Oil prices and government bond risk premiums

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By

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Abstract :

This article analyses the impact of oil price on bond risk premiums issued by emerging economies. No empirical study has yet focussed on the effects of the oil price on government bond risk premiums. We develop a model of credit spread with data from the EMBIG index of seventeen countries, from 1998 to 2008. An analysis in time series has been carried out on each country. Then we use a panel analysis to determine the global impact of oil prices on the risk perceptions of investors. Finally, we suggest a new estimator for the oil price to take into account the effect of the price variance. We show that the oil price influences the risk premiums of sovereign bonds, along with the price volatility that increases the accuracy of the model.

Keywords : Oil prices, sovereign debt, risk premium

JEL classification : F30, G12, G15

The authors thank the referees for their very helpful comments.

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Introduction

For decades, government financing is an increasing problem for every country worldwide. Globalization offers more way of financing but also more uncertainty, particularly for countries with political problems or not from the most developed subsample.

Emerging economies such as Brazil or China have been developing steadily since the beginning of the 1990s. During this period, their issuing of government bonds has considerably increased, underlining their need for substantial investment in infrastructure and long-term projects. But, at the same time, they have had to face a series of financial crises which has greatly reduced their credit capacity and increased the spread, therefore the cost, of financing. The explaining factors of this spread and macroeconomic indicators alone cannot explain the investors' perception of risk.

Among the factors determining the risk associated with bonds, the oil price is one of the key elements for consideration. As S. Edwards (1985) points out, nine of the ten last recessions have been preceded by oil crises. Moreover, the volatility of oil price has strongly increased since January 1998. Therefore, the effect of variations in the oil price on economic performance has been the subject of empirical studies (Blanchard and Gali, 2007) they have shown the impact that variations in the oil price can have on growth, productivity and inflation.

If international liquidity has been a subject of interest that has been well discussed in financial literature, the impact of the oil price has not excited anything like the same interest. The article by Min (1998) is, to our knowledge, the only article which includes the oil price as an explanatory variable in his model. However the author

does not find significant links between the variations in the oil price and government bond spreads.

This article aims to analyse the impact of the oil price on bond risk premiums issued by emerging economies. It is included in the wider framework of studies on the risk measure associated of foreign bonds (Edwards, 1985; Min, 1998; Pan and Singleton, 2007). In spite of the multiplicity of works, it would seem that no empirical study has yet focussed on the effects of the oil price on government bond risk premiums. It is this question that is dealt with here. In order to do this, we develop a model of credit spread[1][1] with data from the EMBIG index (Emerging Market Bond Index Global) of seventeen countries from 1998 to 2008.

The empirical study proceeded with three estimates. The first is an analysis of each country in time series. It shows the influence of the individual characteristics of a country on the relation between the oil price and the risk premium of government bonds. The second is a panel analysis. The empirical study shows the essential role of the oil price as risk factor that is both global and external. Finally, the third estimate is an improved variant of the panel analysis. It confirms the essential role of the volatility of oil price in the estimation of the risk associated with sovereign bonds.

1. Literature review

1.1. Factors determining the risk associated with government bonds

During the 1990s, the issuing of government bonds in emerging countries has highly increased, improving the liquidity of this financial product. Today, it's the first source

[1] This spread corresponds to the difference between the yield of a risky bond and that of one which is virtually risk-free such as the treasury bills issued by the US.

of financing in developing countries after foreign direct investment. At the same time the public-debt market in the developing countries has experienced serious upheavals following several financial crises. In these conditions, it is important to understand the factors determining the prices of government bonds.

1.1.1. Macro-economic determinants

Different models allow for the selection of macro-economic k variables from a modelling of the borrowing status of a country. The principal indicators of solvency are weak stock of debt, weak interest rate or production growth. The level of openness of the economy is another key factor in the international solvency of the country. Other variables of competitiveness such as the exchange rate can play an important role in the credit risk of countries.

One of the founding articles of empirical literature on the international credit markets is that of Edwards (1985). He is particularly interested in the measurement of government bonds in the context of the debt crises of the 1980s. He develops a model that considers the emerging countries as small borrowers within an almost perfect financial market: the spread depends on the default probability which itself results from macro-economic variables.

The data comes from the World Bank and the International Monetary Fund (IMF) and concerns 727 debt instruments of 19 of the least developed countries covering the period from 1976 to 1980. Several determining factors are considered: the ratio of investment growth as a per centage of GDP, the average amount to be invested, the growth of GDP per unit of capital, the rate of inflation, international reserves, the deflation rate, and government spending added to GDP.

