ARE THE INTERNATIONAL BOND PORTFOLIOS THE WAY TO... 1137

ARE THE INTERNATIONAL BOND PORTFOLIOS THE WAY TO GET HIGH REWARDS FOR LOW RISKS?

V. DANESI*, P. SEQUIER** & J. SIKORAY**
* RESEARCH DEPARTMENT, CREDIT COMMERCIAL DE FRANCE
** CCF-SAM
103, AVENUE DES CHAMPS ELYSEES
75008 PARIS FRANCE
PHONE: 33 1 40 70 33 96
FAX: 33 1 40 70 75 23

ABSTRACT

The last couple of years has been especially tumultuous on the international bond markets. After having experienced a very profitable year 1993, bond managers have seen an impressive crash during the year 1994. The objective of our paper is to show that none of these two years is significant of what one can expect of international bond investments. The bond markets are neither a perpetual free lunch nor the less profitable markets all over the years to come.

This paper focuses on international bond investments hedged against the currency risk. It presents some simple descriptive statistics and then explain how quantitative Error Correction Models can produce forecasts of returns that can be used in a classical mean-variance framework. The last part presents the results of portfolio simulations for three different investors. These simulations shows that international hedged bond portfolios provide undoubtedly very profitable opportunities of investments for investors whatever their base currency.
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RESUME

1993 et 1994 resteront deux crus mémorables sur les marchés obligataires internationaux. Mais le contraste entre ces deux années est très fort. 1993 a vu les marchés monter jusqu’au ciel, ou presque. L’année qui a suivi les a vus descendre aux enfers. Notre papier a pour objectif de montrer que cette situation exceptionnelle ne reflète en rien une réalité de long terme telle que l’on peut l’anticiper sur ces marchés. L’excès de rémunération qu’ils offrent par rapport aux marchés monétaires n’a rien d’un miracle financier, il n’est que la juste compensation du risque pris.

Ce papier est centré sur la capture des primes obligataires internationales, que l’on peut effectuer à partir d’investissement en obligations systématiquement couvert. Nous rappelons d’abord la pertinence d’un tel concept à l’aide de données de marchés dans une perspective historique. Le papier introduit ensuite une modélisation à correction d’erreur des taux d’intérêt, comme outil de prévision servant d’input à une optimisation classique dans un cadre moyenne variance. La dernière partie fournit les résultats de trois simulations pour des investisseurs dans différentes monnaies. Les résultats semblent très probants : les portefeuilles obligataires internationaux couverts contre le risque de change que nous avons construits constituent une alternative très performante à des investissements domestiques, et ceci, indépendamment de la devise de base.
Introduction

1993 has been an exceptional year for the international bond markets. Due to the recession in most of the countries, the long rate have fallen dramatically throughout the year to make long bond investments especially profitable. Meanwhile, the increase in many public deficits has given opportunities of safe investments with high yields for investors willing to manage their portfolio internationally. This new step towards international portfolio has increased the needs for asset allocation tools. These tools are important for two crucial issues of international bond investment. First, they help to control the risk of the portfolio so that the investor can obtain the benefit of international bond portfolio without increasing too much the total risk of the portfolio. The type of funds managed is crucial as well. The currency-hedged portfolios make the manager focus on the forecast of rates premia without being involved in the prediction of the exchange rate. On the other hand the portfolio which can either be hedged or not makes compulsory to have ideas of the way currencies will fluctuate.

In this paper we have focused on portfolios fully hedged against currency risk, not because we think that stable profits can not be made from tactical or strategic currency exposure, but because we do believe that there is already a strong incentive for domestic bond investors to buy foreign bonds hedging the currency risk. The complete hedging decision is driven by a risk/return argument since with such an asset allocation investors are able to pick up the foreign bond premia while reducing the global risk of the portfolio. This “free lunch” has already been partially noticed and analysed in [1], [2] and [3].

