPM is very simple to implement, does not show any residual and directly measures the added value of each step of the management process. However, with the SPM, there is an influence of the order of decisions on results. Furthermore, a correspondence is necessary between the structure of the benchmark and the management process and there is no detail at instrument level.

The main advantages of the SSM are the independence of effects, the ability to analyze all types of products - even non-standardized- and the deep insight that it provides into the constituents of the securities' performance. Conversely, it is difficult to construct intermediary yield curves, and the complexity of calculation formulas explains the possible appearance of a residual.

Nonetheless, each of these two methods presents some advantages that were interesting to preserve. This is why we tried to regroup these two methodologies in order to keep the favourable characteristics of each one and, at same time avoiding their main defaults.

II. Presentation of the Combined Methodology : Best of Both Worlds

a. The Particularity of the Investment Process

Normally in a typical equity investment process, the investments decisions are either top-down or bottom-up, without any combination of the two possibilities. Furthermore, the number of decision steps is limited to a maximum of three or four.

For a fixed income investment process, the approach is very different. The process, which could integrate up to ten different decisions, requires a more complex and precise framework of analysis.

Among the most important decisions are:

- The currency decision, which represents the choice of the exposure on each currency within the portfolio.

- The global duration: the result of the different duration choices by currency.

- The government yield curve positioning: represents the yield curve bucket where the managers decide to invest. The two main factors taken into account for this decision are the current yield and rate movements.

- The spread decision: concerns the spread given by the specific security at the origin and the spread variation that will be supported during the period. This global decision includes at least three different sub-decisions: the country of investment, the sector and the rating of the security.

In the investment decision process, the first two steps are generally a common decision taken by one or several investment committees, whereas the following steps are the specific domain of the Fund Managers. Therefore, a classical investment process can be summarized by the Chart 3.