The empirical results show that the development of the spread takes into account the economic characteristics proper to the countries under consideration. For example the debt-to-GDP ratio is positively correlative to the spread level. Also, the sum of international reserves is significant and plays an important role in determining the amount of the risk premium. The proportion to invest has a negative impact on the default probability and the spread of government securities. The study shows that temporal differences within the same country are more important than the differences between countries. Edwards concludes that investors have taken the individual macro-economic specificities of countries into account.

Cantor and Packer (1996) analyse the determinants of the government bonds spread in over 49 countries in 1995, taking account of the growth in GDP, inflation, current account, debt, indicators of economic development and agency ratings (Moody's, Standard & Poor's). The authors do not find any significant relations between the macro-economic indicators of the countries and the fluctuations in the spread.

An empirical study by Kamin and van Kleist (1997) analyses more than 304 sovereign bonds issued in the 1990s. They find that the spread in Latin American countries is, on average, more than 39 per cent higher than those in Asia. This result points to a segmented government bonds market.

Min (1998) carried out an empirical study from 1991 to 1995 to analyse the economic determinants of the yield from government bonds made out in American dollars in the emerging countries. The determinants of default probability are regrouped into four groups of variables that explain the spread level: liquidity and solvency, basic macro-economics, variables of external shocks and indicative variables. The results show that the liquidity and solvency of the economy play an essential role through GDP-to-debt ratio, and the ratio of international reserves to GDP, and integrates the effect of

external shocks on the risk of default by a country. Most of the regional specificities are not significant which indicates that common factors determine the spread level. This result is confirmed by recent studies such as those by Longstaff and al. (2007). Finally, it shows that the volatility of the spread is symmetrically influenced both by liquidity and by macro-economic fundamentals such as the rate of inflation, the GDP-to-debt ratio and the ratio of international reserves to GDP.

Following the increase in sovereign debt volatility at the end of the 1990s, many investors appeared on the market to take advantage of investment opportunities. Goldman and Sachs (2000) were the first to establish an arbitration model on bond spreads issued in fifteen emerging economies from 1996 to 2000. In the same way as Min (1998), Goldman and Sachs (2000) break the macro-economic variables down into four categories: solvency (real GNP), liquidity (Debt/PIB, International reserves, Budgetary balance/GNP, LIBOR), external shocks (exchange rate, exports/GNP) and indicative variables (previous default). From the evaluation model, it would seem that twelve of the fifteen countries considered had undervalued bonds while only one country reached its basic value.

Eichengreen and Moody (1998) analysed more than 1300 bonds issued by 55 emerging economies between 1991 and 1997. The explanatory factors of the spread are the ten-year interest rate on American bonds, the ratio of external debts to GDP, the ratio of debts to exports, the ratio of international reserves to GDP, the level of growth to GDP and finally budget deficit to GDP. Their result confirmed that an increase in the quality of a country's credit increases the probability of bond issuing and reduces the government bond premium. The market differentiates between the countries as a function of the quality of the borrower.

1.1.2 Government bonds: a real class of assets?

Is the risk associated with government bonds merely idiosyncratic or rather determined by global economic factors?

To answer this question, Longstaff and al. (2007) studied the profile yield/risk of government bonds. The interest of their study is to analyse the credit risk determinants relating to government bonds in the context of the Capital Asset Princing Model. Their study concerns the monthly CDS premiums made out in US dollars between October 2000 and May 2007 for each of the 26 countries studied. The CDS premiums have the advantage of directly reflecting the risk perception of investors. Moreover, the CDS government bonds market is often more liquid than the bonds market itself.

In order to analyse the determinants of the CDS sovereign bonds premium, the authors include four categories of explicative variables: the local variables (yield of the local market, exchange rate and sum of reserves), the financial variables of the market which concern the stock market and American bonds market, the variables of global risk premiums, (yield of the S&500 index, variation of the spread between the historic volatility and estimated on the options of the VIX index), and an investment flow variable.

Their results reveal a very strong correlation between the CDS premiums of the different countries: Three principal global factors explain 50 per cent of their variation. The spread of the CDS on government bonds depends on American shares (S&P 500 and NASDAQ indices), on the bonds market and on a global risk premium. Pan and Singleton (2007), show that the spreads of different countries are strongly correlated with the VIX index. The global risk, identical in the 26 countries, determines more than 30 per cent of the total development of the CDS spreads on

government bonds. The macro-economic determinants specific to the country only represent a small part of the total development of premiums. As in the work of Min (1998), or Ferrucci (2003), it seemed that the risk premiums are higher in Latin America than in the other continents.

1.2. Impact of oil prices on growth, inflation and productivity

1.2.1. Oil crisis and economic performance: empirical evidences

Economists have long been examining the relation between the oil price and macro-economic performance. Since the 1970s and a growing dependence on oil-importing economies, many oil crises have occurred: the crash in 1986, the increase of 1990-1991 associated with the Gulf war, the growth of 2000 and the crisis of 2003 associated with the war in Iraq. In 2007-2008 the oil price strongly increased resulting from a conjunction of economic, political, geological and climatic factors.