This paper presents the models that CCF-SAM and the research department of CCF have built to support the allocation decision. The models are error correction models which have been designed to get an answer as efficient as possible to the following questions: how will the premium of long rate versus short rate will move in the weeks or the months to come? How to allocate portfolio so that the premium can be captured with a suitable level of risk? Based on the principle that nobody would follow a model with no connections with the macro economic situation, these models aim to determine a long term equilibrium for each long term rate. These “macro-economics” equilibriums are estimated using the cointegration theory. The fact that all the markets are correlated is also taken into account in the estimation process. The next step of the process is very important as well since it would be useless to get a long term equilibrium if we have no idea of the way long term
interest rates are adjusted toward this long term trends. This second part of the modelling aims to understand this shorter term dynamics. The goal is to explain the fluctuation of the rates through the spread between the actual long term rates and the theoretical ones that has been observed at the former date.

The first part of the paper provides some simple descriptive statistics on the main bond markets, then we present the characteristics of currency-hedged bond portfolios. The third part deals with the theoretical framework that is used to build forecast on bond markets and in the last part we present numerical results on our models and on portfolio which have been managed using these models.

I World bond premia and hedged investments

This first part is mainly descriptive. One reminds the motivations which could drive an investor towards the long term bonds. Then, some simple statistics computed on the long term bond premium of the five main bond markets in the world are presented and finally there is an analysis of the financial characteristics of such investments in terms of risk and return.

I.1 The bond premium

What is the justification of a domestic long term government bonds investment? The classical answer is simple and twofold. First, people are looking for default risk free vehicles which allow to transfer money over time in real terms. In the second place investors expect to pick up an extra yield over a short term risk free investment. This extra yield is the fair reward in return for the risk that they have born. Using interest rate data series from MSCI and OECD we can compute statistics on the various bond premia in G5 countries. We shall only consider investors based in a currency of the G5 countries, and shall refer to the FRF investor when speaking of a FRF based investment in G5 government bonds. For each G5 country we define the ex-ante bond premium as the spread between the 10-year interest rate and the 3-month rate given by MSCI data (all these rates are default risk free rates).

The table 1 presents some statistics on the premium in the G5 countries from January 1970 to April 1989. One can observe that on average these
Are the international bond portfolios the way to... premia are positive. Fortunately the yield curve is upward slopping on average: the risk born by the longer term investors is actually rewarded. However, the historical distribution of this premium is very wide. Thus, over the period the investor who has been exposed on the bond market is happy on average but has also experienced very difficult times. When one focuses more precisely on individual countries, France, UK and Germany seem to have had higher premia than Japan and US. For the Japanese market, the low level of the whole interest rate curve makes the difference expressed in relative terms much less important.

<table>
<thead>
<tr>
<th>Ex ante premia 1970 1989</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.97%</td>
<td>1.35%</td>
<td>1.48%</td>
<td>0.46%</td>
<td>0.33%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.82%</td>
<td>1.41%</td>
<td>2.80%</td>
<td>1.59%</td>
<td>1.85%</td>
</tr>
<tr>
<td>Minimum</td>
<td>-4.78%</td>
<td>-3.44%</td>
<td>-4.31%</td>
<td>-4.15%</td>
<td>-5.54%</td>
</tr>
<tr>
<td>Maximum</td>
<td>4.39%</td>
<td>3.74%</td>
<td>8.17%</td>
<td>2.77%</td>
<td>3.04%</td>
</tr>
</tbody>
</table>

Table 1

Once observed that a positive bond premium exists on average in the countries of our sample, the investor is interested in testing the ex-post relevance of long term bond investments. In order to achieve it, we have compared the return on a 5-year zero-coupon bond investment which
represent the actual riskfree investment over the 5 year period and the return on a short term risk free investment rolled over on a monthly basis during the same 5-year period. For sake of simplicity, we have assumed that the 5-year zero-coupon return is exactly the yield to maturity of a 10-year straight bond.

Table 2 provides some statistics for the entire set of 5 years long investments made during the 1970-1989 period. The last investment starts in April 1989 and ends in April 1994. The ex-post figures confirm partially the ex-ante expectations. On average, the DEM and the FRF based investor did actually pick up the positive bond premium which he could expect from the ex ante figures. However, the results are much less promising than one could hope looking at table 1. The Japanese case is very similar since the ex-post premium is positive and a bit lower than the ex-ante. The results which are genuinely disappointing are the American and the British ones. The first is even negative while the second is merely the tenth of what we should expect given the ex ante premium.