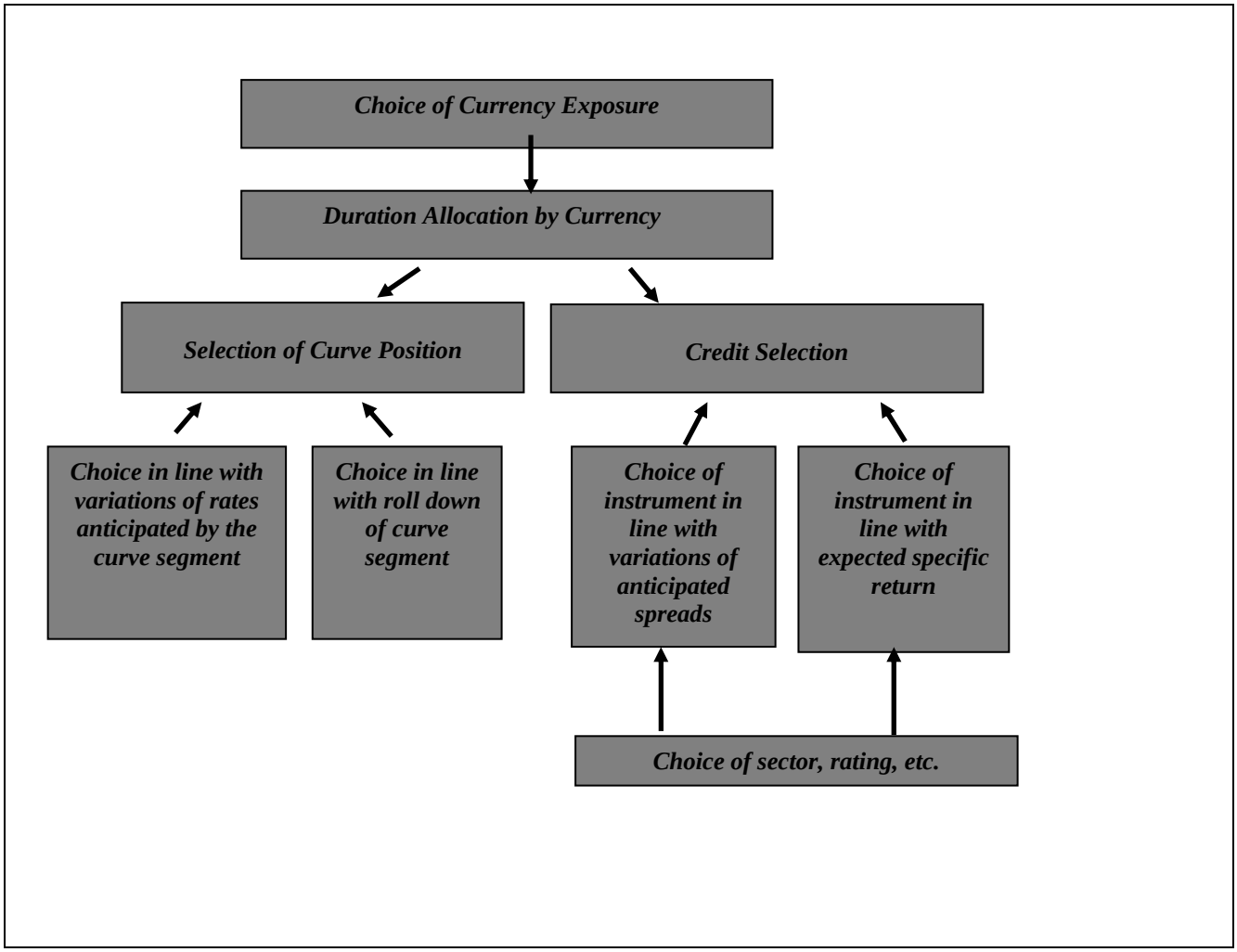

Chart3: a typical fixed-income decision process

In this process, we can observe that, in fact, we have a combination of two different types of decision processes, because it is a mix of a top-down decision process with a bottom-up approach. This particularity is

typical of the fixed-income world and partially explains why a simple Brinson performance attribution approach is not relevant.

The mix of top-down and bottom-up approaches explains why we decided to combine the two main fixed income methodologies studied through the GRAP, the successive portfolio methodology representing the top-down approach (decisions one to three in our chart) and the successive spread methodology for the bottom-up approach (decisions four and five in our chart).

In the case of a total return portfolio with no benchmark, only the successive spread methodology is to be used.

b. The Three Steps of the Combined Methodology

The methodology we are describing involves three main steps which could be named as "defining on intermediate portfolios" for the first step "the determination of the elements of the performance" for the second one and "the pooling of the performance elements" for the last one.

i. Step One: determine intermediate portfolios[4]

This first step consists of creating, for example, two intermediate portfolios:

The currency portfolio is derived from the benchmark; the only difference will be the currency exposure level which will be equal to the real portfolio level.

The duration portfolio is built in the same way, derived from the currency portfolio in order to reach the real portfolio duration.

The way to access these intermediate portfolios is to vary the number of each security in the former portfolio to obtain the desired exposure. In order to compensate, the amount of cash will be adjusted to reach the net asset value of the portfolio.

These actions being processed, the following calculations can be made:

- the performance difference between the benchmark and the first fictive portfolio measures the impact of over or under-weighting the currency exposure compared to the benchmark. In order to do that, we use a Singer-Karnosky approach.

- the performance difference between the currency portfolio and the duration portfolio will evaluate the impact of the duration decision

- the remaining performance gap between the duration and the real portfolio globally measures the impact of the other investment decisions: yield curve positioning and credit selection.

We can summarize this first step with the following equation:

$$R(P - B) = (RP_c - RB) + (RP_d - RP_c) + (RP - RP_d) \quad (1)$$

Over performance — **Currency Effect** — **Duration Effect** — **Curve+Credit Effect**

ii. Step Two: determine of the elements of the performance

In this step, we proceed to an in depth analysis of the last effect ("Curve + Credit" in the previous equation #1) through a successive spread methodology. The performance of each bond within, at the same time, the duration and the real portfolio is split into five main components which are the exchange rate, the Government yield roll-down, the interest rate variation, the spread roll-down and the spread variation.