Thus the variations in the oil price depend to a large extent on exogenous events such as those linked to the political situation in the Middle East, the development of cartels or military conflicts.

The increase in the oil price is deemed responsible for recessions, inflation and for the reduction in productivity of the mid-1970s. Numerous empirical studies such as that of Hamilton (1983) have shown that the relation between the oil price and GDP is more than a simple statistical coincidence. Determining the mechanisms by which the oil price influences macro-economic conditions is essential to quantify the impact of oil prices on the solvency of a country and to measure the spread of sovereign bonds. Nevertheless, this idea has been called into question by certain economists (Barsky

and Kilian, 2002) who believe that macro-economic variables partly determine the fluctuations in the oil price.

1.2.2. How oil price influences growth, inflation and productivity.

1.2.2.1. The effect of energy consumption on GDP

The elasticity of production to energy prices depends on the proportion of energy in production. Empirically, this proportion is relatively small. For example, in 2000, in the USA, the consumption of oil which reached 7.2 million barrels only represented 2.2 per cent of GDP. However, it is important to point out that this per centage has risen substantially following recent rises in the oil price, yet remain small in relation to production.

Nevertheless, the relations of cause and effect between the variations in the oil price and GDP are all but simple. Bohi (1991) shows that there is no empirical evidence which supports the idea that countries with higher energy costs are more severely affected by an oil crisis than countries who are less reliant on oil as a source of energy. The empirical studies show that the cost of an oil crisis is not so much the result of an increase in the oil price, as that of a reduction in the consumption of other factors of productions that it leads to. Rotemberg and Woodford (1996) show that an increase of 10 per cent in the oil price can result in a reduction of 2.5 per cent of GDP over an eighteen month period.

1.2.2.2. Sectoral reallocations

An oil crisis can have a different impact upon capital and employment, and can cause a reallocation between sectors of activity. Hamilton (1983) shows that oil crises cause a reduction in demand in other industries which leads to a redistribution of work

between the sectors of activity. The costs of capital adjustment and work, following an oil crisis, have been the subject of much research (Lee and al.,1995).

1.2.2.3. Monetary policies and inflation

Certain studies highlight the role of monetary policy in the relation between the oil price and GDP. According to Barsky and Kilian (2004), the recession of 1973-1974 was one of the consequences of the monetary expansion of the US federal reserve in order to respond to fears about inflation which resulted in an increase in the oil price. Monetary policies can also cause inflationary spirals, wages-prices, caused by the oil price.

The macro-economic effect of an increase in the oil price can potentially result in stagflation. This phenomenon is particularly important as an explanation of the crisis of the 1970s. As the rate of inflation is linked to monetary policy, the impact of an oil crisis depends primarily on the reaction of central banks to this economic shock. Hooker (2002) illustrates this phenomenon by showing that oil crises significantly contributed to causing inflation in the US up to 1981, the date on which the question of inflation became a priority of monetary policy.

1.2.2.4 Modifications of channel transmissions

While the economies of OECD countries have seen real variations in the oil price in 2000 and 2003 which were as serious as the oil crises of 1973 and 1979, no variation in GDP and the rate of inflation were recorded. This fact calls into question the mechanisms put in place with regard to the relation between the oil price and macro-economic conditions.

Blanchard and Gali (2007) confirm the hypothesis that the oil price influenced the stagflation of the 1970s, but point out that other effects were at work. Globally, the economies and notably those of the OECD are a lot less sensitive to fluctuations in the oil price. The impact of a variation in the oil price on the inflation rate has weakened. Several explanations can be given for this. On the one hand, wages inflexibility has increased. It partly explains the reduction of the impact of fluctuations in oil prices. On the other hand, the central banks have actively adopted a policy of maintaining a low rate of inflation since the beginning of the 1980s (Herrera and Pesavento, 2009). Finally, energy consumption and the dependence of economies on oil has dropped, even though there are disparities according to the country concerned.

1.2.3. Oil price and economic risk: the case of oil producing countries

Most studies have focussed on oil importing countries. However, the relation between economic growth and the oil price is radically different in an oil-producing country. Mechanically, an increase in the oil price should increase result in an increase in GDP. This connection is questioned by the efficiency of wealth redistribution systems and economic development models.

The model of Corden and Neary (1982), known as “Dutch disease”, predicted that an important increase in oil revenues can damage the GDP of certain developing countries. This model was empirically backed up in oil-producing countries during the 1970s. The production of oil was developed to the detriment of the manufacturing and agricultural sectors.