<table>
<thead>
<tr>
<th>5-year zero-coupon premium</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.71%</td>
<td>0.53%</td>
<td>0.17%</td>
<td>0.33%</td>
<td>-0.12%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.17%</td>
<td>2.23%</td>
<td>2.38%</td>
<td>1.56%</td>
<td>2.46%</td>
</tr>
<tr>
<td>Minimum</td>
<td>-3.15%</td>
<td>-3.90%</td>
<td>-3.46%</td>
<td>-2.58%</td>
<td>-4.87%</td>
</tr>
<tr>
<td>Maximum</td>
<td>5.51%</td>
<td>5.24%</td>
<td>7.74%</td>
<td>2.66%</td>
<td>4.48%</td>
</tr>
</tbody>
</table>

Table 2
One can also compute the ex-post premium using bond index vehicles with a constant duration over time. This simulation corresponds to investors who keep their interest rate exposure constant over time. Using MSCI/OECD data we have built synthetic local bonds indices with a constant 5-year modified duration. As already pointed out in [4], one expects very similar results when using other indices such as JP Morgan or Salomon Brothers indices. The table 3 shows some statistics on the annualised out performance of a 5-year bond index holding versus a short term risk free investment which is rolled over on a monthly basis during the same five years period. The figures show that on average a constant duration bond investment is also able to pick up the ex-ante bond premium. However the range of the ex post premium is once again very wide so that one has to avoid bad market timing decisions!

<table>
<thead>
<tr>
<th>5 years ex-post premium</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.14%</td>
<td>1.15%</td>
<td>0.85%</td>
<td>0.77%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>2.78%</td>
<td>4.11%</td>
<td>3.25%</td>
<td>2.11%</td>
<td>3.98%</td>
</tr>
<tr>
<td>Minimum</td>
<td>-3.30%</td>
<td>-5.73%</td>
<td>-5.84%</td>
<td>-2.96%</td>
<td>-8.35%</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.71%</td>
<td>11.87%</td>
<td>10.44%</td>
<td>5.43%</td>
<td>7.66%</td>
</tr>
</tbody>
</table>

Table 3
Whatever the selected strategy, either holding zero-coupon bonds or bond indices, the previous figures are conclusive: investors are rewarded for the risk born by being on domestic long term bonds. Then a question arises naturally: can a domestic investor take profit from the foreign bond premia while keeping merely the same level of risk in the portfolio?

I.2 The hedged bond returns

For any domestic bond investor, to introduce new assets in his portfolio is a fine choice in a risk/return trade-off. It is all the more efficient as the new assets are uncorrelated with the domestic one. When looking at the ex ante bond premium correlations between the various G5 countries in table 4, we can notice that the correlations between the different bond premia are low and then suspect that investing abroad to pick up foreign bond premium can be a highly profitable move.

<table>
<thead>
<tr>
<th>1970/994</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEM</td>
<td>1.00</td>
<td>0.60</td>
<td>0.38</td>
<td>0.29</td>
<td>0.31</td>
</tr>
<tr>
<td>FRF</td>
<td>0.60</td>
<td>1.00</td>
<td>0.24</td>
<td>0.36</td>
<td>0.03</td>
</tr>
<tr>
<td>GBP</td>
<td>0.38</td>
<td>0.24</td>
<td>1.00</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td>JPY</td>
<td>0.29</td>
<td>0.36</td>
<td>0.06</td>
<td>1.00</td>
<td>0.15</td>
</tr>
<tr>
<td>USD</td>
<td>0.31</td>
<td>0.03</td>
<td>0.05</td>
<td>0.15</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 4

The way to obtain these hedged returns is very simple: one has to invest in a long term foreign bond and hedge the currency risk selling a short term forward exchange contract. Given the following notations:

- $P_t$: the price of a foreign bond at time $t$
- $Y_t$: the yield to maturity of bond at time $t$
- $S$: the sensitivity or modified duration of the bond at time $t$
- $d_t$: the maturity of the forward contract
- $r_d$: the domestic short-term interest rate with a maturity $d_t$
- $r_f$: the foreign short-term interest rate with a maturity $d_t$

The return $r$ between $t$ and $t+dt$ of the bond purchase hedged against the currency risk is:
\[ r = \frac{Y_t \times dt}{(1)} - S \times (Y_{t+dt} - Y_t) + \frac{(r_d - r_f) \times dt}{(2)} + \varepsilon \frac{(r_d - r_f) \times dt}{(3)} \]

(1) is the interest earned with the mere passing of time
(2) is the capital gain/loss on the bond
(3) is the currency hedging cost
the fourth term is a second order term which we shall neglect in the following.

Using the previous formula, we are now able to build currency-hedged bond indices with a constant modified duration and to compute some statistics on this kind of investments. The tables 5 and 6 show the returns and the risks on unhedged and fully currency hedged bond index investments for the G5 countries. As far as returns are concerned, the figures are not conclusive between hedged and unhedged returns. This is not surprising since on this type of period, the currency effect is either positive or negative and should not be that stable for the following years. As mentioned previously, an active management of the currency exposure can undoubtedly be very efficient but unhedged passive strategy should not lead to high profit on a regular basis.

<table>
<thead>
<tr>
<th>Country</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
<th>DEM</th>
<th>FRF</th>
<th>GBP</th>
<th>JPY</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unhedged returns</strong></td>
<td>6.9%</td>
<td>10.0%</td>
<td>9.8%</td>
<td>10.4%</td>
<td>7.0%</td>
<td>6.9%</td>
<td>8.3%</td>
<td>7.5%</td>
<td>8.1%</td>
<td>9.4%</td>
</tr>
<tr>
<td><strong>Hedged returns</strong></td>
<td>7.3%</td>
<td>10.5%</td>
<td>10.5%</td>
<td>10.9%</td>
<td>7.5%</td>
<td>9.0%</td>
<td>10.5%</td>
<td>9.6%</td>
<td>10.3%</td>
<td>11.6%</td>
</tr>
<tr>
<td><strong>Country view</strong></td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
</tr>
<tr>
<td><strong>Hedged returns</strong></td>
<td>8.3%</td>
<td>11.5%</td>
<td>11.3%</td>
<td>11.9%</td>
<td>8.4%</td>
<td>10.7%</td>
<td>12.2%</td>
<td>11.3%</td>
<td>11.9%</td>
<td>13.3%</td>
</tr>
<tr>
<td><strong>Country</strong></td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
</tr>
<tr>
<td><strong>Hedged returns</strong></td>
<td>2.4%</td>
<td>5.4%</td>
<td>5.2%</td>
<td>5.8%</td>
<td>2.5%</td>
<td>4.6%</td>
<td>6.0%</td>
<td>5.2%</td>
<td>5.8%</td>
<td>7.1%</td>
</tr>
<tr>
<td><strong>Country view</strong></td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
<td>DEM</td>
<td>FRF</td>
<td>GBP</td>
<td>JPY</td>
<td>USD</td>
</tr>
<tr>
<td><strong>Hedged returns</strong></td>
<td>8.4%</td>
<td>11.6%</td>
<td>11.4%</td>
<td>12.1%</td>
<td>8.5%</td>
<td>6.0%</td>
<td>7.4%</td>
<td>6.6%</td>
<td>7.2%</td>
<td>8.5%</td>
</tr>
</tbody>
</table>

Table 5

The risk tables is much more appealing. The level of volatilities are very different whether investors hedge the currency risk or not and that whatever the nationality of the investor. Furthermore, the foreign markets exhibit risks which are completely identical to those of the domestic markets so that diversification should undoubtedly leads to lower risk for similar returns.
II. Tactical asset allocation of an international hedged bond portfolio

As we have seen in the previous section, investing in foreign bonds can be very interesting on the risk/return trade-off point of view. However, the investor must now tackle a new issue: How to allocate optimally the portfolio across the new universe? More precisely, given a benchmark reflecting the long term objective of the investor, how to modify the portfolio around the benchmark in order to take into account the current situation and the environment of the markets for the few weeks and months to come?