- The currency component: represents the influence of the currency movements on the performance of each bond contained in the portfolio. It can be calculated as follows:

$$R1(A) = \left[\frac{D_A^1}{D_A^0}\right] + \left[R_A^0 * \frac{\Delta t}{n}\right] \qquad (2)$$

Where:

D_A^1 = the exchange rate of the currency of the portfolio vs. the currency of the security at the end of the period

D_A^0 = the exchange rate of the currency of the portfolio vs. the currency of the security at the beginning of the period

R_A^0 = the one month risk free rate of the currency in which the asset is quoted

Δt = the period of analysis (one day for a daily-linked analysis)

n= the number of days in a year, which could depend on the notional habits.

- The interest rate roll-down: represents the component of the performance due to the roll-down of government lending. This can be expressed as :

$$R2(A) = \left[(1 + R_e^0)^{\frac{\Delta t}{360}} - 1\right] - \left[R_A^0 * \frac{\Delta t}{360}\right] \qquad (3)$$

Where, in addition to the previous variables,

R_e^O = the yield of the government bond corresponding to the studied security in the portfolio

- The interest rate variation represents the performance of the asset invested in the portfolio due to the government's interest rate movements. We propose calculating it as follows :

$$R3(A) = -ModifiedDuration * (\Delta R_e^0) + \frac{1}{2} Convexity (\Delta R_e^0)^2 \qquad (4)$$

- The spread roll down: represents the component of the performance due to the roll-down of the spread between the specific security and the corresponding government bond. This is expressed as:

$$R4(A) = \left[(1 + (R_A^0 - R_e^0))^{\frac{\Delta t}{360}} - 1 \right] \quad (5)$$

- The spread variation: represents the performance of the asset invested in the portfolio due to the spread movements. This can be expressed as:

$$R5(A) = -ModifiedDuration * (R_A^0 - R_e^0) + \frac{1}{2} Convexity * (R_A^0 - R_e^0)^2 \quad (6)$$

Furthermore, the difference between the contributed performance of the instrument and the sum of calculated decompositions brings into evidence a gap. This gap could be divided in two parts:

- The first part is due to the existence, in the portfolio, of non typically fixed-income products.
- The second part corresponds is a residual

After testing the model, we observed that this gap remains very weak.

In this step, we also have to calculate the difference between the performance of the instrument in the duration portfolio with the performance of the instrument in the real portfolio. We can then notice that:

- The sum of performance spreads linked to the exchange will be null by construction.

- The sum of performance spreads linked to roll down and to variations of government rates will represent the yield curve positioning effect

- The sum of performance spreads linked to the spread roll down and to spread variations will represent the credit effect.

iii. Step Three: the grouping of the performance elements

In this step, we proceed to a grouping of performance elements obtained according to the characteristics of assets composing the portfolio by currency, maturity band, rating, sector or any relevant characteristic used in the investment process. To analyze the yield curve positioning, we recommend grouping the elements by maturity band, and for the credit we recommend using sector or rating groups. It is, of course, necessary to respect the chain of decisions of the investment process when we proceed to the grouping.

After numerous discussions with the users, we conclude that the most relevant presentation of the reporting could be split in three main parts. Firstly, a short summary of the total return and of the main effects determined by the successive portfolio methodology. This summary could be presented as follows:

Performance Summary

	Performance	Weight	Contribution
Portfolio			
Benchmark			
Difference			

Currency exposure	
Duration	
Government	
Credit effect	
Residual	

Table 1: Performance summary

Secondly, a detailed analysis of the government yield curve related effects, which could be summarized as presented below:

	Government Yield Effect	Government Yield Movement Effect	Total Government Effect
Total <1 1- 3- 5-			

Government Yield

	Government Yield Effect	Weight Within Portfolio	Weight in Duration Portfolio	Weight Differences	Average Government Return - Real Securities	Average Government Return - Securities Duration	Average Return Difference
Total <1 1- 3- 5-							