It is certain that the oil price influences the credit risk of all governments. If the relation between the oil price and macro-economic performance has been developed since 1980, it remains significant. However no empirical study has specifically

studied the impact of the oil price on the Government bonds spread. This is specifically the subject of the second part of our article.

2. Empirical study

The objective of the empirical study is to quantify the impact of the development of oil prices on the risk premium of government bonds. To do this, after the presentation of some descriptive statistics, we will proceed with an analysis in time series on each country considered, then to a panel analysis.

2.1. Data

We use government bond spreads across fourteen emerging countries and four regions, Latin America, The Middle East, Asia and Africa. The data are daily and obtained from DataStream and Reuters. The period covered is almost ten years from the 1st January 1998 to the 30th May 2008.

2.1.1. Explained variables

The government bond spread refers to the risk premium that the bond holder demands from the seller to hold the bond. For bonds issued at par, the spread corresponds to the difference between the interest rate of the bond and the no-risk interest rate, here the interest rate of bonds from the American treasury.

We use the EMBIG index published by JP Morgan. It is an index of the spread of government bonds from emerging countries made out in US dollars. This index measures the difference between the premium paid by the emerging countries and that of an American treasury bond of similar maturity. It is calculated from the average of all the bonds weighted by the capitalisation of the bonds market, in contrast to the EMBI index (Emerging Market Bond Index) which includes only liquid bonds

including Eurobonds and Brady bonds whose minimum face value is 500 million US dollars. The EMBIG index is of a maturity higher than two and a half years and covers more than 27 countries since 1998 (the EMBI index covers five countries from 1991 to 1995 and 11, since 1995).

Including the two series in the same empirical study creates a selection bias because the EMBI index only covers Brady-type bond yields and the yields on certain structured instruments. Moreover, these two indices EMBI and EMBIG can also give different risk measurements because the composition of the two bond portfolios is different. We only consider EMBIG indices: their quantity is largely sufficient to bring the empirical estimation to a satisfactory conclusion.

The EMBIG index allows a more pertinent geographical analysis by region rather than by country. The indices by region are calculated as a geometrical average of the country indices.

2.1.2 Explanatory variables

Our study draws on the models studied in the first part. The EMBIG index makes it possible to obtain data gathered over several decades which is not the case in most macro-economic series.

Following Longstaff and al. (2007), three groups of independent variables have been included in our model: the market risk variables, exchange rates and external shocks.

The market risk is interpreted by two indices: the Chicago Board Options Exchange Volatility Index (VIX) and the S&P500 index. The VIX index is a measure of the implicit volatility of a bond in the S&P500 index. It concerns the perception of risk by the investors. An increase in the VIX index is explained by an increase in the bonds

spread. Pan and Singleton (2007) show that the premium bonds of the different countries are strongly correlated to the VIX index and, more generally, to the S&P500 index, a factor of global risk. We suppose that these two indices have positive impacts on the spread.

The interest rate of the country by dollar unit (USD), noted as FX, is included in ouir model. It reflects both the competitiveness of the economy and the solvency of the country. These two factors have a distinct impact on the spread. An increase in the exchange rate reduces the competitiveness of a country and increases the EMBIG index, while an increase in the exchange rate increases the ability of a country to fulfil its contract and thus reduce the bond risk premium.

The external shocks are highlighted in this study by international liquidity and oil price. An increase in the interest rate increases the cost of new finance and debts that have already been contracted. Eichgreen and Mody (1998) confirmed this result. The impact of international liquidity is analysed by the interest rate over a three month period of US T-bills or short-term interest rate (STI), and the ten-year interest rate or Long Term Interest Rate (LTI) of US treasury bonds. As explained by the liquidity preference theory and shown empirically in Ferrucci (2003) and Kamin and Kleist (1999), the impact of STI should be positive while that of LTI should be negative.

2.1.3. Impact of the oil price

The variation in the oil price is represented by the West Texas Intermediate (WTI), also known as the Texas Light Sweet. The WTI index is an index of light crude oil which serves as a yardstick for establishing the average oil price from America. Economic theory suggests studying the real oil price rather than its nominal price. Nevertheless, while taking account of the high range of fluctuations in the oil price

and the low inflation rate over the period considered, the fact of using the real price or the nominal oil price does not interfere with the estimation of the spread. In the tradition of most empirical studies, our estimation adopts a nominal price level in logarithm form, noted as LN (WTI).

2.2. Descriptive statistics

Tables 1 and 2 present the statistical description of the variables.

The average differs greatly according to the country and the region. Therefore with an average EMBIG index of more than 509.59, the bonds issued by Bulgaria show the highest spread in the sample. Contrary to this, with an EMBIG index average at 111.07, Argentina has the lowest spread of the countries and regions covered in this study.