II.1 Few figures on portfolios of hedged bonds

The part I of the paper has proved that on an individual basis the G5 markets exhibit interesting features. The following question is thus to know what happens on a portfolio point of view. There is no optimisation question in this paragraph and we just present few results on two portfolios. The first one represents the dream of every fund manager. It is the portfolio which has been all over the period invested on a monthly basis on the best performing
market. Obviously, such a goal is almost impossible to reach, however its performances shows that a skilful tactical allocator has many profit to make on such markets. The second portfolio is undoubtedly closer to reality. It is the portfolio which weights all the five markets of our sample at 20%. The more striking characteristics of this portfolio is that for returns, most of the time, similar to those of domestics investment the diversification effect leads to a much lower risk.

<table>
<thead>
<tr>
<th>Hedged portfolio</th>
<th>Return of the best portfolio</th>
<th>Return of the equally weighted portfolio</th>
<th>Volatility of the equally weighted portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEM view</td>
<td>25.83%</td>
<td>7.93%</td>
<td>3.74%</td>
</tr>
<tr>
<td>FRF view</td>
<td>35.52%</td>
<td>10.91%</td>
<td>3.65%</td>
</tr>
<tr>
<td>GBP view</td>
<td>30.25%</td>
<td>11.76%</td>
<td>3.57%</td>
</tr>
<tr>
<td>JPY view</td>
<td>23.19%</td>
<td>5.66%</td>
<td>3.66%</td>
</tr>
<tr>
<td>USD view</td>
<td>24.80%</td>
<td>7.06%</td>
<td>3.53%</td>
</tr>
</tbody>
</table>

Table 7

II.2 The classical mean-variance optimisation as theoretical framework

Furthermore, we can try to improve the allocation so that the portfolio can have financial features even better than the equally weighted portfolio. On a theoretical point of view, the objective of the allocation is to maximise the utility function of the investor conditionally to the information available at the time of the decision within a medium term horizon. We will not discuss in this part the form of the utility function which better suits the investor behaviour. We have chosen to solve the tactical allocation problem within the classical mean-variance framework. The optimisation that we perform is the maximisation of the return of the portfolio given a selected level of its variance.

To compute the calculation mentioned above, the inputs which are necessary are the expected covariance matrix of the asset returns and a vector
of expected returns. Knowing that the covariance matrix is more stable than the return vector we have concentrated ourselves on the returns prediction. There is no doubt that improvements of the risk estimation can be made but the forecasting of the returns is certainly the issue with the largest impact on the success of the allocation.

III Forecasting returns with “Error Correction Models”

To be efficient on a practical point of view a forecasting model must have different characteristics. Among them, the results produced must be understandable, we must avoid by all means to build a black box on which we will not rely and that no investor would buy. To be more precise the forecasts must be clearly founded on macro-economics features. This objective has driven us to select the Error Correction Models class since associated with the cointegration theory, it will exhibit a long term economic equilibrium and the short term adjustment around this equilibrium. These characteristics fulfill exactly our purpose of readability of our model.

III.1 Cointegration theory and Error correction models

The so called "Error Correction Models" were first introduced by Davidson, Hendry, Srba and Yeo in [5] and were developed by Engle and Granger in [6]. This kind of models is directly linked with cointegration theory and the problem of asymptotically non stationary time series. This theory comes genuinely from macroeconomics and can be seen as the theoretical development of long-term macroeconomics equilibriums.

The main goal of this theory is to take into account the fact that some series can have common deterministic or stochastic trends.

Let us start with some definitions:

- A time series admits a unit root if 1 is a root of its AutoRegressive polynomial. Such an AutoRegressive polynomial can be written:
\( \Phi(L) = (1 - L)^d \tilde{\Phi}(L) \)

- The integration degree \( d \) of a time series is the minimum number of time we have to differentiate this series so that it has no more unit root.