Government Yield

	Government Movements Effect	Contributed Portfolio Duration	Contributed Duration of Duration Portfolio	Modified Duration Spread	Average Weight Government Movements in Real Portfolio	Average Weight Government Movements in Duration Portfolio	Government Rate Difference
Total <1 1- 3- 5-							

Table 2: Analysis of the Government effect

In this part, we split the results by maturity buckets in order to measure the government yield curve positioning impact. As far as the yield is concerned, we present the respective weights of each maturity bucket in the fictitious duration portfolio and the real portfolio versus the respective government yields measured as a weighted mean of the government bonds corresponding to the securities included in the fictitious duration portfolio and in the real portfolio. As far as the yield movement is concerned, we simply list the contributed modified durations of the buckets within the portfolios and also the average movements of the government yield. These elements allow us to describe the origin of the yield curve positioning effect.

And thirdly, a focus on the credit effect which could be detailed in the following way :

Credit Effect Analysis

	Credit Yield Effect	Spread Movement Effects	Credit effects
Total Collaterized Corporate Sovereigns Sub-sovereigns			

Credit Yield Effect

	Credit Yield Effect	Weight in the real portfolio	Weight in the duration portfolio	Weight differences	Average spread in the portfolio	Average spread in the duration portfolio	Spread difference
Total Collaterized Corporate Sovereigns Sub-sovereigns							

Variation Spread

	Spread movements effects	Contributed modified duration in the real portfolio	Contributed modified duration in the duration portfolio	Modified Duration Difference	Average spread movement in the real portfolio	Average spread movement in the duration portfolio
Total Collaterized Corporate Sovereigns Sub-sovereigns						

Table 3 : Credit effect analysis

In this step we divide the results by sector in order to analyze the credit choice impact. The yield spread is explained through the weights of each bucket in the portfolios compared to the average spread at the starting date. The spread movement is explained in the same way by showing the respective modified duration and the spread variation of the two final portfolios (duration and real).One can also split the results by rating in this section.

III. Practical Implementation and Case Study

a. Practical Implementation

i. Requested Data

The methodology requires the use of a set of very simple data. This set includes the daily valuations of the portfolio. We recommend calculating the attribution effect on a daily basis for a couple of reasons, notably to minimize the impact of the mathematical approximations. Thanks to the use of a daily valuation, we do not necessarily need transactions. The only impact of a position-based implementation is to exclude the trading effect, as we assume that the transaction of the results will be within with the daily quotation of the portfolio. Of course the use of transactions, which remains possible, will improve the quality
.
As expected, the use of three main determinants of fixed income products is necessary: modified duration, yield to maturity and return. In the same way, the instrument' characteristics like the sector or rating and the currency exchange rates are also needed.
Unfortunately, data that is difficult to source, such as the government yield curves (one curve by currency used in the portfolio) and the benchmark detailed composition are needed.
Regarding the yield curve, we recommend using as many maturity spots as possible to avoid any implicit linear interpolation. This advice is given in order to determine the relevant government yield associated to any security in the portfolio.

ii. Hypothesis and simplification

The combined methodology isolates the linear performance factor of the complex products such as convertible bonds or inflation linked securities. The non-linear factor of performance could also be further analyzed, but that was out of our scope.

Moreover, the hedge fund process needs to clearly identify the results of the arbitrage strategies. Even if this type of attribution was out of the primary scope, it is merely a matter of system/data. The most evident solution consists of creating a common fictitious product linking all the basic securities included in the strategy.

Of course, like most of the performance attribution methodologies, we assume that the portfolios analyzed are managed against a benchmark with a well-known composition. For funds managed without a benchmark, including total return funds or hedge funds, it is best to use only the SSM part of the combined methodology, which does not requires the use of a benchmark.

For Balanced (fixed income + equities) portfolios, we still need to deal with the same problems as for the classic Brinson model for performance attribution. This includes the split of the cash between the different management processes and assigning all the products which can be used by either the equity team or by the fixed income and allocation teams.

b. Case Study

i. Presentation of the Data

The data used for this case study is the same as the data used by the GRAP. Therefore, the results can be directly compared to those obtained by the GRAP. Furthermore, as this set of data is not provided by us, it can be considered as strictly neutral and not manipulated to suit our purposes.