The variance is also very different according to the country. Argentina shows the weakest standard deviation, that is, 41.62, while Russia shows the strongest at 185.45. It would seem that the countries that have the highest average level of Government bond spread have a particularly high variance.

[INSERT TABLE 1 HERE]

[INSERT TABLE 2 HERE]

The short-term risk-free interest rate (STI, 3 months maturity) is lower than the long term risk free interest rate (LTI, maturity 30 years).

A unit root test[7] was carried out on each time series sample. It transpires that the government bonds spread is part of a first order integration (1).

2.3. Estimation and Interpretation

2.3.1. Analysis in time series for each country

In the first instance the study proceeds by a time series analysis of government bond spread for each country and region. This makes it possible to rely on the impact of the oil price on the EMBIG index on the idiosyncratic situation of the country. We use a linear model with Least Squares estimation.

$$\text{Log}(EMBIG_{it}) - \text{Log}(EMBIG_{it-1}) = \beta_{i1}(STI_t - STI_{t-1}) + \beta_{i2}(LTI_t - LTI_{t-1}) + \beta_{i3}(VIX_t - VIX_{t-1}) + \beta_{i4}(S\&P500_t - S\&P500_{t-1}) + \beta_{i5}(\text{Log}(WTI)_t - \text{Log}(WTI)_{t-1}) + \quad (1)$$

Where :

LTI is the Long Term Interest Rates

STI is the Short Term Interest Rates

WTI is the West Texas Index

VIX is the Chicago Board Options Exchange Volatility Index

Table 3 shows the results of this model, that is to say, the impact of independent variables on the EMBIG index logarithm.

[INSERT TABLE 3 HERE]

The test of White has a very weak p-value: we can rejects the null hypothesis of homoscedasticity. The t-stats presented are therefore adjusted by the correction of White which makes it possible to have a consistent covariance matrix estimator and a direct test for heteroscedasticity. The F-tests show that the groups of coefficients are significant at the threshold of 5 per cent.

First of all, the oil price is a significant indicator of the global risk of external factors (Table 3). The majority of coefficients are positive and significant at the 5 per cent level. Any increase in global risk has a knock-on effect on the bonds market. For

example, the spread of a country like Mexico increases in the case of an increase in the oil price. An increase in the oil price increases the perception of global risk by investors whatever the individual characteristics of the country and the EMBIG index level.

In addition the effect of the oil price differs greatly according to the country. Russia, Argentina and Venezuela are the three countries for which the impact of the oil price on spread is the highest. An increase of 1 per cent in the oil price manifests itself by an increase in the EMBIG index of 0.04 per cent in Russia and 0.03 per cent in Venezuela. The oil price has a negative impact on the EMBIG index for the regions of Asia, the Middle East and countries such as China.

The results show that the development of the oil price has a different impact depending on the country studied. This difference could be explained by the fact that that certain countries import oil while others export it. An increase in the oil price constitutes a financial burden for the former and a benefit for the latter. This transfer of wealth could have an impact on the default probability and the losses associated with it for the borrowing countries.

With regard to the other explanatory variables (VIX, S&P500, STI, LTI), our estimate partly confirms the empirical results reviewed in the first part of our study, with the exception of the VIX index. This index of market risk has a coefficient which is negative most of the time and significantly on the threshold of 5 per cent. This result could be explained by the migration of investors towards government bonds which are relatively low risk following an increase in risk in the stock market. The influence of the S&P500 index is positive and significant. The effect of the exchange rate on the EMBIG index is negative and significant. This seems to indicate that an increase in

the exchange rate is synonymous with an increase in solvency rather than a drop in competitiveness. Finally, the sign of the long-term interest rate concurs with the results of Ferrucci (2003).

2.3.2. Panel Analysis

The previous study gives an insight into the individual impact of the oil price on the EMBIG indices of each country. It would be interesting to design a model that can quantify this impact from a global point of view. The question would therefore be to know what effect an increase in the oil price could have on the government bonds spread.

The data we have used for this study include more than 17 countries and regions, on a daily basis, during almost ten years from January 1998 to April 2008. A panel analysis was necessary to improve the results. Model (2) used is of the form:

$$\log\left[EMBIG_{it}\right] = \alpha_i + \beta_1 STI_{it} + \beta_2 LTI_{it} + \beta_3 VIX_{it} + \beta_4 SP500_{it} + \beta_5 \log\left(WTI_{it}\right) + \varepsilon_{it} \quad (2)$$

The number of observations is 25.669 and the number of groups, 17. Table 4 shows the results of the panel analysis. The t-stats are indicated between brackets below the coefficients. All the coefficients are significantly at the 5 per cent level.