- A set of time series are said to be cointegrated if and only if there exist a linear combination of those series which integration degree is lower than the lowest in the initial set of time series. In other words, if \( X_t^0, \ldots, X_t^n \) are all admitting unit roots and if \( d_k \) is the lowest integration degree then, those series are cointegrated if and only if there exists \( n \) real numbers \( \beta_1, \ldots, \beta_n \) such that the integration degree of the new time series \( X_t^0 + \beta_1 X_t^1 + \cdots + \beta_n X_t^n \) is strictly lower than \( d_k \). This linear relationship can then be interpreted as a long term equilibrium.

Having this long-term equilibrium, the problem is then to determine how the short-term movement can be modeled: the principle being that the short-term movements are some local disequilibrium around the long-term relationship. In other words, at each time the total phenomenon is a mean-reversion movement with the previous long-term equilibrium as the mean. Then, if we consider the disequilibrium as the error of the first part of the model, the second part tries to "correct" this error which explains the name of the model class.

III.2 An Error Correction Model for international interest rates.

The model which has been developed for the interest rates is a five country model. For each of these countries, it involves the long-term interest rate, the short-term interest rate and the annual rate of inflation. The first part of the model which represents a long-term equilibrium involves simultaneously these different time series. These equations, if aggregated, can be interpreted as a long-term translation model between real long-term and real short-term interest rates. The second part of the model involves the previous series differentiated and the residuals of the long-term equilibrium. If we only consider the differentiated short-term interest rates and the
differentiated rates of inflation then this second part of the model is only the
first model taken in its differentiated form and one time lagged.

More precisely the long-term part of the model can be written as follows:

\[
\begin{align*}
LT_i^t &= \alpha + \beta_1 ST_i^t + \cdots + \beta_p ST_i^p + \delta_1 IR_i^1 + \cdots + \delta_p IR_i^p \\
i &= 1, \ldots, p \\
\text{s.t.:} & \quad \beta_1 + \cdots + \beta_p + \delta_1 + \cdots + \delta_p = 1
\end{align*}
\]

where: 
- \( p \) denotes the number of countries considered in the model
- \( LT_i^t \) the long-term interest rate for country \( i \) at time \( t \)
- \( ST_i^t \) the short-term interest rate for country \( i \) at time \( t \)
- \( IR_i^t \) the annual rate of inflation for country \( i \) at time \( t \)
- \( \Delta \) is the difference operator.

Then, if one denotes \( \text{Re} S_i^t \) the different residuals of the former
equations, the short-term part of the model is then:

\[
\begin{align*}
\Delta LT_i^t &= \alpha'_1 \text{Re} S_i^{t-1} + \cdots + \alpha'_p \text{Re} S_i^{t-p} \\
&\quad + \beta'_1 \Delta ST_i^{t-1} + \cdots + \beta'_p \Delta ST_i^{t-p} \\
&\quad + \delta'_1 \Delta IR_i^{t-1} + \cdots + \delta'_p \Delta IR_i^{t-p} \\
&\quad + \gamma'_1 \Delta LT_i^{t-1} + \cdots + \gamma'_p \Delta LT_i^{t-p} \\
i &= 1, \ldots, p
\end{align*}
\]

Now if one looks in more details, the presence of lagged long-term
interest rates in the right part of the equation should lead to positive values for
\( \gamma \), if there are trends in the movement of long-term interest rates. On the other
hand, one expects negative values for \( \alpha \) since the short term adjustments
should model a reversion towards the long-term equilibrium. Thus, the global
model take into account different kinds of movements from one month to
another combining economics and pure interest rates dynamics. Using this
model, we are able to forecast the variations of the long-term interest rates
and then, using the formula defining the currencies hedged bond returns, to predict the future returns of each bond markets. As a degree of freedom one can restrict some of the parameters of those models for any economic or financial reason. Concerning the statistical inference, a generalized least squares estimation method is performed so that the simultaneity of these equations is taken into account. A more financial interpretation is simply that the international bond markets are all connected and that a model which would treat all of them individually would miss this global dimension.
IV Simulations of international hedged bond portfolios