The portfolio is analyzed over a period of one week from June 30th 2000 to July 6th 2000. It contains 9 different securities (one corporate mid-term bond and eight government bonds), quoted in three main currencies (EUR, USD and GBP). The benchmark contains only 5 of the mentioned securities plus one additional long term corporate bond.

The exact composition of the portfolio and the benchmark is given in Table 4:

Securities	Currency	Bench	Portfolio
RFF	EUR	8,45%	0,00%
BTP	EUR	0,00%	16,94%
MANNESMANN	EUR	0,00%	8,66%
OAT	EUR	17,39%	4,34%
BUND	EUR	16,01%	7,99%
US Treasury	USD	0,00%	9,83%
US Treasury	USD	13,22%	8,80%
US Treasury	USD	14,66%	14,64%
GILT	GBP	0,00%	21,24%
GILT	GBP	30,27%	7,56%
Total		**100,00%**	**100,00%**

Table 4 : Benchmark and Portfolio composition

In this example, no transactions occurred during the period. This decision was made in order to simplify the treatment, however, as mentioned before, a transaction-based approach can easily be derived from this approach.

During the period, as shown in Chart 4, the government yields increased by about 10 basis points except on the short term maturities.

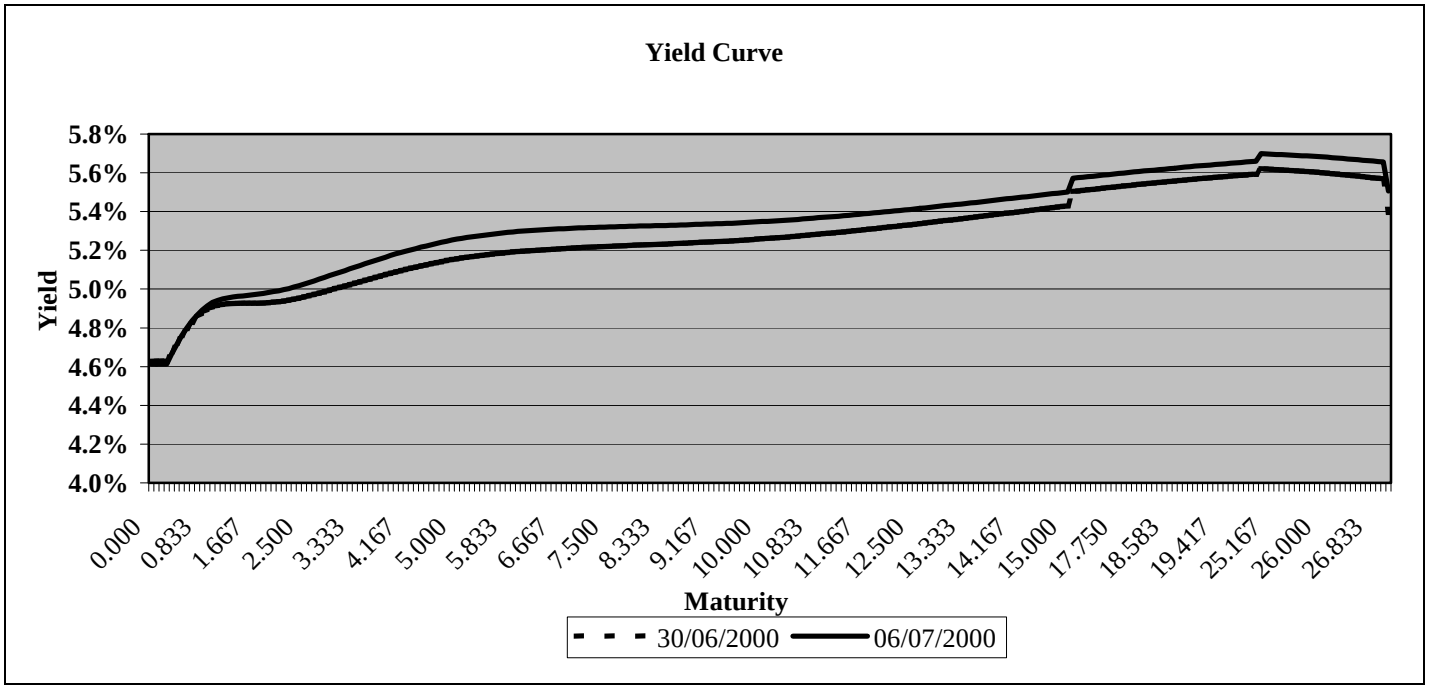

Chart 4 : Yield curve evolution

For the currencies, we can observe that the USD grew versus Euro by 34 basis points when the GBP dropped by 28 basis points. As the portfolio is under-weighted in Euro and GBP and over- weighted in USD, we can conclude that the currency effect will be positive. The Modified Duration of the portfolio (4.39) is lower than that of the benchmark (7.88). As the yield curve moved up during the period, we should observe a high positive duration effect.

Table 5 summarizes the over/under weightings of the portfolio:

	Euro	USD	GBP
PORTFOLIO	37,93	33,27	28,8
BENCHMARK	41,85	27,88	30,27
Difference	-3,92	5,39	-1,47

Table 5 : Over/underweighting of the portfolio

For the curve positioning, the main decision concerns the Gilt bucket. The Asset Manager decided to include in the portfolio a short term gilt and to underweight the long term Gilt. As the rates moved up on the long term part of the yield curve, this choice appeared to be a smart move. Globally, the other yield curve positions had no real impact on the total over-performance.