[INSERT TABLE 4 HERE]

In the case of a fixed effects model, the most relevant R^2 value is the R^2 within because it gives an idea of the intra-individual share of the dependent variable explained by the explanatory variables. The R^2 within is 0.6396 which is very satisfactory. The R^2 between (0.1044) gives an idea of the contribution of fixed effects to the model.

In order to determine which of the two models is the most relevant, we can go back to using the Haussmann test whose hypotheses are as follows:

H0: the random models are equivalent.

Ha: the fixed-effect model is better than the random effect model.

The application of this test makes it possible to reject the null hypothesis according to which the models are equivalent. Here the most relevant model is the fixed-effect model.

If the test makes it possible to categorize between the two models, the model carried over must depend on other more theoretical considerations. Allowing for the existence of random effects comes back to the supposition that the factor representing the individual effects is not correlated with the explanatory variables. This hypothesis is particularly strong for our model and, consequently, the fixed-effect model is the more appropriate one for our study.

The panel analysis makes it possible to show that the oil price has a significant effect on the EMBIG index. An increase of 1 per cent in the oil price brings about an increase in the spread of 0.298 per cent.The coefficient of the oil price is significantly at the 1 per cent level. The development of the oil price is a factor of global and external risk which influences the cost of credit of all the governments.

With regard to the other explanatory variables, the empirical study rejoins the results suggested by theory and empirical literature. As Ferrucci (2003) shows, the long-term interest rates have a weaker impact than the short-term rate. The VIX index has a positive and significant effect on the EMBIG index. The influence of the S&P500 index on the explanatory variable is relatively weak. This can be explained by the fact

that the market risk is already represented by the volatility of the options of the S&P500 index, graded VIX. Finally σ corresponds respectively to the fixed effect and the random effect of the models.

Numerous empirical studies, such as that of Blanchard and Gali (2007), have shown that the effect of oil prices on macro-economic performance has significantly dropped since the 1980s. Certain studies explain this development by an increase in the variance of the oil price. In the following panel analysis, the empirical study makes it possible to construct an index of oil price corrected for volatility.

The literature review has shown that the impact of an oil price increase on economic activity has dropped since the 1980s. In fact, it is the mechanisms of transmission of oil crises on economic performance that have changed. The literature shows the important role of the volatility of oil price on the economic growth of a country.

A study developed by Lee and al. (1996) shows that the relation between economic growth and oil price is no longer significant since 1986. The authors defend the idea that the oil price has not lost its influence on GDP if we take into account the extent of variations in the oil price. The crises relating to oil prices are more likely to have an influence on economic performance in an environment of stable oil prices than in an environment where the movements of the oil price are erratic.

Lee et al. (1996) developed an indicator of the oil price corrected of its variance. The authors note that this indicator significantly influences macro-economic performances regardless of the period under consideration. This result concurs with the idea that the impact of the oil price on economic activity is different according to whether or not it is anticipated.

Following the example of empirical studies such as Hamilton (1997), Lee and al. (1996) state that the effect of oil price is asymmetrical: an increase in the oil price is associated with a significant drop in GNP, while a drop in the price is not significantly linked to economic activity. This is why we will use a positive semi-variance.

In the present study, we have put in place an indicator which concurs with the empirical results on the nature of the impact of the oil price on economic activity. From this point of view, the indicator appears as a risk premium of oil which takes into account the volatility of the oil price. This variable, noted as WTI premium, is defined by the relation between the yield of the WTI index and a positive three-month semi variance:

$$\mathrm{Pr}imeWTI = \frac{WTI}{T^{-1}\sum\left(\left(WTI_t - \overline{WTI}\right)^2\right).I\left(WTI_t > \overline{WTI}\right)} \qquad (3)$$

An increase in the oil price is just as likely to influence the risk premium of government bonds as its variance is weak. This leads us to conclude that such a variable has a positive and significant impact on the measurement of government bonds spread.

We then proceeded to a panel analysis whose results are shown in Table 5. The method of estimation adopted is similar to that of the analysis in the previous panel.

[INSERT TABLE 5 HERE]

The t-stats are presented in brackets. The R^2 within and between presented in Table 5 indicates that the independent variables explain more than 66 per cent of the

fluctuation in the EMBIG index. The R^2 within and between are both higher than in model 2(a).

The coefficients are all individually significant at the 5 per cent level except the S&P500. The latter has no effect on the risk perception of sovereign bonds. The coefficient of the new indicator of the variations in the oil price, noted as Prime WTI, is particularly high and significant on the threshold of 1 per cent. According to model (2b), an increase of 1 per cent of the ratio of the oil price to its variance causes an increase of 0.5622 per cent on the EMBIG index.

This model validates the theory according to which the variance of the oil price plays a determining role in the measurement of the risk associated with government bonds. Correcting the oil price by its semi-variance makes it possible to obtain better estimates.