Once the model presented in the part above has been built, it is possible to derive portfolios optimally under the mean variance criterion for different level of risks. We have decided to compute simulations of the portfolios which can be implemented following the tactical asset allocation model since it represents exactly the final use of such a process. The model has been used to simulate three international bond management respectively referring to a French, a Japanese and an American investor. The three of them invest in the five bond markets of the G5: France, Germany, Japan, UK and USA. These simulations last from January 1987 to May 1994. The portfolios are monthly rebalanced using the forecasts made with the error correction model on the long-term interest rates. All those simulation are performed out of sample so that it represents the actual use a fund manager could have made of our model. The models are re-estimated on a monthly basis in order to use each month all available information. For example, for January 1987, the sample covers the period January 1970 to December 1986.

The following ex-post efficient frontiers represent the sets of portfolios one could have obtain using our strategy for different level of risks ie for different behaviours vis a vis the risk. The performance of each individual bond markets are also plotted so that one can compare the efficiency of an international allocation and that of fully invested portfolios. Those three ex-post efficient frontier are, of course, very close due to the very low volatility of short-term interest rates when compared to the volatility of domestic bond returns. One can also see that our model is not perfect in the sense that for every investor the pure German bond offered a lower risk than any of our portfolios.

These graphs show clearly that any investor, French, Japanese or American, would have obtain a higher return for a level of risk equal or lower than a pure domestic investment. This confirms the figures which had been presented in part I showing similar levels of risk for foreign hedged bonds and domestic bonds.
On this first graph we can notice that the French investor following our strategy would have increased his domestic performance by 270 basis points or, for the same level of return, could have seen his risk decrease from 4.55% to 3.66%.

In the case of the Japanese investor, all the efficient portfolios, even the riskier ones, have been less risky than the domestic investment! For the same
level of return, the volatility would have been lower by more than a 3% margin and the riskier international portfolio would have provided an excess return of 300 bp for a 2% lower volatility.

The last but not the least case is the American one. A US investor following our strategy would have gained 167 basis points of return for the same level of risk and would have seen his risk decrease from 4.76% to 3.82% for the same level of return. This last example shows that even for an investor based in the largest domestic bond market in the world, diversifying internationally is highly profitable.

Conclusion

This paper shows that international bond portfolios represent a very efficient way to enhance performances for investors who are mostly invested on their domestic bond markets. First, we present some simple statistics on the financial features of hedged bonds which are very impressive since they prove that large excess return over domestic bonds can be easily picked up by most of the international investors. Then, we explain the framework of the study. Finally, we demonstrate that tactical asset allocation tools can lead to quite remarkable performances.
These results are satisfactory since the model which has been developed in this paper is still a simple one. However, one can certainly improve it, notably on the risk estimation point of view. For example, the bond markets as most of the financial markets would probably be described more accurately by taking into account some heteroskedasticity and the performance of the tactical asset allocation should be improved by using appropriate models. The return forecasts could be better as well, the enhancement obtained being very far from the best one presented in part II. Even if reaching this best possible return is a utopia, our model could be completed by using other macroeconomics variables such as current account or trade balance or by improving the description of the connections existing among the markets.
Bibliography:


Biography:

Vladimir Danesi is graduate from University Strasbourg in probability and statistics. He holds a master degree from ENSAE in applied statistics. Before joining CCF, he was an analyst with Compagnie Bancaire. Since 1992 he is a quantitative analyst in the Research and Innovation department, in charge of applied econometrics for asset management.

Pierre Séquier holds a PhD from ENPC (Ecole Nationale des Ponts et Chaussées) and a master degree from ENSAE. He joined CCF research department in 1989 as a quantitative analyst. He specialized in international markets and currencies. In 1994 he joined CCF-SAM as a senior bond manager.

Jacques Sikorav holds a PhD from University Paris IX Dauphine in applied mathematics and graduated from Ecole Normale Supérieure de Saint-Cloud. From 1986 to 1989, he was a senior researcher at INRIA (Institut National de Recherche en Informatique et Automatique). He joined CCF in 1990 as a senior quantitative analyst in the research department, specialized in derivatives. Since 1993 he is the chief investment officer with CCF-SAM.