For the spreads, the RFF spread (which was discarded from the portfolio) evolved from 58 basis points to 49 basis points at the end the period, whilst the Mannesman spread widely increased from 84 to 102 basis points. As the RFF security is present in the benchmark and not in the portfolio and as the Mannesman is not included in the benchmark, this represents two lots of bad news for the portfolio. This should be translated in the results through a negative spread effect. However, as the government bonds included in the benchmark and the portfolio are not exactly the same as the securities included in the yield curve, a slight additional positive effect should be observed.

ii. Results and Comments

Tables 6-7-8 give the results of the analysis of the over-performance using the combined methodology.

CURRENCY	**0,024%**		**DURATION**	**0,218%**	
EURO	-0,003%		EURO	0,199%	
USD	0,024%		USD	-0,001%	
GBP	0,003%		GBP	0,019%	
CURVE	**0,060%**		**SPREAD**	**-0,067%**	
EURO	0,017%		EURO	-0,055%	
0-5	-0,030%		GOVERNMENT	0,030%	
05-10	0,051%		CREDIT	-0,085%	
> 10	-0,004%				
			USD	0,001%	
USD	0,004%		GOVERNMENT	0,001%	
0-5	0,002%		CREDIT		
05-10	0,002%				
> 10					
			GBP	-0,013%	
GBP	0,040%		GOVERNMENT	-0,013%	
0-5	0,029%		CREDIT		
05-10					

Table 6: Summary of the results

As forecasted above, the currency effect is slightly positive (0.024%), mainly thanks to the USD position. Our underweighting in GBP also explains a positive effect in GBP (+0.003%). The negative effect in EUR is consequently due to the depletion of the EUR invested cash.

The Duration effect of 0.218% is fully linked to the EUR Duration. The under-sensitivity of the portfolio (2.00 for the portfolio vs. 4.17 for the benchmark) during a bearish period granted us 19.9 basis points of duration effect.

The positive curve effect (0.06 %), is mainly due to the yield curve positioning in GBP. A detailed analysis of this point is made in the table below.

The spread effect is unfavorable, mainly due to the EUR credit decisions. This is also developed below.

There is also the existence of a small mathematical residual. The level of the residual is not linked to the short period of time of the analysis. The residual does not increase with the increment of the period.