3. Conclusion

The oil price represents a global risk factor likely to influence the credit risk of a country. This analysis is the first to demonstrate the significant effect of the variation in the oil price on the bond spread of a country.

The empirical study proceeds firstly with an analysis in time series of each of the 17 countries from January 1998 to 2008. The models developed concur with the theoretical models. Also, the impact of the oil price on the risk associated with government bonds depends on the individual characteristics of the country considered.

Secondly, the empirical study analyses the impact of the oil price on the EMBIG index as a factor of global risk. This explains the use of a panel analysis. The estimate

means used is a fixed effect model. The oil price has a positive and significant impact on the risk premiums of government bonds. An increase of 1 per cent in the oil price increases the EMBIG index by 0.26 per cent.

Thirdly, the panel analysis uses an indicator which corrects the oil price volatility. This indicator is justified by the fact that a large number of empirical studies underline the importance of the oil price volatility to the relationship between the oil price and macro-economic performances. An increase of 1 per cent in the oil price leads to an increase of 0.56 per cent in the EMBIG index. From these results, it seems that the first panel analysis underestimates the real impact of the oil price on government bond risks.

In terms of the overall picture, we show that the oil price significantly influences the risk premiums of sovereign obligations. The inclusion of such a variable in the measurement models of risk associated with government bonds is clearly justified.

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Table 1: Statistical description of dependent variables

	Mean	Median	Maximum	Minimum	Standard deviation	Observation
Africa	339.79	344.00	530.00	130.00	115.15	2500
Argentina	111.07	104.00	194.00	46.00	41.62	2500
Asia	218.45	219.00	340.00	100.00	66.41	2500
Brazil	339.74	271.00	665.00	111.00	165.38	2500
Bulgaria	505.59	542.00	745.00	182.00	150.12	2500
China	217.84	233.00	301.00	136.00	47.72	2500
Colombia	183.31	172.00	327.00	69.00	72.25	2500
Latin America	239.77	211.00	382.00	116.00	75.03	2500
Middle East	162.99	165.00	255.00	99.00	46.12	2499
Mexico	253.46	261.00	394.00	117.00	79.34	2500
Nigeria	344.26	328.00	539.00	136.00	144.25	2500
Panama	428.93	408.00	712.00	198.00	144.49	2500
Poland	269.33	282.00	387.00	162.00	62.23	2500
Russia	342.74	379.00	627.00	25.00	185.45	2500
South Africa	260.36	282.00	379.00	109.00	78.84	2500
Thailand	160.25	175.00	194.00	74.00	34.35	2500
Turkey	233.17	213.00	396.00	91.00	93.68	2500
Venezuela	355.40	281.00	637.00	96.00	163.75	2500

Table 2: Statistical description of independent variables

Variables	Mean	Median	Maximum	Minimum	Standard deviation	Observations
WTI[4]	41.16	31.85	121.57	10.73	22.46	2 610
VIX Index	20.29	20.00	45.00	9.00	6.86	2 717
S&P 500	1, 217.88	1, 215.81	1, 565.15	776.76	176.77	2 618
Short-term interest rate[5]	3.53	3.94	6.42	0.61	1.71	2 584
Long-terminterest rate[6]	6.62	6.46	9.09	4.16	1.02	2 717

[4] WTI signifies West Texas Instrument Intermediate

[5] American treasury bills with three-month interest rate.

[6] American treasury bills with thirty year interest rate.

Table 3: Impact of independent variables on the EMBIG (a)[8] index

	Market risk			External shock			
	S&P 500	VIX Index	Exchange rate	**WTI**	Long term interest rate	Short terminterest rate	R^2 adjusted
Africa	0.031***	-0.001***		**0.006***	-0.004	-0.002	0.044
	(2.80)	(-7.62)		**(1.86)**	(-1.58)	(-0.99)	
Argentina	0.048*	-0.002***	-0.038***	**0.032****	0.007	-0.015***	0.046
	(1.86)	(-9.42)	(-3.65)	**(2.55)**	(1.45)	(-3.06)	
Asia	0.017***	0.000***		**-0.002**	-0.002	-0.002*	0.004
	(2.58)	(-4.75)		**(-0.52)**	(-1.59)	(-1.95)	
Brazil	0.021	-0.002***	-0.156***	**0.012****	-0.004	-0.007**	0.211
	(1.15)	(-14.04)	(-20.57)	**(2.33)**	(-1.25)	(-2.06)	
Bulgaria	0.013	-0.001***		**0.010**	-0.002	-0.003	0.045
	(0.87)	(-10.80)		**(1.33)**	(-0.77)	(-1.18)	
China	0.015**	0.000***	-0.025	**0.006***	-0.003**	0.001	0.009
	(2.35)	(4.44)	(-1.57)	**(1.81)**	(-2.53)	(0.66)	
Colombia	0.027**	-0.001***	-0.010	**-0.010**	-0.002	-0.003	0.043
	(2.03)	(-10.62)	(-1.48)	**(-1.48)**	(-0.75)	(-1.22)	
Latin America	-0.002***	-0.015		**0.015****	-0.004	-0.007***	0.081
	(-14.38)	(-1.11)		**(2.24)**	(-1.42)	(-2.61)	
Midle East	-0.014**	0.000		**-0.021*****	-0.002	-0,002**	0.03
	(-2.18)	(-1.28)		**(-2.59)**	(-1.61)	(-2.03)	
Mexico	-0.010	-0.001***	-0.034***	**0.007***	-0.003*	-0.003**	0.156
	(-1.16)	(-8.06)	(-17.51)	**(1.69)**	(-1.95)	(-2.05)	
Nigeria	0.017	-0.001***		**0.013**	-0.007**	-0.004	0.015
	(1.10)	(-5.78)		**(1.64)**	(-2.35)	(-1.25)	