Government effect

	Total Government Effect	Government Yield Movement Effect	Government Effect
EUR	**0,017%**	**0,001%**	**0,016%**
0-5 years	-0,030%	0,02%	-0,032%
5-10 years	-0,051%	0,00%	-0,051%
> 10 years	-0,004%	0,00%	-0,004%
USD	**0,004%**	**0,00%**	**0,004%**
0-5 years	0,002%	0,00%	0,002%
5-10 years	-0,051%	0,00%	0,002%
> 10 years			
GBP	**0,040%**	**0,001%**	**0,039%**
0-5 years	0,029%	0,00%	0,029%
5-10 years			
> 10 years	0,011%	0,001%	0,010%
TOTAL	**0,060%**	**0,002%**	**0,058%**

Government Yield Effect

	Government Yield Effect	Weight in the real portfolio	Weight in Duration Portfolio	Weight Differences	Average Government Yield in The Real Portfolio	Average Government Yield in The Duration Portfolio	Government Yield Difference
EUR	**0,001%**	**37,93%**	**37,93%**				
0-5 years	0,001%	25,60%		25,60%	5,07		5,07
5-10 years	0,00%	7,99%	11,72%	-3,73%	5,25	5,24	0,01
>10 years	0,00%	4,34%	8,33%		5,48	5,48	
Virtual Cash			17,88%	-17,88%			
USD	**0,000%**	**33,27%**	**33,27%**				
0-5 years		24,47%	12,16%	12,31%	6,29	6,23	0,06
5-10 years		8,80%	10,96%	-2,16%	6,13	6,13	
>10 years							
Virtual Cash			10,15%	-10,15%			
GBP	**0,001%**	**28,80%**	**28,80%**				
0-5 years	-0,01%	21,24%		21,24%	5,89		5,89
5-10 years							
>10 years	0,01%	7,56%	15,96%		5,17	5,17	
Virtual Cash			12,84%	-12,84%			

Government Yield Movements effects

	Government Yield Movements Effect	Contributed Modified Duration In the real portfolio	Contributed Modified Duration in the Duration Portfolio	Modified Duration Difference	Average Government Yield Movement in Real Portfolio	Average Government Yield Movement in Duration Portfolio
EUR	**0,016%**					
0-5 years	-0,032%	0,84		0,84	0,05	
5-10 years	0,051%	0,55	0,82	-0,27	0,10	0,14
> 10 years	-0,004%	0,61	1,17	-0,56	-0,01	-0,01
USD	**0,004%**					
0-5 years	0,002%	0,59	0,44	0,15	-0,01	-0,02
5-10 years	0,002%	0,60	0,75	-0,15	0,02	0,02
> 10 years						
GBP	**0,039%**					
0-5 years	0,029%	0,65		0,65	-0,05	
5-10 years						
> 10 years	0,010%	0,58	1,23	-0,65	0,02	0,02
TOTAL	**0,058%**					

Table 7:In-depth government effect analysis

The previous table gives us an insight into the government effect. For instance, the 3.9 bp government effect in GBP can be split into two different buckets: 0-5 years bucket where an overweighting (21.24% in the portfolio vs. 0% in the benchmark) explained a 2.9 basis points positive contribution to the curve movement and more than 10 years bucket for which an underweighting (7.56% in the portfolio vs. 15.96% in the benchmark) explains a 1 positive basis points effect also due to the curve movement. We can make the same analysis for each currency. The 1.6 basis points of the Euro are mainly due to the underweighting (7.99% in the portfolio vs. 11.72% in the benchmark) of the 5-10 years bucket.