Panama	0.012	-0.001***		**0.021*** **	0.002	0.002	0.044
	(1.14)	(-10.31)		**(4.03)**	(1.16)	(0.96)	
Poland	0.012	0.000***	-0.029***	**-0.008** **	-0.002	0.002**	0.037
	(1.58)	(-4.95)	(-8.17)	**(-2.13)**	(-1.38)	(2.29)	
Russia	-0.038	-0.002***	-0.011***	**0.040** **	-0.006	0.008	0.058
	(-1.18)	(-8.09)	(-8.76)	**(2.54)**	(-0.88)	(1.26)	
South Africa	0.038***	0.000	-0.010***	**0.012** **	0.001	0.003	0.018
	(3.32)	(1.57)	(-5.96)	**(2.14)**	(0.41)	(1.46)	
Thailand	0.024**	0.000***	-0.002***	**-0.007**	-0.006***	-0.001	0.014
	(2.41)	(-3.65)	(-3.02)	**(-1.33)**	(-2.86)	(-0.59)	
Turkey	0.036**	-0.001***	-0.177***	**0.010**	-0.008**	0.007**	0.099
	(2.29)	(-5.11)	(-14.84)	**(1.28)**	(-2.44)	(2.42)	
Venezuela	-0.031	-0.002***		**0.026*** **	-0.006	-0.006	0.060
	(-1.66)	(-12.04)		**(2.93)**	(-1.57)	(-1.61)	

(a) The adjusted t-stats of the White correction are presented in brackets below the coefficient.

Table 4: Results of the panel analysis 2a

Explained variables : (EMBIG) log		
Explanatory variables[1]	**Random effect model**	**Fixed effect model**
Constant	4.90169***	4.90171***
	(-58.47)	(150.63)
STI	-0.02093***	-0.02093***
	(-11.32)	(-11.32)
LTI	-0.04473***	-0.04473***
	(-7.36)	(-7.36)
S&P500	0.00016***	0.00016***
	(8.48)	(8.48)
VIX	0.00265***	0.00265***
	(6.45)	(6.45)
Log(WTI)	0.29838***	0.29838***
	(96.68)	(96.69)
Σ	0.31851	0.32599
Error	0.29196	0.29196
R^2 *within*	0.63960	0.63960
R^2 *between*	0.10440	0.10440
Number of Observations	25669	25669

Note 1: STI signifies Short Term Interest Rate; LTI, Long Term Interest Rate; S&P500, Standards and Poor 500; VIX, Chicago Board Exchange Volatility Index; σ, random effect fixed effect.

Table 5: Results of the model 2b panel analysis

Explained variables :(EMBIG)log		
Explanatory variables[1]	**Random effect model**	**Fixed effect model**
Constant	4.20574***	4.20576***
	(122.37)	(49.74)
STI	-0.02365***	-0.02365***
	(-13.23)	(-13.23)
LTI	-0.12707***	-0.12707***
	(-24,99)	(-24,99)
S&P500	0.00001	0.00001
	(0.39)	(0.39)
VIX	0.00352***	0.00352***
	(7.69)	(7.69)
WTI Premium	0.56223***	0.56223***
	(108.19)	(108.19)
σ	0.31852	0.32600
Error	0.28260	0.28260
R^2 within	0.66240	0.66240
R^2 between	0.10440	0.10440
Number of observations	25 669	25 669

Note 1 : STI signifies Short Term Interest Rate ; LTI, Long Term Interest Rate ; S&P500, Standards and Poor 500 ; VIX, Chicago Board Exchange Volatility Index; σ, random effect, fixed effect.