Credit Effect Analysis

	Credit Effect	Credit yield Effects	Spread Movement Effects
EUR		0,001%	-0,056%
Government		0,001%	0,029%
Corporate		0,001%	-0,086%
USD		0	0,001%
Government		0	0,001%
Corporate			
GBP		0	-0,013%
Government		0	-0,013%
Corporate			
Total	-0,067%	0,001%	-0,068%

Credit Yield Effect

	Credit Yield Effect	Weight in the real portfolio	Weight in the duration portfolio	Weight differences	Average spread in the portfolio	Average spread in the duration portfolio	Spread difference
EUR	**0,001%**	**37,93%**	**37,93%**				
Government		29,27%	16,00%	**13,26%**	12	6	6
Corporate	0,01%	8,66%	4,05%	4,62%	84	58	26
Virtual Cash			17,88%	-17,88%			
USD	**0,00%**	**33,27%**	**33,27%**				
Government		33,27%	23,12%	10,15%	3	5	-2
Corporate							
Virtual Cash			10,15%	-10,15%			
GBP	**0,00%**	**28,80%**	**28,80%**				
Government		28,80%	15,96%	12,84%	-1		-1
Corporate							
Virtual Cash			12,84%	-12,84%			
TOTAL	**0,001%**	**100%**					

Variation Spread

	Spread movements effects	Contributed modified duration in the real portfolio	Contributed modified duration in the duration portfolio	Modified Duration Difference	Average spread movement in the real portfolio	Average spread movement in the duration portfolio
EUR	**-0,056%**					
Government	0,029	1,66	1,70	-0,04	5	6
Corporate	-0,0086	0,33	0,30	0,04	18	-9
Virtual Cash						
USD	**0,001%**					
Government	0,001%	1,19	1,19		-2	-1
Corporate						
Virtual Cash						
GBP	**-0,013%**					
Government	-0,013%	1,23	1,23		1	
Corporate						
Virtual Cash						
TOTAL	-0,068%	4,42	4,42			

Table 8: In-depth credit effect analysis

In Table 8, we can see a negative credit effect on the Euro (-5.5 basis points). This effect can be explained by several factors. On the one hand, we have a positive effect of 0.1 basis points due to the credit yield and on the other hand a -5.6 basis points effect due to the spread movement. This effect can itself be split into two sub-effects. It is evident that the main reason of this under-performance comes from the negative evolution of the spread. In fact, the manager over-weighted the corporate vs. the government in the portfolio, which was a bad decision, because, as we can observe, the spread increases of 18 basis points during the period in the portfolio. All the other variations could be explained with the same decomposition.

With these different Tables, we can follow easily and intuitively all the effects of each management decision and their origin. We can also separate and examine the different components of over-performance.

IV. Conclusion

The combined methodology consists of two phases. In the first phase, the added value of each step of the decision process is identified and measured. In the second step the detailed elements of contribution to the performance are isolated and calculated. Therefore, it becomes easy to understand where the sources of the over or under-performance of a portfolio come from, regardless of the investment process. This methodology allows a two level analysis: a bird's eye view of the performance is easy to make from Table 1, whereas a deeper insight of the results can be achieved looking at Tables 2 and 3.

The combined methodology has been fully tested. The results obtained are in accordance with the expected results, as it is shown in the example of the part III.

This methodology has been implemented within BI-SAM's system at IXIS Asset Management, a major Global Fixed Income Asset Manager, and the portfolio managers and the clients are fully satisfied with it. The combined methodology represents a universal tool for the performance control and is used both for internal and external purposes.

Moreover, the precise knowledge of the performance sources allow us to measure the variability of the performance attribution effects and thus leads to the risk attribution analysis which constitutes a new major challenge for the industry.

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END NOTES:

[1] : The GRAP (Groupe de Réflexion en Attribution de Performance – Performance Attribution Research Group) comprised of 10 Asset Managers from France, Belgium and Switzerland, 3 software vendors from France, UK and Canada, all supervised and organized by Deloitte & Touche Consulting. They spent two years arguing their points of views and discussed fixed income performance attribution. Some of the results of these discussions are available on the Deloitte & Touche Consulting website (albeit in French):
http://www.deloitte.com/dtt/article/0,1002,sid%253D21684%2526cid%253D36748,00.html

[2] : for a top-down process.

[3] : a detailed presentation of these two methods has been made by C. Giguere in "Thinking through fixed income attribution – A GRAP initiative", Working Paper, in the forthcoming *Journal of Performance Measurement*.

[4] : The methodology described here to define the intermediate portfolio is one of the possible methodologies. Other ones could also be used.